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ARTICLE

REFINING THE PRECAUTIONARY PRINCIPLE IN INTERNATIONAL ENVIRONMENTAL LAW

James E. Hickey, Jr.*

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I. INTRODUCTION

States have long recognized as a matter of domestic and international law that it is generally preferable to prevent pollution than to deal with pollution after it has occurred.¹ In statutory, regulatory, judicial, and foreign affairs contexts, states have applied preventive measures to a wide range of environmental settings, all without much conscious purpose to articulate a specific principle of law. In 1985 and in 1987, however, parties to the Vienna Convention and the Montreal Protocol formally stated their determination to take "precautionary measures" to prevent emissions of ozone layer depleting substances.² Since 1987, other international environmental instruments have increasingly referred to the "precau-

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¹ See *infra* notes 22-31 and accompanying text.

² Protocol on Substances that Deplete the Ozone Layer, Sept. 16, 1987, 26 I.L.M. 1541, 1551 [hereinafter Montreal Protocol]: "Determined to protect the ozone layer by taking precautionary measures to control equitably total global emissions of substances that deplete it, with the ultimate objective of their elimination on the basis of developments in scientific knowledge, taking into account technical and economic considerations." *Id.* The Protocol was negotiated as a protocol to the Vienna Convention for the Protection of the Ozone Layer. *Id.* at 1541.

tionary principle,"³ to the "precautionary approach,"⁴ or to the "principle of precautionary action"⁵ when dealing with regional and global environmental and developmental problems such as marine pollution,⁶ water pollution,⁷ climate change,⁸ ozone layer depletion,⁹ hazardous waste,¹⁰ and energy development.¹¹ References to precaution reveal a variable, vague, and often confusing "principle" for states to follow in preventing pollution.¹²

The assertion and "codification" in international agreements and instruments of an ill-defined, ambiguous "principle" has created uncertainty in international environmental law.¹³ Uncertainty

³ E.g., Convention on the Protection and Use of Transboundary Watercourses and International Lakes, Mar. 17, 1992, 31 I.L.M. 1312, 1316 [hereinafter U.N. Transboundary Watercourses Convention]:

[T]he Parties shall be guided by the following principles:

(a) The precautionary principle, by virtue of which action to avoid the potential transboundary impact of the release of hazardous substances shall not be postponed on the ground that scientific research has not fully proved a causal link between those substances, on the one hand, and the potential transboundary impact, on the other hand.

Id.

⁴ E.g., Rio Declaration on Environment and Development, June 14, 1992, 31 I.L.M. 874, 879 [hereinafter Rio Declaration]. "In order to protect the environment, the precautionary approach shall be widely applied by states according to their capabilities. Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation."

Id.

⁵ E.g., Report of the Governing Council on the Work of Its Fifteenth Session, United Nations Environment Programme, U.N. GAOR, 44th Sess., Supp. No. 25, 12th mtg. at 153, U.N. Doc. A/44/25 (1989) [hereinafter UNEP Report].

⁶ E.g., Ministerial Declaration Calling for Reduction of Pollution, Nov. 25, 1987, 27 I.L.M. 835 [hereinafter Second North Sea Declaration].

⁷ See, e.g., U.N. Transboundary Watercourses Convention, *supra* note 3, at 1312.

⁸ E.g., Framework Convention on Climate Change, May 9, 1992, 31 I.L.M. 849 [hereinafter Climate Change Convention]. The United States ratified the Convention on October 15, 1992. See U.N. GAOR, 7th Sess., Item 4 of the provisional agenda, at 12, U.N. Doc. A/AC.237/INF.10/Rev.1 (1993).

⁹ See Montreal Protocol, *supra* note 2, at 1541.

¹⁰ E.g., Bamako Convention on Hazardous Wastes Within Africa, Jan. 30, 1991, art. 4, 30 I.L.M. 773 [hereinafter Bamako Convention].

¹¹ The Draft European Energy Charter Treaty Annex I, Sept. 14, 1994, 27/94 CONF. 104 [hereinafter Energy Charter].

¹² See *infra* part III.

¹³ Dr. Lothar Gündling, *The Status in International Law of the Principle of Precautionary Action*, 5 Int'l J. Estuarine & Coastal L. 23, 30 (1990). See generally James Cameron & Juli Abouchar, *The Precautionary Principle: A Fundamental Principle of Law and Policy for the Protection of the Global Environment*, 14 B.C. Int'l & Comp. L. Rev. 1, 20-23 (1991) (surveying the precautionary principle as an emerging principle of environmental law in state practice, international declarations, and as a rule of customary international law; proposing a definition with key elements that include an evidentiary threshold, burden of proof, a duty owed to the international society as a whole, and a policy for action in the

exists on several interrelated topics: the legal and practical significance of the principle; the obligations assumed by states; the application of the principle to affected businesses; the relation of the obligation to scientific data; and the future shape and content of such a principle. For the business community, an unpredictable precautionary principle inhibits efficiency and realistic corporate planning, and increases the costs and risks of doing business. For the larger international community, the present precautionary principle impedes the development of rational, coordinated, and predictable environmental law and policy.

States and international organizations have invoked the precautionary principle in an attempt to resolve certain technical problems and political tensions when dealing with international environmental problems. Technically, the precautionary principle responds to the varying degrees of scientific uncertainty and environmental risk by imposing a duty on states to prevent pollution despite a lack of scientific information.¹⁴ Politically, the precautionary principle attempts to address the inherent tension between territorial state sovereignty and the international community's growing need to address certain transnational, regional, and global environmental and developmental problems. States have traditionally accommodated technical problems and political tensions, at least in part, through international instruments such as bilateral and multilateral treaties or international conventions. In general, the greater the certainty of pollution and the greater the potential harm from pollution, the less states tend to resist a requirement to prevent pollution.

In balancing such problems and tensions since 1987, states have begun to refer explicitly to a precautionary principle of international law. If the present precautionary principle is to provide more than platitudinal support for pollution prevention, it must evolve into a refined rule that would adjust to new and evolving

face of uncertainty); Ellen Hey, *The Precautionary Concept in Environmental Policy and Law: Institutionalizing Caution*, 4 Geo. Int'l Env'tl. L. Rev. 303, 303 (1992) (recognizing that the meaning of the precautionary principle is unclear and, therefore, limiting the article's scope to an analysis of the principle); Bernard A. Weintraub, *Science, International Environmental Regulation and the Precautionary Principle: Setting Standards and Defining Terms*, 1 N.Y.U. Env'tl. L.J. 173, 182-91, 198-200 (1992) (examining the development and criticism of the precautionary principle, as it has been applied under various standards; noting the inherent difficulty of formulating environmentally protective standards while also promoting growth).

¹⁴ See Hey, *supra* note 13, at 305; see also Weintraub, *supra* note 13, at 178 (noting the principle's controversial requirement of environmentally protective decisions before harmful effects have been scientifically proven).

factual situations, to more sophisticated norms of international law, and to advances in scientific knowledge. The global community needs a more specific rule of restraint adaptable to a wide range of new environmental circumstances, rather than isolated agreements that share only a general preference for pollution prevention.

The evolution of a set of refined precautionary obligations at regional and global levels will be difficult to achieve. Both states and private actors will resist a precautionary principle that is informative and enforceable by the international community. States naturally want to protect their territorial sovereignty, and private actors understandably seek freedom from regulation. The international community needs to agree to some means to overcome that resistance and to refine the precautionary principle.

This Article suggests criteria to refine the precautionary principle, to remove the present uncertainty, and to provide a measure of needed predictability that presently does not exist. The Article presents a process framework through which states may refine the content of the precautionary principle in a consistent and predictable way. Part II sets out a brief contextual background for the precautionary principle as an emerging term of art in international environmental law. Part III analyzes the present uncertainty in a representative cross section of existing statements of the precautionary principle. Part IV proposes that states adopt an agreed set of criteria for drafting statements of the precautionary principle in future international agreements. If the criteria proposed here are uniformly applied, every articulation of the precautionary principle would contain: (1) a reasonably precise statement of the desired environmental goal and the environmental condition that justifies invoking the precautionary principle; (2) an identification of the jurisdictional scope of the agreed precautionary obligations under the principle; (3) a specification of those human activities for which precautionary measures are required; and (4) a clear statement of the precautionary measures that must be undertaken before engaging in a covered activity.

II. BACKGROUND

The rapidly developing body of international environmental law has evolved partly out of domestic tort law principles that require compensation when legally protected interests are injured. The Roman law concept of *immissio* imposed responsibility on a person for water, smoke, fragments of stone, and the like, introduced to a

neighbor's property.¹⁵ Similarly, the British common law imposed an obligation on a person to compensate for resulting damage when he used his property in a way that injured another person's property.¹⁶ Early domestic law imposed no duty, and therefore no compensation was due, until an injury occurred.

In international law states are held responsible for polluting activities inside their territory that cause harm in neighboring states according to the foundational premise upon which all state responsibility rests: "one must so use his own as not to do injury to another" (*sic utere tuo ut alienum non laedas*).¹⁷ By the middle of the twentieth century, the concept had been applied in a variety of forms and circumstances,¹⁸ including pollution of international

¹⁵ See Max Kaser, *Roman Private Law* 122 (Rolf Dannenbring trans., 3d ed. 1980); see also James E. Hickey, Jr., *Custom and Land-Based Pollution of the High Seas*, 15 San Diego L. Rev. 409, 422 n.32 (1978).

¹⁶ The most famous common law adoption of this principle is found in *Rylands v. Fletcher*, 1868 L.R.-Z. & I. App. 330, 339-40 (1868). Lord Cairns, L.C., concurring with and quoting Blackburn, J., stated:

We think that the true rule of law is, that the person who, for his own purposes, brings on his land and collects and keeps there anything likely to do mischief if it escapes, must keep it in at his peril; and if he does not do so, is *prima facie* answerable for all the damage which is the natural consequence of its escape.

Id.

¹⁷ Hickey, *supra* note 15, at 422; see also *Corfu Channel* (Gr. Brit. v. Alb.), 1949 I.C.J. 57 (Apr. 9). International law obliges every state "not to allow knowingly its territory to be used for acts contrary to the rights of other states." *Id.* at 61. It should be noted that in the *Corfu Channel* case, the injury to British warships for which Albania was held responsible occurred inside Albanian territorial waters rather than beyond its borders. *Id.* at 58. For an analysis of *sic utere tuo* in customary international law, see Hickey, *supra* note 15, at 422-75.

¹⁸ See United Nations Secretariat, *Survey of International Law in Relation to the Working Codification of the International Law Commission*, at 34, U.N. Doc. A/CN.4/1/Rev.1 (1949) ("There has been general recognition of the rule that a state must not permit the use of its territory for purposes injurious to the interests of other States in a manner contrary to international law.").

rivers,¹⁹ transboundary air pollution,²⁰ and pollution of outer space.²¹

For the most part, the responsibility of states for extraterritorial pollution until recently has been approached in international law on a case-by-case basis through assignments of compensation after

¹⁹ See Helsinki Rules on the Uses of the Waters of International Rivers, Report of the Conference, arts. X, XI, at 477, 496-505 (1967) ("[A] state . . . must prevent any new form of water pollution . . . in an international drainage basin which would cause substantial injury in the territory of a co-basin state [T]he state responsible [for causing substantial injury] shall be required to cease the wrongful conduct and compensate the injured co-basin state."); see also R. R. Baxter, *The Law of International Waterways* 2 n.3 (1964) (describing reconciliation of competing river uses, including prohibition of uses restraining preferred uses by other states); The Law of International Drainage Basins (A. Garretson et al. eds., 1967); C.B. Bourne, *International Law and Pollution of International Rivers and Lakes*, 6 U.B.C. L. Rev. 115, 120-35 (1971) (citing "equitable utilization" as a basis for resolving conflicting interests in international drainage basins, a doctrine requiring consideration of the harm that might flow from one basin use to other co-basin states); Albert E. Utton, *International Water Quality Law*, in *International Environmental Law* 154, 158-69 (Ludwik A. Teclaff & Albert E. Utton eds., 1974).

²⁰ Decision, *Trail Smelter Arbitral Tribunal*, 35 Am. J. Int'l L. 684 (1941) (holding that a state is responsible for injury to the neighboring territory by noxious fumes emanating from works within the state:

[U]nder the principles of international law, as well as the law of the United States, no state has the right to use or permit the use of its territory in such a manner as to cause injury by fumes in or to the territory of another or the properties or persons therein, when the case is of serious consequence and the injury is established by clear and convincing evidence.

Id.).

²¹ See Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies, Jan. 27, 1967, art. IX, 18 U.S.T. 2410, 2416-17, (*in force* Oct. 10, 1967), 6 I.L.M. 386, 388 (1967) [hereinafter *Outer Space Treaty*]. The Outer Space Treaty represents the best evidence of applicable principles of international law for outer space and adopts the duty of states not to pollute extraterritorial outer space. With regard to pollution of outer space, it employs somewhat tentative precautionary language in obligating states to engage in international consultation if their planned activities are potentially harmful:

States Parties to the Treaty shall pursue studies of outer space, including the moon and other celestial bodies, and conduct exploration of them so as to avoid their harmful contamination and also adverse changes in the environment of the Earth resulting from the introduction of extraterrestrial matter and, where necessary, shall adopt appropriate measures for this purpose. If a State Party to the Treaty has reason to believe that an activity or experiment planned by it or its nationals in outer space . . . would cause potentially harmful interference with activities of other States Parties in the peaceful exploration and use of outer space . . . it shall undertake appropriate international consultations before proceeding with any such activity or experiment.

Id. As of 1991 there were 98 parties to the Treaty. See *Declaration of Legal Principles Governing the Activities of State in the Exploration and Use of Outer Space*, G.A. Res. 1962, U.N. GAOR, 18th Sess., Supp. No. 15, at 15, U.N. Doc. A/5515 (1963) (adopted unanimously by the United Nations General Assembly).

environmental harm has occurred.²² This post-delictual approach has reflected a strong state sovereignty presumption that states are free to behave as they please and are answerable, if at all, only after their behavior either has infringed on the sovereign rights of other states or has violated international law.²³ The compensatory approach has also reflected the traditional view that pollution is largely a local concern that poses isolated risks to a local environment.

The 1972 United Nations Conference on the Human Environment held in Stockholm, Sweden (Stockholm Conference) reflected an effort by the international community to address pollution.²⁴ That movement, however, did little to disturb traditional notions of state sovereignty, which tended to preserve the post-injury approach to state responsibility for polluting acts. For example, the Stockholm Conference Report required that substances introduced into the sea must "result" in "deleterious effects" before they could be defined as marine "pollution."²⁵ That is, unless it could be established that actual harm occurred no liability could be imposed on states.²⁶ The Stockholm Conference Report also required that deleterious effects be established by a demonstrable scientific certainty.²⁷ Potential deleterious effects or the likelihood of deleterious effects were not within the meaning of pollution. Under the Stockholm definition of pollution, states

²² See *supra* notes 17-21. The post-delictual approach to state responsibility was not without exception. For example, the parties to the 1967 Outer Space Treaty agreed to consult in circumstances where their activities have the potential to harm outer space, and the Helsinki rules contain river pollution prevention obligations that would be imposed on drainage basin states.

²³ See *supra* note 17 and accompanying text.

²⁴ See Report of the United Nations Conference on the Human Environment, U.N. Doc. A/Conf. 48/14 and Corrigenda 1 (1972) [hereinafter Stockholm Conference Report]; see also G.A. Res. 2994-3004, U.N. GAOR, 27th Sess., Supp. No. 30, at 42-48, U.N. Doc. A/8730 (1973). For example, the Stockholm Conference Report defined marine pollution in terms of generic effects: "The introduction by man, directly or indirectly, of substances or energy into the marine environment (including estuaries) resulting in such deleterious effects as harm to living resources, hazard to human health, hindrance to marine activities including fishing, impairment of quality for use of sea water, and reduction of amenities." Stockholm Conference Report, *supra*, at 73.

²⁵ Stockholm Conference Report, *supra* note 24, at 73. In part, this Report acknowledged that waste disposal was a legitimate use of the oceans as much as fishing or navigation. It was only when waste disposal had "deleterious effects" that it became both pollution and objectionable. See generally *The North Sea: Challenge and Opportunity* 78 (M.M. Sibthorp ed., 1975) ("[I]t is generally acknowledged that disposal of wastes into the sea is essential and, therefore, acceptable . . .").

²⁶ Stockholm Conference Report, *supra* note 24, at 74.

²⁷ *Id.* at 22-24. In *Trail Smelter Arbitral Tribunal*, *supra* note 20, the Tribunal similarly required "substantial injury" demonstrated by "clear and convincing evidence."

could only be held responsible under international law after discharges into the environment had occurred, and then only if environmental harm was established.²⁸

In the 1980s, environmental concern began to encompass both threats of regional and global injuries, such as marine pollution, global warming, ozone layer depletion, sea level rise, deforestation, acid rain, and desertification,²⁹ and collective human and corporate activity that could cause cumulative injury to a weakened global environment.³⁰ As a result of that concern the focus of international environmental attention expanded from local, trans-boundary harms to regional and global harms, from isolated polluting activities to broad patterns of activity, and from case-by-case determinations to general proscriptions of behavior. With the change in focus, the shield of state sovereignty began to yield, and states began to acknowledge some responsibility for preventing pollution. For example, the 1982 Law of the Sea Treaty (LOST) expanded the Stockholm Conference definition of marine pollution to include substances that are "likely to result" in deleterious effects.³¹ By implication, this definitional expansion imposed an element of precautionary obligation on parties to the LOST, possibly even in circumstances of scientific uncertainty about harm and causation.

Any legal duty international law imposes on states to refrain from polluting activities (such as a general duty to exercise precaution) or to prevent others from polluting necessarily involves a diminution or relinquishment of territorial state sovereignty because states no longer are free to deal with pollution originating

²⁸ This approach was consistent with then-existing international law. See Hickey, *supra* note 15, at 458-59.

²⁹ See, e.g., Montreal Protocol, *supra* note 2; United Nations Conference on Environment and Development, June 14, 1992, 31 I.L.M. 874; Ministerial Declaration on Environmentally Sound and Sustainable Development in Asia and the Pacific, U.N. Doc A/Conf. 151/pc 38 Annex 2 (1991) (discussing the necessity for global partnership in environmental efforts).

³⁰ See Alfred Aman, *The Earth as an Eggshell Victim: A Global Perspective on Domestic Regulation*, 102 Yale L.J. 2107-08 (1993); see also J.E. Lovelock, *Gaia: A New Look at Life on Earth* (1979) ("The Earth's living matter, air, oceans, and land surface form a complex system . . . with a composite identity . . . [and not] the mere sum of its parts.").

³¹ Third United Nations Conference on the Law of the Sea, 21 I.L.M. 1261, 1271 (Dec. 10, 1982) ("['P]ollution of the marine environment' means the introduction by man, directly or indirectly, of substances or energy into the marine environment, including estuaries, which results or is likely to result in such deleterious effects as harm to living resources and marine life, hazards to human health, hindrance to marine activities, including fishing and other legitimate uses of the sea, impairment of quality for use of sea water and reduction of amenities.") (emphasis added).

inside their territory in any way they choose.³² For that reason, an imposition of state responsibility should not be inferred lightly. For the most part, no obligation is imposed on a state under treaty law unless the state expressly consents to the obligation.³³ The state expression of consent to be bound to exercise precaution with respect to polluting activities has begun to appear in a variety of international environmental instruments.³⁴ The articulations to date offer little specific predictive certainty for either the form or the content of the precaution obligation in the years ahead. The transition from an inchoate general obligation of pollution prevention to a well-defined principle or rule of precautionary obligation would be facilitated by the consistent application of agreed-upon criteria. These criteria could be used to articulate precautionary obligations in future agreements and to facilitate subsequent adoption of consistent implementation procedures and enforcement schemes.

III. CURRENT UNCERTAINTY IN THE PRECAUTIONARY PRINCIPLE

The articulations of the precautionary principle since 1987 reveal a variable, vague, and confusing "principle" under which states are

³² See International Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, Dec. 29, 1972, 26 U.S.T. 2403, 2406 [hereinafter *Dumping Convention*]. The Convention asserted

that States have, in accordance with the Charter of the United Nations and the principles of international law, the sovereign right to exploit their own resources pursuant to their own environmental policies, and the responsibility to ensure that activities within their jurisdiction or control do not cause damage to the environment of other States or of areas beyond the limits of national jurisdiction.

Id.; see also Convention on Biological Diversity, June 5, 1992, 31 I.L.M. 818, 822 ("Reaffirming that States have sovereign rights over their own biological resources; [r]eaffirming also that States are responsible for conserving their biological diversity and for using their biological resources in a sustainable manner.").

³³ The understandable concern about sovereignty diminution has led states to rely on the treaty form rather than on customary international law to address pollution prevention obligations. See James E. Hickey, Jr., *Land-Based Pollution of the High Seas and International Law*, 1980 Marine Tech. 216, 218-19. States prefer the clarity of written treaties that are the product of direct state negotiations and result in an overt, contractual state acceptance. See Vienna Convention on the Law of Treaties, art. 11, 8 I.L.M. 679, 684 (1969) ("The consent of a state to be bound by a treaty may be expressed by signature, exchange of instruments constituting a treaty, ratification, acceptance, approval or accession, or by any other means if so agreed."); see also Ian Sinclair, *The Vienna Convention on the Law of Treaties* 39-42 (2d ed. 1984) (discussing ways a state may express intent to be bound by a treaty).

³⁴ See *infra* part III.A.

to carry out various duties to prevent pollution. The articulations below are contained in a series of international instruments that range from a non-binding report issued by the United Nations Environment Programme³⁵ to the binding European Union Treaty.³⁶ The articulations also vary from non-binding, but fairly specific articulations like that contained in the North Sea Protection Declaration,³⁷ to articulations that are binding in form, but very vague in content, like that in the Climate Change Convention.³⁸ The great variety in form, the different binding effects of the instruments, the wide scope of subjects addressed, and the differing identity of participants from instrument to instrument do not permit a more useful grouping of the articulations of the precautionary principle than the chronological order presented below. The emphasis here is on the articulations themselves rather than on the instruments in which they appear, or on the positions (preambles, articles, summaries, etc.) they occupy in any particular document.

A. *Articulations of the Precautionary Principle*

This subpart reproduces, in chronological order, articulations of the precautionary principle in the major environmental instruments.

1. *Ozone Layer Protocol:*

Parties to this protocol . . . *Determined* to protect the ozone layer by taking precautionary measures to control equitably total global emissions of substances that deplete it, with the ultimate objective of their elimination on the basis of developments in scientific knowledge, taking into account technical and economic considerations.³⁹

2. *Second North Sea Declaration:*

[I]n order to protect the North Sea from possibly damaging effects of the most dangerous substances, . . . a precautionary approach is addressed which may require action to con-

³⁵ UNEP Report, *supra* note 5, at 152-53.

³⁶ Treaty on European Union, Sept. 21, 1994, 31 I.L.M. 247, 285-86.

³⁷ Final Declaration of the Third International Conference on the Protection of the North Sea, Mar. 7-8, 1990, 1 Y.B. Int'l Env'tl. L. 658, 662-73 (1990) [hereinafter Final North Sea Declaration].

³⁸ Climate Change Convention, *supra* note 8, at 854-55.

³⁹ Montreal Protocol *supra* note 2, at 1551. This agreement was negotiated as a protocol to the Vienna Convention for The Protection of the Ozone Layer. *Id.* at 1541; see also Vienna Convention for the Protection of the Ozone Layer, Mar. 22, 1985, 26 I.L.M. 1516.

trol inputs of such substances even before a causal link has been established by absolutely clear scientific evidence
....⁴⁰

3. *United Nations Environment Programme:*

Recommends that all Governments adopt the "principle of precautionary action" as the basis of their policy with regard to the prevention and elimination of marine pollution.⁴¹

4. *Nordic Council's Conference:*

[A]nd taking into account . . . the need for an effective precautionary approach, with that important principle intended to safeguard the marine ecosystem by, among other things, eliminating and preventing pollution emissions where there is reason to believe that damage or harmful effects are likely to be caused, even where there is inadequate or inconclusive scientific evidence to prove a causal link between emissions and effects.⁴²

5. *Final North Sea Declaration:*

The participants . . . will continue to apply the precautionary principle, that is to take action to avoid potentially damaging impacts of substances that are persistent, toxic and liable to bioaccumulate even where there is no scientific evidence to prove a causal link between emissions and effects . . .⁴³

6. *Bergen Declaration on Sustainable Development:*

In order to achieve sustainable development, policies must be based on the precautionary principle. Environmental measures must anticipate, prevent and attack the causes of environmental degradation. Where there are threats of serious or irreversible damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.⁴⁴

⁴⁰ Second North Sea Declaration, *supra* note 6, at 838.

⁴¹ UNEP Report, *supra* note 5.

⁴² The Nordic Council's International Conference on the Pollution of the Seas: Final Document, *agreed to* Oct. 18, 1989, in *Nordic Action Plan on Pollution of the Seas*, 99 app. V (1990) [hereinafter *Nordic Council Conference*].

⁴³ Final North Sea Declaration, *supra* note 37, at 661.

⁴⁴ Bergen Ministerial Declaration on Sustainable Development in the ECE Region, UN Doc. A/CONF. 151/PC/10 (1990), *reprinted in* 1 Y.B. Int'l Env'tl. L. 429, 431 (1990) [hereinafter *Bergen Declaration*].

7. *Second World Climate Conference:*

In order to achieve sustainable development in all countries and to meet the needs of present and future generations, precautionary measures to meet the climate challenge must anticipate, prevent, attack, or minimize the causes of, and mitigate the adverse consequences of, environmental degradation that might result from climate change. Where there are threats of serious or irreversible damage, lack of full scientific certainty should not be used as a reason for postponing cost-effective measures to prevent such environmental degradation. The measures adopted should take into account different socio-economic contexts.⁴⁵

8. *Bamako Convention on Transboundary Hazardous Waste:*

Each Party shall strive to adopt and implement the preventive, precautionary approach to pollution problems which entails, inter-alia, preventing the release into the environment of substances which may cause harm to humans or the environment without waiting for scientific proof regarding such harm. The Parties shall cooperate with each other in taking the appropriate measures to implement the precautionary principle to pollution prevention through the application of clean production methods, rather than the pursuit of a permissible emissions approach based on assimilative capacity assumptions⁴⁶

9. *European Union Treaty:*

Community policy on the environment . . . shall be based on the precautionary principle and on the principles that preventive actions should be taken, that environmental damage should as a priority be rectified at source and that the polluter should pay.⁴⁷

10. *Helsinki Convention on the Protection and Use of Transboundary Watercourses and International Lakes:*

The precautionary principle, by virtue of which action to avoid the potential transboundary impact of the release of hazardous substances shall not be postponed on the ground that scientific research has not fully proved a causal link

⁴⁵ Ministerial Declaration of the Second World Climate Conference (1990), *reprinted in* 1 Y.B. Int'l Envtl. L. 473, 475 (1990) [hereinafter Second World Climate Conference].

⁴⁶ Bamako Convention, *supra* note 10, at 781.

⁴⁷ Treaty on European Union, *supra* note 36, at 285.

between those substances, on the one hand, and the potential transboundary impact, on the other hand⁴⁸

11. *The Rio Declaration on Environment and Development:*

In order to protect the environment, the precautionary approach shall be widely applied by States according to their capabilities. Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation.⁴⁹

12. *Climate Change Convention:*

The Parties should take precautionary measures to anticipate, prevent or minimize the causes of climate change and mitigate its adverse effects. Where there are threats of serious or irreversible damage, lack of full scientific certainty should not be used as a reason for postponing such measures, taking into account that policies and measures to deal with climate change should be cost-effective so as to ensure global benefits at the lowest possible cost. To achieve this, such policies and measures should take into account different socio-economic contexts, be comprehensive, cover all relevant sources, sinks and reservoirs of greenhouse gases and adaptation, and comprise all economic sectors. Efforts to address climate change may be carried out cooperatively by interested Parties.⁵⁰

13. *UNCED Text on Ocean Protection:*

A precautionary and anticipatory rather than a reactive approach is necessary to prevent the degradation of the marine environment. This requires, *inter alia*, the adoption of precautionary measures, environmental impact assessments, clean production techniques, recycling, waste audits and minimization, construction and/or improvement of sewage treatment facilities, quality management criteria for the proper handling of hazardous substances, and a comprehensive approach to damaging impacts from air, land and water. Any management framework must include the improvement

⁴⁸ U.N. Transboundary Watercourses Convention, *supra* note 3, at 1316.

⁴⁹ Rio Declaration, *supra* note 4, at 879.

⁵⁰ Climate Change Convention, *supra* note 8, at 854.

of coastal human settlements and the integrated management and development of coastal areas.⁵¹

14. *Energy Charter Treaty*:

In pursuit of sustainable development and taking into account its obligations under those international agreements concerning the environment to which it is party, each Contracting Party shall strive to minimize in an economically efficient manner harmful Environmental Impact occurring either within or outside its Area from all operations within the Energy Cycle in its Area, taking proper account of safety. In doing so each Contracting Party shall act in a Cost-Effective manner. In its policies and actions each Contracting Party shall strive to take precautionary measures to prevent or minimize Environmental Degradation. The Contracting Parties agree that the polluter in the Areas of Contracting Parties, should, in principle, bear the cost of pollution, including transboundary pollution, with due regard to the public interest and without distorting investment in the Energy Cycle or International Trade.⁵²

B. *Analysis*

The above articulations of the precautionary principle permit several positive observations. First, each articulation consistently affirms the premise that pollution prevention is preferable to post-delictual assignments of responsibility after damage has occurred.⁵³ Second, these articulations link scientific evidence, and potentially risk analysis, to any determination of pollution prevention obligations, by asserting that the necessary degree of precaution is primarily a function of the available scientific data which establishes that necessity. Third, the current articulations of the precautionary principle generally require a greater obligation to exercise precaution in proportion to the risk of irreversible permanent damage to human life or health. Fourth, the growing frequency with which the precautionary principle is invoked strongly suggests that future

⁵¹ UNCED Text on Protection of Oceans, Preparatory Committee for the United Nation's Conference on Environmental Development, Protection of Oceans, All Kinds of Seas Including Enclosed and Semi-Enclosed Seas, Coastal Areas and the Protection, Rational Use and Development of Their Living Resources, U.N. GAOR, 4th Sess., UN Doc. A/CONF. 151/PC/100/Add. 21 (1991) [hereinafter UNCED Text].

⁵² Energy Charter, *supra* note 11, at 30.

⁵³ See *supra* notes 22-31 and accompanying text.

international treaties and legal instruments will continue to invoke precaution and link that precaution to scientific analysis.

Beyond those general propositions, however, the articulations since 1987 have not refined the pollution prevention obligation into a predictable substantive rule of precautionary obligation. Fundamental uncertainties still must be addressed. First, it is unclear whether precaution is a recommendation, an obligation, or some intermediate duty. In some articulations "a precautionary approach . . . may require action,"⁵⁴ a report only "recommends" adoption of a "principle of precautionary action,"⁵⁵ or an agreement only urges the parties to "strive to adopt and implement the preventive, precautionary approach."⁵⁶ Other articulations encourage precaution by asserting that the participants "will continue to apply the precautionary principle,"⁵⁷ or by declaring that environmental measures taken by states "must anticipate, prevent and attack the causes of environmental degradation."⁵⁸

Second, the level of environmental risk that triggers precautionary measures remains unsettled. While scientific certainty is not a precondition to a recommendation or obligation to exercise precaution, the degree of scientific uncertainty that must be overcome before precaution is required is unclear. The precautionary principle might be invoked in some articulations "even before a causal link has been established by absolutely clear scientific evidence,"⁵⁹ "even where there is inadequate or inconclusive scientific evidence to prove a causal link,"⁶⁰ or "even where there is no scientific evidence to prove a causal link."⁶¹ Other articulations emphasize that "lack of full scientific certainty should not be used as a reason for postponing [precautionary steps]."⁶² Finally, some articulations are silent on the amount of scientific proof or knowledge necessary to link the activity to its detrimental effects.⁶³

Third, uncertainties exist regarding not only which sciences, factors, or scientific determinations are relevant, but also the factual

⁵⁴ Second North Sea Declaration, *supra* note 6, at 835, 838.

⁵⁵ UNEP Report, *supra* note 5.

⁵⁶ Bamako Convention, *supra* note 10, at 781.

⁵⁷ Final North Sea Declaration, *supra* note 37, at 661.

⁵⁸ Bergen Declaration, *supra* note 44, at 431.

⁵⁹ Second North Sea Declaration, *supra* note 6, art. VII, at 838.

⁶⁰ Nordic Council Conference, *supra* note 42, at 99.

⁶¹ Final North Sea Declaration, *supra* note 37, at 661.

⁶² Second World Climate Conference, *supra* note 45, art. II(7), at 475.

⁶³ E.g., Treaty on European Union, *supra* note 36, at 285; Energy Charter, *supra* note 11; UNCED Text, *supra* note 51.

settings in which different levels of scientific knowledge would apply. The obligation to exercise precaution is sometimes rendered imprecise by references to "economic considerations,"⁶⁴ "different socio-economic contexts,"⁶⁵ and application by states "according to their capabilities."⁶⁶ The Rio Declaration, in providing that "the precautionary approach shall be widely applied by States according to their capabilities," contains all of the above uncertainties, falling ambiguously between recommendation and obligation.⁶⁷

The uncertainties and ambiguities in the articulations of the precautionary principle have allowed sovereign nations to sign agreements they otherwise might not sign because the precautionary obligations are likely to be unenforceably vague. Now that the precautionary principle has become a widely accepted international political practice, the next phase should be to strengthen the content of future articulations and to refine and develop the substantive obligation to exercise precaution.

IV. CRITERIA OF ADEQUACY FOR FUTURE ARTICULATIONS OF THE PRECAUTIONARY PRINCIPLE

A. Introduction

Several preliminary comments are appropriate. The first concerns a developmental process through which substantive principles of international law might evolve. In the early stages of invoking a novel "principle" of international law, the substantive implications of the new principle might not be fully appreciated, and precise obligations might not be politically acceptable. In addition, there does not then exist the history of state practice that eventually provides substantive content and specific contours to the principle over time. It is understandable, therefore, that initial articulations would be somewhat unformed and general. It is in this manner that articulations of the precautionary principle to date have often left unresolved the basic types of uncertainties discussed in the previous Part.

⁶⁴ Montreal Protocol, *supra* note 2, at 1550.

⁶⁵ Second World Climate Conference, *supra* note 45, art. II(7), at 475.

⁶⁶ Rio Declaration, *supra* note 4, princ. 15, at 879.

⁶⁷ *Id.* Interestingly, the Climate Change Convention produced at the Rio Conference reverts to recommendation rather than obligation with language that states "should" exercise precaution to prevent climate change. Climate Change Convention, *supra* note 8, art. III, at 854.

The evolution of an effective precautionary principle, however, requires the gradual removal of such core uncertainties. This process of eliminating uncertainty can be made more efficient by agreeing upon the nature of future treaty articulations of the precautionary principle. If a consensus can be reached about criteria of adequacy for future articulations, then such criteria would provide a useful list of elements that precautionary provisions should incorporate. Increased clarity in future articulations would in turn better enable states, businesses, and citizens to predict which of their future activities are likely to conform to their duties under the evolving precautionary principle.

Second, the evolution of the precautionary principle has reached a stage at which it seems possible to forge such a consensus on criteria of adequacy. Virtually all states have by now repeatedly affirmed the general axiomatic notion that preventing environmental harm is preferable to trying to remedy the harm once it has occurred.⁶⁸ States therefore seem ready to become more specific about what a precautionary principle of international law entails. The international community needs to agree to reject the level of vagueness that has prevailed in many of the past precautionary treaty provisions.

Third, any fruitful set of criteria should take into account the best of the treaty articulations agreed upon to date. Such evolutionary continuity supports the claim that the proposed criteria are intended to promote a refinement of a principle that the international community has already accepted. Articulations of the principle in a few regional treaties, such as the North Sea treaties,⁶⁹ come close to being "adequate" under the proposed criteria, and this helps to legitimate the proposal that parties should achieve the specified level of detail in every future treaty. States should now agree to achieve a minimal amount of precision in all future articulations of that principle of precaution on which they have already agreed in general in the past.

Fourth, at this stage of development, agreement on criteria of adequacy is more likely to occur than agreement on a list of substantive obligations and rights. This tendency is due to the complicated nature of environmental protection and to the apparent political unacceptability of more substantive requirements. Governments and private parties do not always agree on what specific

⁶⁸ See *supra* notes 22-31 and accompanying text.

⁶⁹ Second North Sea Declaration, *supra* note 6; Final North Sea Declaration, *supra* note 37; see also discussion *infra* part IV.B.5.

precautionary measures are necessary, technologically possible, economically feasible, or likely to succeed.⁷⁰ Moreover, different environmental problems involve balancing different combinations of such relevant factors as type of injury, economic impacts, and private rights. Presumably, this complexity is one reason why so many treaties to date have settled for vague articulations of the precautionary principle. Given these problems, it is unlikely that any present formulation of the principle would be substantively informative and politically acceptable, and yet strike the "right" balance for all environmental problems.

In addition, not many states would adopt or implement a sweeping surrender of national sovereignty. Any criteria designed to promote further elucidation of a precautionary principle must recognize that reality. Therefore, national interests and activities should continue to enjoy presumptive legitimacy unless some international environmental concern warrants precautionary intervention. A theory of adequacy for articulations of the precautionary principle should respect the national sovereignty of states, allow as much freedom of action as possible to private and governmental actors, yet balance that respect and freedom against the legitimate interest of the international community in protecting global and regional environments.

What states can usefully agree upon at the present time are process-oriented criteria that (a) set minimal standards of content for articulations in future agreements, (b) allow states to continue to balance in particular cases their concerns for state sovereignty and economic well-being with concerns for environmental protection, yet (c) promote the gradual evolution of the precautionary principle through more informative articulations than in the past. Adequate articulations would put the international community on notice as to precise terms of the parties' agreement, and thus would contribute to the evolution of a useful and accepted content for the precautionary principle itself. Finally, states should agree that all future articulations will satisfy these criteria.

⁷⁰ See, e.g., William H. Rogers, Jr., *Environmental Law* 24-39 (2d ed. 1994) (emphasizing the interdisciplinary aspects of environmental law, and describing the field as "an ongoing kaleidoscope of tussling organizations, interests, jurisdictions, and states whose strategies, goals, and outcomes are subject to constant redefinition").

B. *Proposed Criteria of Adequacy*

This Article proposes the following four criteria for testing the adequacy of articulations of the precautionary principle in future agreements.

1. Any future articulation should contain a reasonably precise statement of the environmental goals to be achieved, and should cite those goals in justifying the invocation of the precautionary principle.
2. Any future articulation should specify the jurisdictional scope of the invocation, either geographically or by reference to some portion of the ecosystem to be protected. It may, but need not, further restrict the scope of the invocation by specifying the type of harm or hazard subject to the treaty.
3. Any future articulation should clearly identify the "covered" human activities for which the principle requires precautionary measures. These covered activities may be identified by enumeration or by a generic formula referring to the type of harmful effect targeted, to the environmental condition capable of causing those harmful effects, and to the required degree of scientific confidence about effects and causation.
4. Any future articulation should clearly state the procedural, investigative, and substantive measures that are required in connection with any covered activity.

This Article will now discuss each of these criteria in turn.

1. *The Statement of Environmental Goals*

A statement of the environmental goals, in the context of justifying the invocation of the precautionary principle, serves several functions. First, such a statement specifies for the parties to the treaty and for the larger world community the desirable environmental condition on which the parties have agreed. Examples of goal statements that are reasonably specific and informative include the elimination or reduction of anthropogenic climate changes,⁷¹ or of anthropogenic effects on the ozone layer,⁷² or of anthropogenic harmful effects on the marine environment.⁷³ Such

⁷¹ See Second World Climate Conference, *supra* note 45, art. II(10), at 476.

⁷² See Montreal Protocol, *supra* note 2, at 1551.

⁷³ See Final North Sea Declaration, *supra* note 37, at 661.

specific goal statements may help the parties to interpret treaty provisions or to resolve later disputes over enforcement.⁷⁴ Such affirmative agreements on specific environmental goals within specific ecosystems may also be informative to other states that are not parties to the agreement, in ways to be discussed below.

Second, articulating the need for precaution helps legitimate the intervention of international interests and notifies all parties of that intervention. The treaty registers with the international community yet another agreement between states in which there is a consensus as to the importance of a specific environmental goal, and the desire to avoid the costs of an environmental injury.

It is important that the statement of environmental goals should take into account only environmental considerations. The statement should identify a desirable environmental end-state that reflects only the concerns of environmental science. Political and economic factors should be balanced in a different element of the provision invoking the precautionary principle. If such a statement is confined to the ultimate environmental goal, it can be articulated with more precision, without the vagueness that results from bending to the many political, economic, and cultural pressures that seek to divert progress toward that goal. Moreover, if the parties can focus on the environmental goal as such, it might be easier for them to reach agreement at least on what is ultimately best for the environment. The statement of environmental goal or end-state should therefore reflect almost exclusively the conclusions of ecological scientists.

The Rio Declaration on Environment and Development illustrates how political and economic concerns can lead to a largely uninformative and platitudinal goal statement.⁷⁵ The Rio Declaration invokes a precautionary approach in order to "protect the integrity of the global environmental and developmental system . . . [r]ecognizing the integral and interdependent nature of the Earth, our home"⁷⁶ Although this statement may be universally acceptable to every political, economic, and cultural constituency, it lacks the detail and clarity needed to inform the world community about the environmental goal agreed upon.

Such general or precatory statements are not necessarily useless, for they may play an essential role in the initial development of an

⁷⁴ See *Mistretta v. United States*, 488 U.S. 361, 375-79 (1989) (illustrating how goal statements provide guidance to administrative agencies).

⁷⁵ Rio Declaration, *supra* note 4, at 879.

⁷⁶ *Id.* at 876 (emphasis omitted).

international law principle and may help to achieve important political objectives. However, a commitment to "precaution" on every front is by its nature uninformative, and the least meaningful thing for governments to agree upon is that "the biosphere and its ecosystem" should be protected. Parties to treaties should agree on detailed environmental goals and articulate when the precautionary principle requires concrete efforts to achieve such goals.⁷⁷

Over time, the collection of future agreements that include environmental goal statements should begin to create an informative and reasonably comprehensive mosaic of a desirable global environment. The environmental goal statements from numerous bilateral and multilateral agreements will constitute a list of environmental conditions warranting international precautionary measures. Such statements may create pressure and progress toward a global consensus on what the environmental condition of the planet should be. Ultimately, a common vision of the desirable global environment might be reflected by international law in the form of prohibitions and mandates. Unfortunately, such progress is hampered by treaties in which political, economic, and cultural concerns tend to produce language that is vague and compromising even with respect to environmental goals.

2. *The Scope of Application*

An adequate articulation of the precautionary principle should also identify the scope of application for the principle. The scope of application typically is specified either geographically or by the aspect of the ecosystem to be protected. For example, some recent agreements apply in geographically specified areas, such as the North Sea⁷⁸ or Africa.⁷⁹ Other treaties have specified their scope by the aspect of the ecosystem to be protected, such as the ozone layer,⁸⁰ climate change,⁸¹ and the marine environment.⁸²

Parties can further clarify or limit the scope of application by identifying either a type of harm or a type of hazard. The type of harm to be avoided can be identified specifically, such as "ozone

⁷⁷ See Second World Climate Conference, *supra* note 45, at 475-76; Montreal Protocol, *supra* note 2, at 1550-51; Final North Sea Declaration, *supra* note 37, at 661; see also *supra* notes 71-73 and accompanying text (discussing adequate statements).

⁷⁸ See Final North Sea Declaration, *supra* note 37, at 659 n.1.

⁷⁹ See Bamako Convention, *supra* note 10, at 776.

⁸⁰ See Montreal Protocol, *supra* note 2, at 1541.

⁸¹ See Second World Climate Conference, *supra* note 45, at 473; Climate Change Convention, *supra* note 8, at 854.

⁸² See Final North Sea Declaration, *supra* note 37, at 659.

layer . . . depletion”⁸³ or “eutrophication and acidification,”⁸⁴ or by a general rule, such as “irreversible damage to the marine environment.”⁸⁵ Agreements can also be limited to specific types of hazard or causal agents that can bring about harm, such as agreements to protect the ozone layer against certain substances such as chlorofluorocarbons (CFCs),⁸⁶ to prevent climate change due to greenhouse gases,⁸⁷ or to protect the African environment against hazardous waste.⁸⁸ Agreements that can be achieved, however, without further limiting their scope to specified harms or hazards will provide greater environmental protection.

There are several reasons why this criterion should lead to a more substantive principle of international law. First, parties are more likely to make agreements invoking the precautionary principle if they know the precise scope of the agreement, since they can then determine the extent to which agreement on the principle would encroach upon their sovereignty. This criterion respects the sovereignty of states, while encouraging them to surrender it in limited areas for the sake of environmental protection. Second, when a party to an agreement approves the principle’s jurisdictional reach, it identifies the extent to which the party’s sovereignty has been abridged. Hence, even though this criterion (more than the statement of environmental goals) reflects each party’s self-interested balancing of political concerns, such balancing results in definite jurisdictional boundaries agreeable to the parties. Third, the scope of application provides objective standards by which the world community can judge each party’s performance under the precautionary principle. It also signals the parties’ willingness to allow others to judge their performance objectively. Fourth, even an invocation of the precautionary principle that limits the scope of the principle’s application acknowledges and helps illuminate the principle. Over time, even self-interested applications of that principle with limited scopes of jurisdiction will begin to chart the extent of the principle’s accepted reach, and the extent to which states customarily accede to that principle.

⁸³ See Montreal Protocol, *supra* note 2, at 1550-51.

⁸⁴ U.N. Transboundary Watercourses Convention, *supra* note 3, at 1314.

⁸⁵ UNEP Report, *supra* note 5, at 152. The UNCED Text, *supra* note 51, at 8, provides a list of the “greatest threat” contaminants to the marine environment.

⁸⁶ Montreal Protocol, *supra* note 2, at 1541.

⁸⁷ See Second World Climate Conference, *supra* note 45, at 476.

⁸⁸ Bamako Convention, *supra* note 10, at 775.

3. *Identification of Activities Requiring Precaution*

Any informative articulation of the precautionary principle should clearly identify those human activities that require precautionary measures — for example, dumping solid waste, discharging hazardous liquid, emitting air pollutants, or transporting hazardous materials. Such specification should contain criteria objective enough to enable any actor to determine in advance whether the contemplated activity triggers precautionary measures under the agreement.

Identifying the activities requiring precaution has several advantages. Vague references to covered activities can undermine a primary objective of the precautionary approach by creating the possibility that an activity is not known to be covered until after the environmental harm occurs. Identification of specific activities to which precaution applies enables private and governmental actors to plan their conduct, and provides them due notice concerning potential costs and penalties. Specification also helps to ensure that obligated states do not construe the covered activities too narrowly or too broadly.

a. Identification Independent of Effects

One useful way to satisfy this criterion is to identify the covered activities by enumeration, using descriptions that are independent of the effects caused by the activities. The Bamako OAU Convention, for example, regulates the “generation, transportation and disposal of hazardous wastes”⁸⁹ by listing categories of “hazardous wastes”⁹⁰ and “hazardous characteristics.”⁹¹ All of the advantages discussed above are achieved by such a listing of the triggering activities, especially if the list is comprehensive and if it clearly specifies the covered activities in terms that are objective and that allow for the identification of those activities before they are undertaken.

b. Identification by Effects

An alternative is to identify covered activities by means of the adverse effects produced.⁹² Although identifying covered activities

⁸⁹ *Id.* at 791.

⁹⁰ *Id.* at 781 (Annex I: Categories of Wastes Which are Hazardous Wastes).

⁹¹ *Id.* at 774 (Annex II: List of Hazardous Characteristics).

⁹² There is a distinction between using effects to define the “scope of application” and using them to identify the “covered activities” (those triggering the precautionary measures). Identifying jurisdictional scope and triggering activities are functionally distinct

by their effects runs some risk of not fully achieving the advantages listed above, the risk is lessened if the likely effects are well-documented in advance. The most useful "specification-by-effect" contains at least three types of information: the nature of the adverse effect, the environmental conditions capable of bringing about that adverse effect, and the degree of confidence required for conclusions about the first two types of information. All three types of information are generally needed before the desired degree of clarity has been achieved.

i. Kinds of Adverse Effects

A number of environmental treaties characterize the covered activities as those having "irreversible" effects.⁹³ Irreversible effects allow no practical opportunity to correct the environmental damage once it has occurred. A paradigm for an irreversible effect is a nuclear explosion: the nuclear chain reaction, once begun, creates adverse radioactive effects lasting perhaps thousands of years. Marine pollution treaties also define covered activities by reference to their effects when they ban the release of substances that persist in the environment or substances that bioaccumulate in marine species. Some formulations target human activities that release substances capable of producing serious harmful effects.⁹⁴

tasks. Geography or subject matter define the scope within which the precautionary principle has been invoked, while the covered activities occur within that scope. The jurisdictional scope may remain constant over time, for example, but new covered activities may be added within that scope as new scientific information becomes available. Identifying covered activities by their effects allows regulation of new activities under the treaty without amending the treaty.

⁹³ See UNEP Report, *supra* note 5, at 152 ("[T]he impact of pollutants discharged into the marine environment may result in irreversible damage."); Bergen Declaration, *supra* note 44, at 431 ("[W]here there are threats of serious or irreversible damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.").

The meaning of "irreversible" probably implies a human time frame. The appropriate time frame in a given case, however, may vary from species to species, from ecosystem to ecosystem, and from adverse effect to adverse effect. Of course, from the standpoint of the individual organism, death and many biological changes are irreversible.

⁹⁴ See Second North Sea Declaration, *supra* note 6, art. XVI(1), at 840 (accepting the principle of safeguarding the North Sea by reducing "polluting emissions of substances that are persistent, toxic and liable to bioaccumulate"); see also Montréal Protocol, *supra* note 2, at 1550 ("Recognizing that world-wide emissions of certain substances can significantly deplete and otherwise modify the ozone layer in a manner that is likely to result in adverse effects on human health and the environment."); UNCED Text, *supra* note 51, at 8 ("Contaminants which pose the greatest threat to the marine environment are sewage, nutrients, synthetic organic compounds, sediments, litter and plastics, metals, radionuclides, oil/hydrocarbons, and polycyclic aromatic hydrocarbons (PAHs).").

This approach might assume that while any death is irreversible, a human death is more serious than the death of any other organism.

ii. Exposure Conditions Capable of Causing the Adverse Effects

Many substances cause harm at a particular environmental exposure, concentration, or dose, but are harmless or even essential for life at other levels. In such cases, if the treaty identifies the covered activities by their effects, the agreement should also identify the condition or concentration of environmental concern. Specifying only the type of harm to be avoided might not be sufficient to justify the placement of restrictions on activities in the name of an international principle of precaution.

The environmental conditions that trigger precautionary obligations may vary dramatically, depending on the toxic agent and the exposure mechanism through which that agent operates. For example, a single release of one substance might directly result in a concentration that is toxic,⁹⁵ while another substance might achieve a toxic concentration only due to a persistence in the environment and bioaccumulation in living organisms. Another substance might cause a serious condition only after adverse effects accumulate from numerous releases.⁹⁶ An agreement can also specify the triggering environmental condition by some other means, such as iden-

Domestic laws in the United States contain similar formulations. *See, e.g.*, Occupational Safety and Health Act, 29 U.S.C. § 655(b)(5) (1988 & Supp. V 1993) (regulating toxic materials in the workplace by occupational health standards predicated on "material impairment of health or functional capacity even if [an] employee has regular exposure to the hazard dealt with by such standard for the period of his working life"); Resource Conservation and Recovery Act § 1004(5), 42 U.S.C. § 6903(5) (1988) (defining "hazardous waste" in part in terms of ability to "cause, or significantly contribute to an increase in mortality or an increase in serious irreversible, or incapacitating reversible, illness"); Clean Air Act §§ 112(a)(6), (b)(2), 42 U.S.C. §§ 7412(a)(6), (b)(2) (1988 & Supp. V 1993) (identifying "hazardous air pollutant[s]" according to "adverse human health effects (including, but not limited to, substances which are known to be, or may reasonably be anticipated to be, carcinogenic, mutagenic, teratogenic, neurotoxic, which cause reproductive dysfunction, or which are acutely or chronically toxic) or adverse environmental effects whether through ambient concentrations, bioaccumulation, deposition, or otherwise").

⁹⁵ A single release might create an acute toxic exposure, or it might be so persistent that it produces a concentration threatening toxicity from chronic exposure. *Cf.* Committee on the Institutional Means for Assessment of Risks to Public Health, National Research Council, Risk Assessment in the Federal Government: Managing the Process 17-50 (1983) [hereinafter Risk Assessment] (discussing factors in risk assessment and regulatory decision-making; noting that risk characterization turns on more than hazard identification).

⁹⁶ Examples are releases of ozone-depleting compounds or greenhouse gases, whose adverse effects of international concern are due to the discharge of large quantities.

tifying a particular environmental pathway and a critical affected group.⁹⁷

iii. *Degree of Confidence Required to Trigger Precautions*

If covered activities are identified by virtue of a causal link to effects, through specifying the kind of adverse effect and the exposure levels of concern, then the precautionary articulation should state the required degree of confidence in our knowledge about that causal link. Scientific uncertainty is inherent in all scientific information, usually derivative of five sources of error in the scientific method: the variables chosen, the measurements made, the samples drawn, the models employed, and the causal relationships inferred.⁹⁸ The task for treaty drafters is to determine what degree of uncertainty is acceptable in identifying covered activities. In other words, what degree of confidence in the scientific evidence about effects should be required before precautionary measures are mandated under international law?⁹⁹

As a practical matter, articulations of the precautionary principle in an international environmental instrument can be expected to avoid extreme degrees of confidence in scientific conclusions about the extent of harm or causation. The general principle itself certainly rejects requiring absolute certainty or even "reasonable certainty" before triggering precaution. Yet requiring precautionary measures to be taken on the basis of speculation about mere possibilities of harm and causation, without any rational basis in sound scientific data, is also generally rejected. The interest of states in maintaining their sovereignty and the social interest in private

⁹⁷ For a proposed release of radioactivity to the environment, for example, there might be a particular pathway through which a group of people (the "critical group") is expected to receive a radiation dose much larger than that received by the rest of the population. If members of this group receive an insignificant dose, then it follows that other members of the public probably do also. However, environmental pathways may change with time. For example, the critical group for discharge of radioactive waste into the Irish Sea changed from a few individuals with a particular liking for laverbread made from edible seaweed to a few salmon fishermen who were exposed to radioactivity deposited on the shore. See James E. Hickey, Jr., *International Law of the Land-Based Pollution of the High Sea*, I.15, I.37 (1976) (unpublished Ph.D. dissertation, Cambridge University).

⁹⁸ These distinct types of scientific uncertainty have also been defined as conceptual uncertainty, measurement uncertainty, sampling uncertainty, modeling uncertainty, and causal uncertainty. See Vern R. Walker, *The Siren Songs of Science: Toward a Taxonomy of Scientific Uncertainty for Decisionmakers*, 23 Conn. L. Rev. 567, 572 (1991).

⁹⁹ Treaties sometimes use vague language to describe the required degree of confidence. See Second North Sea Declaration, *supra* note 6, at 838 ("possibly damaging effects"); Montreal Protocol, *supra* note 2, art. 7, at 1550 ("adverse effects resulting or likely to result").

industrial development oppose speculation as a predicate for international intervention. Unfortunately, the appropriate degree of confidence beyond mere speculation but short of certainty is difficult to define. The standard probably varies from one environmental situation to another, and is dependent on many factors, including the gravity of the harm addressed.

Articulations of the precautionary principle that identify the covered activities by means of their effects, however, should specify the required degree of confidence in the scientific information. Without such specification, precautionary principle provisions in treaties are subject to an unacceptably wide range of interpretations by the parties and the world community. Two levels of confidence are suggested here as useful in formulating a precautionary principle: a level of "reasonable scientific *possibility*" and a level of "reasonable scientific *probability*." A reasonable scientific possibility could be said to exist whenever empirical scientific data (as opposed to mere hypotheses, speculation, or intuition) provide a rational basis that warrants drawing the conclusions from the data, even though reasonable scientific experts might disagree on whether that conclusion is the only valid inference from the data.¹⁰⁰ A reasonable scientific probability (or likelihood) exists whenever scientific experts generally agree that the available data and methods used to interpret the data are valid and reliable, and when there is also general acceptance by the relevant scientific community of the specific conclusions drawn from the data. "General acceptance" means something less than unanimity, but more than a minority opinion.

This criterion of adequacy could be satisfied by specifying either of these two degrees of confidence, or both in combination. For

¹⁰⁰ This degree of confidence can be satisfied in the face of wide disagreement among scientists. It is similar to the degree of confidence required by various judicial bodies in order to defer to findings of fact made on the basis of controverted scientific evidence. For example, trial judges in the United States defer to jury determinations of fact, deciding only whether there is sufficient evidence for a reasonable jury to decide an issue. Fed. R. Civ. P. 50(a). Appellate judges defer to factual findings of trial judges, deciding only whether the finding was "clearly erroneous" given the evidence. See *Anderson v. Bessemer City*, 470 U.S. 564, 573-76 (1985) (holding that the court of appeals conducted an improper de novo review in setting aside the district court's finding in a sex discrimination case that the petitioner was better qualified than another candidate for the job). Trial and appellate courts defer to determinations of administrative agencies, overruling the agency's factual determinations only if they have no rational basis. See, e.g., *Ethyl Corp. v. EPA*, 541 F.2d 1, 36-37 (D.C. Cir. 1976), *cert. denied*, 426 U.S. 941 (1976) (describing the arbitrary and capricious standard as merely an inquiry into whether the agency decision was rational).

example, an agreement might require a reasonable scientific "probability" that the activity can produce the kind of adverse effect that is to be avoided, but only a reasonable scientific "possibility" that the exposure contribution from the contemplated activity will produce the adverse effect.¹⁰¹ To refine the requirements of the precautionary principle of international law, some particular degree of confidence should be chosen and defined in the agreement.

4. *Required Precautionary Measures*

An adequate articulation of the precautionary principle would specify the precautionary measures required by international law for undertaking a covered activity.¹⁰² Although environmental treaties sometimes prohibit a covered activity,¹⁰³ treaties more commonly allow covered activities provided precautionary measures are taken. Precautionary measures include procedural requirements, study requirements, and substantive standards.

a. *Procedural Requirements*

Treaties often require certain procedures before covered activities may be undertaken; for example, notification must be given,

¹⁰¹ In the technical terminology of regulatory risk assessment, there would be a reasonable scientific probability about the hazard assessment and the dose-response assessment, but only a reasonable scientific possibility concerning the exposure assessment. See European Commission Directive 93/67, 1993 J.O. (L 227) 9, 10-11 (defining a five-step risk assessment — hazard identification, dose (concentration)-response (effect) assessment, exposure assessment, risk characterization, and recommendations for risk reduction); see also Risk Assessment, *supra* note 95, at 19-20 (identifying four steps in risk assessment — hazard identification, dose-response assessment, exposure assessment, and risk characterization).

¹⁰² The articulation of these precautionary measures should not be confused with the statement of the environmental goal, or end-state. See *supra* part IV.B.1. The statement of the environmental goal describes precisely the desirable state of the environment. The precautionary requirements, by contrast, are the agreed means of achieving that environmental goal. While the statement of environmental goals should avoid balancing non-environmental factors, the precautionary requirements balance environmental objectives with such considerations as technological feasibility, cost, cost-effectiveness, economic dislocation, and administrative feasibility. Agreements to "minimize," "limit," or "reduce" pollution discharge are not very informative, because they contemplate a balancing of multiple, non-environmental factors, but do not provide sufficient guidance on precisely which factors are relevant and how the balance should be struck. Cf. Risk Assessment, *supra* note 95, at 18-19, 69 (distinguishing risk assessment and risk management).

¹⁰³ For example, Article III, Annex I of the Intergovernmental Conference on the Convention on the Dumping of Wastes at Sea prohibits outright the dumping of land-based organohalogen compounds such as DDT. 11 I.L.M. 1291, 1295-97, 1310 (1972).

permits obtained, licenses issued, or reporting requirements met.¹⁰⁴ Although procedural requirements serve important functions, by themselves they often fail to guarantee sufficient environmental protection in a context where the threat of environmental degradation is so serious that the precautionary principle is needed.

b. Study Requirements

Whenever there is significant scientific uncertainty about actual effects, covered activities might be allowed only if the actor is obligated to help reduce that uncertainty. Information-gathering activities might include compiling inventories of emissions,¹⁰⁵ preparing environmental impact assessments,¹⁰⁶ or monitoring the effects of a covered activity.¹⁰⁷ A treaty might also require a contribution to more general research efforts beyond the specific action being undertaken. One legitimate objective of the international community is to reduce the scientific uncertainty that created the need to invoke the precautionary principle in the first place.

c. Substantive Standards

An articulation may also establish substantive standards that must be met before a covered activity may be undertaken. The choice of a substantive standard should reflect the severity of the risk posed by the covered action. Where the risk of severe environmental damage is great, an agreed articulation of the precautionary principle might require actors to use the "Best Available Technology" to reduce or treat emissions,¹⁰⁸ or require them to prove that the planned activity will not cause or contribute over time to harmful environmental effects.

¹⁰⁴ See, e.g., Bamako Convention, *supra* note 10, art. 6, at 785-86; U.N. Transboundary Watercourses Convention, *supra* note 3, arts. 13, 16, Annex III, at 1321, 1322, 1350-52.

¹⁰⁵ See Climate Change Convention, *supra* note 8, art. 4(1)(a), at 855.

¹⁰⁶ See U.N. Transboundary Watercourses Convention, *supra* note 3, art. 3(1)(h), at 1317.

¹⁰⁷ See Bergen Declaration, *supra* note 44, art. IV(15)(b), at 436 (encouraging industry to report annually on its environmental records, including information on the efficiency of the use of energy and raw materials); Nordic Council Conference, *supra* note 42, at 101 (stressing the need for "an increased dissemination of information about new research results concerning developments in marine pollution, its causes and its effects"); U.N. Transboundary Watercourses Convention, *supra* note 3, art. 11, at 1320 (joint monitoring and assessment provisions); Second North Sea Declaration, *supra* note 6, art. XVI(8), at 840 (agreeing to "establish, nationally and internationally, appropriate procedures for monitoring inputs to the North Sea and for reporting the results of such monitoring").

¹⁰⁸ See Final North Sea Declaration, *supra* note 37, at 662; U.N. Transboundary Watercourses Convention, *supra* note 3, art. 3(1)(f), at 1317.

If a treaty adopts a substantive standard, it should also identify a suitably high degree of confidence that a planned activity will satisfy that standard.¹⁰⁹ In areas where the precautionary principle is invoked, part of the uncertainty the articulation should resolve is how certain a party or actor needs to be that the substantive standard will be met. Once the need for the precautionary principle has been established and a covered activity is contemplated, it might be appropriate to err on the side of restrictiveness before allowing an actor to undertake potentially harmful activities. For example, an actor might be required to establish that there is a reasonable scientific probability that the specific action neither poses nor contributes to a risk of serious and irreversible adverse effects of the kind addressed in the treaty.

d. Other Actions

The parties might also agree that they are obligated under the precautionary principle to undertake other kinds of activities. Examples include agreements to "increase the flow of capital and environmentally sound technology" to less-developed countries¹¹⁰ or commitments to sign or comply with the precautionary provisions of other treaties or conventions.

5. Applying the Criteria

It is not the intent of this Article to evaluate the many precautionary articulations in each of the existing treaties by using the proposed criteria of adequacy. As suggested throughout the above discussion, however, some articulations meet those criteria better than others. The North Sea declarations provide illustrations of very informative articulations.¹¹¹ These declarations have the stated environmental goal of avoiding "potentially damaging impacts of substances that are persistent, toxic and liable to bioaccumulate."¹¹² The scope of application is geographically delineated.¹¹³ Many activities are clearly identified as covered activities

¹⁰⁹ See *supra* part IV.B.3.b.iii for a discussion of degrees of confidence.

¹¹⁰ Bergen Declaration, *supra* note 44, art. II(13)(e), at 432; see also Climate Change Convention, *supra* note 8, art. IV(10), at 858.

¹¹¹ Second North Sea Declaration, *supra* note 6; Final North Sea Declaration, *supra* note 37.

¹¹² Final North Sea Declaration, *supra* note 37, at 661; see also Second North Sea Declaration, *supra* note 6, art. VII, at 838.

¹¹³ Final North Sea Declaration, *supra* note 37, at 659 n.1 ("the North Sea comprises the body of water: a) southwards of latitude 62° N, and eastwards of longitude 5° W at the north west side[,] b) northwards of latitude 57° 44.8' N from the northern most point of

without reference to their effects, such as operating municipal sewage treatment plants, dumping sewage sludge at sea, and conducting marine incineration.¹¹⁴ Required precautionary measures include significantly reducing inputs by use of "Best Available Technology," preventing PCBs from entering the marine environment, and reducing the risk of losing packaged goods at sea by implementing specific international maritime codes for transportation of goods.¹¹⁵

By contrast, adequate treaty articulations of the precautionary principle need not be as voluminous or detailed as in the North Sea declarations. An articulation could satisfy the four criteria with even minimal content and commitment. For example, an articulation might take the following approach and still meet the criteria:

Chemical C might prove to be so toxic to marine species S that the precautionary principle must be applied throughout marine area A to avoid the risk of further reduction of the population of S in that area. Therefore, before any quantity of C is discharged into marine area A, an environmental impact statement must be prepared and permits must be obtained from at least two governments that are signatories to this agreement.

Such a treaty articulation is at least adequate in its specificity, since the world community would gain an informative statement of the agreed precautionary requirements needed in that specific context.

V. CONCLUSION

For decades states have recognized, in specific situations, the need to take precautions to protect the environment. In some of those situations, states have even been willing to sign agreements to take precautionary measures. It is time, however, to develop precaution beyond the realms of mere need and voluntary undertakings, and into an international obligation. The great complexity of environmental matters, and the concerns of territorial sovereignty and individual freedom, may caution against a premature and forced substantive statement on the nature of that obligation. Yet states should no longer be able to *seem* to invoke international "law" by merely referring in treaties to a "precautionary princi-

Denmark to the coast of Sweden, and c) eastwards of longitude 5° W and northwards of latitude 48°30' N, at the south side"); Second North Sea Declaration, *supra* note 6, art. I, at 838.

¹¹⁴ Final North Sea Declaration, *supra* note 37, at 664-65.

¹¹⁵ *Id.* at 662-63, 667.

ple," while *actually* failing to acknowledge in those treaties that any substantive obligations flow from this international principle. States should now begin to provide a minimal amount of content whenever they agree that precautionary obligations are required under international law.

The proposed criteria are designed to facilitate the evolution of a more substantive precautionary principle, without imposing any particular content on it at the present time. It is hoped that by consistent use of the proposed criteria on an agreement-by-agreement basis, there will emerge a more substantive principle of international law, upon which most states and private parties can eventually agree. In other words, the four criteria proposed here do not force that evolution down any particular substantive path, but are intended to provide a structure for the evolutionary process itself.

Parties that invoke the precautionary principle in future treaties must formulate a clear vision of what is required by the precautionary principle. Ideally, every future articulation of the precautionary principle should satisfy the four proposed criteria. It is no longer adequate simply to pay tribute to a vague desire to prevent pollution. In the future, treaties that invoke the precautionary principle should be explicit about the required precautions that are mandated by international law.

A commitment to use these four criteria is a commitment to a process which leaves to future negotiations the precise articulations that balance sovereignty concerns and freedom of action against the legitimate public interest of the international community in protecting regional and global environments. Without a commitment to such a process, states will remain free to employ platitudinal articulations of the precautionary principle that will not protect the environment, develop international environmental law, or advance the cause of achieving true sustainable development in the decades ahead.

Adherence to the four criteria will result in clearer and more detailed treaty articulations of the precautionary principle in the future. Treaty obligations will be easier to predict as consistency among treaties emerges in the articulation of the precautionary principle. Clarity and consistency will contribute to the evolution of a precautionary principle that would bind all segments of the international community whether or not they are parties to any specific treaty. International agreement to use these proposed criteria will be an important and positive step in that direction.