

FROM THE HARPOON TO THE HEAT: CLIMATE CHANGE AND THE INTERNATIONAL WHALING COMMISSION IN THE 21ST CENTURY

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An occasional paper of the:

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ISBN: 1-893790-03-7

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Executive Summary

In recent years, the International Whaling Commission has recognized that environmental change (climate change; chemical pollution, physical and biological habitat degradation; effects of fisheries; ozone depletion and UV-B radiation; Arctic issues; disease and mortality events; and the impact of noise) poses a serious threat to the viability of cetaceans. The purpose of this paper is to focus on the IWC's efforts in the context of one of these threats, climate change.

Climate change is likely to pose serious threats to cetaceans. In the Antarctic, a doubling of greenhouse gas emissions from pre-industrial times, projected to occur later this century, could reduce sea ice in the Southern Hemisphere by more than 40 per cent. A reduction in sea ice may lead to a decline in the productivity of algae, the primary source of food for the zooplankton species krill during the winter and could deny krill larvae critical protection from predators. As krill are the primary food source for cetacean species in the Antarctic, it could have serious implications for populations in the region. Changes and the distribution of polynyas could also impair cetacean foraging of phytoplankton, further threatening the species.

In the Arctic, sea ice decline associated with warming could result in the diminution of phytoplankton populations. This could lead to 'knock-on effects' throughout the Arctic food chain, including declines in the stocks of several key prey species of cetaceans, such as copepods and plankton-feeding fish, including Arctic cod, a key prey species for narwhal and beluga whales. Warming and the attendant ice melt might result in greater stratification of the water column and decreased nutrient resupply, limiting the growth of phytoplankton populations that are a critical link in the cetacean food chain in the region. Additionally, projected reductions in sea ice area could also open up the Northwest Passage. This could expose cetaceans to increased ship traffic and mineral exploitation.

In other regions of the world, warming may also alter ocean upwelling patterns, fostering increased blooms of dinoflagellates, many of which produce brevetoxins. Additionally, warming may result in an increased incidence of violent weather events, or increased intensity of such events. Increased precipitation associated with such storms could result in more pollutants running off from land into coastal waterways inhabited by whales, as well as the introduction of river-borne contaminants into Arctic waters. Elevated levels of atmospheric carbon dioxide could also increase seawater acidity, potentially raising the concentration of heavy metals in ocean ecosystems, exacerbating the toxic effect of these substances on cetaceans.

The International Whaling Commission has sought to confront the threat to cetaceans from climate change through a research program that began in 1996. However, this program is under funded and the prospects for additional funding from the parties are not good. Moreover, even if the research initiatives of the IWC and other organizations improve our understanding of the impact of climate change on cetacean species, these impacts ultimately can be averted only if nations demonstrate the resolve to substantially reduce greenhouse gas emissions. Unfortunately, the parties to the United Nations Framework Convention for Climate Change (UNFCCC) have shown little resolve to meaningfully reduce emissions, and even full implementation of the Kyoto Protocol

under the treaty would not substantially reduce projected warming over the next century. In the context of climate change, the International Whaling Commission's most important role in the future may be coordinating its efforts with the UNFCCC and other international treaty regimes that have an impact on the viability of cetacean stocks, such as the Commission for the Conservation of Antarctic Marine Living Resources.

While we debate the limits that should be placed on whaling in order to protect the status of the stocks, a silent menace threatens to destroy the populations we strive to protect.

D. James Baker, U.S. Commissioner to the International Whaling Commission

1. INTRODUCTION

The 50th Meeting of the parties to the International Convention for the Regulation of Whaling (ICRW),¹ held in Oman in May 1998, may ultimately be recognized as a watershed in the history of the International Whaling Commission's (IWC) efforts to manage and conserve cetacean species. While the primary focus of most meetings of the IWC during its first half century was on regulating the harvesting of regulated species, IWC50 was dominated by questions of how to confront perhaps the gravest long-term threat to cetaceans: environmental change. As identified by the IWC's Scientific Committee, the term "environmental change" encompasses the following: climate change; chemical pollution, physical and biological habitat degradation; effects of fisheries; ozone depletion and UV-B radiation; Arctic issues; disease and mortality events; and the impact of noise.² The purpose of this article will be to assess the implications of one of these threats, climate change, for the viability of cetacean species, and the role of the IWC in seeking to ameliorate climate change impacts. In this pursuit, I will:

1. Discuss the potential ramifications of climate change for cetacean species;
2. Outline the history of the IWC's treatment of climate change issues; and
3. Assess the viability of the IWC's strategies to protect cetaceans from climate change in the next century and the role of other institutions in this context.

2. CLIMATE CHANGE AND CETACEANS

2.1 Climate Change Scenarios

The surface of the Earth is heated by solar radiation emanating from the sun at short wavelengths between 0.15 and 5 μm . Approximately one-third of incoming solar radiation is reflected back to space in the form of thermal infrared, or longer-wave radiation, at wavelengths of 3-50 μm with the remainder being absorbed by land, ocean and ice surfaces.³

¹ International Convention for the Regulation of Whaling with Schedule of Whaling Regulations, Dec. 2, 1946, 62 Stat. 1716, T.I.A.S. No. 19\849, 161 U.N.T.S. 361.

² 50th Meeting of the International Whaling Commission, *Resolution on Environmental Change and Cetaceans*, IWC Resolution 1998-6 (1998). The resolutions from 50th Meeting are available on the American Society of International Law - Wildlife Interest Group website, <<http://www.eelink.net/~asilwildlife>>.

³ GRAEME APLIN, et al., *GLOBAL ENVIRONMENTAL CRISES* (2d ed. 1999), at 218-219; INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE (IPCC), *RADIATIVE FORCING OF CLIMATE CHANGE* 7 (1994).

Some of the outgoing infrared radiation is absorbed by naturally occurring atmospheric gases — principally water vapor (H₂O) -- as well as carbon dioxide (CO₂), ozone (O₃), methane (CH₄), nitrous oxide (N₂O), and clouds.⁴ This absorption is termed the ‘natural greenhouse effect,’ because these gases, which are termed ‘greenhouse gases,’ operate much like a greenhouse: they are ‘transparent’ to incoming short-wave radiation, but ‘opaque’ in terms of outgoing infrared radiation, trapping a substantial portion of such radiation and re-radiating much of this energy to the earth’s surface.⁵ This process is critical to the sustenance of life on earth, elevating surface temperatures by about 35° C.⁶

Prior to the Industrial Revolution, the net incoming solar radiation at the top of the atmosphere was balanced by net outgoing infrared radiation, contributing to climatic stability.⁷ However, with the advent of fossil fuel burning plants to support industry, automobiles, and the energy demands of modern consumers, “humans began to interfere seriously in the composition of the atmosphere.”⁸

The burning of fossil fuels, mainly coal, oil, and gas, has soared since the beginning of the Industrial Revolution, producing more than six gigatons of carbon annually in recent years, nearly all of which enters the atmosphere as CO₂.⁹ As a consequence, concentrations of carbon dioxide in the atmosphere have increased approximately 25 per cent since 1850¹⁰ — from 270-280 parts per million (ppm) by volume in pre-industrial times to over 360 ppm today — with most of the increase occurring in the past 50 years.¹¹ Anthropogenic activities have also resulted in substantially increased atmospheric concentrations of other greenhouse gases, including

⁴ MELVIN A. BENARDE, GLOBAL WARMING . . . GLOBAL WARMING 45 (1994).

⁵ UNEP Information Unit on Climate Change, *Radiation, Climate and Climate Change*, Fact Sheet No. 4 (May 1993).

⁶ James McDonald, *Scientific Basis for the Greenhouse Effect*, in THE CHALLENGE OF GLOBAL WARMING 124 (D. Abrahamson, ed. 1989). The “greenhouse effect” phenomenon was first described by the French scientist Fourier in 1827. Weart, *From The Nuclear Frying Pan Into The Global Fire*, BULL. ATOMIC SCI., June, 1992, at 18.

⁷ *Scientists Remain Unanimously Concerned Over Climate Change*, 23 ECO-LOG WK., July 14, 1995 (LEXIS, World Library). (“For the past 8,000 years, the world’s climate has been very stable, varying only within a range of + or - 1 degrees C”).

⁸ Fred Pearce, *World Lays Odds On Global Catastrophe*, NEW SCI., April 8, 1995, at 4.

⁹ JOHN HOUGHTON, GLOBAL WARMING 31 (1994). An additional 1.5 gigatons is released to the atmosphere from land-use changes, e.g. deforestation. Cement production also contributes a small additional amount. Hadley Centre, *The Greenhouse Effect and Climate Change* 5 (1999).

¹⁰ Kevin Jardine, *Finger On The Carbon Pulse*, 24 ECOLOGIST, No. 6 (Nov./Dec. 1994), at 220.

¹¹ Tom M.L. Wigley, *The Science of Climate Change*, Report of the Pew Center on Climate Change (1999), at 5; Christopher Flavin & Odil Tunali, *Getting Warmer*, WORLD WATCH, Mar./Apr. 1995, at 13. Atmospheric concentrations of CO₂ have reached their highest levels in 160,000 years. UNEP, GEO-2000, The State of the Environment – Global Issues, <<http://www.unep.org/geo2000/english/0034.htm>> (1999).

methane and nitrous oxides,¹² as well as new sources, including chlorofluorocarbons and halons.¹³

Human-driven buildup of greenhouse gases in the atmosphere has resulted in greater absorption of outgoing infrared radiation, and ultimately an increase in temperatures when a portion of this radiation is reflected back to the Earth's surface, the phenomenon known as "radiative forcing."¹⁴ Climate researchers have concluded that increased concentrations of greenhouse gases are responsible for the increase in average global temperatures of about 0.6° C in the past century.¹⁵ However, their greatest trepidation is in terms of the next 100 years.

Projected increases in atmospheric greenhouse gases over the next century could elevate temperatures on Earth by 3°C or more by the year 2100,¹⁶ with the trend

¹² Jardine, *supra* note 10, at 220 ([Since 1850] "methane . . . levels have increased by 100 per cent; and nitrous oxide levels by 15 per cent"). The primary sources of methane production are rice cultivation, animal husbandry, landfills and coal seams. U.S. Environmental Protection Agency, *Policy Options for Stabilizing Global Climate Change*, Executive Summary, (Feb. 1989), at 15; VED P. NANDA, INTERNATIONAL ENVIRONMENTAL LAW & POLICY 244 (1995). Significant sources of nitrous oxide include nitrogen-based fertilizers, the clearing of land, biomass burning and fossil fuel combustion. U.S. Environmental Protection Agency, *supra* at 13.

¹³ Guy Brasseur, *Global Warming and Ozone Depletion: Certainties and Uncertainties*, in GLOBAL WARMING AND THE CHALLENGE OF INTERNATIONAL COOPERATION: AN INTERDISCIPLINARY ASSESSMENT 29-30 (Gary C. Bryner, ed. 1994). Overall, CO₂ accounts for 65 per cent of the total radiative forcing resulting from anthropogenically released greenhouse gases, methane contributes an additional 19 per cent, chlorofluorocarbons, 10 per cent, and nitrous oxide about 6 per cent. Aplin, *supra* note 4, at 222.

¹⁴ IPCC, *supra* note 3, at 8.

¹⁵ United Kingdom Department of the Environment, Transport and the Regions, *Climate Change and its Impacts* 9 (1999). "20th Century global mean temperature is at least as warm as any other century since at least 1400AD." IPCC, *Contribution of Working Group I to the IPCC Second Assessment Report*, IPCC-XI/Doc. 3 (1995), at SPM.2. Warming has accelerated in the last 25 years, more than doubling that of the 20th Century average. William K. Stevens, *1999 Continues Warming Trend Around Globe*, N.Y. TIMES, Dec. 19, 1999, at 1.

¹⁶ The IPCC, comprised of 2500 climate scientists from throughout the world, was established by the United Nations in 1988 to gather information and coordinate research related to climate change, to evaluate proposals for reducing greenhouse gas emissions, and to assess the viability of compliance mechanisms. G.A. Res. 43/53, U.N. GAOR 2d Comm., 43rd Sess., Supp. No. 49, at 133, U.N. Doc. A/43/49 (1989); David Lewis Feldman, *Iterative Functionalism and Climate Management Organizations: From Intergovernmental Panel on Climate Change to Intergovernmental Negotiating Committee*, in INTERNATIONAL ORGANIZATIONS & ENVIRONMENTAL POLICY 1195-996 (Robert V. Bartlett et al. eds., 1995).

The current 'best estimate' by the IPCC is a 3° C increase in average global temperature by 2100. Hadley Centre for Climate Prediction and Research, *Climate Change & Its Impacts*, <http://www.meto.govt.uk/sec5/CR_div/Brochure98/science.html> (1998); Global Network of Environment & Technology News, *Global Warming Forecast Raised One Degree*, <<http://www.gnet.org>>, December 19, 1998.

However, based on reduced projections of SO₂ emissions over the next century (a gas that ameliorates the greenhouse effect when oxidized) in the IPCC's upcoming Special Report on Emissions Scenarios, Wigley has recently ratcheted the IPCC's projections in its Second Assessment upwards, from 0.8-3.5° C to 1.3-4.0° C. Wigley, *supra* note 11, at 21. Moreover, a new study by the Hadley Centre indicates that the carbon absorption capabilities of vegetation and soil, which are now responsible for sopping up 50% of carbon emissions, may start to decline with rising temperatures. As a consequence, the Centre now projects that concentrations of carbon dioxide could rise to 1,000 ppm, resulting in temperature increases of 8° C by the end of the century.

accelerating thereafter.¹⁷ While this may seem like a slight shift in temperatures, it would constitute “a change, although gradual, unparalleled in recent millennia.”¹⁸

The last time it was three degrees warmer [Fahrenheit] than now was 100,000 years ago. Then, Central Europe had a climate like Africa's. And just three degrees separate today from the other climatic extreme, the last ice age of 10,000 years ago. Then, half of Europe lay under ice, and the sea level was 390 feet lower than it is today. A bitter north wind nipped at the ears of the polar bears living atop the frozen Baltic Since the end of the last ice age, average global temperatures have never fluctuated by more than one degree.¹⁹

2.2 Cetaceans and Climate Change

In assessing the possible impacts of climate change on cetaceans, it must be emphasized at the outset that our ability to assess future impacts at the regional level, which is critical for ascertaining the possible ramifications for many cetacean species,²⁰ remains limited.²¹ Climate model researchers use computer models, derived from weather forecasting, to represent the Earth's energy and water cycles and to predict how enhanced levels of greenhouse gases will affect the Earth's climate. The most sophisticated of these models, general circulation models (GCMs), use a three dimensional grid overlaying the surface of the earth with grid points a few hundred kilometers per side, within which cells are stacked about twenty layers deep.²²

Vertical layers of the model represent levels in the atmosphere and depths in the ocean, dividing the surface of the planet into a series of horizontal boxes separated by lines similar to latitudes and longitudes.²³ Within each grid point, a series of equations are run on a super-computer, producing simulations of key climatic components, including wind, air-pressure, temperature, humidity, ice coverage, and land surface processes.²⁴

¹⁷ IPCC, *The IPCC Assessment of Knowledge Relevant to Article 2 of the United Nations Framework Convention on Climate Change: A Synthesis Report* 1995, (1995) (draft), at sec. 3.2.

¹⁸ *The Calamitous Cost of a Hotter World*, WORLD PRESS REV., July, 1995, at 9 (reprinted from DER SPIEGEL). “Such a change could be 10 to 50 times as fast as the natural average rate of temperature change since the last glaciation.” Margret M.I. van Vuuren & Maarten Kappelle, *Biodiversity and Global Change*, Dutch National Research Programme on Global Air Pollution and Climate Change, Report No. 410 200 014 (1998), at 14.

¹⁹ *Id.*

²⁰ IWC, *Report of the IWC Workshop on Climate Change and Cetaceans*, SC/48/Rep 2 (1996), at 2.

²¹ William C.G. Burns, *The Impact of Climate Change on Pacific Island Developing Countries in the 21st Century*, in CLIMATE CHANGE IN THE SOUTH PACIFIC: IMPACTS AND RESPONSE IN AUSTRALIA, NEW ZEALAND, AND SMALL ISLAND STATES (Alexander Gillespie & William C.G. Burns, eds. 2000), at 234.

²² Hadley Center for Climate Prediction and Research, Regional Climate, <http://www.meto.gov.uk/sec5CR_div.bak/Brochure/regn_pre.html>; IPCC, *An Introduction to Simple Climate Models used in the IPCC Second Assessment Report*, (1997), at 10.

²³ Kevin J. Hennessy, *CSIRO Climate Change Output*, Internet, WWW, <<http://www.dar.csiro.au/pub/programs/climod/impacts/data.htm>>.

²⁴ Eric J. Barron, *Climate Models: How Reliable Are Their Predictions?*, CONSEQUENCES 17, 18 (August 1995).

Climate models are usually run for several simulated decades, with the derived results compared to actual statistics on climatic indicia, such as mean temperatures and precipitation, over this period. Subsequently, the models are run with changes in external forcing, such as projected increases in atmospheric greenhouse gas concentrations over a series of decades or centuries. "The differences between the two climates provide an estimate of the consequent climate change due to changes in that forcing factor."²⁵

However, as Solman and Nunez recently observed, computer models remain crude instruments for regional climate projections:

[General circulation models] have difficulty in reproducing regional climate patterns, and large discrepancies are found among models. In many regions of the world, the distribution of significant surface variables, such as temperature and rainfall, are often influenced by the local effects of topography and other thermal contrasts, and the coarse spatial resolution of the GCMs can not resolve these effects.²⁶

Climate researchers have developed several strategies to conduct regional assessments. Nested models seek to simulate regional climates by the application of limited area models nested in a GCM.²⁷ In recent years, some of these models have yielded high correlations between regional climate predictions and observed climatic phenomena, including precipitation, thermal inertia of water bodies, and temperature.²⁸ Downscaling by statistical means, deriving statistical relationships between observed local climatic variables and large-scale variables, has also proved successful, *inter alia*, in linking large-scale spatial averages of precipitation and surface temperature to local precipitation and temperature-time series.²⁹

With the caveat in mind that regional climate assessments remain speculative, recent research indicates that cetaceans may be seriously threatened by projected warming in the next century. In the Antarctic, where 90 per cent of the world's great whales feed,³⁰ temperatures in some areas have risen more than 2°C in the last 50 years,³¹

²⁵ M.E. Schlesinger, *Model Projections of CO₂-Induced Equilibrium Climate Change*, in CLIMATE CHANGE AND SEA LEVEL CHANGE (R.A. Warrick, et al., eds. 1993), at 171.

²⁶ Silvina A. Solman & Mario N. Nunez, *Local Estimates of Global Climate Change: A Statistical Downscaling Approach*, 19 INT'L J. CLIMATOLOGY 835, 835-36 (1999). See also Hadley Centre, *supra* note 9, at 14.

²⁷ K. YA. KONDRATYEV & A.P. CRACKNELL, OBSERVING GLOBAL CLIMATE CHANGE 381 (1998); Hadley Centre, *supra* note 10, at 14.

²⁸ Kondratyev & Cracknell, *supra* note 27, at 383-84; Norman Miller, *Climatically Sensitive California: Past, Present, and Future Climate*, in POTENTIAL IMPACTS OF CLIMATE CHANGE AND VARIABILITY FOR THE CALIFORNIA REGION, Report to the United States Global Change Research Program National Assessment (1998), at 25-26.

²⁹ Solman & Nunez, *supra* note 26, at 836.

³⁰ Gerard Baker, *Japan Threatens to Quit Whaling Commission*, FIN. TIMES, May 28, 1994, at 4. Three species of whales reside year-round in the ice pack, bottlenose, minke and killer whales, while sperm, humpback, blue, fin, sei and some minke stocks migrate to the Southern Ocean during the Antarctic winter. Paul Lincoln Stoller, *Protecting the White Continent: Is the Antarctic Protocol Mere Words or Real Action?*, 15 ARIZ. J. INT'L & COMP. L. 335, 337 (1995).

³¹ British Antarctic Survey, *Antarctica: Climate Change and Sea Level*, <<http://www.nerc-bas.ac.uk/public/info/antwarm.html>> (1999). See also Raymond C. Smith, *Marine Ecosystem Sensitivity to Climate Change*, 49 BIOSCI. 393, 395 (1999). Mid-winter surface air temperatures in the western Antarctic

substantially greater than the world average during that period.³² While the lack of long time-series and natural climatic variability in the region makes it impossible to definitively attribute the region's warming to climate change,³³ recent modeling by the Hadley Centre for Climate Prediction and Research provides some evidence for such a link.³⁴

Recent research projects that a doubling of greenhouse gases from pre-industrial times could reduce sea ice in the Southern Hemisphere by more than 40 per cent in the next century.³⁵ This may adversely affect in several ways the abundance of the zooplankton species krill (*Euphausiacea*),³⁶ the primary source of food for whales in the Southern Hemisphere.³⁷ First, a diminution in sea ice may lead to a decline in the

have risen 5.5°C over the 1941-1991 period. R.C. Smith, S. Stammerjohn & K.S. Baker, *Surface Air Temperature Variations in the Western Antarctic Peninsula Region*, in 70 FOUNDATIONS ECO. RES. WEST ANTARCTIC REGION, AGU Antarctic Research Series (R.M. Ross, L.B. Quentin & E.E. Hofmann, eds. 1996), at 20.

³² Intergovernmental Panel on Climate Change, *Contribution of Working Group I to the IPCC Second Assessment Report*, IPCC-XI/Doc. 3 (1995), at SPM.20. See also Grover Foley, *The Threat of Rising Seas*, 29(2) THE ECOLOGIST 76, 78 (1999) (“Antarctica appears to be warming faster than anywhere else on the planet . . .”)

³³ SCAR Global Change Programme, *A Summary of Change in the Antarctic* (1997), <<http://www.antrc.utas.edu.au/scar/newsletter2/2summary.html>>; Andrew Clark & Eugene Murphy, *A Long-Term Fast Ice Record from the South Orkney Islands*, 1 GLOBAL CHANGE RES. (1996), at 1; Sean Ryan, *Global Warming*, SUNDAY TIMES, March 26, 1995.

³⁴ British Antarctic Survey, *supra* note 31. “Measurements made over the Antarctic Peninsula and the Falkland Islands show that the level of peak electron concentration in the ionosphere F-region (at about 300 km altitude) has fallen by about 8km over 38 years . . . While the lower atmosphere warms in response to increasing concentrations of greenhouse gasses, the upper atmosphere cools. Theoretical studies indicate that the observed fall in the height of the F-region is compatible with expected temperature changes in the thermosphere.” However, annual mean temperature increases of 2° C over the past 50 years on the Antarctic Peninsula are not consistent with predictions of climate models. *Id.*

³⁵ *Report of the IWC Workshop on Climate Change and Cetaceans*, *supra* note 19, at 3. However, some researchers argue that warming either may have very little effect on ice sheets in the Antarctic, or may even portend an increase in volume, at least for the next century or two, due to an increase in snowfall caused by higher evaporation. University of Tasmania, Antarctic Cooperative Research Centre, *Polar Ice Sheets, Climate and Sea-Level Rise*, <http://www.antrc.utas.edu.au/antrc/about/Position_Statement_2.html>; British Antarctic Survey, *supra* note 11; David Schneider, *The Rising Seas*, SCI. AM., Mar. 1997, at 114; C.L. Hulbe, *Recent Changes to Antarctic Peninsula Ice Shelves: What Lessons have been Learned?* 1 NATURALSCI., April 11, 1997, <http://naturalscience.com/ns/articles/01/ns_clh.html>.

However, recent research by Bamber, et al., suggests that models of the draining of discharge from the Antarctic Ice Sheet as a consequence of warming may have underestimated ice stream flow rates, “implying that parts of the interior of Antarctica and probably former ice sheets can respond more rapidly to climate forcing than model simulations might suggest.” Jonathan L. Bamber, David G. Vaughan & Ian Joughin, *Widespread Complex Flow in the Interior of the Antarctic Ice Sheet*, 287 SCI., February 18, 2000, at 1249.

³⁶ “Krill” is a general term that encompasses about 85 species of ocean crustaceans in the group called *euphausiids*. Five species of krill are found in the Antarctic, the most abundant being *Euphausia superba*, which grow up to about 6 centimeters and live between 5-10 years. Australian Antarctic Division, *Krill: Magicians of the Southern Ocean*, <http://www.antdiv.gov.au/resources/more_res/krill.html>.

³⁷ David Helvarg, *On Thin Ice*, SIERRA, November/December 1999, at 40; O. Balashov. & B. Hare, *Polar Meltdown. The Changing Climate in Antarctica*. A Report for Greenpeace International (1997). Blue whales may consume as much as four tons of krill per day. Hulbe, *supra* note 35.

Krill are the major biomass component of the epipelagic marine ecosystem in the Seasonal Pack-ice Zone and parts of the Ice-free and the high-Antarctic Zone, comprising approximately 500 million tons of biomass. Charles Arthur, *Global Warming Poses New Threat to Whales' Survival*, THE INDEPENDENT,

productivity of algae, the primary source of food for krill during the winter.³⁸ Second, a reduction in sea ice could deny krill larvae critical protection from predators.

Finally, sea ice decline could result in the proliferation of the pelagic tunicate *Salpa Thompsoni*, one of the most abundant macrozooplankton species in the ice-free and seasonal pack-ice zone of the Southern Ocean.³⁹ Salps persist in low numbers under sub-optimal conditions, but can rapidly proliferate when sea ice recedes and phytoplankton becomes more readily available during early spring.⁴⁰

This salp proliferation could prove disastrous for krill populations in the region. Salps could act as strong competitors of krill for food prior to the onset of phytoplankton blooms in the spring. This increased competition for food can stunt krill gonadal development, resulting in a reduction in recruitment the following year.⁴¹ Moreover, dense salp blooms can interfere with krill reproduction and kill off their larvae.⁴²

Finally, warming and possible shifts in wind patterns, could affect the distribution and characteristics of polynyas in the Antarctic region.⁴³ Polynyas are areas of open waters in the polar ice pack, formed by a combination of currents, tides, upwellings, and winds.⁴⁴ While snow and ice reflect most of the sun's incident energy, dark polynya water absorbs it, resulting in nutrient upwelling and profusive blooms of phytoplankton.⁴⁵ Cetacean species that rely on ice edges for phytoplankton foraging might be adversely affected by reductions in the areal extent and latitudinal shift of ice-edge habitats.⁴⁶

The populations of several baleen whale species in the Antarctic, including blue and humpback, were decimated in the past by commercial whaling operations,⁴⁷ and blue

June 26, 1997, at 3. Krill support an array of species in the region, including penguins, seabirds, such as the albatross, and fur seals. Debora MacKenzie, *In for the Krill*, N. SCI., June 5, 1999, 26; Andrew Brierley, *Kingdom of the Krill*, N. SCI., Apr. 17, 1999, at 36.

³⁸ World Wide Fund for Nature, *Climate Change: Parks at Risk*, <http://www.panda.org/climate/parks/dr_I_park9.htm>. Brine channels on the underside of sea ice connect to underlying water and nutrients that are important for the growth of algal species. Alfred Wegener Institute for Polar and Marine Research, *Microstructure*, <<http://www.awi-bremerhaven.de/Eistour/mikrostruktur-e.html>>.

³⁹ Arthur, *supra* note 37, at 3.

⁴⁰ K.H. Kock & V. Siegel, *Temporal Variations in Sea-Ice Dynamics and Krill Abundance in the Antarctic Peninsula Region – Implications for the Krill-Dominated Food Web*, International Whaling Commission, Scientific Committee, SC/M86/CC10 (1996), at 3; V. Siegel & V. Loeb, *Recruitment of Antarctic Krill 'Euphausia superba' and Possible Causes for its Variability*, 123 MAR. ECO. PROGRESS. SER. 45, 54 (1995).

⁴¹ SIEGEL & LOEB, *supra* note 40, at 54.

⁴² Arthur, *supra* note 37, at 3. Krill also face other serious threats, including loss of prey species and direct damage from ozone depletion, Colin Woodard, *Food-Chain Alarm from a Low-Ozone Zone*, CHRISTIAN SCI. MONITOR, Dec. 11, 1998, and perhaps in the future, overexploitation by commercial fishing concerns. *See infra* note 119.

⁴³ *Report of the IWC Workshop on Climate Change and Cetaceans*, *supra* note 21, at 10.

⁴⁴ *Anomalous Sea Ice Conditions in the Cosmonaut Sea During 1999*, <http://www.atmosph.physics.utoronto.ca/ANTARCTIC/cosmo_1999.html>; Fred Bremner, *Northern Oases: Polynyas, Where Arctic Waters Teem with Wildlife*, 114 CANADIAN GEO. 54 (1994).

⁴⁵ Laura Cheshire, *Phytoplankton and Polynyas*, National Snow and Ice Data Information Center, <http://www-nsidc.colorado.edu/NASA/YEARBOOK_1995/polynya.html>

⁴⁶ *Report of the IWC Workshop on Climate Change and Cetaceans*, *supra* note 20, at 10.

⁴⁷ By the early 1960s, aided by new technology, including explosive harpoons and stronger vessels, whalers drove blue and humpback whales to the point of commercial extinction. JAMES C.F. WANG, HANDBOOK ON OCEAN POLITICS & LAW 152 (1992). Blue whale populations have plummeted from a pre-exploitation level of 200,000 to as few as 500 in the Southern Hemisphere, and humpbacks have declined from 120,000 to

whales may never recover.⁴⁸ Reductions in food supplies as a consequence of warming could further diminish the carrying capacity of whales in the Antarctic and push these species closer to extinction in the next century.⁴⁹

Climate change may also have grave implications for cetaceans in the Arctic. Temperatures in the region have increased several times the global rate over the past century,⁵⁰ with sea-ice thickness declining more than 40 per cent since 1958,⁵¹ and sea-ice areal extent declining 3.0-4.5 per cent per decade in the past 20 years.⁵²

It should be emphasized that it is difficult to establish a causal link between melting ice and anthropogenic climate change, because this phenomena could also be attributable to other factors, such as changes in precipitation and snow cover, or advective processes accompanying the North Atlantic Oscillation in the late 1980s and 1990s.⁵³ However, a recent study by Vinnikov comparing satellite and surface observations with two existing computer models concluded that there was less than a 0.1 per cent chance that ice shrinkage was due to natural cycles.⁵⁴

The Intergovernmental Panel on Climate Change in its most recent regional assessment concluded that further substantial losses of sea ice will occur in the region over the next century as a result of projected warming trends.⁵⁵ Richard Moritz, Director of the Surface Heat Budget for the Arctic Ocean project (SHEBA) goes further in a recent assessment, predicting that the Arctic's year-round icepack could totally disappear in 50 years.⁵⁶

approximately 10,000. WWF, *Wanted Alive!* 1 (1998); John Carey, *Embattled Behemoths; Whales*, 25(3) INT'L WILDLIFE 4 (1995).

⁴⁸ *Whaling 1989/1990*, 23(3) ORYX 184 (1989).

⁴⁹ World Wide Fund for Nature, *Protected Areas at Risk* (1997), <http://www.panda.org/climates/parks/dr_i_park9.htm>. A portent of the danger to whale populations of declining krill biomass may be the substantial drop in Adelie penguin populations in recent years, which some researchers attribute in part to declines in krill populations. Kock & Siegel, *supra* note 40, at 1; Greenpeace, *Antarctic Warming – Early Signs of Global Climate Change* (1995), <<http://www.greenpeace.org/search/shtml>>.

⁵⁰ Greenpeace, *The Threat of Climate Change to Arctic Wildlife*, <<http://www.greenpeace.org/~comms/97/arctic/library/biodiversity/wildlife.html>> (1997). "The polar amplification of warming in the Arctic is attributed to the positive albedo feedback of snow and sea-ice." *Report of the IWC Workshop on Climate Change and Cetaceans*, *supra* note 20, at 13. See also Michael E. Mass & Raymond S. Bradley, *Northern Hemisphere Temperatures during the Past Millennium: Inferences, Uncertainties, and Limitations*, American Geophysical Union, Paper No. 199GL900070 (1999).

⁵¹ D.A. Rothrock, Y.Yu & G.A. Maykut, *Thinning of the Arctic Sea-Ice Cover*, GEOPHYSICAL RES. LETTERS, Dec. 1, 1999, at 1.

⁵² Ola M. Johannessen, Elena V. Shalina & Martin W. Miles, *Satellite Evidence for an Arctic Sea Ice Cover in Transformation*, 286 SCI. 1937 (1999); Kenneth Blackman, *Global Warming Worries Indigenous People*, INTER PRESS SERVICE, Aug. 13, 1998, LEXIS, World Library.

⁵³ Rothrock, *supra* note 51, at 5.

⁵⁴ Konstantin Y. Vinnikov, et al., *Global Warming and Northern Hemisphere Sea Ice Extent*, SCI., December 3, 1999, at 1936. See also, D.K. Perovich, et al., *Year on Ice Gives Climate Insights*, EOS, TRANSACTIONS AMERICAN GEOPHYSICAL UNIT, Oct. 12, 1999, at 481.

⁵⁵ Vinnikov, *supra* note 55 at 1936; Robert T. Watson, Marufu C. Zinyowera & Richard H. Moss, *The Regional Impacts of Climate Change: An Assessment of Vulnerability*, Special Report of IPCC Working Group II (1997), <<http://www.ipcc.ch/pub/sr97.htm#polar>>. Climate models project that average sea surface temperatures in the northern North Pacific and North Atlantic will increase 2-3° C over the next 60-80 years. *Report of the IWC Workshop on Climate Change and Cetaceans*, *supra* note 20, at 13.

⁵⁶ Mariana Gosnell, *Meltdown? Sea Ice May Be Thawing, Which Could Mean Disruption of Life at Earth's Polar Ends*, 28(4) INT'L WILDLIFE 12 (1998).

Further losses of sea ice over the next century could have adverse impacts on cetaceans in the region. While no single species dominates the Arctic food chain, as does krill in the Antarctic,⁵⁷ sea ice decline associated with warming could result in the diminution of phytoplankton populations.⁵⁸ This could lead to 'knock-on effects' throughout the Arctic food chain, including declines in the stocks of several key prey species of cetaceans, such as copepods and plankton-feeding fish, including Arctic cod, a key prey species for narwhal and beluga whales.⁵⁹ Some cetacean species in the region, such as fin and bowheads, have demonstrated adaptability in feeding behavior and may be able to shift to other prey species.⁶⁰ However, other species, or stocks of such species, including narwhals and belugas, might be seriously affected by the loss of ice-dependent prey species.⁶¹

Polynyas are important spring feeding and breeding grounds for marine mammals in the Arctic, as well as overwintering sites for white and possibly bowhead whales.⁶² Warming and the attendant ice melt might result in greater stratification of the water column and decreased nutrient resupply, limiting the growth of phytoplankton populations that are a critical link in the cetacean food chain in the region.⁶³

Projected reductions in sea ice area could also open up the Northwest Passage. This could expose cetaceans to increased ship traffic and mineral exploitation.⁶⁴ Collisions with ships have adversely affected cetacean stocks throughout the world.⁶⁵ Vessel noise may also disrupt cetacean migration patterns,⁶⁶ increase mortality through

⁵⁷ *Report of the IWC Workshop on Climate Change and Cetaceans*, *supra* note 20, at 14.

⁵⁸ Environmental Investigation Agency, *Whales in a Changing Ocean* 6 (1994).

The freshening of high latitude seas from freshwater inputs and melt water could be expected to increase the period of halothermal stratification, increase the depth of the halocline and exacerbate the saline concentration gradient. The longer period of stratification is predicted to disadvantage larger phytoplankton such as diatoms and increase the number of smaller species. This will lengthen the food chain between primary producers and larger consumer species, effectively reducing the biomass of the latter ... The greater depth of the halocline means that all phytoplankton will spend a greater amount of time in sub-optimal illumination, while the strengthened concentration gradient will make it more difficult for nutrients to enter the surface layer from below. Both of these factors are expected to reduce overall productivity. *Id.*

⁵⁹ *Id.* See also *Report of the IWC Workshop on Climate Change and Cetaceans*, *supra* note 20, at 14; Cynthia T. Tynan & Douglas P. DeMaster, *Observations and Predictions of Arctic Climatic Change: Potential Effects on Marine Mammals*, ARCTIC, Dec. 1997 (LEXIS, World Library).

⁶⁰ *Report of the IWC Workshop on Climate Change and Cetaceans*, *supra* note 20, at 14.

⁶¹ *Id.* Changes in thermohaline circulation and the intensification of coastal upwelling as a consequence of warming may also adversely affect cephalopod species. *Id.* at 13.

⁶² M. Holst & I. Stirling, *A Note on Sightings of Bowhead Whales in the North Water Polynya, North Baffin Bay, May-June 1998*, 1(2) J. CETACEAN RES. MGT. 153, 153 (1999).

⁶³ *Observations and Predictions of Arctic Climatic Change: Potential Effects on Marine Mammals*, *supra* note 59.

⁶⁴ *Report of the IWC Workshop on Climate Change and Cetaceans*, *supra* note 20, at 13.

⁶⁵ Randall R. Reeves & Stephen Leatherwood, DOLPHINS, PORPOISES, AND WHALES 19 (1994); *Wanted Alive!* *supra* note 47, at 1 (1998); Michael Lipske, *A Whale of a Story*, NATIONAL WILDLIFE, Feb./Mar. 1993, at 6.

⁶⁶ World Wildlife Fund, *supra* note 61, at 14; Kim E.W. Shelden & David J. Rugh, *Bowhead Status Report*, National Marine Mammal Laboratory (1998), at 17, <<http://nmm101.afsc.noaa.gov/CetaceanAssessment/bowhead/bmsos.htm>>; Alexander Gillespie, *Whale-Watching and the Precautionary Principle: The Difficulties of the New Zealand Domestic Response*, 17

stress,⁶⁷ result in hearing loss,⁶⁸ and interfere with communications, which may result in strandings.⁶⁹ Mineral exploitation may also threaten cetaceans through pollution,⁷⁰ noise,⁷¹ and in the case of oil and gas exploration, water dispersal during the drilling phase.⁷²

In other regions of the world, warming may also alter ocean upwelling patterns, fostering increased blooms of dinoflagellates, many of which produce brevetoxins.⁷³ Dinoflagellate blooms have been associated with the deaths of marine species throughout the world, including cetaceans in the Mediterranean.⁷⁴ The warming of tropical waters may also contribute to epizootics, such as the one that killed thousands of striped dolphins in the Mediterranean in the early 90s,⁷⁵ and augment the spread of marine disease agents and parasites.⁷⁶

Warming trends will also likely raise ocean surface water temperatures to above 26° C in the next century.⁷⁷ This temperature increase could result in a greater of exchange of energy and add momentum to the vertical exchange processes critical to the development of tropical typhoons and cyclones.⁷⁸ As a consequence, some researchers predict that the occurrence of tropical typhoons and cyclones could increase by as much as 50-60 per cent,⁷⁹ and their intensity by 10-20 per cent.⁸⁰ Increased precipitation

N.Z. U. L. REV. 254, 261-62 (1997); James E. Scarff, *The International Management of Whales, Dolphins, and Porpoises: An Interdisciplinary Assessment*, 6 ENVTL. L. Q. 326, 416 (1977).

⁶⁷ David Harrison, *Noise Drives Whales Crazy*, THE OBSERVER, May 31, 1998 (LEXIS, World Library).

⁶⁸ Natural Resources Defense Council, *Sounding the Depths* (1999), at 5, <<http://www.nrdc.org/nrdcpro/sound/sdinx.html>>.

⁶⁹ *Id.* See also Judith D. Hutchinson, *Fisheries Interactions: The Harbour Porpoise – a Review*, in THE CONSERVATION OF WHALES AND DOLPHINS 154-155 (Mark P. Simmons & Judith H. Hutchinson, eds. 1996).

⁷⁰ Bernd Würsig, *Cetaceans and Oil: Ecologic Perspectives*, in SEA MAMMALS AND OIL: CONFRONTING THE RISK 129-165 (Joseph R. Geraci & David J. St. Aubin, eds. 1990); Thomas Land, *Co-Ordinated Action is Key to Black Sea Pollution Strategy*, LLOYDS LIST, January 2, 1998 (LEXIS, World Library).

⁷¹ Swiss Coalition for the Protection of Whales, *Polar Exposure: Environmental Threats to Arctic Marine Life and Communities* (1997), at 13.

⁷² *Id.*

⁷³ *Whales in a Changing Ocean*, *supra* note 58, at 26.

⁷⁴ William C.G. Burns, *The Agreement on the Conservation of Cetaceans of the Black Sea, Mediterranean Sea and Contiguous Atlantic Area (ACCOBAMS): A Regional Response to the Threats Facing Cetaceans*, 1 J. INT'L WILDLIFE L & POL'Y 113, 116 (1998); Fred Pearce, *Dead in the Water: Attempts to Save the Grossly Polluted Mediterranean Seen as Doomed as the Sea Itself*, N. SCI., February 4, 1998; Joby Warrick, *Dead Dolphins and Toxin Fish: Scientists Hunt Down Seaborne Saboteurs*, INT'L HERALD TRIBUNE, September 24, 1997, at 6.

⁷⁵ Burns, *supra* note 74, at 115; Seamus Kennedy, *Infectious Disease of Cetacean Populations*, in THE CONSERVATION OF WHALES & DOLPHINS, *supra* note 69, at 344-45; Environmental News Network, *Global Warming Poses Threat to Whale Conservation*, MARCH 21, 1996, <<http://www.enn.com/specialreports/climate/news/03whal26.txt>>.

⁷⁶ *Report of the IWC Workshop on Climate Change and Cetaceans*, *supra* note 20, at 16.

⁷⁷ NASA Goddard Institute for Space Studies, *How Will the Frequency of Hurricanes Be Affected by Climate Change?*, <<http://www.giss.nasa.gov/research/intro/druyan.02/>> (1999); Thomas R. Karl, Neville, Nicholls & Jonathan Gregory, *The Coming Climate*, SCI. AM., <<http://www.sciam.oc/0597/issue/0597karl.html>> (1997).

⁷⁸ *Insurers Refuse to Cover Global Warming Risks*, THE INDEPENDENT, May 8, 1992, at 11 (LEXIS, World Library).

⁷⁹ NASA, *supra* note 77; R.J. Haarsman, *Tropical Disturbances in a GCM*, 8 CLIMATE DYNAMICS 247 (1993).

associated with such storms could result in more pollutants running off from land into coastal waterways inhabited by whales,⁸¹ as well as the introduction of river-borne contaminants into Arctic waters.⁸² Elevated levels of atmospheric carbon dioxide could also increase seawater acidity, potentially raising the concentration of heavy metals in ocean ecosystems, exacerbating the toxic effect of these substances on cetaceans.⁸³

3. THE IWC AND CLIMATE CHANGE

The ICRW was entered into 54 years ago by 15 nations “in the face of precipitous declines in the stocks of most important whale species”⁸⁴ to “establish a system of international regulation for the whale fisheries to ensure proper and effective conservation and development of whale stocks.”⁸⁵ For the first 35 years of its existence, the IWC focused almost exclusively, and for the most part unsuccessfully,⁸⁶ on establishing catch quotas for the commercial whaling industry. However, at the IWC’s 38th meeting the Commission’s Scientific Committee acknowledged the need to assess the impact of human influences other than direct exploitation, including environmental changes.⁸⁷ At the IWC’s 44th meeting, the parties decided that the Scientific Committee should establish a regular agenda item to address environmental change issues.⁸⁸

⁸⁰ Thomas R. Knutson, Robert E. Tuleya & Yoshio Kurihara, *Simulated Increase of Hurricane Intensities in a CO₂-Warmed Climate*, 279 SCI. 1018, 1018 (1998). Not all climatologists agree that warming will result in increases in the incidence or intensity of storms, see Bette Hileman, *Climate Observations Substantiate Global Warming Models*, CHEM. & ENG. N., Nov. 27, 1995, <<http://pubs.acs.org/hotartcl/cenear/951127/pgl.html>>; G.J. Holland, *The Maximum Intensity of Tropical Cyclones*, 54 J. ATMOSPHERIC SCI. 2519 (1995).

⁸¹ *Global Warming Poses Threat to Whale Conservation*, *supra* note 37.

⁸² *Observation and Predictions of Arctic Climatic Change*, *supra* note 59. As the International Whaling Commission has noted, pollution is one of the gravest threats facing cetaceans. *Resolution on Environmental Change and Cetaceans*, *supra* note 2. See also Letizia Marsili & Silvano Focardi, *Organochlorine Levels in Subcutaneous Blubber Biopsies of Fin Whales (*Balaenoptera physalus*) and Striped Dolphins (*Stenella coeruleoalba*) from the Mediterranean Sea*, 92 ENVTL. POLLUTION 1 (1995); ALLISON MOTLUK, *Deadlier than the Harpoon*, NEW SCI., July 1, 1995; William C. Burns, *The International Whaling Commission and the Regulation of the Consumptive and Non-Consumptive Uses of Small Cetaceans: The Critical Agenda for the 1990s*, WISCONSIN INT’L L.J. 105, 119 (1994).

⁸³ Catherine Dold, *Toxic Agents Found to Be Killing Off Whales*, N.Y. TIMES, June 16, 1992, at B8. For an analysis of land-based toxic contaminants that threaten species in the Arctic, see Arctic Council, *Regional Programme of Action for the Protection of the Arctic Marine Environment from Land-Based Activities*, <<http://arctic-council.usgs.gov/99-0376-eng.pdf>>.

⁸⁴ William C. Burns, *The International Whaling Commission and the Future of Cetaceans: Problems and Prospects*, 8 COLO. J. INT’L ENVTL. L. & POL’Y 31, 33 (1997).

⁸⁵ International Convention for the Regulation of Whaling, *supra* note 1, Preamble.

⁸⁶ “The first few decades of whale management under the IWC can be described as an “era of ‘quota whaling,’ . . . during which the recommendations of the Commission’s Scientific Committee were often ignored by pro-whaling nations eager to hunt as many whales as possible.” (citations omitted). Sarah Suhre, *Misguided Morality: The Repercussions of the International Whaling Commission’s Shift from a Policy of Regulation to One of Preservation*, 12 GEO. INT’L ENVTL. L. REV. 305, 309 (1999); *The International Whaling Commission and the Future of Cetaceans: Problems and Prospects*, *supra* note 84, at 35.

⁸⁷ 37 REP. INT’L WHALING COMMISSION 151 (1987).

⁸⁸ *Resolution on the Need for Research on the Environmental and Whale Stocks in the Antarctic Region*, 43 REP. INT’L WHALING COMMISSION 39-40 (1992).

In 1996, the Scientific Committee convened a workshop on climate change and cetaceans.⁸⁹ While observing that assessment of the possible impacts of climate change on cetaceans was “severely limited” by the limitations of climate models, the workshop concluded that “concerns about the ability of at least some cetacean populations to adapt to future conditions are justified.”⁹⁰ It called on the IWC to encourage its members to join international efforts to reduce greenhouse gas emissions.⁹¹ Additionally, the Scientific Committee invited scientists with expertise in the field to attend future Committee meetings and recommended that a future workshop be convened to review progress.⁹²

In the same year, the IWC endorsed the Scientific Committee’s establishment of a Standing Working Group on Environmental Concerns (SWGEC) to assess the effects of environmental change on cetaceans and the Committee’s proposal for increased cooperation with other organizations working on environmental change issues.⁹³ At the 49th meeting, the IWC endorsed the recommendations of the climate change workshop, as well as those from a meeting on pollution issues, and called on the Scientific Committee to produce detailed scientific proposals for future work on environmental concerns. It also encouraged party states to carry out relevant non-lethal research and called upon members to provide additional funds to support the work of the Scientific Committee and SWGEC.⁹⁴

At the 50th meeting, the IWC commended the body’s Scientific Committee for its two ongoing initiatives on the impacts of pollutants and chemical contaminants and baleen whale habitat and prey studies related to climate change and identification of physical and biological habitat degradation and Arctic issues.⁹⁵ It also directed the Scientific Committee to accord high priority to implementing the research initiatives of the SWGEC and to produce costed proposals for non-lethal research.⁹⁶ Furthermore, the IWC addressed the critical issue of funding for such initiatives, allocating approximately \$170,000 US from the Commission’s reserves to fund environmental research in the eight

⁸⁹ *Report of the IWC Workshop on Climate Change and Cetaceans*, *supra* note 8.

⁹⁰ *Id.* at 22.

⁹¹ *Id.*

⁹² *Id.*

⁹³ 48th Meeting of the International Whaling Commission, *Resolution on Environmental Change and Cetaceans*, IWC/48/44 (1996), at 1. In the context of climate change issues, these other organizations include Global Ocean Ecosystem Dynamics (GLOBEC), a program adopted by UNESCO’s International Geosphere-Biosphere Program to “advance our understanding of the structure and function of the global ocean ecosystem,” <<http://www.ibss.iuf.net/links/globec/globec1.html>>; The Convention on the Conservation of Antarctic Marine Living Resources (CCAMLR), 19 ILM 841 (1980); the Scientific Committee on Antarctic Research/Antarctic Pack Ice Seals; the South Channel Ocean Productivity Experiment; and the Palmer Long Term Ecological Program of the National Science Foundation’s Office of Polar Programs. *Report of the IWC Workshop on Climate Change and Cetaceans*, *supra* note 8, at 3-4 & 23; 50th Meeting of the International Whaling Commission, *Report of the Standing Working Group on Environmental Concerns*, IWC 50/4, Annex H (1998), at 3. The IWC at its 50th meeting also encouraged Japan to coordinate its Whale Research Programme under a Special Permit in the Antarctic with the SWGEC. 50th Meeting of the International Whaling Commission, *Resolution on Coordinating and Planning for Environmental Research in the Antarctic*, IWC Resolution 1998-7 (1998).

⁹⁴ 49th Meeting of the International Whaling Commission, *Resolution on Environmental Change and Cetaceans*, IWC Resolution 1997-7, Appendix 7, (1997), at 21.

⁹⁵ *Resolution on Environmental Change and Cetaceans*, *supra* note 2.

⁹⁶ *Id.*

priority areas identified by the Scientific Committee.⁹⁷ Additionally, the parties agreed to consider the establishment of a dedicated Environmental Research Fund at the 51st meeting to facilitate environmental research and the attendance of invited participants with relevant expertise at future meetings of the Scientific Committee.⁹⁸ Finally, the parties agreed to establish a regular Commission agenda item for environmental concerns to facilitate reporting by the Scientific Committee on its progress in this context and reporting to the parties on national and regional initiatives.⁹⁹

At the 51st meeting, the IWC noted that the SWGEC had agreed to focus on one or two priority topics at each meeting to maximize its effectiveness.¹⁰⁰ The Scientific Committee endorsed SWGEC's decision to prioritize two programs in 2000: the Southern Ocean Whale and Ecosystem Research Programme (SOWER 2000) and POLLUTION 2000+.¹⁰¹

The IWC decided to provide approximately \$214,000 US for core funding of environmental research programs in 1999/2000.¹⁰² However, it noted that the SOWER 2000 and POLLUTION 2000+ programs would cost more than \$510,000 US in the first year alone,¹⁰³ and called upon parties to the IWC, other governments, international organizations, and other bodies to provide supplemental funding for the programs.¹⁰⁴

The SOWER 2000 research program will be relevant to issues surrounding the possible impacts of climate change on cetaceans. In cooperation with the Commission for the Conservation of Antarctic Marine Living Resources,¹⁰⁵ and the Southern Ocean

⁹⁷ 50th Meeting of the International Whaling Commission, *Resolution for the Funding of Work on Environmental Concerns*, IWC Resolution 1998-6. For a list of the eight priorities cited by the Scientific Committee, see note 2 and accompanying text.

⁹⁸ *Resolution for the Funding of Work on Environmental Concerns*, supra note 97.

⁹⁹ *Id.*

¹⁰⁰ 51st Meeting of the International Whaling Commission, *Resolution for the Funding of High Priority Scientific Research*, IWC Resolution 1999-5 (1999).

¹⁰¹ *Id.* The IWC also agreed to a feasibility study on fin and minke whales off West Greenland, and to accord priority to research in this context in 2000/2001 and subsequent years. *Id.*

¹⁰² *Id.*

¹⁰³ *Final Press Release*, 51st Meeting of the International Whaling Commission (1999), <<http://ourworld.compuserve.com/homepages/iwcoffice/Press99.htm>>.

¹⁰⁴ *Resolution for the Funding of High Priority Scientific Research*, supra note 100.

¹⁰⁵ The Convention on the Conservation of Antarctic Marine Living Resources (CCAMLR), May 20, 1980, 33 UST 3476, 19 ILM 841 (1980), applies "to the Antarctic marine living resources of the area south of 60 deg south latitude and to the Antarctic marine living resources of the area between that latitude and the Antarctic Convergence which form part of the Antarctic marine ecosystem." *Id.* at art. I(1). "Antarctic marine resources" are "populations of fin fish, molluscs, crustaceans and all other species of living organisms, including birds, found south of the Antarctic convergence." *Id.* at art. I(2). The Convention seeks to prevent the decrease "of any harvested population to levels below those which ensure its stable recruitment." *Id.* at art. II (3)9a). Parties to the Convention pledge to not engage in activities that will contravene the purposes of the agreement. *Id.* at art. III. The Commission was established under the Convention to ensure achievement of the Convention's objectives by, *inter alia*, facilitating research and studies of Antarctic marine living resources; identifying conservation needs; and formulating and adopting conservation measures. *Id.* at art. IX. The Commission and the Convention's Scientific Committee are required under the Convention to "develop co-operative working relationships, as appropriate with inter-governmental and non-governmental organizations which could contribute to their work, including . . . the International Whaling Commission." *Id.* at art. XXIII(3).

IWC observers are also onboard research vessels participating in the CCAMLR's 2000 Krill Synoptic Survey, which seeks to improve estimates of the pre-exploitation biomass of krill, a critical

Global Ocean Ecosystems Dynamics (GLOBEC) program,¹⁰⁶ the SWGEC will conduct an international survey program with two major components: abundance estimates of minke whales and other baleen whales, and an assessment of the status of Southern Hemisphere blue whales.¹⁰⁷ The IWC hopes that this research will facilitate mapping of cetacean distribution and abundance in relation to krill distribution in the Antarctic and possible changes in cetacean foraging behavior in response to changes in krill abundance and distribution.¹⁰⁸

4. CETACEANS AND CLIMATE CHANGE: PROSPECTS IN THE NEXT CENTURY

4.1 The Institutional Role of the IWC in Protecting Cetaceans from Climate Change

It is difficult to be sanguine about the prospects for the IWC to effectively address the threats that cetacean species may face from climate change. First, it is doubtful whether the IWC possesses, or will be able to cobble together, the financial resources to

parameter for establishing the sustainable yield of the Southern Ocean krill fishery. *CCAMLR 2000 Krill Synoptic Survey of Area 48*, <http://www.ccamlr.org/English/e_scientific_committee/e_sc_krill_surv.htm>. The IWC observers will also conduct observations of whale abundance and distribution. Personal correspondence from Eugene Sabourenkov, Science Officer, CCAMLR Secretariat.

The full text of the CCAMLR, and other Antarctic agreements, is available on the American Society of International Law - Wildlife Interest Group's website at: <<http://www.eelink.net/~asilwildlife/aa.html>>. For additional information on the Commission, see its website, <<http://www.ccamlr.org/>>; Stuart Kaye, *Legal Approaches to Polar Fisheries Regimes: A Comparative Analysis of the Convention for the Conservation of Antarctic Marine Living Resources and the Bering Sea Doughnut Hole Convention*, 26 CAL. W. INT'L L.J. 75 (1995).

¹⁰⁶ The Global Ocean Ecosystems Dynamics (GLOBEC) was adopted by the International Geosphere-Biosphere Programme, to "advance our understanding of the structure and functioning of the global ocean ecosystem, its major subsystems, and its response to physical forcing so that a capability can be developed to forecast the response of the marine ecosystem to global change." GLOBEC is co-sponsored by the Scientific Committee on Oceanic Research (SCOR) and the Intergovernmental Oceanographic Commission of UNESCO. Intergovernmental Oceanographic Commission, <<http://ioc.unesco.org/iyo/activities/conferences/globec.htm>>. Southern Ocean GLOBEC is one of GLOBEC's major research programs. Its major research activities will begin over the next two years and will focus on the impacts of physical forces on population dynamics and predator-prey interactions between key species in the region, with special emphasis on the overwintering strategies of zooplankton and top predators. Researchers hope this research will advance the understanding of Southern ocean ecosystems and enhance the ability to monitor and predict climate change impacts. U.S. GLOBEC, <<http://www1.npm.ac.uk/globec/Reg%20Progs/major2new.htm>>. See also, *Report of the IWC Workshop on Climate Change and Cetaceans*, *supra* note 20, at 4.

¹⁰⁷ International Whaling Commission, *Report of the Scientific Committee, Annex Z, Report of the Ad Working Group on Future SOWER Planning*, reprinted in 1 J. CETACEAN RES. & MGT. 263-266 (Suppl. 1999).

¹⁰⁸ International Whaling Commission, *Report of the Scientific Committee, Annex H, Appendix 3, Observer's Report of the Meeting of the Southern Ocean GLOBEC Planning Group*, (1999), reprinted in 1 J. CETACEAN RES. & MGT. 204 (Suppl. 1999).

conduct meaningful climate research. Cetacean research is extremely expensive because many species are highly migratory and often never come near land.¹⁰⁹ As a consequence of the cost-prohibitive nature of such research, “there are few cases where whale or dolphin populations have been studied for long enough to determine their overall status, let alone identify the key environmental factors which control populations.”¹¹⁰ Cetacean research in the context of climate change will be particularly costly. Climate modeling is a very expensive proposition and research in the context of cetaceans will necessitate extensive modeling. For example, in the Arctic, modeling will be required to ascertain regional ice dynamics, winds, mesoscale features, and mechanisms of nutrient resupply.¹¹¹

Yet, the parties to the IWC allocated less than \$200,000 at the 50th meeting to address the impact of *eight* major environmental threats to cetaceans.¹¹² As indicated above, the parties at the 51st meeting did provide additional funding for the 1999/2000 research program, which includes a climate change component, but they acknowledged a \$300,000 shortfall for the first year of the program alone.

It is unlikely that the parties will be forthcoming with substantial additional funding for environmental research. As Burke observes, the “IWC is . . . given little or no capacity of its own to increase knowledge and understanding of whales . . . It must rely on member states and on private groups, neither of which can be presumed to do objective science or to interpret conditions without bias.”¹¹³ Given the incredible rancor that characterizes IWC deliberations in this era,¹¹⁴ it is difficult to believe that the parties will now bolster the Secretariat’s autonomy by providing it a substantial new source of funding.¹¹⁵

¹⁰⁹ Joseph P. Rosati, *Enforcement Questions of the International Whaling Commission: Are Exclusive Economic Zones the Solution?*, 14 CAL. W. INT’L L.J. 114, 124 n.101 (1984); Scarff, *supra* note 66, at 333.

¹¹⁰ Paul Thompson & Sue Mayer, *Defining Future Research Needs for Cetacean Conservation*, in THE CONSERVATION OF WHALES & DOLPHINS, *supra* note 69, at 412. *See also* Koen van Waerebeek, et al., *Spatial and Temporal Distribution of the Minke Whale, Balaenoptera acutorostrata (Lacépède, 1804, in the Southern Northeast Atlantic Ocean and the Mediterranean Sea, with Reference to Stock Identity*, 1(3) J. CETACEAN RES. & MGT. 223 (1999); Animal Welfare Institute, *Debunking the RMP: The Case for Practical Reality over Abstract Theory* 14-17 (1993).

¹¹¹ Tynan & DeMaster, *supra* note 59, at 20.

¹¹² *See supra* note 97 and accompanying text.

¹¹³ WILLIAM T. BURKE, THE NEW INTERNATIONAL LAW OF FISHERIES 292 (1994).

¹¹⁴ The primary source of conflict in the IWC is between nations such as Japan and Norway that believe that the moratorium on commercial should be lifted on the grounds that sustainable harvesting of at least one species, minke whales, is now tenable, and those nations that oppose lifting the moratorium either on ethical/moral grounds or because they question the sustainability of the harvest. *See* Kristen Fletcher, *The 49th Annual Meeting of the International Whaling Commission: Prelude to the Next Fifty Years*, 1 J. INT’L WILDLIFE L. & POL’Y 134, 134 (1998); William C.G. Burns, *The Forty-Ninth Meeting of the International Whaling Commission: Charting the Future of Cetaceans in the Twenty-First Century*, COLO. J. INT’L ENVTL. L. & POL’Y 64, 67 (1997). As Michael Canny, the Chairman of the International Whaling Commission, recently concluded, there is increasing concern “that the inability of the IWC to reach a consensus on fundamental questions . . . will lead to a breakup of the IWC with detrimental effects on the conservation of whales.” Michael Canny, *Opening Statement of the Government of Ireland, IWC/49/OS/Ireland* (1997).

¹¹⁵ Indeed, Norway has expressly declared its misgivings about IWC efforts to assess environmental impacts on cetaceans, with the exception of pollution impacts. At the 51st Meeting, Norway’s delegate argued that the IWC should concentrate its limited resources on monitoring of and research related to abundance and distribution of cetaceans, changes in biological parameters and the effects of pollution. The

Even assuming, *arguendo*, that the IWC is able to conduct adequate research in the future on its own or in cooperation with other agencies, its ability to protect cetaceans from climate change may be extremely limited. Should the moratorium on commercial whaling be lifted in the future, the IWC could incorporate findings of adverse effects of climate change into its calculation of sustainable takes under the mechanism that will be used to set quotas, the Revised Management Scheme.¹¹⁶ However, this would likely do little to protect cetaceans because the depleted status of most species would preclude the setting of catch quotas for more than one or two species in the foreseeable future.

The parties could also vote to expand the boundaries of existing sanctuaries established by the IWC in the Pacific sector of the Southern Ocean, the Southern

Norwegian delegate also issued the veiled threat that if the Scientific Committee were to accord less priority to advice on whaling issues, Norway might be compelled to seek advice on its whaling activities from another international body, such as the North Atlantic Marine Mammal Commission (NAMMCO), an intergovernmental organization established under the Agreement on Cooperation in Research, Conservation and Management of Marine Mammals in the North Atlantic, <<http://www.eelink.net/~asilwildlife/nam.html>,> by the Faroe Islands, Greenland, Iceland and Norway in 1992 conduct scientific study, conservation and management of marine mammals in the North Atlantic region. Professor Lars Walloe, *IWC Should Focus on Central Issues, Not on General Environmental Topics*, High North Alliance, <<http://www.highnorth.no/Library/Policies/National/lw-IWC-99.htm>>. For an overview of NAMMCO, see David D. Caron, *The International Whaling Commission and the Atlantic Marine Mammal Commission: the Institutional Risks of Coercion in Consensual Structures*, 89 AM. J. INT'L L. 154, 164-165 (1995). Some fear that NAMMCO will ultimately become "an option for those in the North Atlantic region that decide to withdraw from the IWC or, more likely, to opt out of particular obligations." *Id.* at 165.

¹¹⁶ The Revised Management Scheme is a mechanism for estimating the abundance of discrete species and sustainable catch limits, as well to establish methods to ensure such limits are adhered to. It consists of the Revised Management Procedure, "a framework to assess the viability of exploiting discrete stocks of cetaceans to facilitate the establishment . . . of sustainable harvesting quotas for said stocks," and several other components, including an inspection and observation scheme to deter cheating. William C. Burns, *The International Whaling Commission and the Future of Cetaceans: Problems and Prospects*, 8 COLO. J. INT'L ENVTL. L. & POL'Y 33, 54-56 (1997); *Resolution of Provisions for Completing the Revised Management scheme Proposed by US, UK, Netherlands, Denmark, Norway*, IWC/48/42, Agenda Item 11.4.2 (1996). Under the RMP, catches are not to be permitted on stocks that are below 54 per cent of the estimated carrying capacity. International Whaling Commission, *Whale Population Estimates*, <<http://ourworld.compuserve.com/homepages/iwcoffice/Estimate.htm>>. Current scientific research on the RMP centers largely on simulation testing of possible application to specific species and ocean areas. Testing began with North Atlantic and Southern Hemisphere minke whales and has now moved on to North Pacific minke and Bryde's whales. International Whaling Commission, *Report of the Scientific Committee, Annex D. Report of the Sub-Committee on the Revised Management Procedure*. 1 J. CETACEAN RES. & MGT. (Supplment) 263-266 (1999).

The IWC has accepted and endorsed the Revised Management Procedure; however, several outstanding issues remain before the IWC will consider lifting the commercial moratorium, including the specification of the inspection and observer system and "arrangements to ensure that total catches over time are within limits set under the RMS." International Whaling Commission, *Final Press Release*, 1998 Annual Meeting, May 20, 1998; IWC Resolution 1996-6 (1996).

At its 50th Meeting, the IWC the parties passed a resolution agreeing that any catch limits established under the RMS "shall be calculated by deducting all human-induced mortalities that are known or can be reasonably estimated, other than commercial catches, from the total allowable removal." *Resolution on Total Catches Over Time*, IWC Resolution 1998-2.

Hemisphere, and the Indian Ocean,¹¹⁷ or create new sanctuaries. This could provide additional protection for cetacean species that may be threatened by climate change by precluding direct exploitation. However, again, since only a few species are likely to be subject to commercial whaling in the future if the moratorium is lifted, this action would not benefit most of the species most threatened by climate change.

The IWC may ultimately find that its most effective tool for protecting cetaceans from climate change lies in advocacy of their interests in other forums that may ultimately have far more influence on their fate. For example, as outlined above, in the Antarctic, warming may result in diminution of krill stocks, seriously threatening cetaceans in the region.¹¹⁸ Thus, it may be incumbent upon the IWC to lobby the Convention on the Conservation of Antarctic Marine Living Resources, the primary body to manage marine resources in the region,¹¹⁹ to limit commercial harvesting of krill in the future.¹²⁰ Similarly, the IWC should press the Intergovernmental Panel on Climate Change, the primary scientific research body to inform the decision making of the United Nations Framework on Climate Change,¹²¹ to incorporate cetacean data in its impact assessments. The IPCC assessments to date have not addressed this specific issue.

4.2 The Institutional Role of the United Nations Framework Convention on Climate Change

Even if the research initiatives of the IWC and other organizations improve our understanding of the impact of climate change on cetacean species, these impacts ultimately can be averted only if nations demonstrate the resolve to substantially reduce greenhouse gas emissions. The primary international instrument to achieve this objective is the United Nations Framework Convention Change (UNFCCC),¹²² which entered into

¹¹⁷ Article V(1)(c) of the ICRW, *supra* note 2, permits the parties to establish “open and closed waters, including the designation of sanctuary areas.” The IWC designated most of the Pacific sector of the Southern Ocean as a sanctuary at the outset of the ICRW, banning the catching of baleen whales. In 1979, it established the Indian Ocean Sanctuary, prohibiting commercial whaling in “the waters of the Northern Hemisphere from the coast of Africa to 100°E, including the Red and Arabian Seas and the Gulf of Oman; and the waters of the Southern Hemisphere in the sector from 20°E to 130°E, with the Southern boundary set at 55°S.” ICRW, Schedule, sec. III(7)(a), as amended at the 51st Annual Meeting (1999). <<http://ourworld.compuserve.com/homepages/iwcoffice/Schedule.htm>>. 90 per cent of the world’s whales feed in the Southern Ocean Sanctuary. Gerard Baker, *Japan Threatens to Quit Whaling Commission*, FIN. TIMES, May 28, 1994, at 4. For a history of the establishment of IWC sanctuaries, see Cassandra Phillips, *Conservation in Practice: Agreements, Regulations, Sanctuaries and Action Plans*, in THE CONSERVATION OF WHALES & DOLPHINS 460-463 (Mark P. Simmonds & Judith D. Hutchinson eds., 1996).

¹¹⁸ See *supra* notes 36-42 and accompanying text.

¹¹⁹ See *supra* note 105 and accompanying text.

¹²⁰ Up to this point, efforts to commercially exploit krill in the Antarctic have been minimal, with only approximately 80,000 tons being harvested annually, primarily by the Japanese. However, an American agri-business concern is gearing up for a much larger harvest to supply the aquaculture industry and as a protein supplement for human food. Moreover, it is anticipated that fishers from Britain, several Eastern European nations, China, Canada and perhaps Chile will soon join the hunt. Don Woolford, *Ozone and Overfishing Threaten UV-sensitive Krill*, AAP NEWSFEED, Feb. 8, 1999 (LEXIS, World Library); *Ozone Hole Killing Antarctic Krill Stocks, Scientists Warn*, DEUTSCHE PRESS-AGENTUR, Feb. 8, 1999 (LEXIS, World Library). “[K]rill may take over as the major issue facing CCAMLR . . . Woolford, *supra*.

¹²¹ See *supra* note 16.

¹²² 31 I.L.M. 849 (1992).

force in 1994 and has been ratified by 180 countries.¹²³ The overarching objective of UNFCCC is to “achieve . . . stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system.”¹²⁴

Reflecting the Convention’s emphasis on common but differentiated responsibility,¹²⁵ the Convention requires developed country parties to “take the lead in combating climate change and the adverse effects thereof.”¹²⁶ Article 4(2) requires developed country parties and other parties included in Annex I¹²⁷ to “adopt national policies and take corresponding measures on the mitigation of climate change, by limiting [their] anthropogenic emissions of greenhouse gases and protecting and enhancing [their] greenhouse gas sinks and reservoirs.”¹²⁸

Unfortunately, the record of the UNFCCC’s Annex I parties has been disheartening. Initially, the major greenhouse gas emitting states agreed to “aim” to reduce their greenhouse gas emissions to 1990 levels by 2000.¹²⁹ Yet, all industrialized nations flouted this pledge, leading the Organization for Economic Cooperation and Development to conclude that emissions from industrialized nations could rise by 11-24% in the next fifteen years.¹³⁰

At the First Conference of the Parties, the parties concluded that their existing commitments were inadequate on three grounds. First, most Annex I nations were not on track to meet their initial aim by 2000. Second, the UNFCCC contained no provision for controlling greenhouse emissions beyond 2000. Third, the parties acknowledged that stabilization of emissions at 1990 levels would be insufficient to stabilize atmospheric greenhouse gas concentrations. Consequently, in a decision referred to as the “Berlin Mandate,” the parties established a process to strengthen UNFCCC commitments through

¹²³ International Institute for Sustainable Development, *Summary of the Fifth Conference of the Parties to the Framework Convention on Climate Change*, 12(123) EARTH NEGOTIATIONS BULLETIN 2 (1999). For the negotiating history leading up to the UNFCCC, see Elizabeth P. Barratt-Brown, et al., *A Forum for Action on Global Warming: The UN Framework Convention on Climate Change*, 4 COLO. J. INT’L ENVTL. L. & POL’Y 103, 106-109 (1993).

¹²⁴ *Id.* at art 2.

¹²⁵ UNFCCC, *supra* note 113, at arts. 3(1) & 4(1); Paul G. Harris, *Common But Differentiated Responsibility: The Kyoto Protocol and United States Policy*, 7 N.Y.U. ENVTL. L.J. 27, 27 (1999). The principle of common but differentiated responsibility was also adopted in Principle 7 of the Rio Declaration on Environment and Development, requiring nations to share responsibility for confronting environmental problems, but taking into account nations’ different contributions to these problems and capacity to confront them. Rio Convention on Environment and Development, Principle 7, U.N. Doc. A/CONF.151/5/Rev. 1, 31 I.L.M. 874 (1992)

¹²⁶ UNFCCC, *supra* note 113, at art. 3(1).

¹²⁷ Annex I of the UNFCCC is comprised of country parties that were members of the Organization for Economic Cooperation and Development at the time of adoption of the treaty, some Eastern European nations and some nations that were part of the former Soviet Union.

¹²⁸ UNFCCC, *supra* note 113, at art. 4(2)(a).

¹²⁹ *Id.* at art. 4(2).

¹³⁰ *US Greenhouse Gas Emissions Continue to Climb*, GLOBAL ENVTL. CHANGE REP., April 26, 1996, at 2; see also *EU Moves on Emissions, Warms CO2 Pollution Rising*, REUTER NEWS SERVICE, Mar. 9, 2000, <<http://www.planetark.org/dailynewsstory.cfm?newsid=5917>>; *Cabinet Okays Plan to Fight Global Warming*, <<http://www.theglobeandmail.com/gam/Environment/19991215/UWARMN.html>> (1999).

adoption of a protocol or other legal instrument, with the goal of establishing quantified emissions limitation and reduction objectives for the period past 2000.¹³¹

At the Third Conference of the Parties of the UNFCCC, the parties adopted the Kyoto Protocol,¹³² under which industrialized nations agree to reduce their collective emissions of six greenhouse gases¹³³ by at least 5 percent below 1990 levels by 2008-2012.¹³⁴ However, hostility to the Protocol by powerful sectors in the United States, including organized labor, fossil fuel producers, and influential members of the Senate,¹³⁵ may thwart its adoption. This would severely undercut the treaty's effectiveness, as the United States is responsible for approximately one-quarter of greenhouse gas emissions.¹³⁶

Moreover, because many greenhouse gases persist in the atmosphere for decades, "their radiative forcing – their tendency to warm Earth – persists for periods that are long compared with human life spans."¹³⁷ As a consequence of this, and the exclusion of developing countries from reduction commitments,¹³⁸ full implementation of the Kyoto Protocol will only reduce 2050 warming by one-twentieth of one degree,¹³⁹ and delay doubling of atmospheric concentrations of carbon dioxide from pre-industrial levels by less than a decade.¹⁴⁰ Thus, many potential impacts of climate change, including those that may be visited upon cetacean species, may be inevitable. Moreover, averting impacts beyond the middle of the next century will require far more dramatic reductions in greenhouse gas emissions. The Intergovernmental Panel on Climate Change has

¹³¹ UNFCCC, Conference of the Parties, 1st Sess., UN Doc. FCCC/CP/1999/7/Add.1, Decision 1/CP.1, at 4-6 (June 6, 1999).

¹³² Kyoto Protocol to the United Nations Framework Convention on Climate Change, FCCC/CP/1997/L.7/Add.1, December 10, 1997.

¹³³ The six greenhouse gases regulated under the Kyoto Protocol are: carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons, and sulphur hexafluoride. *Id.* at Annex A.

¹³⁴ *Id.* at art. 3 (1). "Individual States' commitments to reductions are differentiated with a view to meeting the 5 per cent overall target; the European Community and all its member States are committed to 8 per cent reductions, the United States to 7 per cent and Japan and Canada to 6 per cent. New Zealand, the Russian Federation and Ukraine will stabilise emissions at 1990 levels, whilst some States negotiated an actual increase in emissions." Peter G.G.Davies, *Global Warming and the Kyoto Protocol*, 47 INT'L & COMP. L. Q. 446, 453 (1998).

¹³⁵ Greg Easterbook, *Hot Air Treaty*, U.S. NEWS & WORLD REP., December 22, 1997, at 12; *A New Disinformation Campaign*, RACHEL'S ENV'T & HEALTH WEEKLY, April 30, 1998; Gretchen Vogel & Andrew Lawler, *Hot Year, But Cool Response in Congress*, 280 SCI., June 12, 1998, at 1684.

¹³⁶ Bharat H. Desai, *Institutionalizing the Kyoto Climate Accord*, 29(4) ENVTL. POL'Y & L. 159, 161 (1999); Alex Barnum *Can World Unite, Halt Climate Threat?*, S.F. CHRON., November 28, 1997, at A21. U.S. refusal to adopt the Protocol might result in European nations balking also. This could doom the agreement because it requires ratification by Annex I nations producing at least 55 per cent of greenhouse gas emissions. *Risky Business*, GLOBAL CHANGE, Oct. 1998, at 2.

¹³⁷ Bette Hileman, *Climate Observations Substantiate Global Warming Models*, CHEMICAL & ENGINEERING N., November 27, 1995, <<http://pubs.acs.org/hotartcl/cenear/951127/pgl.html>> See also, Thomas R. Karl, et al., *The Coming Climate*, SCI. AM., May, 1997, at 224 ("as much as 40 percent of [carbon dioxide] tends to remain in the atmosphere for centuries"); Silvio Kusidio, *Climatic Changes are no Longer Preventable, Warn Experts*, DEUTSCHE PRESSE-AGENTUR, March 22, 1995 (LEXIS, News file) ("Even a worldwide stabilization of the emissions would not prevent a rise in the greenhouse gases . . . for the next 200 years . . .")

¹³⁸ See *infra* note 132-135 and accompanying text.

¹³⁹ Martin Parry, et al., *Buenos Aires and Kyoto Targets Do Little to Reduce Climate Change Impacts*, 8 GLOBAL ENVTL. CHANGE 285, 285 (1998).

¹⁴⁰ Roger Jones, *Climate Change in the South Pacific*, 35 TIEMPO 17, 20 (2000).

estimated that it would be necessary to reduce greenhouse emissions by more than 60 percent to stabilize atmospheric concentrations at 1990 levels.¹⁴¹ Given how difficult it was to secure agreement to the much more modest reductions contemplated under the Kyoto Protocol, one must be skeptical about the prospects for nations agreeing to such dramatic cutbacks in the future. Recent research indicates that a commitment to high-efficiency energy technologies could reduce emissions by Annex I states to 1990 levels over the next few decades.¹⁴² However, major greenhouse emitters, most notably the United States, appear to lack the resolve to commit the necessary financial resources to develop such technologies.

Finally, as indicated earlier, the UNFCCC currently only binds developed countries and economies in transition to the reduction of greenhouse gas emissions.¹⁴³ However, given the tremendous projected increases in greenhouse gas emissions in developing countries over the next century,¹⁴⁴ the future effectiveness of the UNFCCC is contingent on engaging these nations in the regime's mission.¹⁴⁵ It is far from certain that developing nations will commit themselves to substantial emission reductions. There is great trepidation among developing countries about possible economic impacts and a sense of unfairness given the tremendous disparity in per capita emissions between industrialized and developing nations.¹⁴⁶

¹⁴¹ World Meteorological Organization/United Nations Environment Programme Intergovernmental Panel on Climate Change, *Climate Change: The IPCC Scientific Assessment* xxxvi (J. T. Houghton, G. J. Jenkins & J. J. Ephraums eds., 1990).

¹⁴² Committee for the National Institute for the Environment, *Energy Efficiency: Budget, Climate Change, and Electricity Restructuring Issues II*, <<http://cnie.org/nle/eng-48a.html>>; World Wildlife Fund & Energy Foundation, *America's Global Warming Solutions 2* (1999); William K. Stevens, *Price of Global Warming?*, N.Y. TIMES, Oct. 10, 1995, at B6.

¹⁴³ UN Framework Convention on Climate Change, *supra* note 113, at art. 4(2) & Annex I; Kyoto Protocol, *supra* note 131, at art. 3. Article 10 of the Kyoto Protocol did affirm the existing commitments imposed on all parties under Article 4(1) of the UNFCCC. These commitments include national emissions reporting to the Conference of the Parties and formulation and implementation of programs containing measures to mitigate climate change.

¹⁴⁴ China's carbon dioxide emissions alone will probably exceed the entire OECD's by the middle of this century. Francis Cairncross, *Global Warming Won't Cost the Earth*, THE INDEPENDENT, March 28, 1995, at 13. *See also*, *Seoul Resists Pressure to Commit to Reducing CO₂ Emissions*, KOREA HERALD, December 8, 1999, <http://www.koreaherald.co.kr/news/1999/12/_02/19991209_0218.htm> (South Korea, with eleventh highest emissions of greenhouse gases in the world, projected that its emissions will rise 76 percent from its 1998 levels by 2020). "[B]y 2100, carbon-dioxide emissions from developing countries will probably be more than the rich world's output." *Global Warming and Cooling Enthusiasm*, THE ECONOMIST, April 1, 1995, at 33.

¹⁴⁵ Clare Breidenich et al., *The Kyoto Protocol to the United Nations Framework Convention on Climate Change*, 92 AM. J. INT'L L. 315, 331 (1998); *Kyoto Protocol: The Unfinished Agenda*, 39 CLIMATIC CHANGE (1998), at 9.

¹⁴⁶ Anita Margrethe Halvorssen, *Climate Change Treaties – New Developments at the Buenos Aires Convention*, 1998 COLO. J. INT'L ENVTL. L & POL'Y 1, 1 (1998); Davies, *supra* note 133, at 457. "20 per cent of the world's population is responsible for 63 per cent of carbon dioxide emissions, while another 20 per cent is responsible for only 2 per cent of these emissions." Robert Engelman, Population, *Consumption and Equity*, TIEMPO, December, 1998, at 5.

Developing countries repulsed an effort at the Third Conference of the Parties in Kyoto to establish emission limitation objectives for wealthier developing states. *Id.* At the Fourth Meeting of the Conference of the Parties, in Buenos Aires, Argentina became the first developing country to commit itself to voluntary emissions reductions. *Address by the President of the Republic of Argentina*, Report of the

5. Conclusion

The IWC's recognition of the need to address environmental change issues, including possible impacts of climate change on cetaceans, is laudable. However, its limited research resources and the speculative future of the UNFCCC likely means that cetaceans will face increasing threats from climate change in the next century. It remains to be seen whether many species of cetaceans that were driven to the brink by harvesting can now survive the onslaught of environmental change, including the specter of global warming.