

sampled. No measurable difference between the groups was detected. Then only females that had given birth to a pup at a colony, and from which a blood sample had been taken, was contrasted with those pupping females that had not been handled for blood sampling. Again, no measurable difference was detected. Finally, the data were examined to see if any age-effect was apparent, hypothesizing that younger animals might react differently than older animals to the sampling procedure. Again, no measurable difference was found.

Although no attempt has been made to quantify or document the particular cause of the response, it appears that placement of a “fish house” or temporary living quarters near a seal colony can affect the distribution of seals at the colony. In particular, seals tend to move away from such structures as the season progresses. This behavior can, of course, be influenced by a number of variables, such as the distance of the structure from the colony and how cracks in the ice where the seals enter and leave the water change as the summer advances. Also, some animals, particularly those to which large packages of scientific instruments have been attached, visibly move away when approached, even after the instruments have been removed. However, continuation of such behavior the next year has not been observed.<sup>2</sup>

Among other things, these study results indicate that long-term studies are likely to be necessary to detect any possible cumulative impacts of ship-based tourism.

## 10. CONCLUSIONS

The information summarized above led the workshop participants to identification of specific needs and opportunities for detecting, avoiding, and mitigating cumulative adverse impacts from ship-based tourism in the Antarctic Peninsula area. The needs and opportunities fall into four general categories: 1) Site Monitoring; 2) Coordination with Related Research and Monitoring Programs; 3) Tour Planning; and 4) Expediting Long-Term Program Planning and Evaluation.

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<sup>2</sup> Additional information on this research can be found in the following:

Testa, J.W. , D.B. Siniff, J.P. Croxall and H. Burton. 1990. Comparison of reproductive parameters among three populations of Weddell seals. *J. Anim. Ecol.* 59:1165-1175.

Siniff, D.B., T.S. Gelatt and M.F. Cameron. 1998. Long term patterns of philopatry in a Weddell seal population. 12th Biennial Conference on the Biology of Marine Mammals, Monaco.

Cameron, M.F., T.S. Gelatt, and D.B. Siniff. Investigations of a Weddell seal (*Leptonychotes weddellii*) population in McMurdo Sound, 1998-1999. *Antarctic Journal*, In Press.

Siniff, D.B. D.P. DeMaster, R.J. Hofman and L.L. Eberhardt. 1977. An analysis of the dynamics of a Weddell seal population. *Ecological Monographs* 47:319-335.

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## Site Monitoring

14. It would be impractical and prohibitively costly to attempt to characterize and monitor every site in the Peninsula area that is or may be subject to visits by ship-borne tourists. Therefore, it would be desirable to identify and focus monitoring efforts on a series of sites believed to be representative of the types of sites of interest to, and being visited by, tourists in the Peninsula area.
15. The Antarctic Site Inventory project is providing the types of information needed to detect possible long-term cumulative impacts at typical sites visited most frequently. At present, however, the project has been limited because it does not have a stable, long-term funding base. Further, it is not clear whether the sampling regime, dependent on opportunistic travel to and no more than a few hours at each site, is adequate to detect any but major changes in the variables being monitored; whether all potentially relevant variables are being monitored or monitored appropriately; whether variables being monitored will yield useful results.
16. Observations at a series of comparable sites along a gradient with different types and levels of tourist activities, and/or observations at a series of comparable sites subjected intentionally to different types and levels of tourist activities likely will be necessary to distinguish any cumulative environmental impacts possibly resulting from tourist activities from those caused by other factors.
17. Reliable information on both tourist and non-tourist activities at particular sites will be needed to do the kinds of retrospective analyses likely to be required to make reasoned judgements as to the cause(s) of any observed changes in the site variables being monitored. That is, reliable information on such things as the number of times that particular sites are visited by season and year, and what visitors do while at the various sites, will be required to make judgments as to the likely cause or causes of any observed changes in the variables being monitored. Such data concerning ship-based tour operations are being compiled and reported by tour operators to the NSF and IAATO. Procedures should be established to periodically review the data being collected to assure that it will enable meaningful retrospective analyses.

## Coordination with Related Research and Monitoring Programs

18. Long-term observation will be necessary to detect possible cumulative environmental impacts of ship-based tourism in the Peninsula area.
19. Changes that may be observed in the variables being monitored could be due to natural variability, fishery-related effects, and, in

some cases, disturbance related to scientific research or related support activities, as well as tourist-related activities. If continued for the foreseeable future, the AMLR, LTER, and other research programs being carried out in the Peninsula area should detect region-wide changes in potentially affected penguin, sea bird, and seal populations, and provide the kinds of information needed to determine whether any changes detected at tourist visitor sites are due to natural processes, fisheries, scientific research, or tourist activities.

20. Mechanisms should be established by the various organizations conducting or supporting related research in the Peninsula area to coordinate research planning, share data and logistic support, and cooperatively analyze and report data of mutual interest. Standard methods for collecting and formats for recording data of common interest should be established. Consideration should be given to the establishment of common base maps and geographic information systems for archiving and analyzing data with geographic attributes.
21. Efforts should be made to promote development of innovative research proposals and to seek funding from both government and private sources for short-term studies to document how disturbance affects the behavior and reproductive success of various species and for long-term monitoring to detect population level effects. Procedures should be developed to take advantage of the research opportunities afforded by accidents such as the grounding of the *Bahia Paraiso* in Arthur Harbor in January 1989 or by natural catastrophes. Prompt publication of research and monitoring results in peer reviewed journals should be encouraged.
22. Consideration should be given to the need for long-term international programs to monitor the presence, level and effects of biological and chemical contaminants and disease organisms in indicator areas and species and to encouraging further holistic research coupling marine and terrestrial systems and exchange of information to assist in assessing human impacts.

### **Tour Planning**

23. It would be desirable to develop site-specific visit guidelines to manage tourist activities at sites that are visited frequently and contain flora, fauna, geological features, or historic artifacts that may be particularly vulnerable to damage or destruction.
24. Codes of conduct or guidelines should be established for whale watching, scuba diving, camping, and other tourist-related activities for which appropriate guidelines do not currently exist.

25. Basic qualification standards should be established for deck officers, expedition leaders, naturalists, zodiac drivers, and observers responsible for safe and environmentally benign tour operations in the Peninsula area.

#### **Expediting Long-Term Program Planning and Evaluation**

26. Recognizing the broad scope and complexity of these tasks, the most effective way to proceed might be to establish an independent steering group, made up of appropriate experts, to assist in scoping, implementing, and over-viewing the needed actions. Among other things, such a group might:
  - Develop or oversee development of a handbook of standard methods for characterizing tourist visitor sites and detecting the possible cumulative impacts of ship-based tourism;
  - Assist in the identification of representative “type” areas in which monitoring efforts should be focused;
  - Help identify and determine how best to access historic data and data from ongoing research and monitoring programs that could contribute to detecting and determining how best to avoid, minimize, or mitigate the possible adverse cumulative effects of ship-based tourist activities in the Peninsula area; and
  - Assist in the development of site specific codes of conduct, visit guidelines, and monitoring plans for the most frequently visited areas.