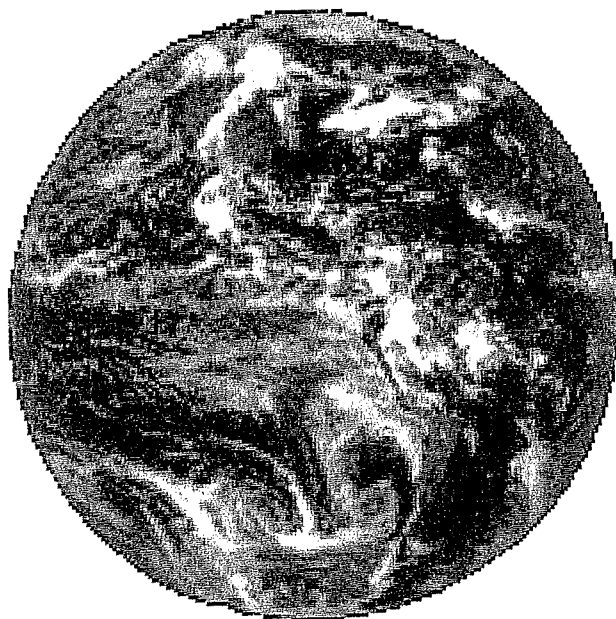


EVENT K396
CONT 501

*ANTARCTICA –
An indicator of global
environmental change*

A literature based review



JOANNE BISHOP

Literature based review : Antarctica-an indicator of global environmental change.

Introduction

This literature review covers an aspect of the syndicate group topic. The syndicate topic involved looking at Antarctica as a strategic asset, a large topic that was subsequently addressed in smaller parts by members. This review is not comprehensive but provides a range of associated literature regarding the importance of Antarctica as an indicator of global environmental change. This review will focus on the examples of ozone depletion and global warming as well as the importance of Antarctica to the rest of the world.

The main themes that will be addressed in this report include the following;

- ❖ The interconnectedness of the global oceanic, atmospheric, and terrestrial ecosystems
- ❖ Indicators of global change in the Antarctic environment and their sensitivity
- ❖ Changes in global attitude
- ❖ The differing opinions regarding global climate change, the depletion of the ozone layer and the relevance of current scientific research in Antarctica.

"Antarctica plays a critical role in maintaining the equilibrium of the planets climate" (Puri, 1997, p 35). "Antarctica is vital to life on earth" (Puri, 1997, p 28). Statements such as these are among many used to describe the importance of Antarctica. The body of this report will cover the four themes and finish with a brief conclusion.

Common Themes

Interconnected ecosystems

There appears to be an increasing awareness about the closeness of the Antarctic environment to the rest of the world. The potential of activity elsewhere to impinge on Antarctica's environment must be considered (Puri, 1997). A link between ozone depletion and global warming has also been established. Although greenhouse gases warm the Earth's surface they cool the stratosphere, and this is predicted to enhance ozone depletion (Shindell et al, 1998).

Understanding the intricate links between the atmosphere, oceans and land is paramount in addressing issues such as the global climate and it's change. The book by Puri published in 1997 has a strong focus on the links between the various global systems. It discusses at depth, the need to have international bodies that can address these global issues. It is a study in international politics and is very readable leaving the reader with a strong understanding of the need for integrated management. Antarctica and research done there has "increased public awareness of the dangers which such human activities may pose to the Antarctic environment and to the global system" (Puri, 1997, p 60). This is not only indicative of the connections between all systems, but also the worth of research at Antarctica.

Ozone depletion, which is greatest in the polar regions, particularly the South Pole, is a global issue. Antarctica is a vital for research into ozone depletion and is a sensitive indicator of change. An article titled "The Witches Cauldron" gives a readable account of what ozone is and how it is formed and destroyed. The importance of ozone in the stratosphere is discussed, "only ozone can effectively block these wavelengths which have been shown to be harmful to life" (Westerkov, 1991). The writer offers a vivid account of personal experiences at Antarctica and this is interspersed with the science.

Specific information regarding ozone measuring devices is given and the reader is able to gain a broad understanding of the current research. An unusual relationship between upper atmosphere chemistry and temperature is apparent in Antarctica. In normal circumstances chemical reactions are slowed down by colder temperatures, however the Antarctic winter and extremely low temperatures see the greatest ozone depletion (Westerkov, 1991).

Greenhouse gases, namely CO₂ emitted round the world are having an effect on ozone depletion. Global warming and ozone depletion have often been confused and now studies suggest that the two are connected (Kerr, 1998). Kerr's article includes bold statements from other studies about another 'ozone hole' similar to the Antarctic one forming in the near future. "Greenhouse gases and chlorofluorocarbons together may be ganging up to destroy ozone" (Kerr, 1998, p 202). The article has a strong focus toward the links between ozone depletion and global warming.

The effects of global warming from the increased greenhouse gases will occur worldwide and could be disastrous for the ice sheets of Antarctica and the Arctic. There are natural temperature variations, but the effect of global warming on these natural fluctuations is not well known (Maslin, 1993). Maslin writes about the important links between the oceans and the rest of the planet, using the example of global warming and its effect on the ice sheets. This article ties in well with the theme of worldwide links and the value of the polar regions as indicators of change (Maslin, 1993).

Indicators of global environmental change

Antarctica is invaluable as a global indicator. The continent has often been termed a 'global barometer' in terms of measuring, and a 'baseline', for assessing the impacts of pollutants on global ecosystems (Puri, 1997). Antarctica is valuable as a global monitor, in the sense of it being so far from any main sources of pollution. "If it's wilderness is preserved, Antarctica may act as a warning signal" (Puri, 1997).

Ice sheets have the ability to indicate past trends by ice core analysis, and may also help with future predictions (Maslin, 1993).

An interesting article writes about the use of microbes as sensitive indicators of climate change. The frozen lakes of Antarctica are the "most inhospitable environment on this planet", yet support the life of microbes (Priscu, cited in Knight, 1998, p 13). These microbes that lead a precarious life in the suspended sediment of the frozen lake, may prove to be a sensitive indicator of any change in the climate. A

slight increase in temperature may lead to the sinking of the sediment, which reduces the amount of available light, causing death of the microbe. A slight decrease in temperature may also spell disaster for the microbes as they are barely surviving the current extreme temperatures (Knight, 1998). It was interesting to read that "you might see changes in the biota before you saw changes in the ice" (Sullivan cited in Knight, 1998, p 13).

Saltwater lakes in Antarctica are providing another indicator of climate change, particularly global warming (Anderson, 1996). The lakes have become less saline possibly a result of global warming and increased snow. "Algae are sensitive to salinity" (Anderson, 1996, p 17). Samples on older sediment have shown there to be more species that prefer saline conditions, whereas current samples have shown an increase in species that thrive in fresher waters (Anderson, 1996).

A complex article in the Bulletin of the American Meteorological Society looks at variations in sea ice and air temperature. It suggests that enhanced warming in the Polar Regions is a result of increasing greenhouse gases. Warming is shown to be enhanced in areas of snow and ice retreat such as Antarctica (Chapman et al, 1993). However, using the simulation discussed in the article Antarctica was found to not have the trends seen in the Arctic. "Antarctic sea ice shows little change in at least some of the simulations with doubled CO₂" (Chapman et al, 1993, p 46). This type of projection gives an interesting indication for the future and the article takes a different angle than others on climate change.

Global attitudes

Antarctica has often triggered an attitudinal change in people toward the global environment. There is a growing concern and media driven fear as to what the future holds for the environment and climate. There has been a global move to replace chlorofluorocarbons (CFC's) with 'ozone friendly' products, and this has been successful in the western world (Westerkov, 1991). In some countries the need to address urgent issues at home takes precedence to CFC reduction (Westerkov, 1991).

Some interesting misconceptions have arisen from all the publicity of global warming and ozone depletion. An interesting one found people questioning their safety if they visited New Zealand (Westerkov, 1991). This is indicative of a fear that is emerging globally, that could have some interesting repercussions on New Zealand. The article was written in 1991, which is relatively recent but may be referring to past attitudes. It makes the reader aware of the different perceptions.

The value of Antarctica as an indicator of environmental change, particularly of the climate is high. In addition, the ability of Antarctica to act as a trigger for a global change in attitude is equally high. People need to be made aware of the intricate links between the global ecosystems and the fact that activities elsewhere in the world can impinge on Antarctica.

There needs to be a pro-active attitude toward environmental issues. Puri writes about the "human induced environmental change" as being reflective of past changes in other continents (Puri, 1997, p 38). There is a growing opinion that people do not

want Antarctica's future to follow that of other countries, and its protection is paramount.

Conflicting opinions towards global environmental change and the value of the research

The majority of the literature reflected a general concern for the environment and the future of the global climate. However a couple of articles had quite the opposite view and took a sceptical approach to such global issues. A lot of these articles are disclaimed by the scientific community as being inaccurate and unprofessional.

One particular article by Toynbee attempts to disprove some of the theories behind ozone depletion. He makes suggestions that the people synthesising these theories are on the 'ozone trends panel' and do not want to have their theories proven wrong. He often refers to another book that looks at the weaknesses in the ozone scare, and uses a lot of emotive terms such as 'alarmists' and 'ozone fraudsters'. Toynbee builds a reasonably convincing argument and questions the accuracy of the scientific research. It is questionable whether the chlorine levels that are currently being detected are in fact greater or actually the same as in the past. In the past the technology to measure exact chlorine levels was not available so it is difficult to make accurate comparisons. The effects of Mount Erebus coupled with natural ozone destruction make the effect of chlorine on the ozone layer relatively small (Toynbee, 1993).

"Ignore everything relating to the Antarctic ozone hole, just as no notice is taken of equally sensational, similarly transient, natural variations in ozone levels elsewhere" (Toynbee, 1993, p 18). This article has the ability to spark debate and get people thinking laterally. The people that stand to benefit from claims about ozone destruction may include Greenpeace, media and refrigeration manufacturers; maybe personal benefit is the driving force behind these claims.

Dr Clarkson claims to be an atmospheric scientist that stands to gain nothing from ozone research and virtually rebuts everything said by Toynbee. "Ozone depletion remains a major global problem" (Clarkson, 1993, p 4). The precautionary principle must be applied when deciding on the future management of the global environment hence the ratification of the Montreal Protocol. The chlorine released by the Erebus plume seldom travels to the upper atmosphere, as it is water soluble (Clarkson, 1993). Clarkson speaks strongly against such sceptics and highlights that such publications do not undergo the same analysis as scientific essays.

Another article titled 'Greenhouse Wars' addresses the conflicts between the climate modellers and sceptics. "They can't go on forever tinkering with their models, trying to make them fit reality" (Pearce, 1997, p 38). Sceptics suggest that we look at the simple explanation rather than trying to mould complex models to the information. There is a strong possibility that the climate is not as sensitive to warming by greenhouse gases as models suggest (Pearce, 1997). To balance the argument the author highlights that sceptics are lacking a coherent story to explain what is happening in the atmosphere. "There are a lot of things we don't know, but that doesn't disprove global warming, or the models" (Parker, cited in Pearce, 1997, p 43).

"Greenhouse Wars" is a good summary of the varied opinions that are present. It offers the reader an opportunity to view both sides of the debate. Pearce is skilled in being able to deliver both sides leaving the reader to form their own opinions.

Another irony found in the literature is the threats to the ice sheets. Some believe that the ice sheets will become instable with increased temperatures and some argue that there is contradictory evidence. Some of the contradictions arise when studying the ice sheets of cold and dry polar environments, where the ice sheets are inhibited by a shortage of snow rather than warm temperatures. An increase in the temperature can result in more air moisture, greater snowfall and ice sheet expansion (Sugden, 1992). Sugden is cited in another article that challenges the meltdown theory. As well as believing that temperature may expand the ice sheets, he also believes that "global warming is not occurring as rapidly as the growth of greenhouse gases would lead us to expect" (Sugden cited in Mc William, 1995, p 5).

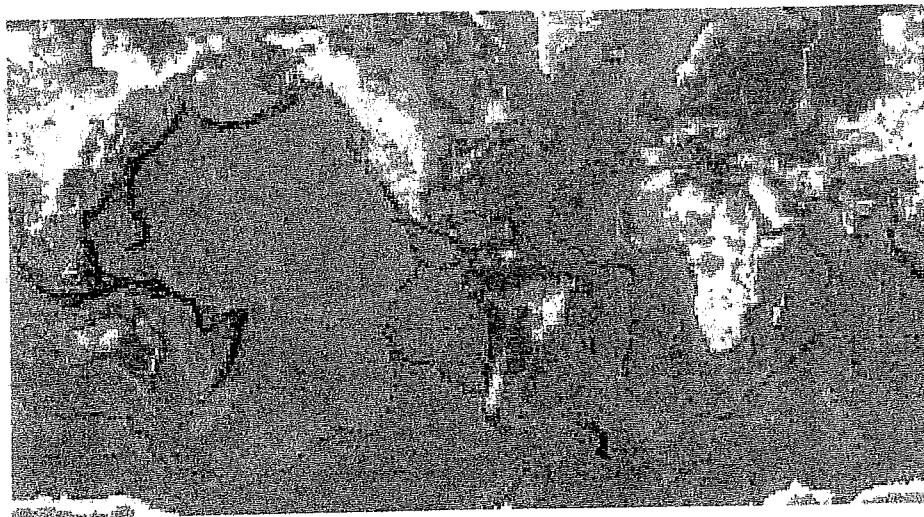
New Zealand has experienced a loss in ozone over the past ten years. Although it is not clear whether it is a direct result of the Antarctic hole, it still justifies concern (Dee, 1990/1991). The theme emerging here is that of precaution, the writer recognises the misunderstandings of the ozone phenomenon and equally the need for concern. "The danger of a major hole forming outside the Antarctic is serious enough to warrant intensive research and far more active steps to reduce CFC usage than have been to date" (Dee, 1990/1991, p 11). It is accepted here that research is justified and reduction in CFC use vital.

As the literature suggests, there is a great deal of debate surrounding the issue of global warming and ozone depletion. There is a lot of literature that covers these processes, as well as an increasing amount that deals with the sceptical slant. It seems the items written by the sceptics lack some of the knowledge and integrity of the scientific articles. They do serve the purpose of getting people to think about what the media is feeding them and allows them to make appropriate conclusions. The misconceptions show the gaps in the knowledge and literature. There is a lot of research being done in the fields of ozone depletion and global warming and a lot of the sceptics question the worth of such research. In some articles Antarctica is not seen as a crucial indicator of environmental change and research is deemed a waste of time.

Conclusions

This literature review has looked at some major themes with reference to the relevant material. The quality of literature varies, ranging from personal accounts and opinions to complex scientific papers. In the time available, only a small part of the literature was read, but it was a broad range so as to give a general idea of the issues. The debate and strong viewpoints that come out in the literature make for an interesting read. The topic of Antarctica being an indicator of global environmental change led to a variety of readings in the areas of ozone depletion, global warming, interesting indicators of change, and global opinions. There are numerous misunderstandings within these areas and a lot of gaps in knowledge, but there is a lot of literature written. I have just touched on some of the literature and have attempted to break down a large topic into relevant themes.

"If there is a strong connection between the world climate and the antarctic environment; if degradation in one leads to degradation of the other, it goes without saying that it is the business of any and everybody to save the Antarctic environment so that the world does not suffer because of the greed of a few" (Puri, 1997, p 102). This quote summarises the themes, in terms of the interconnectedness of the world and the cautious approach we should adopt toward the environment. Proactive global management of all ecosystems is important.



Reference List

- Anderson, I. *Polar Lakes watered down by snow*. New Scientist, 30 November 1996
- Chapman, W.L., Walsh, J.E. *Recent Variations of Sea Ice and Air Temperature in High Latitudes*. Bulletin of the American Meteorological Society, 1 January 1993, vol 74, no 1.
- Clarkson, T. *Ozone depletion : the science versus the myths*. New Zealand International Review, Sept/Oct 1993, vol XVIII, no 5.
- Dee, C. *Ozone-The Wider Picture*. New Zealand Science Monthly, Dec/Jan 1990/1991, vol 1, issue 4.
- Kerr, R.A. *Ozone loss, Greenhouse Gases Linked*. Science, 10 April 1998, vol 280.
- Knight, J. *On Thin Ice*. New Scientist, 4 July 1998.
- Maslin, M. *Waiting for the Polar Meltdown*. New Scientist, 4 September 1993, vol 139.
- Mc William, F. *Meltdown Theory Challenged*. August 1995, The Geographical Magazine.
- Pearce, F. *Greenhouse Wars*. New Scientist, 19 July 1997.
- Puri, R. 1997. *Antarctica- A natural reserve: A study in international politics*. Indian Institute of Advanced Study.
- Shindell, D.T. et al. *Increased polar stratospheric ozone losses and delayed eventual recovery owing to increasing greenhouse-gas concentrations*. Nature, 9 April 1998, vol 392
- Sugden, D. *Antarctic Ice Sheets at Risk?* Nature, 29 October 1992, vol 359.
- Toynbee, P. *Ozone Depletion Myths*. New Zealand International Review, July/August 1993, vol XVIII, no 4.
- Westerkov, K. *The Witches Cauldron*. New Zealand Geographic, Jan-March 1991, no 9.

