GUANABARA BAY OIL SPILL 2000, BRAZIL – CETACEAN RESPONSE

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ABSTRACT: *On the 18th January 2000 a broken pipeline owned and operated by the oil company Petrobras spilt some 1300 tonne of bunker fuel into Guanabara Bay, Rio de Janeiro. The wildlife response was divided amongst 2 operational strategies and included – avian fauna and cetaceans. This paper deals with the cetacean response only. Cetaceans are generally not considered as an important feature of an oil spill response. Contingency planning for cetaceans in oil spills is now becoming an important element for preparedness for some countries. The cetacean response in Guanabara Bay specifically targeted a pod of about 70 members of the species* Sotalia fluviatilis, *a small dolphin that inhabits the bay. The response included the development of a plan that included a response system, a monitoring program and action plans. The response system detailed the mechanism for the plan to work and adopted the incident control management system. The monitoring program related to the study of any short term or long term deleterious effects resulting from the spill and consisted of basic spatial, temporal and behavioural studies. Action plans were developed specific to the character of Guanabara Bay and included the rescue and rehabilitation strategies necessary to respond to oil affected cetaceans. A training program was then developed and implemented to personnel who were to enact the cetacean response.*

Discussion

Spill history. On January 18th 2000 some 1300 tonne of marine fuel 380 (a blend of diesel and a residual low flash point fuel oil) spilt into Guanabara Bay, Rio de Janeiro, Brazil. The spill was sourced from a broken pipeline from the Petrobras owned and operated Duque de Caxias refinery.

Responsible parties. Petrobras took direct responsibility for the containment and clean up of oil and for the wildlife response associated with the spill event. The operational part of the wildlife response was divided amongst the aspects: 1) birds and; 2) cetaceans. The bird response was managed by the Centro de Recuperacao de Animais Marinhos through an existing partnership developed with Petrobras in 1999 (Ruoppolo, Silva and Barcellos, 2000). The cetacean response was managed by the Instituto Sea Shepherd Brasil (Sea Shepherd Brasil), this working relationship with Petrobras was only founded as a part of the 2000 Guanabara Bay spill event.

Sea Shepherd Brasil is a non-government organization dedicated principally to the conservation of marine resources with its headquarters located to the south of Brazil in Porto Alegre. Sea Shepherd Brasil at that time had limited experience in oiled wildlife events and to facilitate an effective cetacean response sought assistance from overseas expertise. Dr Sam Dover, a specialist marine veterinarian, from the Santa Barbara Zoo, California, USA and Mr. Michael Short oiled wildlife response and marine strandings response expert from Australia, were brought in to develop contingency plans and training programs specific to the spill event.

Cetaceans and oil spills. Cetaceans are not commonly considered as a part of oiled wildlife responses. There is no conclusive evidence that there are either acute or chronic impacts resulting from hydrocarbon contamination associated with oil spill events for cetaceans. There are however records of above normal levels of mortalities occurring during oil spill events. The Santa Barbara Channel spill, California, USA 1969, reported 4 porpoises, 6 whales and several seals washed ashore just after the incident (Brownwell 1971). *Exxon Valdez*, October 1989: 26 Grey whales, 5 Harbor porpoises, 2 Minke whales, 1 Fin whale and 3 unidentifiable whales washed ashore dead (Loughlin 1994). Also in 1989, 33% of the resident population of killer whales disappeared in the first year after the spill (Loughlin 1994). Assuming the resident killer whale losses were mortalities and did not just move away, this equated to a death rate of 20.7% compared to normal anticipated level of 2.2% (Loughlin 1994).

Possible effects of oil on cetaceans. The possible effects of oil on cetaceans can be summarized into 4 different categories: toxicity; eye and sensitive membrane effects, displacement and separation; and collisions with response vessels.

Toxicity can be divided into the aspects petroleum vapors and consumption of hydrocarbons. Most hydrocarbons associated with oil spills contain a portion of light compounds that evaporate readily from the slick surface. Cetaceans as air breathers minimize their time at the surface by taking in new air as close to the sea surface as possible. The likelihood of petroleum vapors being consumed at this point of air intake is therefore highly likely. Petroleum vapours certainly may cause death at levels greater than 10,000ppm; inflammation, haemorrhage and congestion of the lungs at levels up to 1000ppm; and have been shown to cause central nervous system disorders, brain degeneration, liver damage, adrenal damage, acute fatal pneumonia and reproductive failure (Engelhardt 1983; Geraci & St.Aubin 1980; Geraci 1990). The concentration of vapours at the slick surface is not commonly measured during spill events and will vary with oil type and environmental conditions. Fortunately vapours are generally only an issue for fresh unweathered oils, occurring generally only during the first few days of a spill event. Consumption of hydrocarbons is detailed in the literature as being an important feature causing damage to the lining of the stomach and intestines, effecting motility, digestion and absorption and being able to bio-accumulate through the food chain (Baines, Pierpoint & Earl 1997). The real implications for cetaceans with respect to consumption during a spill event however are poorly documented.

Hydrocarbons certainly are likely to cause irritation and inflammation to the eyes and sensitive membrane of cetaceans. As a comparison when considering effects to the eyes, research on seals has shown that exposure to oil after 24 hours caused firstly conjunctivitis and then permanent corneal erosion of the eyes (Gilbert 1998). Both which can cause impaired vision and reduce the hunting ability and hence survival of a marine animal.

During spill events there is often an increase in vessel activity associated with the operational side of the response (pers. Obs. M.Short). These may result in displacement and separation effects. Studies considering the effects of normal vessel activities on marine animals have commonly shown displacement effects to normal migratory behaviour and area usage and caused separation of adults from calves. Similar effects are therefore likely during spill responses especially where spills occur in remote, low vessel activity areas. As a secondary point, increased traffic conditions certainly may exasperate the risk of collisions with cetaceans. Collisions of vessels with cetaceans are well documented and commonly occur where there are high densities of animals and vessel activity (pers.obs. M.Short).

Sotalia fluviatilis. The species *Sotalia fluviatilis* is a resident of Guanabara Bay. The species is widely distributed along the Brazilian coast and is an important feature of local culture (Silva and Best, 1996). A pod of about 70 animals was known to inhabit the bay prior to the spill event. The Projeto Maqua has closely studied *Sotalia* in Guanabara Bay over a period of about 20 years prior to the spill event. This program is operated through Universidade do Estado do Rio de Janeiro (UERJ) with studies focusing on behavior and population dynamics of the species.

Contingency plan development

During the Guanabara Bay spill a detailed contingency plan and training program was developed and implemented specific to the resident population of *Sotalia*. The plan was divided amongst: Response Structure; Background Information; Action Plans; and Resource Contact List, Forms and Information Sheets. The plan was effective prior to the clean up of the oil.

Response team. This component of the planning dealt with the response structure and processes used to drive the operation. This was based on the incident control management system (ICMS) a standard for most emergency responses internationally. This part of the planning and training described the ICMS, its function and how it could be implemented specifically to an oiled cetacean response.

Background information. This part of the plan was used to introduce the concepts and knowledge necessary to better understand the response processes and implications for dealing with cetaceans during an oil spill. It provided a level of information for those who have not dealt with oil spills and cetaceans in the past and enabled the responder to obtain a basic level of information quickly. This aspect was very important as to be effective in a response it is necessary that individuals have a basic knowledge of the problems associated with an oil spill, the response process, how to respond to stranded cetaceans and what measures can be put in place to limit displacement, separation and collision effects.

Action plans. The action plans were divided into 2 operational phases: 1) wildlife operations and 2) monitoring operations.

The objectives of the wildlife operation were to rescue and rehabilitate stranded or oil affected cetaceans in Guanabara Bay. This part of the plan considered: the natural resource advice necessary; general control strategies; safety considerations; the personnel resources to drive the response; list of resources necessary; different response strategies based on habitat; maps of habitat types; approaches to triage and euthanasia; necropsy procedures; transportation of wildlife; rehabilitation actions and facilities; carcass disposal and reporting requirements.

The monitoring operation phase had the objective to monitor the cetaceans in Guanabara Bay for deleterious effects resulting from the oil spill both at the acute and chronic level. There are short term effects that may occur from the time of the spill through to about one month after clean up operations have ceased. Additionally there are longer term or chronic effects that may not been seen for many months or years after the event. This phase involved the development of basic spatial, temporal and behavioural studies. Data generated from these studies could then be compared to data sets collected by the Projeto Maqua over a 20 year period prior to the spill event and used to detect any likely effects from the spill event.

Resource contact list, forms and information sheets. This section provided lists of key personnel and the paperwork necessary to meet the reporting requirements.

Observed effects of the Guanabara Spill on the resident population of *Sotalia*

This paper will only briefly detail the observed acute features. Soon after the spill event occurred the resident population of *Sotalia* were seen leaving Guanabara Bay, moving out to the open coastline. The limited monitoring resources at that time did not allow other specific behavioural changes to be observed. Similar avoidance type strategies have been observed during other spill events (Gilbert 1998). Studies by Geraci, Aubin & Reisman (1983) have shown that the dolphin *Tursiops truncatas* can detect a 1mm film oil using smell and sight and detect patches of heavy oil using echolocation and that they do avoid oil where possible. During the *Mega Borg* spill, New Mexico, 1990, it was reported that a pod of *Tursiops* became trapped in the spill and were unable to avoid the slick given its physical size (Wursig & Smultea 1991). Other studies have also shown that the

dependence of food and social interaction may override this avoidance strategy (Gilbert 1998). Prior to oil clean up operations being complete the population of *Sotalia* returned to the bay. They moved to their original feeding habitats and continued normal type behaviours. These feeding habitats were void of oil at that time and this was likely to have stimulated the observations seen. Guanabara Bay is normally dominated by large amounts of vessel activity; the resident population of *Sotalia* are therefore likely to have assimilated to this level of use prior to the spill. During clean up operations most normal vessel activity ceased and this was replaced by a similar level of activity associated with clean up vessel operations. The operations associated with clean up activity did not seem to offset any normal behaviour of the *Sotalia* population.

Conclusion

The important feature of oil and cetaceans is not to show a causal relationship between the two but to be aware that mortalities of cetaceans do occur during spills events and that vessel activities may have a negative effect on cetacean behaviour. As a part of the normal approach to contingency planning for oil spills cetaceans therefore need to be formally considered as a part of the response process. The Guanabara spill showed that the resident population of *Sotalia* were able to respond to the threat of oil and avoid the primary effects of contamination.

Biography

Michael Short is based in Cairns, Australia where he works for Queensland Parks and Wildlife Service. He is responsible for oiled wildlife response in the Great Barrier Reef World Heritage Area and Marine Strandings for the northern half of Queensland.

References

1. Baines, M.E., Pierpoint, C.J.J. & Earl, S.J. (1997) A Cetacean sighting database for Wales and an evaluation of impacts on cetaceans from Sea Empress oil spill. Report to Countryside Council of Wales.
2. Brownwell, R.L. (1971) Whales, dolphins and oil pollution. In: Biological and Oceanographic Survey of the Santa Barbara Channel Oil spill 1969-1970. Vol 1. Biology and Bacteriology. In Straughan, D (Ed) Sea Grant Publ. No.2. Vol.1 Allan Hancock Found. Univ. Southern California. Pg255-276
3. Engelhardt, F.R. (1983) Petroleum effects on marine mammals. Aquat. Toxicol. 4:199-217.
4. Geraci, J.R. & St.Aubin, D.J. (Eds) (1982) Study of the effects of oil on cetaceans. Contract No. AA 551-CT9-29. U.S. Department of Interior, Bur. Land Manage., Washington
5. Geraci, J.R., Aubin, D.J. & Reisman, R.J. (1983) Bottlenose dolphins can detect oil. Canadian Journal of Fisheries and Aquatic Science. 40:1515-1522
6. Geraci, J.R. (1990) Physiological and toxic effects on cetaceans. Sea Mammals and Oil: Confronting the Risks. (Eds: Geraci, J.R. & St.Aubin, D.J.)pp.167-197. Academic Press. Toronto.
7. Gilbert, T. (1998) Response to Non-Avian Oiled Wildlife in Australia, Proceedings of Spillcon 98 Technical Workshop Oiled Wildlife Session – Cairns, Australia
8. Loughlin, T.R. (1994) Tissue hydrocarbon levels and the number of cetaceans found dead after the spill. Ch.20.Pg.359-376. In: Loughlin, T.R (Ed) Marine Mammals and the Exxon Valdez. Academic Press, London.
9. Silva, V.M.F and Best, R.C 1996. Mammalian Species *Sotalia fluviatilis*. American Society of Mammalogists. No 527 pp1-7
10. Ruoppolo, V. Silva, R.P. & Barcellos, L. 2000. Rehabilitation response efforts to the birds affected by the oil spill in Guanabara Bay on January 2000, Rio de Janeiro, Brasil. Proceedings of the Effects of Oil on Wildlife 2000.
11. Wursig, B. & Smultea, M.A. (1991) Bottlenose dolphin reactions to the Mega Borg oil spill. Marine Mammal Research Program, Texas A&M University, Galveston.