

Dolphin deaths in the Swan Canning Riverpark and comments on the Bunbury inner waters, South-west of Western Australia

Report to the Minister for Environment

by the

Chief Scientist of Western Australia
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30 April 2010

The Minister for Environment, the Hon Donna Faragher JP MLC, requested in December 2009 that the Chief Scientist of WA provide her with advice in relation to the Swan River Trust's "Dolphin Situation Report" (20 November 2009), and provide any further comments or information on the issue, which is the subject of this advice report.

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Acknowledgements

The Chief Scientist acknowledges that throughout the consultations there was an exceptionally high level of goodwill and commitment from all stakeholders.

There was clear evidence of the collaboration between government agencies and science institutions in response to the 2009 dolphin deaths. Those involved included staff of the Swan River Trust, Murdoch University, Perth Zoo and the Department of Environment and Conservation, as well as the Department of Fisheries and the Department of Water. The commitment of the veterinary science community is particularly acknowledged.

The Chief Scientist also acknowledges the important role of the community, in particular the River Guardian Dolphin Watch volunteers, for their contribution to improving our knowledge on the Swan Canning Riverpark dolphins.

The Chief Scientist particularly acknowledges the contributions of members of an expert reference group who provided wisdom and advice at a senior level. Members of the reference group provided advice on the basis of their experience and expertise in matters such as cetaceans, veterinary pathology, environmental science and government policy, and were not representative of any particular organisation. Members of the reference group were:

- Mr John Bannister MA, FLS, FZS
- Dr Bernard Bowen AM, BSc, DSc (Hon), FTSE
- Professor Nick Costa BAgSc, PhD
- Mr Peter Millington BSc (Hons), MEnvSt, MSc, FAICD
- Emeritus Professor Mal Nairn AM, BVSc, MSc, PhD, Hon DSc, DipACVP, FTS, FAIM

Particular acknowledgement is also given to Dr Nick Gales who provided a national and international perspective on the 2009 dolphin deaths in the Swan Canning Riverpark. Dr Gales is a veterinarian and marine mammal scientist with 30 years of experience. He leads the Australian delegation to the International Whaling Commission Scientific Committee, is Australasian Coordinator of the International Union for Conservation of Nature (IUCN) Cetacean Specialist Group, is a Member of the Antarctic Predator Specialist Group, and has published about 100 papers in peer reviewed literature, including a book on marine mammal and human interactions.

Whilst the consultations with, and contributions of, stakeholders and members of the expert reference group and Dr Gales were extremely valuable, the views and opinions in this report are those of the Chief Scientist of Western Australia.

Dolphin Deaths in the Swan Canning Riverpark and comments on the Bunbury inner waters, South-west of Western Australia

Executive Summary

On 21 December 2009 the Minister for Environment, the Hon Donna Faragher MLC JP, announced that she had referred the Swan River Trust's situation report into the deaths of dolphins in the Swan Canning Riverpark to the Chief Scientist of Western Australia, Professor Lyn Beazley AO, and asked her to *"provide me with advice in relation to the report and provide any further comments or information on the issue"*.

The Minister asked the Chief Scientist of Western Australia to:

- gather additional information from relevant stakeholders and interested parties;
- consider the dolphin deaths in the context of ecosystem health within the Swan and Canning rivers; and
- provide advice on actions to be undertaken to enhance knowledge relevant to the cause of the deaths.

In her announcement that the Chief Scientist was to undertake further research into dolphin deaths, the Minister noted that: *"Efforts to protect Swan River dolphins for the long-term require a collaborative approach working across government agencies, research institutions and with community involvement"*. The Minister stated that ongoing research aimed to identify the causes of deaths and investigate any links to similar deaths in the Bunbury inner waters and waterways throughout Australia and internationally.

On 19 November 2009 the Minister for Environment and the Minister for Water issued a media statement regarding initial and ongoing research into dolphin deaths in the Bunbury inner waters. The Minister for Water noted the research had the capacity to identify a potential problem affecting the State's dolphin population. In addition, he stated that: *"The research clearly states that we need to better understand the health of our estuarine and coastal marine animals"*.

The report presented here is primarily concerned with the dolphin population in the Swan Canning Riverpark, but also considers dolphins in the Bunbury inner waters and may have implications for other estuaries in the South-west of Western Australia.

Consultations and investigations

In investigating the dolphin deaths, consultations were undertaken with stakeholders and interested parties by invitation or on request. Additional information was sought on the dolphin deaths, ecosystem health, and possible actions to enhance knowledge relevant to the cause of the deaths. The Chief Scientist is grateful for the contribution of all those consulted, and in particular acknowledges the valuable contribution an expert reference group, to assist in the development of this report.

Key findings

Key findings from the investigation of the dolphin deaths in the Swan Canning Riverpark, that also have relevance to the Bunbury inner waters and possibly other estuaries of the South-west of Western Australia, are as follows:

- 1) There is a high level of community interest in dolphin populations and a desire that dolphins remain part of Western Australia's ecosystem.
- 2) Similar to other estuaries in Western Australia, throughout Australia and globally, the Swan Canning Riverpark is a dynamic environment. It changes in response to short term events, seasonal and longer term influences, and in addition the Riverpark has inherited a legacy of past human use pressures that contribute to its stressed condition.
- 3) The Swan River Trust facilitated a high level of coordination between key government agencies and personnel within science institutions in response to the unexpected dolphin deaths in 2009, particularly for the pathology investigations. The investigations encompassed possible causes of the dolphin deaths and related issues of estuarine health.
- 4) The investigations into the dolphin deaths significantly advanced our knowledge of the likely causes notwithstanding that the procedures followed for collecting and analysing the deceased dolphins were understandably *ad-hoc* and were developed rapidly to address the urgency of the situation.
- 5) It is likely that there was a spike in dolphin deaths in the Swan Canning Riverpark in 2009. The most likely cause was an increase in viral, bacterial and/or fungal infection(s), during conditions when the river system was flushed with fresh water associated with rainfall events. It is not feasible to determine if other factors have predisposed the dolphins to disease but possibilities include exposure to contaminants and stress induced by human activities.
- 6) Some information is available concerning the structure and behaviour of the Swan Canning Riverpark dolphin population. However, the available data are mostly for 2001 to 2003 and have been subject to only partial analysis.
- 7) A successful Dolphin Watch program has been initiated by the Swan River Trust that has the potential to contribute to scientific knowledge about the Swan Canning Riverpark and its dolphins.
- 8) Issues of estuarine health have implications across government agencies, and extend beyond the Ministry for the Environment, including those of Science and Innovation, Fisheries, Agriculture and Food, Water, Health and Tourism.

Recommendations

Adopting the proposals in this report would allow a timely and coordinated approach towards the protection and management of the dolphins in the Swan Canning Riverpark and other South-west estuaries as well as address issues of estuary health. The recommendations could underpin further development of government policy in an area of considerable community interest.

- 1) The Minister to initiate as a priority a review of protocols to be followed in the unfortunate event of dolphin deaths within South-west estuaries. The protocols should take account of statutory and management responsibilities, and be compatible across jurisdictions. The Director General of the Department of Environment and Conservation should conduct the review in consultation with other agencies, for adoption by Government. The community should have ready access to information consistent with the protocols to allow ready reporting of sick or dead dolphins. A further review of the protocols developed should take place in two years.
- 2) The Minister to recognise the need for responsible agencies to be able to finance in a proper manner the work required in the event of dolphin deaths including collection of the dolphin, its transportation to a laboratory, conducting *post mortem* examinations and analyses, and communications. It is not possible to estimate the extent of funds required as it would depend on the number of deaths and the necessary analyses. However, a funding mechanism should be identified to facilitate a ready response and completion of required pathology.
- 3) The Minister to note the value of completing analyses of data relating to the structure and behaviour of the Swan Canning Riverpark dolphins for 2001 to 2003 and the importance of undertaking studies of the current populations in the Swan Canning Riverpark and other estuaries in the South-west of Western Australia.
- 4) The Minister to recognise the importance of programs, both short and longer term, that monitor estuarine health. Procedures and protocols should be regularly examined, and if necessary modified, to ensure that scientific analyses are in accord with internationally recognised standards. Where appropriate, mechanisms should facilitate consistent and shared reporting of estuarine health information across government agencies and other scientific organisations. Indices should be regularly updated and information made widely available as a “report card” of estuarine health. As a priority, estuarine health indices for the Swan Canning Riverpark currently being developed should be expedited and completed.
- 5) The Minister to note the importance of community awareness programs, and the key role played by education initiatives, that seek to benefit not only dolphin health but also estuarine health. All programs should be subject to regular evaluation for their effectiveness.
- 6) The Minister to request that the responsible Minister further engage with the fishing community to promote fishing practices to protect dolphins. In particular, measures should be encouraged for the responsible use and disposal of fishing line, as a way to minimise dolphin entanglements. It will be important to monitor the feasibility of the more widespread use of dissolvable fishing line as an alternative to high tensile non-biodegradable line.

- 7) The Minister to note the important role of science to further understand Western Australia's marine mammal health and estuarine health, particularly as these relate to the dolphin population. Leadership and focus is needed and would be provided through the appointment of a senior person specialising in the field.
- 8) The Minister to establish a working group with extensive experience of science and government policy. The group should report within six months and recommend initiatives that build on existing local expertise and science infrastructure in the field of marine mammal health and estuarine health. The working group should consider ways to achieve greater integration between government agencies, science institutions, industry and the community. Arrangements should ensure that the scientific activities are conducted to an international standard and that there are clear reporting mechanisms of achieved outcomes.

Dolphin Deaths in the Swan Canning Riverpark and comments on the Bunbury inner waters, South-west of Western Australia

1. Preamble

On 21 December 2009 the Minister for Environment, the Hon Donna Faragher MLC JP, announced that she had referred the Swan River Trust's situation report into the deaths of dolphins in the Swan Canning Riverpark to the Chief Scientist of Western Australia, Professor Lyn Beazley AO, and asked her to *"provide me with advice in relation to the report and provide any further comments or information on the issue"*.

The Minister asked the Chief Scientist of Western Australia to:

- gather additional information from relevant stakeholders and interested parties;
- consider the dolphin deaths in the context of ecosystem health within the Swan and Canning rivers; and
- provide advice on actions to be undertaken to enhance knowledge relevant to the cause of the deaths.

In her announcement that the Chief Scientist was to undertake further research into dolphin deaths, the Minister noted that: *"Efforts to protect Swan River dolphins for the long-term require a collaborative approach working across government agencies, research institutions and with community involvement"*. The Minister stated that ongoing research aimed to identify the causes of deaths and investigate any links to similar deaths in the Bunbury inner waters and waterways throughout Australia and internationally.

On 19 November 2009 the Minister for Environment and the Minister for Water issued a media statement regarding initial and ongoing research into dolphin deaths in the Bunbury inner waters. The Minister for Water noted the research had the capacity to identify a potential problem affecting the State's dolphin population. In addition, he stated that: *"The research clearly states that we need to better understand the health of our estuarine and coastal marine animals"*.

The report presented here is primarily concerned with the dolphin population in the Swan Canning Riverpark, but also considers dolphins in the Bunbury inner waters and may have implications for other estuaries in the South-west of Western Australia.

2. Consultations and investigations

In investigating the dolphin deaths, consultations were undertaken with stakeholders and interested parties by invitation or on request. Additional information was sought on the dolphin deaths, ecosystem health, and possible actions to enhance knowledge relevant to the cause of the deaths. The Chief Scientist is grateful for the contribution of all those consulted, and in particular acknowledges the valuable contribution an expert reference group, to assist in the development of this report.

The investigation included reviewing relevant background material and the international scientific literature. Recently generated information was considered both on the possible causes of the dolphin deaths, particularly findings from *post mortem* examinations by veterinary pathologists at Murdoch University and Perth Zoo, and on estuarine health. Advice was sought also from senior research scientists with Australia-wide and international experience of marine mammals and veterinary pathology.

An induction tour led by Swan River Trust staff provided an opportunity to see at first hand matters concerning the ecology, river health, human uses, and management of the Swan Canning Riverpark.

3. Key findings

Key findings from the investigation of the dolphin deaths in the Swan Canning Riverpark, that also have relevance to the Bunbury inner waters and possibly other estuaries of the South-west of Western Australia, are as follows:

- 1) There is a high level of community interest in dolphin populations and a desire that dolphins remain part of Western Australia's ecosystem.
- 2) Similar to other estuaries in Western Australia, throughout Australia and globally, the Swan Canning Riverpark is a dynamic environment. It changes in response to short term events, seasonal and longer term influences, and in addition the Riverpark has inherited a legacy of past human use pressures that contribute to its stressed condition.
- 3) The Swan River Trust facilitated a high level of coordination between key government agencies and personnel within science institutions in response to the unexpected dolphin deaths in 2009, particularly for the pathology investigations. The investigations encompassed possible causes of the dolphin deaths and related issues of estuarine health.
- 4) The investigations into the dolphin deaths significantly advanced our knowledge of the likely causes notwithstanding that the procedures followed for collecting and analysing the deceased dolphins were understandably *ad-hoc* and were developed rapidly to address the urgency of the situation.
- 5) It is likely that there was a spike in dolphin deaths in the Swan Canning Riverpark in 2009. The most likely cause was an increase in viral, bacterial and/or fungal infection(s), during conditions when the river system was flushed with fresh water associated with rainfall events. It is not feasible to determine if other factors have predisposed the dolphins to disease but possibilities include exposure to contaminants and stress induced by human activities.
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- 7) A successful Dolphin Watch program has been initiated by the Swan River Trust that has the potential to contribute to scientific knowledge about the Swan Canning Riverpark and its dolphins.
- 8) Issues of estuarine health have implications across government agencies, and extend beyond the Ministry for the Environment, including those of Science and Innovation, Fisheries, Agriculture and Food, Water, Health and Tourism.

4. Recommendations

Adopting the proposals in this report would allow a timely and coordinated approach towards the protection and management of the dolphins in the Swan Canning Riverpark and other South-west estuaries as well as address issues of estuary health. The recommendations could underpin further development of government policy in an area of considerable community interest.

- 1) The Minister to initiate as a priority a review of protocols to be followed in the unfortunate event of dolphin deaths within South-west estuaries. The protocols should take account of statutory and management responsibilities, and be compatible across jurisdictions. The Director General of the Department of Environment and Conservation should conduct the review in consultation with other agencies, for adoption by Government. The community should have ready access to information consistent with the protocols to allow ready reporting of sick or dead dolphins. A further review of the protocols developed should take place in two years.
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5. The Swan Canning Riverpark dolphin population in 2009

Dolphins (*Tursiops sp*) have particular social and cultural significance for Western Australians. In addition to general community interest, the dolphins are important to the local tourism industry. Moreover, being at the top of the food web, dolphins are often considered an indicator of ecosystem health. In the case of dolphins in the Swan Canning Riverpark, these marine mammals have entered a challenging estuarine environment both in terms of its natural characteristics and the impact of human activities.

As with other estuaries the Swan Canning Riverpark is a dynamic system in which features including salinity and temperature may change rapidly as a result of extreme weather events. More protracted changes occur within and between seasons and across years, and are possibly influenced by climate change. These changes are all likely to impact on dolphins.

There is little information on the current Swan Canning Riverpark dolphin population. The most recent and detailed information comprises behavioural survey data, including photo-identification, collected between 2001 and 2003 for the Swan Canning Riverpark and Cockburn Sound/Owen Anchorage by Murdoch University. However, only partial analyses of the data have yet been undertaken.

For 2001-2003, compared to the 200 dolphins observed in Cockburn Sound/Owen Anchorage, only up to 40 individuals were considered to enter the Swan Canning Riverpark (Cannell, 2004). Most dolphins favoured the lower and middle reaches of the Swan River, with an estimated 20 to

25 recorded to follow the tidal cycle between the marine and estuarine environments on a daily, or near daily, basis. Within the Riverpark, dolphins appeared to follow consistent pathways and preferred edge habitats. Observations suggested that they foraged frequently in the northern end of the Port of Fremantle, Blackwall Reach, Mosman Bay, Lucky Bay, Port Dundas, and Milyu, and rested in the deep Melville waters. The population was considered to consist of several adult females with dependent calves, small groups of tightly-bonded adult males, and some younger animals.

Dolphins are thought to remain within the area in which they are born and spend their early years. As a consequence, it is likely that any increase within the estuarine population will be based on the reproductive potential of those already resident rather than by recruitment from marine populations.

Although the dolphin deaths have considerable local significance, the loss of these individuals would not impact more widely as the species is not considered to be threatened under either State or Commonwealth legislation.

6. Legislative framework relevant to the Swan Canning Riverpark and its dolphin population

Bottlenose dolphins are listed in Appendix II of CITES (the Convention on International Trade in Endangered Species of Wild Fauna and Flora) and in the Commonwealth of Australia's *Environment Protection and Biodiversity Conservation Act 1999* (Cannell, 2004).

In the context of Western Australia, the *Wildlife Conservation Act 1950* stipulates that the Department of Environment and Conservation has responsibility for the conservation and protection of populations of flora and fauna in the wild. Their remit includes dolphins and other marine mammals, with the Department's activities in regions such as Monkey Mia being particularly well known and respected. One role of the Department is that they must give approval for the removal of native animal carcasses. In the event of the death of native animals, there are often no conservation issues and allowing the carcass to decompose *in-situ* forms part of the natural cycle. However, in event of the death of dolphins or other marine mammals, carcasses may be located in areas used by the community, such as popular swimming beaches. In these instances, it has been necessary to remove the carcasses for safety, health or public nuisance reasons.

In 1988 the *Swan River Trust Act* was enacted and from 1989 the Swan River Trust has been a State government agency charged with protecting and managing the Swan Canning Rivers, of which the dolphin population is a part. The Act was replaced in September 2007 by the *Swan and Canning Rivers Management Act 2006* to develop better ways for government, industry and the community to work together to sustain the health and enjoyment of the rivers. The Swan River Trust reports to the Minister for Environment.

As stated on the Swan River Trust website (www.swanrivertrust.wa.gov.au), key features of the 2006 legislation are to establish the Swan Canning Riverpark, develop targets for river use and environmental health, and improve coordinated management of activities that may affect the

rivers. The legislation was also designed to provide more streamlined and flexible assessment of planning approvals, to introduce the option to use River Protection Notices to manage activities that affect the rivers, and to increase opportunities for public involvement in planning and decision-making.

Other jurisdictions are required to monitor estuarine health within and adjacent to the Swan Canning Riverpark, for example the East Perth Redevelopment Authority and Fremantle Ports. Twenty six local authorities are within the Swan Canning catchment area, of which twenty one have joint shoreline responsibilities for the Swan Canning Riverpark.

7. Activities of the Swan River Trust and their relevance to the dolphin population

The entire range of activities undertaken by the Swan River Trust is directly or indirectly relevant to the dolphin population. In undertaking its responsibilities, as stated on Swan River Trust website, the Trust works with local government, and other State government agencies, industry and the community to:

- manage and protect the river system;
- provide facilities around the rivers;
- advise the Minister for Environment on development proposals in the Trust Development Control Area;
- control and prevent pollution of the rivers and keep them clear of rubbish;
- advise on and control erosion of riverbanks;
- provide advice to local governments and the Western Australian Planning Commission on town planning issues affecting the rivers; and
- promote community awareness of issues affecting the health of the river system and increase community involvement in river protection and restoration.

The Swan River Trust has a number of programs specifically designed to address estuarine health with implications for the dolphin population. Of particular relevance is the *Healthy Rivers Action Plan* (2008). The Plan was developed with community input, extends over five years from 2008 and aims to protect environmental health and community benefit by improving water quality. An achievements report for the first year (2008-09) is available on the Swan River Trust website. The report includes priorities for 2009-10.

The Swan River Trust coordinated the development of the *Swan Canning Water Quality Improvement Plan* (December 2009) following close collaboration with the Federal Government and a number of State agencies, the Western Australian Local Government Association and the Perth Region NRM. Perth Region NRM is a community-led regional organisation responsible for coordinating and delivering natural resource management (NRM) in the Perth Region. The *Water Quality Improvement Plan* includes recommendations for management measures to reduce nutrient levels. Measures include water-sensitive urban design in new developments, improved use of fertilisers, education programs for land use planners and for industry, and foreshore restoration. Another initiative is the construction of nutrient stripping wetlands. One has recently been completed at Ellen Brook, and another is under development at Anvil Way drainage basin in Welshpool.

A three year project that commenced in 2007 has undertaken development of indices of ecosystem health for the Swan Canning Riverpark. The project is funded by the Swan River Trust, the Department of Fisheries and the Department of Water, together with Murdoch University. The indices, which will take account of aspects such as biodiversity, abundance, nursery and food webs, are designed to track estuarine health over time.

The Swan River Trust is currently preparing a River Protection Strategy as required under the *Swan and Canning Rivers Management Act 2006*. The Strategy will provide an overarching “blueprint” to guide future management, and to protect and enhance the ecological health and community’s enjoyment of the Swan Canning river system. It will seek to achieve better coordination and collaboration between management and community organisations. The Strategy is designed to indicate areas that require protection, and opportunities for the community to use and enjoy the rivers responsibly.

More information about the River Protection Strategy is available from the Swan River Trust website, along with links to other programs such as the *Healthy Rivers Action Plan* and the *Swan Canning Water Quality Improvement Plan*.

8. The Swan River Trust’s situation report following dolphin deaths in 2009

Following the deaths of six dolphins in the Swan Canning Riverpark between June and October 2009, the Minister for Environment requested a report by 20 November 2009 outlining the research, ongoing monitoring and further actions being undertaken by the Swan River Trust, other government agencies, researchers and experts.

In response to the Minister’s request, the Swan River Trust prepared a document entitled *Situation Report: Dolphin deaths in the Swan Canning Riverpark*, Report to Hon Donna Faragher JP MLC, Minister for Environment; Youth (20 November 2009). The situation report was prepared by officers of the Trust with contributions from representatives of the Departments of Environment and Conservation, Water, Health, and Fisheries and scientists from Murdoch University and Curtin University of Technology. A copy of the dolphin situation report is available from the Swan River Trust’s website.

The Swan River Trust situation report provided a summary of information to date in relation to the dolphin deaths including: statistics on the deaths and available *post mortem* examination results; dolphin ecology; contaminant levels in the dolphins, in fish likely to form part of the dolphin diet and in the waters and sediments within the Swan Canning Riverpark; water quality; interagency collaboration; communications; comparison and learnings from previous dolphin deaths in Western Australia, Australia and elsewhere in the world; current work including routine monitoring, extension of the 2006 non-nutrient contaminant program and other research on environmental contaminants and indicators of ecosystem health, dolphin collection procedures, dolphin behaviour tracking, contaminant sources; and the Swan River Trust current management actions that aim to improve the ecological health of the Swan Canning Riverpark, and information on marine quality monitoring by Fremantle Ports.

The situation report identified questions that needed to be addressed to more fully understand events related to the dolphins and aspects of contaminants in the environment. The report stated that: *“Broadly, there is a need to understand the effect of disease, contaminants, entanglement, and other threatening processes and develop management strategies that mitigate human activities causing injury and mortality. If this problem is shown to be wider than the Swan and Canning rivers then research needs to take in a wide geographic spread (eg south west WA) and include a range of species to effectively evaluate processes that are complex (eg disease, bioaccumulation of contaminants).”* (Swan River Trust, November 2009). This conclusion is supported by the death of an estimated eight dolphins in the Bunbury region between April 2006 and November 2009.

In its situation report, the Swan River Trust also identified additional actions to improve science communications and proposed further science and monitoring activities to be undertaken as an immediate response to the dolphin deaths.

9. Swan River Trust’s activities in response to the dolphin deaths

Since the release of the dolphin situation report in November 2009, the Swan River Trust has continued to respond to the dolphin deaths. Actions include coordinating completion of the outstanding *post mortem* examinations and continuation of contaminant testing. An investigation is also taking place of contaminants in fish and crabs, part of the dolphin diet.

The Trust has supported the Perth Region NRM to conduct surveys and educational initiatives in industrial areas with the aim of reducing discharge of pollutants into the Swan Canning catchment.

The Trust has also continued to undertake the important role of community education.

10. Information arising from Chief Scientist’s consultations and investigations on the dolphin deaths and ecosystem health for the Swan Canning Riverpark

10.1 A spike of dolphin deaths in 2009

At the outset it was important to determine as far as was possible whether the dolphin deaths represented a spike or were within the expected normal range of mortalities for this species. In addition to senility, animals can die from misadventure, predation or seasonal conditions such as water quality, temperature, and nutritional variations. It has been reported, for example, that elsewhere in Western Australia calf mortality is forty four percent by three years of age (Mann et al, 2000). To make a definitive assessment of whether a spike occurred it would be necessary to have a better understanding of the population size and composition, and the pattern of losses.

Nevertheless, it would seem that the loss of six dolphins from the Riverpark population over a period of six months in 2009 represents an abnormal event justifying investigation to seek to elucidate the cause. Records for the Swan Canning Riverpark suggest the level of dolphin deaths was lower previously at one in both 2002 and 2003, three in 2006, and two in 2007. Data are not available to indicate whether spikes of deaths have taken place historically.

10.2 Conclusions from *post mortem* examinations

The *post mortem* examinations, subsequent investigations and interpretation of the findings have been of a high standard. The findings are currently being collated as a technical report titled “Technical Report on the Bottlenose Dolphin (*Tursiops aduncus*) Unusual Mortality Event within the Swan Canning Riverpark, May-October 2009” produced by Murdoch University for the Swan River Trust.

Post mortem pathology examinations were conducted on four of the six dolphins that died in 2009, with the other two animals being unavailable for analysis due to decomposition. The results were supplemented with data from a dolphin that died in 2007. The results of these examinations have proved to be of crucial importance, although the conclusions must remain tentative. The number of animals was small and one dolphin had experienced severe fishing line entanglement that presumably contributed to its death. Experience worldwide reinforces the conclusion that it is very difficult to determine a definitive cause(s) for deaths of any marine mammals even when large numbers of animals are available for analyses.

Examinations were undertaken by veterinary pathologists at Murdoch University and Perth Zoo and extensively discussed at a workshop that took place on 8 to 10 March 2010. The workshop benefited from the attendance of Dr Padraig Duignan (University of Melbourne), an international expert on diseases of marine mammals.

The collective opinions of the pathologists were as follows:

- a) Ulcerative skin lesions in three dolphins were thought to be sufficiently severe to have caused death. The skin lesions observed could be likened to third degree burns covering seventy percent of the body surface area, resulting in the loss of fluids and protein, weakening the animal and increasing susceptibility to opportunistic secondary bacterial/fungal infection. Similar lesions have been reported for dolphins that have died since 2005 in the Gippsland Lakes (Charlton et al 2009).

The most likely cause of the skin lesions is a pox virus, Tattoo Skin Disease, that is found in dolphins in many parts of the world. It is commonly found in juveniles with those affected normally recovering and gaining immunity from the disease. In the case of the Swan Canning Riverpark dolphins, however, the virus may have been a more pathogenic strain and/or there may have been an underlying condition(s) that rendered the dolphins more susceptible to infection.

It is well known that skin lesions characteristic of Tattoo Skin Disease are common in dolphins in the vicinity of the Swan Canning Riverpark. The Swan River Trust's dolphin situation report described a 2009 study that estimated 27 percent of the 158 dolphins known to inhabit Cockburn Sound displayed skin lesions. Further analyses are being progressed to confirm whether the Tattoo Skin Disease virus was present in the Swan and Canning Riverpark dolphins that died and, if so, whether it represents a more pathogenic variant.

It is not possible to determine whether there were predisposing conditions that led to the virally induced deaths. However, evidence is compatible with exposure to fresh water playing a role. There is a correlation between the dolphin deaths and rainfall events during the winter and spring of 2009 as apparent in the weekly physico-chemical profiles (salinity, dissolved oxygen and temperature) published by the Swan River Trust. The reduced salinity may have caused cellular damage to the epidermis leading to increased susceptibility to viral attack. Of interest is a recent media report that the South Australian Department of Environment and Heritage considers skin lesions affecting two dolphins in the Port River in Adelaide may have resulted from exposure to fresh water inflows (www.abc.net.au/news/stories).

A second, though not mutually exclusive, possibility relates to the dolphins' immune system. The animals were reported at *post mortem* examination to be immunosuppressed, raising the possibility that their immune response was impaired prior to the viral attack. An impaired response could have been due to an underlying infection, exposure to contaminants or other predisposing, possibly human-related factors (Lahvis et al, 1995).

- b) Of the two other dolphins examined, both juvenile, one had a fungal infection of the brain (*Aspergillus* spp) and the other bronchopneumonia and probably septicaemia. Although the infections could have been the primary cause of death, as in the case of the virally induced skin lesions, there may have been an underlying susceptibility(ies). Reports from overseas have associated bacterial organ infections such as bronchopneumonia with a primary infection by morbillivirus, a serious pathogen for dolphins elsewhere in the world. There is

no evidence, however, to suggest that morbillivirus is present in Western Australian waters or elsewhere in Australia or New Zealand. Nevertheless, morbillivirus is difficult to isolate and further studies currently being undertaken will address this issue.

- c) The dolphin that exhibited bronchopneumonia also had severe fishing line entanglement that may have contributed to its death.

In addition to the *post mortem* pathology examinations, contaminant analyses were undertaken for five of the six dolphins that died in 2009, but not for the dolphin that died in 2007. The analyses revealed that levels of total polychlorinated biphenyls (PCBs, as Aroclor 1254) exceeded the estimated threshold (17 µg/g lipid weight) considered to result in adverse health effects in marine mammals, including suppression of the immune system (Kannan et al 2000). The organochlorine contaminants dieldrin and pp-DDE (dichlorodiphenyldichloroethylene), a breakdown product of DDT (dichlorodiphenyl-trichloroethane), were also detected. In addition, levels of zinc appeared to be elevated although the significance of this finding remains uncertain (Wood and Van Vleet, 1996). It should be noted that a threshold is an evidentiary based but nevertheless arbitrary trigger point beyond which there is concern about the effect of a compound.

All analyses of contaminant levels were undertaken for juvenile dolphins or adult females. No adult males were available for analysis. However, even higher estimates might be anticipated in adult males, with values being likely to increase with age as contaminants accumulate. Levels in adult females might be expected to be lower than in males as contaminants pass to the young, particularly their first calf, both transplacentally and during lactation.

Currently it is not possible to estimate the contribution to the dolphin deaths of the contaminants analysed and possibly of others not yet identified. Little is understood about the cumulative and synergistic adverse impact of complex mixtures of contaminants on the overall health of dolphins or on aspects such as their endocrine balance, reproductive capability or foetal development.

In summary, the available pathology suggested that no single cause explained all the mortalities. The most likely cause of the presumed mortality spike is an increase in viral, bacterial and/or fungal infection(s). An explanation compatible with the data is that at least for some dolphins an increase in infections was due to the inflow of fresh water into the Swan Canning Riverpark associated with rainfall events during the winter and spring of 2009 and the spring of 2007. Nevertheless, it is not possible to estimate the contribution of other stressors that may have predisposed the dolphins to disease including exposure to contaminants or the influence of human activities.

10.3 Results of contaminant testing in the dolphin environment and diet

The Action Plan for Australian Cetaceans (1996) identifies non-nutrient contaminants including organochlorines, particularly PCBs, as a potential threat to bottlenose dolphins because of the species' inshore nature (Bannister et al 1996). A variety of heavy metals may also pose a threat to the dolphins (Evans, 2003). A contaminant threat is likely to apply to dolphins in the Swan Canning Riverpark given historical land uses in and beyond the catchment including waste disposal, and other urban and rural activities.

Presumably at least some of the contaminants found in the dolphins at *post mortem* examination were acquired via their diet. The Department of Fisheries has commenced work on this aspect. A systematic study of the transfer of contaminants through the food web would inform our understanding and guide management practices for maintaining or improving dolphin health. Practices could include management of contaminated sites adjacent to the Riverpark or in-flow drains.

Other sources of contaminants for the dolphins include those in river water and its sediments. The Department of Water has provided a series of reports to the Swan River Trust about non-nutrient contaminants in the Swan Canning River System. However, for PCBs and organophosphorus pesticides, the Department of Water cautions the use of the results "*as the laboratory limit of reporting was relatively high concentrations of these compounds that are known to cause deleterious effects to environmental health*" (Nice et al, 2009).

10.4 Results of modelling of nutrients in the Swan Canning Riverpark

The Swan and Canning rivers and their tributaries face similar pressures to those in other estuaries in the State. Of particular importance for the Swan Canning Riverpark are changes in land use and reduced flushing of nutrients causing excessive nutrient loads and algal growth, anoxic conditions, fish kills and loss of biodiversity.

Major contributors to the nutrient load include urban and rural fertiliser use, septic tanks, and sewage overflows. The *Swan Canning Water Quality Improvement Plan* reports that annually 250 tonnes of nitrogen and 26 tonnes of phosphorus enter the system (Swan River Trust, December 2009). Predictive modelling suggests that the load needs to fall by close to fifty percent to meet maximum acceptable levels.

High nutrient loads may affect dolphins directly in ways we do not yet understand. In addition, or as an alternative, the loads may have an indirect influence through generating an adverse environment including toxic algal growth or anoxic conditions that lead to kills within the dolphin food web.

10.5 Community involvement in protecting dolphins

It is evident that many individuals and community groups with concern for the environment have maintained a long standing interest in the protection and management of the Swan Canning Riverpark and other estuaries. The community has a very important and growing role to play in the protection and maintenance of dolphin populations.

The Conservation Council of WA Inc is the umbrella organisation for over 90 affiliated conservation groups, many of which undertake activities to care for particular estuaries and parts of the environment, and contribute significantly to our knowledge base. Many other interest groups share concern for our estuaries including recreational fishermen (with Recfishwest as their peak body), commercial fishermen, tourism operators, and parties who use and enjoy the rivers for recreational, cultural or spiritual enrichment.

The Swan River Trust undertakes several community awareness and involvement programs for the protection and restoration of the river system. These activities reflect the Trust's appreciation that the community has a considerable interest, and an essential role to play, in caring for the river environment and its dolphins. Of particular relevance to the dolphin population, in April 2009, the Minister for Environment launched the River Guardians Dolphin Watch Program.

Through the Program, members record details of dolphin sightings in the Swan and Canning Riverpark, building on research undertaken by Murdoch University in 2001 to 2003. The volunteers are trained in basic observation techniques. They observe but do not disturb the dolphins, in keeping with regulations in the *Wildlife Conservation Act 1950* and Department of Environment and Conservation protocols for marine mammal interactions. The program, currently with more than 80 active members, makes a valuable contribution to scientific research by monitoring the movement and behaviour of the dolphin population.

In addition, the Swan River Trust provides information for the community on how to care for dolphins and the details of whom to contact in the event that members of the public find dolphins that are sick or injured.

11. Comments on dolphin deaths in the Bunbury inner waters

Murdoch University is generating an extensive data set for dolphins in the South-west of Western Australia using boat-based surveys and photo-identification methods. As stated in Attachment 3 of the Swan River Trust dolphin situation report, to date the study has identified 16 dolphins that consistently used the inner waters of Bunbury, the inlet, estuary, river and bay, between March 2007 to November 2009. Eight continued to be sighted as of November 2009.

Ten of the Bunbury inner water dolphins that died between April 2006 and January 2010 were subject to *post mortem* pathology examinations, with analyses of contaminants having been completed in nine. There were striking differences from the findings for the Swan Canning Riverpark dolphins. Several of the Bunbury dolphins were emaciated, and five showed the presence of the lungworm *Halocercus* spp. Two of the dolphins had visible skin lesions.

Although lungworms are widely distributed in dolphins they are not considered significant parasites for this species. However, at least one of the five species of *Halocercus* has been associated with dolphin mortality overseas (Dailey et al 1991).

The total PCBs (as Aroclor 1254) in only one of the Bunbury dolphins studied was found to exceed the threshold for adverse health effects in marine mammals, including suppression of the immune system. High levels of pp-DDE were also found in this dolphin.

12. Concluding comments

It is clear that the general community has a strong interest in, and places a high value on, Western Australia's estuaries and their dolphin populations.

Deaths of dolphins in both the Swan Canning Riverpark and the Bunbury inner waters, albeit with differing pathologies, suggest that strategies should be developed to encompass both of these systems and other estuaries in the South-west of Western Australia.

The unfortunate dolphin deaths in 2009 called upon government agencies and science institutions to respond rapidly to an urgent situation. With the Swan River Trust acting as the coordinating agency, staff from Murdoch University along with those from Perth Zoo and Curtin University of Technology, played an invaluable role in the *post mortem* pathology examinations and contaminant analyses. As a result, it was possible to reach at least tentative conclusions as to the causes of the deaths. However, interim protocols had of necessity to be developed rapidly and it is recommended that these protocols are now reviewed. The protocols that are developed should take account of statutory and management responsibilities, and be compatible across jurisdictions. The Director General of the Department of Environment and Conservation should conduct the review, doing so in consultation with other agencies, for adoption by Government. Financial and other arrangements should also be in place in the event of further deaths.

We have much to learn about the size and characteristics of the dolphin populations in the estuaries of the South-west of Western Australia, information that is vital if we are to protect them. In particular, Murdoch University has played a prominent part in studies of dolphins in the Swan Canning Riverpark and Bunbury inner waters. Further insights could be gained by completion of the partial analyses, both behavioural and genetic, already undertaken for dolphins of the Swan Canning Riverpark in 2001 to 2003. An equivalent study of the present population would be valuable, as would be continuation of the ongoing study of dolphins in the Bunbury inner waters. Information from these studies may form the basis of discussion about the feasibility of establishing one or more dolphin sanctuaries in the South-west of Western Australia.

The community, including groups such as River Guardians Dolphin Watch, has a key role to play in collaboration with scientists, to monitor the dolphin populations. The community programs should be subject to regular evaluation and if necessary to revision. More generally, all those who use the estuaries should be encouraged to adopt behaviours that protect dolphins.

The health of estuarine dolphins is inexorably tied to estuary health. Estuaries in the South-west of Western Australia are complex, change with time and have many features that are unusual or even unique. In addition, the estuaries have a legacy of past human use pressures that contribute on an ongoing basis to their stressed condition. Further studies are essential if we are to improve the health of our estuaries, especially as it is anticipated that there will be an increased number of people living around estuaries or in their catchments.

Western Australia has already participated in the National Land and Water Resources Audit that began to develop indices for Australian estuary health (Department of Water, 2008). It is important to build on the preliminary work to achieve a “report card” of specifically developed estuarine health indices that would help direct future studies and policy development, as well as ensuring the community are well informed.

It is commendable that the role of the community in protecting both the dolphin population and estuarine health is increasingly appreciated and supported. Moreover, it is pleasing to see an increase in the numbers of individuals and groups involved. The community is playing, and will continue to play, an important and evolving role in activities ranging from monitoring the dolphin population and estuarine health to planning and decision-making.

The fishing community has an interest, and an important role to play, in protecting dolphins and estuarine health. The Minister may wish to request the responsible Minister to engage further with the fishing community. In particular, measures should be encouraged for the responsible use and disposal of fishing line, as a way to minimise dolphin entanglements. Dissolvable fishing line is currently being developed and it will be important to monitor the feasibility of its more widespread use as an alternative to high tensile non-biodegradable line.

We know relatively little about the conditions necessary for the health of dolphins in an estuarine environment. Our understanding of the changing estuaries in the South-west of Western Australia is also limited, despite the excellent work of the late Ernest Hodgkin reported in the book *Ernest Hodgkin's Swanland*. An improved understanding of both dolphin health and estuary health will require rigorous science that will in turn inform policy development. Well-designed studies, rigorous data collection and sophisticated computer modelling will be necessary to ensure evidence-based decision-making. The studies must achieve internationally recognised levels of excellence. As an example, all testing procedures should reflect internationally recognised standards with analyses to a sufficient level of sensitivity.

If science is to serve us best, to underpin protection of both the dolphin populations and of estuarine health, it would be timely to take greater advantage of the talented scientists, relevant intellectual and science infrastructure and the data base available in our State. The scientific studies already completed are sound and the scientific community has a strong commitment to the subject, as has been illustrated by the rapid response on the occurrence of the recent dolphin deaths. Nevertheless, there are currently no formal mechanisms to coordinate science activities appropriately or ensure strategic long term plans are executed. Moreover, for individual projects, funding is often provided on a short term basis that may challenge adoption of the most strategic approach. On occasion, scientists devote considerable time to preparing applications for modest funding, an activity that may not be the most efficient use of their time or expertise.

Western Australia is well placed to move to a better structure. The current *ad hoc* arrangements between government agencies and science institutions could profitably be examined. With a strategic and sustained expenditure, the current resources could form the basis of a cohesive, more cost efficient, outcome-oriented initiative that would respond to immediate needs but also address long term goals. A way forward might best be achieved by a more integrated approach encompassing State and local governments, industry, science institutions and the community. Several State government agencies have an interest in dolphin health and estuarine health including those with responsibilities for the environment, science and innovation, fisheries, agriculture and food, water, health and tourism. The benefits of a more integrated approach to funding are evident in the research program into dolphins in the Bunbury area.

A new initiative would mobilise expertise and leverage off existing and future projects for greater value adding. Applications for major support via international or Federal Government funded schemes would be more competitive than at present and the extent of possible support would exceed levels currently achievable. The greater involvement of local government would also be facilitated. The involvement of industry would offer greater opportunities to generate intellectual capital and thereby income, especially in areas such as monitoring of environmental health and design of remediation procedures. A further dimension would be the participation of, and benefit to tourist industry, as dolphins are a considerable tourist attraction. The new structure would also ensure maximum benefit from the activities of the community.

A further advantage of such an initiative would be to provide excellent training in a systematic and coordinated way. The result would be to produce graduates with a range of skills well suited to serve the State's future needs in an area likely to be of crucial long term importance to the majority of Western Australians, environmentally, economically, socially and culturally. Additionally, as with Western Australia, around the world large populations live on estuaries and these face environmental health issues with no ready solutions. The initiative would present Western Australia with the opportunity take advantage of our existing intellectual and science infrastructure and natural assets to become a world leader in an area of internationally recognised need.

To ensure any new initiative is effective will require of new level of leadership. To lead the initiative it would be necessary to appointment an acknowledged world expert with strong leadership skills in the area(s) of marine mammals and/or estuarine health. The current lack of clearly defined leadership may underlie the fact that scientists in this area have yet to take full advantage of international, Federal or State government funded schemes to provide major support for their science activities.

Consideration should be given to establishing as a priority a working group with extensive experience of science and of government policy to provide expert advice to Government. They should report within a six month period, having considered the findings of this report and having sought information from and encouraged dialogue between all interested parties in Western Australia. In addition, the working group may wish to seek input from nationally and internationally recognised experts in the fields of dolphin health and estuary health. The working group may wish to assess the merits of science schemes already in place for other disciplines.

These include Centres of Excellence, a node of an existing Major Research Facility in a related area or on a larger scale a Major Research Facility in its own right. Models already in place that would inform a new initiative include The West Australian Energy Research Alliance (WA:ERA) and the West Australian Marine Science Institution (WAMSI).

In summary, the dolphin deaths have focussed attention on the Swan Canning Riverpark and other estuaries in the South-west of Western Australia. They are regions of considerable importance to the community and have a legacy of adverse human activity. Dolphins are seen by many as iconic and as “the canaries in a coalmine” in terms of estuary health. This report presents a picture of the current situation. It argues that the time is right to move forward by Western Australia adopting a new approach that will build on our strengths, allow us to address better our current situation and strategically position us for future challenges.

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Stakeholder Organisations Consulted by Chief Scientist

- Conservation Council of WA (Inc)
- Curtin University of Technology
- East Perth Redevelopment Authority
- Department of Environment and Conservation
- Department of Fisheries
- Fremantle Ports
- Department of Health
- Murdoch University
- National Toxics Network Inc
- Perth NRM
- Perth Zoo
- Recfishwest
- Save Our Swan community group
- Swan River Trust (including River Guardians Dolphin Watch)
- University of Western Australia (Centre for Water Research)
- Department of Water
- Western Australian Local Government Association