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Global Change, Environmental Security, and the Prisoner's Dilemma*

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Environmental problems, including the recent concern with the 'global change' problematique, now occupy a prominent position on international agendas and are recognized as a legitimate concern of peace research. Numerous scholars, policy-makers, and activists have proposed broadening use of the concept security beyond its traditional geopolitical and military focus to take into account environmental threats that seriously jeopardize human well-being. This article examines arguments that have been made both for and against use of the concept 'environmental security'. To assess the utility of this approach, the core concept 'security' is defined in terms of threats and vulnerabilities. Strategies for enhancing security are distinguished on the basis of whether they are designed (a) to reduce threats or vulnerabilities and (b) to be carried out unilaterally or collectively. Parallels are drawn between the options available to achieve military and environmental security with reference to the Prisoner's Dilemma game, which has been used widely to explain why states seek military security through counterproductive arms buildups rather than through a potentially much less costly strategy of mutual arms reductions. While the logic of the Prisoner's Dilemma did not prevail in the successful negotiations on protecting the ozone layer, it may become a significant factor in international efforts to address the problem of climate change. The larger question for peace research is whether the pursuit of environmental security can be channeled into cooperative arrangements that promote sustainable development rather than self-serving, nationalistic ventures that will heighten international conflict and perpetuate international injustices.

1. *The Environment and Peace Research*

Through the ages, human beings have held nature in awe. Not only have they depended on nature for the necessities of life, but some of the primary sources of insecurity in their lives have been the seemingly random 'forces of nature', such as storms, earthquakes, typhoons, tidal waves, volcanic eruptions, infectious diseases, droughts, floods, insect hords, and intense cold (Buzan, 1992, p. 14). In modern times a rapidly growing and industrializing human population has been seriously degrading the natural systems of the planet, thus bringing upon itself a new realm of environmental insecurities.

In the 1990s the overriding ecological concern is a problematique of human-caused global environmental changes, or what is known more succinctly as 'global change'.¹ The essence of the global change problematique is that human beings, by virtue of their

numbers and the magnitude of their activities, are causing biogeochemical changes in the Earth system that are taking place many times more rapidly than those that are occurring naturally (Price, 1989). Growing concentrations of several trace gases in the atmosphere are especially foreboding for the threat they pose to the stratospheric ozone layer that shields the planet's surface from harmful ultraviolet radiation and for the modifications they appear to be causing in the world's climates, which would have a myriad of other environmental and social consequences.²

In an earlier article in this journal, this author called attention to some implications of environmental degradation for peace research, including the conflicts that arise not only within but also between generations (Soroos, 1976). At the time, few within the peace research community took up the call to expand the agenda of peace research to include 'intergenerational peace'.³ With the passage of time, however, it has been widely acknowledged that demographic and en-

* An earlier draft was presented at the XVth World Congress of the International Political Science Association, Buenos Aires, 21–25 July 1991.

vironmental trends are a pertinent concern of peace research (Pirages, 1991).

The environment has become a part of the agenda of peace research in several ways. First, peace research is concerned with environmental or resource problems that may cause or exacerbate international or domestic tensions that may lead to war or armed conflict (Westing, 1986). Second, peace research seeks to prevent or minimize damage that military operations reek on the environment either as a result of the conduct of war or preparations for war (Westing 1988a, b), and now in the dismantling of armaments and conversion of arms industries to other uses (see Gleditsch, 1992). Third, peace research is sensitive to the need to reconcile ecological imperatives with the economic needs of developing countries and to address injustices that arise from the ways poorer societies are affected by environmental degradation caused by the consumptive habits of the highly industrialized nations (Lodgaard, 1992, pp. 123–4). Finally, peace research examines how environmental exigencies, by virtue of the way they transcend national political boundaries, may be altering the war-prone, state-centric international political order that has prevailed for centuries (Byers, 1991; Brock, 1991).

2. *The Environment and Security*

For several decades the conventional use of the term ‘security’ in the realms of foreign policy and international studies has been to refer to the defense of sovereign states against violent attack, either from other states or from terrorist or revolutionary groups within their borders.⁴ More recently, a deepening sense of urgency about the threats that ecological trends posed to human welfare has prompted a coterie of scholars, activists, political figures to refer to ‘environmental security’.⁵

The term environmental security has also entered the United Nations lexicon as proposals have been made for an Environmental Security Council, most notably by the former Soviet Union (see Shevardnadze, 1988; Schrijver, 1989). ‘Environmental Security and Sustainable Development’ is one of six

general topics on the research agenda of the Human Dimensions of Global Environmental Change Programme, sponsored by the International Social Science Council (Jacobson & Price, 1990; Jacobson, 1992), as well as the subject of a program of the International Peace Research Institute, Oslo. An International Consortium for the Study of Environmental Security was established in 1990 to encourage research on the topic.⁶ Environmental security has also been the subject of numerous academic conferences and projects (e.g. Pietraś & Pietraś, 1991).

The case for adopting the term security in referring to environmental threats is usually based on one or more of the following four types of arguments: (1) conceptual, (2) theoretical, (3) political, and (4) normative. The *conceptual* argument suggests that environmental imperatives are reason for a rethinking of the essence of security. In a generic sense, security implies freedom or protection from serious threats to human well-being. Thus, conceptual consistency dictates that whatever poses such a threat, be it in military, economic, resource, food, or environmental realms, becomes a security problem.⁷ Conventional notions of security focusing on military threats are viewed as an artifact of a world dominated by the East–West confrontation and the specter of nuclear armageddon, and thus too limited in view of contemporary realities, including global environmental changes (Ullman, 1983).

Theoretical arguments focus on empirical cause-and-effect relationships, in particular the potential of major environmental changes to generate and intensify conflict between and within states (Gleick, 1989; Rowlands, 1991). For example, reductions in river flows due to greenhouse warming may cause tensions among the states or other groups that depend upon the increasingly scarce water resources (Myers, 1989). Large movements of ‘environmental refugees’ fleeing drought conditions or rising sea levels may threaten the welfare of the societies upon whose territory they are encroaching (Homer-Dixon, 1991; Homer-Dixon et al., 1993). Nations or societies whose environment is degraded by serious environmental

disruptions, such as acid deposition from the long-range transport of air pollution, may become increasingly hostile to those considered primarily responsible for these problems (Lipschutz & Holdren, 1990).

Adding an environmental dimension to security also draws attention to the impacts that war and other military activities have on the ecological health of the planet. Even during times of peace, armed forces are a major drain on natural resources, such as petroleum, and a substantial source of pollution, including radioactive contamination (Westing 1988a, b). Actual warfare reeks a heavy toll on the environment, but the consequences of modern instruments of war can be particularly devastating and long-lasting. The ultimate war-caused environmental catastrophe would be 'nuclear winter' caused by the detonation of large numbers of nuclear weapons (Sagan & Turco, 1990). While the environmental damage associated with war is usually an inadvertent side effect, combatants have been known to alter the environment to achieve a military advantage, as in the defoliation and cloud-seeding operations of the United States in Indochina (Westing 1976). Environmental blackmail, the threat to cause environmental havoc, was attempted unsuccessfully by Iran to deter an allied response to its seizure of Kuwait (Joyner & Kirkhope, 1992).

The *political* rationale seeks to advance environmental causes by taking advantage of the potency of the term security 'to legitimize exceptional measures of collective action', to borrow a phrase from Barry Buzan (1992, p. 1).⁸ Referring to environmental change as a security threat may bestow the problematique with a greater sense of urgency that elevates it to the realm of 'high politics' and a place near the top of national and international agendas along with military priorities, which have heretofore had a virtual monopoly on the use of the concept (Dalby, 1992; Gleick, 1991, p. 18). To be fully secure implies anticipating 'worst-case' eventualities, regardless of how likely they may be, a logic that has justified enormous military expenditures by the Cold War blocs. Similarly, worst-case analysis could be used to anticipate serious ecological threats that may

not become manifest until it is too late to take action to prevent or lessen them (Romm, 1993, pp. 18–19).

The *normative* case presumes the primacy of environmental values and the threat that modern civilization poses to them. The failure to preserve life-supporting ecosystems undermines the realization of all other human values. Furthermore, the pursuit of other types of security, in particular military and economic security, has all too often been conducted in a single-minded manner with little regard paid to environmental consequences. Military operations in numerous countries have been routinely exempted from environmental assessments and rules that apply to most other sectors of society. Adding an environmental dimension to security thinking places societal values in a more appropriate hierarchy (Mische, 1989).

3. Critiques of the Concept Environmental Security

The term environmental security encounters little resistance if it is interpreted narrowly to refer to situations in which environmental and resource conflicts heighten the probability of armed conflict. Such a definition is consistent with the conventional notions of military security. There is less acceptance of broader conceptions of environmental security which acknowledge the ways in which environmental degradation directly threatens human welfare, even without the immediate prospect of armed conflict.

Paradoxically, some of the strongest reservations about the more encompassing conception of environmental security seem to come less from the practitioners and analysts of military security than from circles of the environmentally concerned. Several issues are typically raised. First, the concept security loses clarity and meaning when it is used more broadly to include threats other than those of a military nature. Second, environmental insecurities bear little resemblance to military threats and thus are dealt with in fundamentally different ways. Third, security as a human value is biased toward preservation of the status quo, whereas rudimentary, indeed revolutionary, social changes

will be needed to address the global change problematique. Fourth, it follows that measures taken in the name of environmental security will perpetuate economic and social injustices both between and within states. Finally, if viewed as a security concern, environmental threats may reinforce nationalistic sentiments and the state system, as well as become an excuse for undemocratic tendencies such as compulsive secrecy and the centralization of power and even a rationale for armed attack.⁹

These arguments raise issues that are too numerous to address fully in this article. Thus, only a few general observations are offered here to provide a basis for the analysis that follows. To begin with, few would deny that conceptual specificity and clarity facilitate intellectual thought and communication. There are, however, certain frequently used concepts that are intrinsically abstract and thus inevitably subject to a variety of interpretations – peace, conflict, justice, and development being examples in peace research. Security is also such a concept. The usefulness of these abstract concepts is not in conveying a precise meaning, which would render them intellectually barren, but in the discussions and indeed in the controversies that they provoke, which lead to new insights and perspectives. Coining of the phrase ‘environmental security’ has prompted a re-examination of the essence of security, thus enriching debate on social priorities and resource allocations.

No major sectors of human activity in their great complexity are entirely similar. Clearly, differences exist between military and environmental threats. To mention one, military insecurities are typically posed by hostile adversaries, whereas most threats to environmental security derive from the cumulative effects of normal day-to-day activities. Comparative analysis of differences can achieve a deeper understanding of the complexity of security considerations. Moreover, being preoccupied with differences may obscure intriguing parallels such as in the basic approaches to pursuing different types of security, which can be fruitfully explored.

As a value orientation, environmental

security is inherently biased toward the status quo in one major respect – the overall objective is to prevent or minimize human-induced changes to the environment that degrade and disrupt it with adverse consequences for current and future generations. For this reason, there is an inherent link between the ‘environment’ and ‘security’. However, environmental security cannot be achieved without an assault on ‘business-as-usual’ practices that are accelerating the process of global change through revolutionary social changes in the productive and consumptive habits of all societies. Thus, while environmental security is a conservative value orientation in regard to maintaining earth systems, it offers no refuge for those desiring to preserve existing human systems and behavior patterns.

Questions of social and economic justice inevitably arise in addressing international environmental problems. Nevertheless, the principle that environmental policies cannot be separated from the economic problems and aspirations of the developing countries has been clearly established in the report the United Nations Commission on Environment and Development *Our Common Future* (1987) and the Rio Declaration and Agenda 21 adopted at the 1992 Earth Summit (United Nations, 1993). Furthermore, the developing countries have considerable leverage on this issue that derives from the immense impact that they will have on the global environment in the future if they are not assisted by the industrialized world in designing and implementing an ecologically sustainable strategy of development. A case in point is China’s plan to fuel its industrial development by drawing upon its immense reserves of coal would more than compensate for any reductions in CO₂ emissions achieved by the developed countries of the West (Lenssen, 1993). For this reason, the environmental security of the industrialized countries cannot be achieved without addressing issues of global economic equity.

Finally, the exaggerated nationalism and anti-democratic practices usually associated with the pursuit of military security are not inherent in the quest for other forms of secur-

ity. Military security is usually sought in a competitive way on the assumption that it is a function of one's own armed strength relative to that of adversaries. Environmental insecurities pose a different type of challenge in that the primary instrumental goal is not to gain an advantage over other states, but to cooperate with them in limiting or phasing out practices that jeopardize the global environment. The cause of environmental security is advanced by an open exchange of information on environmental problems and experiences in addressing them and by the freedom of nongovernmental organizations to pursue the cause of conservation in vibrant democratic systems.

Thus, while any concept can be subverted to illegitimate uses, peace being no exception, there is a basic affinity between environmental security broadly conceived and the traditional foci of peace research on reducing human insecurity, violence, and misery (Pirages, 1991, p. 129). One of the long-standing concerns of peace research has been to illuminate the advantages of cooperative arms reductions over competitive arms buildups as a strategy for achieving peace and security. This article now explores parallels between the options available for pursuing military and environmental security, with reference to the Prisoner's Dilemma game which had been used widely to analyze the choice of security strategies by states.

4. General Approaches and Strategies for Enhancing Security

The pursuit of security involves reducing if not eliminating insecurities. An insecurity arises when there is a combination of a threat and a vulnerability (Buzan, 1983, p. 73). A *threat* is present when developments are possible that would be very harmful to a society if they occur at some future date.¹⁰ A *vulnerability* is present when a society lacks the means to limit the harmful impacts of threatening events or actions that occur.

Strategies for achieving security may be oriented either toward reducing threats or toward reducing vulnerabilities to threatening events or developments should they occur (Buzan, 1992, p. 5). The first approach

of *reducing threats* seeks to diminish either the probability that potentially damaging sequences of events will occur or their strength and intensity if they cannot be prevented completely. Eliminating threats may not be an option, as in the case of natural 'acts of God' such as earthquakes or hurricanes. Human behavior that contributes to threatening situations can often be prevented or altered. The alternative approach of *reducing vulnerabilities* entails preparations to avoid or minimize the consequences of threatening events if they do take place. For example, while volcanic eruptions cannot be prevented, vulnerability to loss of life and property can be lessened if communities are not located near potentially active volcanoes. Given adequate resources, it may be feasible to reduce both threats and vulnerabilities, thereby achieving a high level of security. In most situations, however, resource limitations dictate making choices, bearing in mind that partially reducing both threats and vulnerabilities may not achieve as much security as concentrating available resources on one approach.

Strategies to achieve security can also be undertaken unilaterally or collectively. The *unilateral* approach entails an individual actor using the means at its disposal to reduce threats or to ameliorate their consequences. Thus, a state may seek to secure itself against military aggression by building up its armed forces to destroy or defend against potential attackers. The *collective* approach involves cooperation among a number of actors to deal with mutual insecurities, such as by agreeing to avoid those behaviors that threaten each other or to assist those who bear a disproportionate share of the harm if a threatening event materializes, thereby diminishing their vulnerability.

The combinations of these two paired approaches define four overall strategies through which security can be pursued, as diagrammed in Table I.

Self-prevention. Strategy I, or self-prevention, entails an actor taking steps on its own to reduce threats to its well-being. These could be assertive actions to alter the behavior of, or the alternatives available to, other actors that pose a security threat, an

Table I. General Strategies for Enhancing Security

	Unilateral	Collective
Reduce Threat	I (self-prevention)	II (collective prevention)
Reduce Vulnerability	III (self-defense)	IV (collective defense)

example being a pre-emptive attack on an enemy's weapons installations. Another possibility is restricting activities under its jurisdiction which are contributing to a threatening situation. If an actor accounts for much of the problem, altering its behavior can have a significant impact on mitigating the threat for itself and others. Unilateral threat-reducing actions may also be undertaken as an example for other actors that will induce them to do likewise.

In the competitive context of military threats, self-restraint in the form of unilateral arms reductions has been generally discredited because it may create a vulnerability that could be exploited by aggressive states. Some theorists have proposed, however, that such reductions can be planned and orchestrated to induce reciprocal threat-reducing actions by other states without incurring a military vulnerability (Osgood, 1962).

Collective Prevention. Strategy II, collective prevention, involves a group of actors agreeing among themselves to moderate those behaviors that contribute to one another's insecurities. Each actor agrees to limit its own activities that are troublesome to other actors in return for reciprocal restraint by them. In the military realm, arms control agreements are an example of mutual restraint designed to reduce threats reciprocally without increasing the vulnerability of any of the parties, as may be the case with unilateral initiatives.

Collective prevention is the preferred way of dealing with many insecurities, especially when reducing a threat is a much less costly approach than limiting vulnerabilities. Difficulties may arise, however, in negotiating terms of cooperation that all parties will accept as being equitable and in their

interests. Years and even decades may pass before an agreement comes into effect among sovereign states. Even then, it cannot be assumed that the parties to the agreement will carry out their commitments to moderate their activities, especially if a competitive advantage might be gained by non-complying states. Lack of confidence about compliance has often been an obstacle to arms control agreements.

Self-defense. Strategy III, or self-defense, implies that an actor relies on its own devices to reduce the harmful impact of potentially damaging or disruptive developments. In the military context, a state may act on its own to increase the capacity of its armed forces to repulse conventional attacks. Alternative efforts were once made to reduce the vulnerability of populations to nuclear attacks through the construction of bomb shelters and civil defense planning. Toward a similar end, investments have been made in missile defense systems.

Self-defense may be an attractive option because it can be undertaken independently of other actors, who may be intransigent in negotiations or unreliable in fulfilling commitments. It may, however, be impossible for actors to reduce significantly some of their vulnerabilities, or the costs of self-defense may be much higher than for collective restraints. Furthermore, what one actor does for its own protection may pose a threat to others, as is commonly the case with efforts to enhance military security through the buildup of arms forces and armaments. A counterproductive action-reaction cycle may follow that diminishes the security of all actors, despite substantially increased investments in national defense.

Collective Defense. Strategy IV, or collective defense, is a cooperative strategy for reducing vulnerabilities. This category includes insurance programs that provide compensation to actors who are the victims of a damaging event from a fund created by a group of similarly threatened actors. Another example is the collective security agreement incorporated into the Charter of the United Nations which obliges the membership to come to the assistance of any member that is a victim of armed attack.

Spreading risks and costs over a larger group of actors makes sense when it is impossible or too expensive to reduce threats to an acceptable level or to reduce vulnerabilities unilaterally. However, as with the mutual restraint option, it may be difficult to reach agreement on the terms of cooperation and its implementation, as has too frequently been the case with the United Nations Security Council. Furthermore, commitments to come to the assistance of a victim may not be credible unless the resources for the relief of victims are assembled in advance and are under the control of a common institution.

5. *The Pursuit of Environmental Security*

Environmental security can be pursued using any one, or a combination of the four general types of strategies outlined in the previous section. This section briefly explores the applicability of each of the four strategies for preventing or coping with environmental insecurities and notes several examples in which each has been used.

Environmental Self-defense. States appear to be more willing to act on their own (Strategy I) to reduce environmental threats for themselves and other states than has been the case in the military realm. This can be seen in the unilateral commitments made by eleven European states to cut SO₂ emissions by at least 50% from 1980 levels by 1995, which go far deeper than the 30% reductions mandated by the 1985 Protocol on Sulphur Emissions that was appended to the 1979 Convention on Long-Range Transboundary Air Pollution (Levy, 1993, p. 118). Sweden set an ambitious goal of an 80% reduction in SO₂ emissions, which it has already achieved. The United States took the lead on the ozone depletion problem by banning CFCs in aerosol sprays in 1978, nine years before the Montreal Protocol established a schedule for reducing CFC production and use.

A state may choose to act unilaterally in ways that lessen international environmental threats for several reasons. It may be seeking to set an example that it hopes will persuade other states to reciprocate by acting in ways that will reduce its environmental insecuri-

ties. A primary motivation may also be to reduce the extent to which the state is a source of its own environmental insecurities even though other states also bear much of the responsibility or will benefit from its unilateral actions. Finally, domestic political pressures coming from environmental groups or an aroused public may induce governments to take action on their own to address ecological problems that have both national and international implications.

Unilaterally, imposing rules on environmental matters may put domestic manufacturers and producers at a competitive disadvantage with foreign firms that do not bear the expense of complying with similarly strict rules, a situation known as the 'public goods problem' (Ophuls & Boyan, 1992, pp. 196–7). However, in most cases, unreciprocated environmental initiatives do not put states in as vulnerable a position as substantial unilateral arms reductions, which may disrupt the competitive military balance on which their national security is based. Moreover, if comparable environmental standards are in the offing for other states, the companies that are required to adapt first, such as United States producers of aerosols, may get a significant competitive jump in developing adaptive strategies.

Environmental Collective Prevention. Unless a state is responsible for a significant proportion of an environmental threat, what it does within its jurisdiction may have little impact on lessening the problem. Furthermore, the effect of unilateral efforts to mitigate the threat may be canceled out by other states that continue to increase their impact on the environment. Accordingly, concern has been expressed that whatever steps are taken by Western countries to reduce ozone depletion and climate change will have little effect on the problem if there is a sharp rise in pollutants from less developed countries that are in the early stages of industrialization. Thus, it is important that collective prevention (Strategy II) must be exercised by all of the countries primarily responsible for an environmental threat if it is to be effectively addressed.

International arrangements are in place to address many, but by no means all, of the

threats to environmental security. The United Nations Environment Programme (1991) lists 152 multilateral agreements that address environmental problems, which were concluded up through 1990. Most of these treaties are designed to reduce environmental threats rather than adapt to them (see also Weiss et al., 1992). They address environmental problems as diverse as conservation of species – migratory birds, whales, and polar bears to mention a few; protecting the marine environment by banning the dumping of toxic substances and reducing the risk of oil spills; protecting workers from environmental threats to their health; maintaining the productivity of ocean fisheries; and regulating the export of toxic wastes for disposal. While some of the agreements do much to address specific ecological problems, collectively they do not constitute a comprehensive program for international environmental security (Birnie, 1992).

Even under the best of circumstances, negotiating environmental treaties is usually a long, cumbersome process that extends for years, which heavily taxes the diplomatic resources of states, especially smaller ones. Additional years may pass before a treaty is ratified by enough states to come into force, and, even then, key countries may elect not to become parties. Scientific uncertainties and differing interests among the negotiating parties may preclude agreements that have sufficiently strong provisions to address effectively the environmental threats that are looming.

Environmental Self-defense. States may decide to do what they can on their own to reduce their vulnerabilities to environmental damage or disruptions (Strategy III). Spreading lime on lakes to counteract acidification, as has been done in the Nordic countries, is an example of environmental self-defense. Another illustration is a widely repudiated suggestion attributed to former United States Secretary of Interior Donald Hodel that people stay out of the sun or wear sunglasses and broad-brimmed hats to avoid exposure to UV-B radiation, as an alternative to governmental regulations on CFSs designed to prevent ozone loss (Peterson, 1987).

A self-defensive strategy may be appropriate when there is little prospect of dealing effectively with an environmental threat, either because of the nature of the environmental problem or unfavorable prospects for international cooperation. States that perceive self-defense to be a less expensive and more reliable strategy for addressing a problem of environmental security will normally not agree to international regulations that would require more costly adjustments.

In the environmental realm, the self-defense strategy has disadvantages that are inherent in a reactive approach to security. A comprehensive defense against numerous environmental threats may simply not be possible or feasible. Unless the causes of threats are addressed, the problems they pose may continue to intensify and overwhelm whatever capacities states have to respond. Future surprise developments on the order of the Antarctic ozone hole may also expose inadequacies of defensive approaches.

Environmental Collective Defense. There are few examples of collective strategies being undertaken to reduce environmental vulnerabilities (Strategy IV) to environmental disruptions. An international fund was created under the auspices of the International Maritime Organization in 1971 to compensate victims of damage caused by the escape or discharge of oil from ships. Following the Chernobyl disaster in 1986, the International Atomic Energy Agency adopted a convention which provides for prompt international assistance in the event of nuclear accidents or radiological emergencies. There may be advantages to pooling knowledge and experience with adaptive techniques, as is being facilitated by INFORTERRA and the International Registry of Toxic Substances, which are program activity centers of the United Nations Environment Programme.

Environmental collective defense has the limitations inherent in any reactive strategy, in addition to complications that may be encountered in negotiating and implementing international agreements. States perceiving themselves to be less susceptible to certain environmental disruptions may be

Table II. Examples of Strategies for Coping with Global Warming

Strategy I (Reduce Threat Unilaterally)

Adopt national policies to reduce emissions of greenhouse gases
 Adopt national policies to encourage greater energy efficiency
 Adopt national policies to slow forest harvesting

Strategy II (Reduce Threat Collectively)

Negotiate treaties to reduce emissions of greenhouse gases
 Negotiate treaties to maintain forest cover
 Provide assistance to less developed countries for non-fossil fuel energy sources

Strategy III (Reduce Vulnerability Unilaterally)

Build sea walls around coastal cities
 Relocate people from low lands
 Invest in air conditioning
 Construct additional dams, reservoirs, and irrigation systems
 Develop crops adaptable to new climatic conditions

Strategy IV (Reduce Vulnerability Collectively)

Augment international food security system
 Cooperate on developing heat and drought resistant crops
 Undertake international water projects in shared river basins
 Establish aid program for heavily impacted countries

reluctant to invest in a risk-sharing arrangement. Once environmentally damaging developments do occur, less impacted actors may reassess whether their interests are served by honoring previous commitments to assist others that have been heavily affected and are in need of large amounts of assistance.

6. Responding to Global Change

The prospect of human-induced global climate change warming now looms as the most serious environmental threat to humanity and the natural environment. The problem can be addressed using one or more of the four types of strategies described in the previous sections. Illustrations of each of the four strategies are listed in Table II. The primary decision states will face is whether to invest the limited resources they have for addressing global change into (a) cooperating with other states to minimize the amount of global warming that takes place in the coming decades (Strategy II) or (b) working unilaterally to adapt to the probable consequences of global warming, such as rising sea levels and altered rainfall patterns (Strategy III).

Given the irreversible and potentially catastrophic consequences of global warm-

ing and the immense costs that would probably be incurred in adapting to them, it appears that the more rational course of action for most countries is to cooperate on preventing or minimizing global warming. Nevertheless, it is quite possible that some countries will conclude that they can achieve a greater degree of security by concentrating their efforts on adapting to anticipated changes. To understand why this might happen, let us refer to the game of Prisoner's Dilemma, which has been used extensively to explain why so many states have persisted in building up their armaments (Strategy III) in the pursuit of military security, rather than acting collectively to reduce threats through significant arms control agreements (Strategy II). Will a similar logic prevail in responding to global change?

6.1 The Prisoner's Dilemma

The game of Prisoner's Dilemma involves the outcomes to two actors that follow from the decisions that each makes on whether to cooperate with the other (see Brams, 1975; Rapoport & Chammah, 1965). The structure of the payoffs is presented in Table III in rank order of preference for each actor, with '1' being the most desirable and '4' the least preferred. The first number in each quadrant is the ranked preference of Actor A for that

Table III. Ranking of Payoffs in the Prisoner's Dilemma

		Actor B	
		Cooperate	Defect
Actor A	Cooperate	(I) 2, 2	(II) 4, 1
	Defect	(III) 1, 4	(IV) 3, 3

Source: adapted from Russett, 1983, p. 101.

outcome; the second number is the ranked preference for Actor B.

In weighing the alternatives, both actors face a situation in which the non-cooperative alternative (to defect) results in a more favorable outcome regardless of the choice made independently by the other party. For example, for Actor A Quadrant III is preferable to Quadrant I if Actor B cooperates; Quadrant IV is preferable to Quadrant III if Actor B defects. Thus, Actor A's most rational choice is to defect regardless of what Actor B does. The choices for Actor B are essentially the same. Ironically, when both actors choose to defect on the basis of this logic, the outcome (Quadrant IV) is only the third most desirable one for each. Alternatively, if the two elected do cooperate, they would both achieve their second most preferred result (Quadrant I).

Thus, rational calculations of self-interest result in a sub-optimal outcome for the two parties. In the case of military security, both bear the cost of building up their armaments and must contend with the more imposing threat of the other. If both cooperated, they could save substantially on arms expenditures and face a lesser threat from the other. The actors could be expected to change their behavior only if they were fully confident that the other would reciprocate their cooperation.

6.2 *The Prisoners' Dilemma Applied to Climate Change*

The global warming situation appears to have some similarities to the Prisoner's Dilemma game, as suggested by Table IV. For simplicity of argument, the options of states are narrowed figuratively to two strategies: (a) reducing CO₂ emissions and (b) building sea walls. The first option is to minimize the threat by reducing the amount of global

Table IV. Ranking of Outcomes of Climate Change Strategies

		Other States	
		Reduce CO ₂	Sea Walls
State A	Reduce CO ₂	(I) 2, 2	(II) 4, 1
	Sea Walls	(III) 1, 4	(IV) 3, 3

warming that takes place; the second is an adaptive response that seeks to limit damage caused by rising sea levels triggered by global warming.

For a typical country, the most advantageous outcome of the four would seem to occur if it invests available resources in self-defense by building sea walls, while all the other parties significantly reduce their CO₂ emissions in an effort to diminish the threat of global warming by reducing greenhouse gas emissions (Quadrant III). The amount of global warming would be somewhat lessened for that country, which in the meanwhile has enhanced its capacity to adapt to the changes that do occur. Thus, the non-cooperating country becomes a 'free rider' that benefits from the environmental public good of less climate change that is created by other countries.

The least desirable result would occur for a country that invested heavily in cutting CO₂ emissions while all others engaged in a defensive strategy of reducing their vulnerabilities (Quadrant II). The party engaging in self-restraint to the exclusion of adaptive preparations would be highly vulnerable to climate changes caused by the continuing high level of CO₂ emissions of the other states. Moreover, the benefits of its sacrifice would be shared with all the other countries, including those who invested nothing in prevention.

Of the two remaining outcomes, the more preferable would seem to be for all parties to cooperate in taking decisive action to minimize global warming by reducing CO₂ emissions. Cooperating to limit the amount of climate change that takes place (Quadrant I) would appear to be a less costly venture with a higher likelihood of achieving a measure of security than trying to adapt to

the greater amount of climate change that would occur if most countries opt for adaptive rather than preventive strategies (Quadrant IV).

The ranking of outcomes for the paired combinations of strategies for coping with global change would thus parallel the priority of preferences for the Prisoner's Dilemma game. The logic of the situation would lead countries to invest what they can in sea walls or other adaptive measures leading to an outcome in which they achieve their third preference, rather than the seemingly more desirable second preference that would result if all parties agreed to reduce emissions of CO₂ and other greenhouse gases, thereby minimizing the amount of global warming that takes place.

A Quadrant I outcome as opposed to a Quadrant IV outcome can be achieved through negotiations, which will succeed only if all parties believe that the others are negotiating in good faith to reach an agreement that is acceptable to all significant parties and, furthermore, that they can be counted upon to follow through on their commitments. The general absence of these conditions in the military realm has been a major obstacle to the achievement of significant arms control during the Cold War.

6.3 *The Case of Ozone Depletion*

The ozone depletion regime initially defined by the 1985 Vienna Convention on the Protection of the Ozone Layer and the supplemental 1987 Montreal Protocol on Substances that Deplete the Ozone Layer is a significant example of the achievement of a Quadrant I solution to an environmental security problem that was achieved through international negotiations. The Protocol, revised in 1990 and 1992, provides for progressively stricter international regulations on the production and use of ozone depleting substances, the most recent of which mandates phasing out most of these substances by 1 January 1996.¹¹ Why didn't the logic of the Prisoner's Dilemma prevail in this case?

This remarkable diplomatic accomplishment was made possible by several factors which are usually not present in the military

context, two of which will be noted here. First, while human beings can take steps to reduce their exposure to an intensifying borage of ultraviolet radiation, there is no apparent defense at any cost against the much larger environmental catastrophe that is a likely consequence of a substantial thinning of the ozone layer. In contrast, armed forces and modern weapons are viewed in many countries as a viable way of enhancing security against would-be aggressor states.

Second, the consequences of a Quadrant II outcome for State A and Quadrant III for the other states is not as disadvantageous as in the context of a competitive arms buildup. Threats to State A's security may increase dramatically if it diverts substantial resources from military defense while other states are adding to their arms capabilities. Alternatively, what other countries might do to defend themselves against ultraviolet radiation poses no threat to State A regardless of whether it opts for minimizing or adapting to the problem. Furthermore, restrictions on trade in ozone depleting substances make it unlikely that other states will derive a competitive advantage from failing to comply with the revised Montreal Protocol.

Table V. Ranking of Outcomes of Responses to the Ozone Depletion Problem

		Other States	
		No CFCs	Sunscreen
State A	No CFCs	(I) 1, 1	(II) 3, 2
	Sunscreen	(III) 2, 3	(IV) 4, 4

These two factors alter the priority of outcomes to the pattern suggested by Table V, in which the options have been figuratively simplified to phasing out CFCs, a preventive strategy, and using sunscreen, an adaptive one. Since there is no prospect of an effective defense against the consequences of ozone depletion, Quadrant I is the most desirable outcome for all countries because it minimizes the threat. Quadrant IV is the least desirable result in that nothing is done to limit ozone depletion. Quadrant III is less

attractive to State A because of the ineffectiveness of any defensive measures it might take, and Quadrant II is less disadvantageous because there is no added threat. Thus, taking action to limit the threat results in a better outcome regardless of what the other states do. If all parties follow this logic, the outcome of their choices is Quadrant I, which appears to be what actually occurred.¹²

6.4 *Implications for Negotiations on Climate Change*

Negotiations on a strategy for limiting the emission of CO₂ began in February 1991 in the specially constituted Intergovernmental Negotiating Committee and led to adoption of the United Nations Framework Convention on Climate Change at the 1992 Earth Summit in Rio de Janeiro, where it was signed by representatives from 153 countries. The original convention was a disappointment to many for its lack of a specific timetable for reducing emissions of greenhouse gases. It does, however, call upon the parties to stabilize concentrations of greenhouse gases in the atmosphere at a level that would prevent 'dangerous anthropogenic interference with the climate systems . . . within a time frame sufficient to allow ecosystems to adapt naturally'. Furthermore, it does provide for a process of continuing negotiations on additional national commitments (see Leggett & Hohnen, 1992; Parsons et al., 1992).

There are reasons for caution about the prospects for the achievement of a comprehensive international strategy on limiting global warming. First, the ozone depletion accords were reached on the presumption that substitutes for the controlled substances could be developed and produced at an affordable cost. By contrast, it is widely assumed in policy-making circles that altering energy production and use practices to the extent necessary to keep atmospheric CO₂ concentrations low enough to avert a significant warming would be a very expensive undertaking that would require a massive commitment of resources, substantial economic disruptions, and significant sacrifices in life styles in the highly industrialized

countries. Moreover, there is concern in poorer countries that participating in a global assault on climate change would seriously retard their economic development.

Second, whereas discovery of the Antarctic ozone hole by a British scientific team in 1985 provoked a sense of alarm, especially when it was definitively linked to human pollutants, no comparable surprise or crisis has spurred negotiations on global warming. Moreover, there is continuing skepticism in some scientific and policy-making circles about the warnings of global warming (e.g. Singer, 1992). Moreover, while an effective defense against the consequences of ozone depletion appeared to be impossible, there is a school of thought that practical adaptive steps can be taken, at least by some societies, to cope effectively with global warming that may even be less costly and disruptive than trying to prevent or minimize climate change.¹³

Third, while ozone depletion was generally viewed as global peril that would have serious adverse effects for all countries, negotiations on preventing climate change have been complicated by the perception that some countries may be far more affected by climate change than others. For example, while rising seas would flood much of the agricultural land of Bangladesh and Egypt, and possibly the entire Maldivian Islands, landlocked countries such as Switzerland and Austria would have nothing to fear from higher sea levels, although climate change may affect them in other ways. Moreover, some countries might envision themselves as net gainers from global warming in that the advantages of climate change, such as a longer growing season, might outweigh the costs (Glantz et al., 1990).

Finally, preventing climate change is also likely to be significantly more burdensome for some countries than others. Substantially greater sacrifices may be expected of the countries that are heavy contributors to the problem, such as those that depend heavily on fossil fuels or are economically dependent on the export of tropical hardwoods. The wealthier countries may also factor in the costs of additional economic

and technical assistance that developing countries will need to minimize their contributions to global climate change.

The states most likely to adopt a defensive strategy in the pattern of the Prisoner's Dilemma are those that foresee fewer adverse impacts from climate changes, are confident of their capability to adapt to them, and would bear a substantial share of the cost of the global cost of preventing climate change. Conversely, states may be more inclined to support international efforts to minimize the threat of climate change if they believe they have much to lose from climate change, have little adaptive capacity, and would bear a relatively small share of the costs of preventing global warming. The United States, as well as several other highly developed countries and the transitional states of the former Soviet bloc, may fit into the former group; many of the less developed countries into the latter one, at least on the first two variables (Homer-Dixon, 1991, p. 88). Thus, the potential exists for North/South polarization on the climate change issue.

Such a polarization may not be inevitable. The costs of preventing global warming through strategies such as energy conservation may not be nearly as burdensome as is widely assumed, especially when balanced out against the costs of climate change (see Cline, 1992; Romm & Lovins, 1992/93). Moreover, governments of industrialized states may be impressed by the beneficial impacts that reduced energy production and consumption would have for lessening other environmental problems, such as acid deposition. Countries with extensive tropical forests are becoming more aware of the economic benefits of sustainable use as opposed to widespread clearing of them.

Furthermore, if evidence continues to mount on the varied secondary and tertiary impacts of global warming, confidence that adaptive strategies can be successful and affordable is likely to wane. Fewer states will conclude that global climate change will on balance be advantageous to them. In a highly interdependent world, even those that are less affected directly by climate change may be disadvantaged by dislo-

cations that occur in other countries. The commitments of numerous developed countries to stabilizing and eventually reducing CO₂ emissions within the decade, and the apparent receptivity of the Clinton Administration in the United States to such a goal, indicates that this type of thinking is already on the rise. Thus, there is reason for some hope, if not optimism, that the logic of the Prisoner's Dilemma will not prevail and that a global accord can be reached that will substantially limit climate change.

7. Implications for Peace Research

Environmental problems have already been dealt with extensively in peace research, in particular as a potential cause of armed conflict. Peace research has also been concerned with environmental damage caused by wars and military preparations. In a more fundamental way, the global change problematique that emerged during the 1980s poses significant new threats to human welfare that have given rise to a rethinking of security priorities, and to the coining of the phrase environmental security. Having explored the complex relationship between peace and military security for several decades, it is indeed appropriate that peace researchers now delve into questions pertaining to the meaning of environmental security and how it can be achieved through international cooperation.

This article has analyzed alternative approaches to the pursuit of environmental security in the context of the Prisoner's Dilemma game. In doing so, it has explored the question of whether states will address environmental threats in much the same way as they dealt with military threats, by reverting to defensive, self-help strategies rather than cooperating to minimize or eliminate the sources of their common insecurities. The auspicious achievements in negotiating the ozone accords, or what the United States negotiator refers to as the 'new global diplomacy', demonstrates the possibilities for breaking out of the narrowly self-serving logic of the Prisoner's Dilemma in the environmental realm (Benedick, 1991).

It should not be assumed, however, that global environmental interdependence will ensure that international efforts to address other ecological problems, such as climate change, will be as successful as those on ozone depletion. The 1992 Earth Summit revealed that deep disagreements remain, especially between developed and developing countries, on what constitutes an equitable response to environmental problems, and the priority they should be given relative to the imperatives of reducing poverty and furthering economic development. Peace research can contribute much to an understanding of how constructive international partnerships can be fostered that will minimize global environmental change, facilitate sustainable development, and promote international equity, while avoiding a global 'tragedy of the commons' that would seriously undermine the welfare of humanity if not its very survival.

NOTES

1. 'Global change' is the focus of the International Geosphere-Biosphere Programme, a major scientific research effort sponsored by the International Council of Scientific Unions that was launched in 1986 and will be carried out through the 1990s (see Malone, 1986; Malone & Corell, 1989; US National Committee for the IGBP, 1988). The Human Dimensions of Global Environmental Change Programme, sponsored by the International Social Science Council, is a parallel project that engages the social scientific discipline in global change research (see Jacobson, 1992; Stern et al., 1992).
2. For an overview of the range of environmental problems encompassed by 'global change' research, see Silver & DeFries (1990), Mungall & McLaren (1990), and Dunnette & O'Brien (1992).
3. Weiss (1989) has analyzed intergenerational issues extensively within the context of international environmental law.
4. At this time, the terminology 'national security' came into vogue in the United States to address a somewhat broader range of threats to the national welfare than was implied by 'national defense'. The National Security Act of 1947 established the National Security Council (Romm, 1993, p. 3).
5. Falk (1971) was one of the first to develop this line of thinking. Others making this case include Brown (1977), Ullman (1983), Mische (1989), and Mathews (1989). Interestingly, an early advocate of broadening conceptions of security was General Maxwell Taylor (1974, p. 592), who wrote that 'I for one am fully convinced that the most formidable threats to this nation are in the nonmilitary field'. Johan Jørgen Holst (1989), then Norwegian minister of defense, also links security and the environment.
6. The secretariat is located at the Research Center on Environmental Policies at the Laval University in Quebec City, Canada.
7. Westing (1989, p. 129) proposes the concept 'comprehensive security', which encompasses (1) political security (including military, economic, and social/humanitarian subcomponents) and (2) environmental security (including protection and utilization oriented components). These two components of security, he argues, cannot be achieved separately.
8. While not specifically using the term environmental security, United States Vice-President Al Gore (1992, pp. 270-274) argues that saving the global environment will require commitment of the magnitude that the West made to contain Communism during the Cold War.
9. Such reservations against the concept environmental security are expressed by Deudney (1990, 1991) and Brock (1991).
10. Ullman (1983, p. 133) defines a threat to national security as 'an action or sequence of events that (1) threatens drastically and over a relatively brief span of time to degrade the quality of life for the inhabitants of a state, or (2) threatens significantly to narrow the range of choices available to the government or a state or to private nongovernmental entities (persons, groups, corporations) within the state'.
11. Ozone depletion substances to be phased out include chlorofluorocarbons (CFCs), halons, carbon tetrachloride, and methyl chloroform. However, developing countries are allowed a 10-year grace period for complying. Hydrochlorofluorocarbons (HCFCs), used as substitutes for CFCs, are to be phased out no later than 2030. No timetable has been established for banning methyl bromide, a chemical used in fumigants (Rowlands, 1993).
12. See Benedick (1991) for a historical overview and analysis of the negotiations that led to the remarkable international agreements on preventing ozone depletion.
13. For example, a report of a panel of the United States Academy of Sciences (1991, p. 45) assessed the adaptive capacity of the United States to climate change and concluded that the American people 'likely will have no more difficulty adapting to such future changes than to the most severe conditions in the past, such as the Dust Bowl'. The report concludes, however, that adapting to, as opposed to preventing, climate change is not necessarily the best policy (p. 70).

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