The Precautionary Principle: A Barrier to Innovation and Progress?

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Greenpeace Research Laboratories Discussion Paper 01/2006

September 2006

GRL-DP-01-2006

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Precaution has become central to all environmental issue areas addressed by NGOs insofar as these call for either a Precautionary Approach or for strict application of the Precautionary Principle. The Precautionary Principle acts as the basis of a framework which, when translated and matured into specific precautionary approaches, can be practically implemented as a means of environmental management and protection.

The Precautionary Principle effectively reverses the burden of proof such that those proposing a given activity are placed in the position of having to assure that it will not cause environmental damage. This contrasts with a permissive regulatory approach (still common) where an activity is permitted until evidence of environmental damage emerges via monitoring activity or casual observation. Usually, of course, such damage is only belatedly identified, the type of damage may be totally unexpected and may even be effectively irreversible.

Because a precautionary approach to environmental protection contrasts with the more permissive environmental management regimes and is inevitably less libertarian, such an approach is often characterised as a barrier to science-based human progress and to innovation based on the sciences. Often it is simply portrayed as "unscientific". Those taking such a view tend to favour narrow risk based approaches where the available information is used to derive a (usually highly imperfect) probabilistic risk factor. This is generally expressed in the form:-

- *If Activity X goes ahead there is only a 10% chance of adverse environmental impact,* or;
- *There is no evidence that Activity X will cause adverse impact.*

In many cases, however, risk-based approaches simply equate "absence of evidence" of an impact with "evidence of absence" of that impact. Moreover, all too often the absence of evidence flows simply from the limits of available scientific evaluation techniques when applied to the detection and quantification of hazards and risks. Over-reliance on absence of evidence for reassurance in decision-making is therefore clearly not a scientific approach. In fact, risk assessment is an actuarial or engineering technique which is all too easily misapplied in attempts to obtain predictive analyses within more complex and poorly defined natural systems. Extensive data-bases of information make it reasonably easy to predict the probability of, say, being killed in a road accident, or of the failure of a mechanical part. In fact, such statistics can generally be calculated directly from records of past experience.

The same is not true of damage to ecosystems where comparable detailed information simply does not exist. Furthermore, the identification of even a low risk of an accident or mechanical failure does not imply that further efforts to reduce or even eliminate the risk are not justified – quite the opposite. However, the much less empirical estimates of environmental risks are often taken as an expression of "acceptable" consequences of the pursuit or continuation of a certain activity or technology. These points have been stressed in various discussions of precaution in the published literature.

Accordingly, formulation and implementation of a precautionary approach to environmental protection demand that:

- Serious or irreversible damage to ecosystems must be avoided in advance, both by preventing harm and avoiding the potential for harm.

- High quality scientific research is employed as a key mechanism for the early detection of actual or potential impacts
- Action to protect ecosystems is *necessary* (rather than only possible) even in the presence of uncertainty, ignorance and irreducible indeterminacy
- All future technical, social and economic developments implement a progressive reduction in environmental burden as compared to contemporary baselines.

What then becomes clear from the outset is that there can be no simple analytical, instrumental or institutional 'fixes' for the complexities encountered in the management of technological risks in relation to whole ecosystems. Moreover, while policy making must be based on the best available scientific information, science on its own is not enough. As stated in a recent EC funded study:-

"There are a number of very practical and robust methods which are entirely consistent with the established procedures of risk assessment and which can be applied under a broader and more pluralistic precautionary approach, taking account of a variety of contending options and their associated benefits as well as their risks".

Hence, rather than seeing 'precaution' as being in tension with 'science-based regulation', the key elements of a precautionary approach are entirely consistent with sound scientific practice in responding to intractable problems in risk assessment such as "ignorance" and "uncertainty". This covers not only "*What we know we don't know"* but also the more troublesome "*What we don't know that we don't know"*.

The precautionary philosophy (be it in principle or approach) has been broadly accepted in a number of international fora. These include *inter alia* the London Convention, OSPAR Convention (and HELCOM), EC Treaty, The UN Agreement on High Seas Fishing, the Barcelona Convention and the Stockholm Convention on persistent organic pollutants. Precaution is increasingly a mainstream concept of environmental protection and regulation. Environmental management based on various applications of a precautionary approach is not only fully acceptable to the regulatory community, but is also the only acceptable instrumental device if widespread environmental degradation is to be effectively prevented.

In the case of **hazardous substances**, the emergent definitions of hazard (hazardous properties) coupled with a precautionary approach have led to numerous expressions of a "zero-emissions" approach. This is best exemplified by the Hazardous Substances Strategy under the OSPAR Convention, which enjoins contracting parties to adopt a target of cessation of discharges, emissions and losses of hazardous substances by the year 2020. The Stockholm Convention regulating POPs does so on the basis that ongoing production should be stopped and existing stockpiles destroyed. The new EU REACH chemical legislation as currently proposed is based upon elimination and substitution of hazardous chemicals unless they can be shown to be under adequate control, again a zero-emissions approach. More specifically and most recently, the European Commission has banned six phthalate plasticisers in certain childrens toys. Three of these were regulated on the basis of their known properties, the other three on a precautionary basis.

OSPAR also enjoins signatory nations to move towards zero-emissions for **radioactive substances**.

At the time in the mid 1980's that these types of regulatory measures were first discussed in detail, zero-discharge was regarded as a utopian ideal and precaution as an unscientific basis for regulation as compared to risk-assessment. The debate took some years to both evolve and resolve and, to some degree, remains polarised. However, it is increasingly widely accepted within the regulatory community that, for substances which present such hazardous properties that their continued presence and potential accumulation in the environment is inherently undesirable, the cessation of their manufacture, use and release to the environment is a reasonable, science-based precautionary approach.

It seems that the regulatory process evolving to deal with **genetically-modified organisms** (GMOs) remains at a relatively early stage, comparable to the early debate on toxic substances. This is probably because those engaged in the debate on the industry side are largely unfamiliar with the way that chemical regulation has evolved and continues to develop and have not been part of this debate. Nevertheless, the zero-emissions precautionary regulatory approach can also be applied to releases of GMOs (zero release). Indeed, the joint Ministerial Meeting of the OSPAR and Helsinki Commissions adopted just such a zero-emissions approach to GM marine organisms in their declaration from 2003, stressing both the “inherent threat” presented by releases of such organisms and the need to apply the precautionary principle as the justification for their commitment:-

“to ensure that the culture of genetically modified marine organisms is confined to secure, self-contained, land-based facilities in order to prevent their release to the marine environment”.

In the case of GMOs, such regulatory approaches are based to an even greater extent on a potential to cause harm rather than on knowledge of actual harm. In other words, the scientific justification for precaution is provided by the considerable uncertainties that exist about the impacts of their widespread release, coupled with the lack of scientific information to resolve these uncertainties, as opposed to defined hazardous properties. Interestingly, as the scientific research base develops and these potential impacts may be resolved into likely and actual impacts through defined pathways, so the empirical scientific basis for restricting their release may be consolidated and the initial application of a precautionary approach ever more clearly justified. In short, there is nothing inconsistent with science or the scientific process in the precautionary regulation of GMOs. It can in fact be argued that their early open release would have represented a perversion of standard scientific process.

Formulating a precautionary approach to protecting the planet from dangerous **climate change** is complicated, not least because the world is already committed to a certain level of impact as a result of greenhouse gas emissions since the industrial revolution coupled with the inertia of climate systems. A further complication is the fact that the evaluation of potential impacts is unavoidably a predictive science dependent upon the output from highly complex computer driven climate models and their inherent uncertainties. These predictions can only be supported to a limited extent by observation of trends in the "real world" given the extended timeframes over which impacts are likely to become manifest. Currently, therefore, the overall objective is to restrict the rise in global mean temperatures to less than 2C above pre-industrial levels. This is a precautionary target, taking into account that some level of committed change is already unamenable to intervention and, therefore, unavoidable. Furthermore, the use of a temperature target as opposed to an atmospheric greenhouse gas concentration target can be seen as more precautionary given the considerable current uncertainties surrounding climate sensitivity to raised atmospheric greenhouse gas concentrations.

Defining what constitutes a precautionary approach to achieve the stated precautionary target is, however, a more difficult task. While the precautionary (and, therefore, scientific basis) for chemical, radioactive substance and GMO release regulation is relatively clear cut, with an ultimate expression in “zero-emission”, a precautionary approach to the management of dangerous climate change is seen to be less clearly definable as such. This is in part due to remaining indeterminacies in human understanding of climate systems. Indeterminacies also create difficulties in defining a precautionary management regime for the **exploitation of living resources** (forests and fish). It is unrealistic to assume that forestry and fisheries will ever be universally stopped unless current management paradigms end in their total destruction. In short they will continue to be exploited and, beyond the prohibitive precautionary management regimes essential to maintenance of a sustainable network of marine reserves, there will be an ongoing need to define precautionary management regimes within which the level of exploitation is ecologically sustainable.

In applying precaution to the management of fisheries and forests, this has usually been done by applying “fudge factors” to the mathematically based models used in their management. A good example of such an approach is the RMP/RMS approach by the IWC where, essentially, fisheries models with an increased amount of “slop” are used to compensate for lack of certainty and lack of data. These modeled approaches are as vulnerable as the original, unmodified, models to unforeseen factors and are generally applied in such data-poor environments that it is often impossible to verify that assumed “precautionary” parameters are in fact any more conservative or protective than a simple default value.

An alternative approach is to define sustainability in a meaningful way and derive a precautionary framework from this which embraces the four points defining precaution raised in the text above. In this area it is important to distinguish between the justifiably maligned and largely discredited “maximum sustainable yield” (MSY) used in fisheries management and true ecological sustainability. Useful descriptors of ecological sustainability are provided by the four first order principles detailed in various publications as follows and based on the Natural Step definitions:

- Substances from the earth’s crust must not systematically increase in the ecosphere.
- Substances produced by society must not systematically increase in the ecosphere.
- The physical basis for productivity and diversity of nature must not be systematically diminished.
- Fair and efficient use of resources with respect to meeting human needs (present and future).

The first two principles largely cover chemical and radioactive emissions. GMO regulation is covered partly by the second condition and partly by the third. Climate change issues are largely addressed by the second and third principles and to an extent by the fourth. The third principle also describes most clearly the desired end point of fisheries and forest regulation, while the fourth covers the equity (including transgenerational equity) aspects of sustainability.

In applying these metrics of sustainability to the portfolio of issues above, marked differences in the time frame over which true sustainability can be achieved are likely to exist. The problem lies not so much in defining precautionary frameworks or even initially putting them in place, but rather in enforcing such frameworks and in the latency with which natural systems will respond. In other words, the creation of effective sustainable management regimes cannot be equated with the immediate return of impacted systems to baseline levels. We can only ensure that the mechanisms emplaced guarantee that sustainability will ultimately be achieved.

That said, in the case of GMOs, sustainability can be achieved simply within a time frame required to proscribe and enforce zero-release. This could conceivably not only be emplaced very quickly, but also effective within short timescales. The same is broadly true of chemical discharges, although an investment cycle of around 25 years for plant and process development would need to be accommodated, explicitly recognised within the "one generation" target approach adopted by *e.g* OSPAR. While the same is also true of radioactive discharges, arguably true sustainability can never achieved by the nuclear industry given the extreme longevity of the activity of wastes generated and the associated duty of care and responsibility. Sustainable practice in the energy sector could also be achieved very rapidly given sufficient political will, although returning to baseline conditions may be a problem of millennial timescales and will remain highly dependent upon the scope and scale of actions taken in the short term. Similarly, whereas rapid emplacement of precautionary management frameworks for fisheries and forests could be implemented more or less immediately, the question of when, if ever, pre-exploitation conditions would be achieved cannot be readily answered. Nonetheless, in each case, applying a sustainable management regime arrests the ongoing decline.

Considering sustainability principles together with the elements of a precautionary approach, as applied to the exploitation of living resources, a fundamental conundrum needs to be resolved. How is it possible to assure that fisheries and forests are exploited sustainably (within a precautionary framework), when the data available to gauge sustainability are either non-existent or very scarce and when it is inconceivable that exploitation will cease on a global basis? In short, there are no useful metrics which can be used to assess whether these activities are sustainable since the whole ecosystems within which these activities take place are so poorly characterised and understood. The most obvious way of resolving this problem would be to impose a blanket ban on all these activities until scientific knowledge was able to define and support a sustainable degree of intervention. For obvious reasons , as stated above, this is not likely to be an option and the accusations leveled at environmental organisations are likely to go some way beyond assertions of how unscientific the approach is!

Hence, a compromise is required which, paradoxically, is both prohibitive of unsustainable practice and yet permissive of some useful level of natural resource exploitation in terrestrial and marine environments. This apparent paradox can be resolved through the designation of reserves as a means of preserving biodiversity and providing biological refugia. This is, in fact, the way in which these issue areas appear to be developing within certain regulatory and certification fora. Environmental NGO objectives of a network of forest reserves backed by FSC certification is a way of preserving entire ecosystems or, at least, sufficient portions of ecosystems so as to preserve ecological sustainability, while regulating the market entry of timber products. Similarly, an objective to establish a network of marine reserves moves in a similar direction, although the effectiveness of the MSC as a market regulator needs to considerably strengthened.

Precautionary approaches to marine and terrestrial ecosystem management and exploitation, therefore, hinge on the proportion of the ecosystem which must be placed off-limits. This seems to be the current debating ground. Intuitively, it seems appropriate that the proportion placed off limits will depend upon three inter-related considerations:-

- **Degree of understanding –** The less well a system is understood, then the greater proportion that requires to be set aside to assure that ecosystem integrity is maintained.
- **Intensity of exploitation –** The more intensively a given ecosystem is exploited, then the greater the proportion that needs to be placed off-limits.
- **Extent of degradation –** The more degraded an ecosystem, then the greater proportion required to be placed off-limits to allow for restoration and regeneration.

What remains to be defined is a scientific basis for deciding on the area which needs to be covered by reserves. Furthermore, sustainability of a reserve or network of reserves depends not merely on overall size but also on the size of individual components and their connectivity. In simple terms, preservation of a large number of small isolated ecosystem fragments is unlikely to comprise an effective protection strategy as the sub-populations of some species in each fragment may simply be too small to be sustainable, while ranges and spatial interconnections vital to proper ecosystem function may be lost. Nonetheless, in general terms a precautionary approach for the exploitation of natural systems based upon marine or terrestrial reserves can be seen as fully consistent with the concepts both of precaution and of sustainability.

The Precautionary Principle can thus be applied as a variety of precautionary approaches tailored for each issue area. Far from being unscientific or stifling progress, such approaches move towards the very highest, scientifically-underpinned standards of environmental protection. The aim (and, if properly applied, the outcome) of precaution is not to prevent resource exploitation or technological progress by universal reference to an abstract concept but rather to ensure that all human activities and developments take account of the limits to scientific analysis as well as its achievements. Ultimately, the extent to which precaution is exercised in practice is likely to prove the critical difference between human progression and human regression.