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The Precautionary Principle and the Concept of Precaution

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ABSTRACT

The precautionary principle is frequently invoked in environmental law and policy, and the debate around the principle indicates that there is little agreement on what 'taking precautions' means. The purpose of the present paper is to provide an improved conceptual foundation for this debate in the form of an explication of the concept of precaution. Distinctions between precaution and two related concepts, prevention and pessimism, are briefly discussed. The concept of precaution is analysed in terms of precautionary actions. It is argued that precautionary actions are implicitly assumed to be precautionary *with respect to* something, and that this assumption should be made explicit. A definition of a precautionary action involving three necessary and jointly sufficient conditions (intentionality, uncertainty and reasonableness) is proposed, and the implications of this analysis for the debate on the precautionary principle are discussed.

KEYWORDS

Precautionary principle, precaution, uncertainty

INTRODUCTION

Let's take precautions! Ban the use of brominated flame retardants, don't grow genetically modified crops, make sure that there is a life-vest under your seat.

As these sentences show, precaution is a normatively relevant concept. Getting clear about normatively relevant concepts is an activity which may be interesting in its own right. However, there are also more direct ways in which such an analysis might be relevant for practical decision-making. The reason is

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that the so-called precautionary principle is frequently invoked in environmental law and policy, often in connection with issues of potentially global concern.

In essence, the precautionary principle says that on some occasions, measures against a possible hazard should be taken even if the available evidence does not suffice to treat the existence of that hazard as a scientific fact. For instance, a proponent of the precautionary principle might argue that we do not know whether GM crops are environmentally safe, and for that reason we should prohibit them. Now, of course such a claim can be disputed, on different grounds. First, one may question the truth of the claim that we do not know that GM foods are safe. Secondly, the reasonableness of the 'should' can be questioned – it is not at all obvious that lack of knowledge about GM crops is a reason for prohibiting them. A normative discussion of the precautionary principle should, arguably, concern problems of the second kind.

However, as that debate shows, there are several definitions of the precautionary principle, some of them strikingly vague (Sandin 1999) and there seems to be little agreement on what 'taking precautions' means or should mean. One author goes as far as claiming that '[p]recaution might join [the] class of essentially contested concepts'. (Breyman 1999).

An analysis of the everyday concept of precaution may be a useful way of clearing the path for this doubtlessly important discussion. The reason why an analysis of this everyday concept may be relevant here is that the precautionary principle is commonly thought (rightly, I believe) to be very intimately linked to the everyday concept of precaution or closely related concepts. This is illustrated by the fact that proverbs like 'better safe than sorry'¹ or 'an ounce of prevention is worth a pound of cure'² are used to explain what the precautionary principle contains. Even the Hippocratic Oath has been mentioned as a parallel to the precautionary principle (Ozonoff 1999: 100). Furthermore, several authors make explicit reference to the everyday concept of precaution. For instance, Philippe H. Martin writes:

The precautionary principle is an age-old concept. Unambiguous reference to precaution as a management guideline is found in the millennial oral tradition of Indigenous People of Eurasia, Africa, the Americas, Oceania and Australia. (Martin 1997: 276)

Martin also refers to some passages in early Buddhist writings that 'could accommodate such a concept' (ibid.).

The present essay is an attempt at an analysis of the everyday concept of precaution. I will try to answer the question what 'taking precautions' means. More precisely, I will offer an explication of the everyday concept of a precautionary action. I begin by a discussion of precaution and some related concepts. Then I propose a definition of a precautionary action in terms of three necessary and jointly sufficient conditions. Finally, I give a more detailed account of the

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precautionary principle and discuss the implications of the proposed analysis for the debate about the precautionary principle.

PRECAUTION AND PREVENTION

Superficially, 'precaution' and 'prevention' might seem almost synonymous. For instance, in *The Oxford English Dictionary*, these two terms are treated as near synonyms. However, a closer analysis reveals that the relationship between the two concepts is slightly more complicated than it appears.

Perhaps most interesting is the fact that talking of precaution implies talk of actions. (By an action I here simply mean anything an agent does intentionally.)³ Taking precautions is something agents do. This is not necessarily the case with prevention. We can say 'the small bush prevented me from falling off the cliff' as well as 'George prevented the window from being broken'. It seems that only some cases of prevention are actions whereas all cases of precaution are, if not actions, at least reducible to actions. Let us therefore limit the discussion to (individual) actions.

One intuitively reasonable way of interpreting prevention is the following: 'Prevention is a matter of causing the nonoccurrence of an event. To prevent the window from being broken is to cause the nonoccurrence of a window breaking.' (Collins 2000). This is not the place to inquire more deeply into the nature of causality or causal relata. Thus, for simplicity, I will substitute 'bring about', for 'cause' and tentatively define prevention as the bringing about of the non-occurrence of x , where x may be an event (the window breaking) or a fact (such as the window being broken). I will sometimes use the term 'outcome' to refer to an x of this kind.

According to the definition above, an action a is a case of prevention of x if the action brings about the non-occurrence of x . Note that the fact that an action a is a case of prevention of x does not imply that the agent necessarily intends to bring about the non-occurrence of x . For instance, suppose that by drinking a large glass of Fernet Branca I bring about the non-occurrence of a stomach infection that would otherwise have befallen me. I have obviously prevented the infection, but my reason for drinking the liquor might merely have been my taste for Fernet Branca. I will return to this.

PRECAUTION AND PESSIMISM

In most everyday situations, precaution goes together with pessimism. Pessimists acting on their beliefs would typically take precautions. However, pessimism and optimism are predicated about our beliefs, or derivatively of persons with inclinations towards certain beliefs, while precaution is about what we do. I am

a pessimist if, in relation to a certain norm, I tend to assign (i) low values to future states, or (ii) high probabilities to states to which I assign low values, or (iii) low probabilities to states to which I assign high values. That also optimists may take precautions can be seen from the following example: Consider two persons, Harry and Sally, who both use their private aeroplanes as means of transportation. They hold identical highly optimistic beliefs about the probability (extremely low) and consequences (not very severe) of crashing their respective planes. However, while Harry happily and parachutelessly flies on, Sally acquires a parachute. In this example, both Harry and Sally are equally optimistic, but Sally also takes precautions. We can also easily imagine pessimists who do not take precautions: someone past caring would for instance fall into this category.

THREE CRITERIA FOR PRECAUTION

Let us now turn to the question what makes it true to say that an action is precautionary. I believe that there are three necessary and jointly sufficient criteria, which I will treat in turn.

The criterion of intentionality

Consider a person bringing a fire extinguisher to a fancy dress party as a part of his dress. A fire breaks out, which fortunately is put out with the aid of the fire extinguisher. We would not call the action of bringing the fire extinguisher a precautionary action. The reason is that the intention of preventing fires is absent. An action which is performed without the intention of avoiding something undesirable cannot be said to be a precautionary action. Thus let us state the first necessary criterion for precaution:

- An action is precautionary only if it is performed with the intention of preventing something undesirable.

This formulation is not quite satisfactory. Obviously, there are several undesirable things, and an action performed with the intention of preventing one undesirable thing might well fail to prevent other undesirable things. The action might even promote these other undesirable things. For instance, taking precautions against head injuries through wearing a helmet while driving my motorcycle might result in my being scorned by my daredevil outlaw friends.

This problem should not lead us to believe that there are no precautionary actions or that precaution is normatively unreasonable. But it shows that our definition has to take the problem into account. The key, I believe, lies in the phrase 'with respect to'. When we speak of precautionary actions, we assume that there is something undesirable *with respect to which* we take precautions.

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Of course, this does not rule out that there are other things with respect to which we are not taking precautions.

Failure to recognise the with-respect-to assumption leads to confusion. Thus, when defining precaution, this implicit assumption should be made explicit. Let us therefore refine, not the first necessary criterion of the definiens, but the definiendum itself:

- An action *a* is precautionary with respect to something undesirable *x* only if (1) *a* is performed with the intention of preventing *x*.

Here, following the line discussed above, we allow *x* to be a possible event or fact. We may call (1) the *criterion of intentionality*. It seems to follow from (1) that the agent believes first, that *x* might occur (or prevail), and second that *a* will in fact at least contribute to the prevention of *x*. The phrase ‘might occur’ is deliberately vague, but it should be understood as something stronger than mere logical possibility. Of course, this does not rule out that a failed attempt may also be precautionary. Imagine that you purchase a fire extinguisher for your home, with the intention of using it for putting out fires, should the need arise. You buy a reliable model, maintain it perfectly, perform all necessary checks, and so on. Still, the fire extinguisher fails at the critical moment, and your house burns down. In this case, you must be said to have taken precautions, despite the disastrous outcome.

However, it can be questioned whether the intention of preventing something undesirable is really a necessary condition for an action’s being precautionary. Consider the following case: A janitor is required by her employer to carry a fire extinguisher with her all the time while on duty. So she does, but not because she intends to avoid fires, but merely out of concern for her job, which she will lose if she does not follow her employer’s instructions. The employer’s intention is, of course, to take precautions against fires. Does not the janitor perform a precautionary action when bringing the fire extinguisher? I am inclined to say no. She does not perform a precautionary action, at least not with respect to fires. (It might of course be said that she takes precautions against losing her job, but that is not the issue here.) In this case it is not the action of actually carrying the fire extinguisher that is precautionary with respect to fires, but the action consisting in prescribing that the fire extinguisher should be carried. Perhaps the point may be made even clearer if we suppose that the janitor does not know her boss’s intention. Suppose, for instance, that the janitor works in a potentially radioactive environment. She is required to carry a device, the purpose of which she does not know. The device does in fact contain a Geiger-Müller-counter. It also contains a small recording device. In the unlikely event that the radioactivity rises to an acutely dangerous level, a recording will be heard that warns the surprised janitor that she has to move out of the area. In order not to worry the janitor, her boss had decided not to tell her about the nature of this

device. Is the janitor's action to carry the device a precautionary action? Here, the answer seems more obviously no.

The uncertainty criterion

Let us now turn to the second necessary condition for precaution. When do we consider taking precautions? Typically in situations when we are not certain that the undesirable thing will in fact befall us: 'I'm not sure, but there might be a sabre-toothed tiger in that cave, thus I should avoid entering there, or at least I should bring my stone axe.' Or 'since we don't know whether this chemical is toxic or not, let's use rubber gloves as a precautionary measure'. We might in fact believe that the bad thing happening is highly improbable, but nevertheless take precautions. (One example might be irradiating vast quantities of mail as a precautionary measure against anthrax letters.) On the other hand, if the bad thing is certain or highly probable, it would be odd to call measures intended to prevent it precautionary. The wearing of a parachute by an aerobatics pilot might be a precautionary measure. She hopes and believes that it probably won't be needed. But if I intend to jump out of an aeroplane from 13,000 feet, wearing a parachute is not a precautionary measure. In this case things are fairly certain to go very badly if I do not wear a parachute. We may thus add the second necessary criterion for precaution:

- An action *a* is precautionary with respect to something undesirable *x* only if the agent is not certain that *x* will occur if *a* is not performed.

The second criterion we call the *uncertainty criterion*.

There are of course several ways in which an agent can be 'not certain' that something will occur. Here, the term covers the decision theorist's terms 'risk' as well as 'uncertainty' and 'ignorance'. What we want to rule out are the cases in which the occurrence of something bad is certain or highly probable, such as my death when I jump out of a plane without a parachute. Let us refine the uncertainty criterion into:

- An action *a* is precautionary with respect to something undesirable *x*, only if (2) the agent does not believe it to be certain or highly probable that *x* will occur if *a* is not performed.

In accordance with what was said above, this formulation includes both cases where *x* is an undesirable event and where *x* is something else, such as the consequences of an event. Thus, an action can be precautionary in this sense even in case we have an event which is in fact highly probable, but whose negative consequences are not as probable. Likewise, an action can be precautionary if it aims at the prevention of probable consequences of an unlikely event. (Actions aiming at the prevention of probable consequences of probable events are of course not precautionary.)

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The reasonableness criterion

Are the criterion of intentionality and the uncertainty criterion jointly sufficient? No, as the following example shows: Consider a factory worker in an industrialised country, who is well informed about the dangers of being exposed to a hazardous chemical *X* in his work. As a precautionary measure, he performs a ritualistic dance every morning at the factory gates, believing that this will keep the evil spirits residing in the chemical *X* happy, and consequently, protect him from harm. Is his dance a precautionary action? I believe not. The reason is that his beliefs do not seem reasonable. In this case, he lacks good reasons for believing that his action will reduce the probability of harm. By ‘good reasons’ I here mean reasons that are somehow externally good, external to the agent, that is. I do not think it is necessary to stipulate that the reasons be ‘objectively good’. They may be thought of as relative to the state of modern science, a particular cultural sphere, or the like. The point is that the mere fact that an agent believes that he or she performs a precautionary action does not imply that the action is precautionary (though the converse relation holds).

We should thus add a third necessary criterion, containing three sub-criteria (a)–(c), demanding that the agent has externally good reasons for certain beliefs:

- An action *a* is precautionary with respect to something undesirable *x*, only if (3) the agent has externally good reasons (a) for believing that *x* might occur, (b) for believing that *a* will in fact at least contribute to the prevention of *x*, and (c) for not believing it to be certain or highly probable that *x* will occur if *a* is not performed.

This third criterion we term the *reasonableness criterion*.

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I believe that with the criteria of intentionality, uncertainty, and reasonableness, we have stated necessary and sufficient conditions for calling an action precautionary. I thus propose the following definition of a precautionary action:

- An action *a* is precautionary with respect to something undesirable *x*, if and only if
 - (1) *a* is performed with the intention of preventing *x*,
 - (2) the agent does not believe it to be very probable that *x* will occur if *a* is not performed, and
 - (3) the agent has externally good reasons (a) for believing that *x* might occur, (b) for believing that *a* will in fact at least contribute to the prevention of *x*, and (c) for not believing it to be certain or highly probable that *x* will occur if *a* is not performed.

Once again, this applies to actions that are precautionary *with respect to* something undesirable. That, I believe, is as far as we will get. If we are looking for actions that are precautionary *sans phrase*, we will be looking in vain.

What, then, is the relevance of the proposed explication of the concept of precaution to the discussion of the precautionary principle?⁴

It should be noted that getting clear about how the precautionary principle should be interpreted is not an easy task. Perhaps ‘there is no such thing as “the” precautionary principle’, as one author claims (Graham 2000: 383). But we may note, first, that ‘the precautionary principle’ may refer to one or other principle of national or international law. Various precautionary principles, if I may use the plural, have been included in several international legal documents. Secondly, the phrase ‘the precautionary principle’ is used more broadly, referring to some principle that can (or should) be applied by decision-makers and policy-makers in general.⁵ The reasoning to follow will apply to both types.

Despite differences, many formulations of the precautionary principle share four common elements, which I have elsewhere (Sandin 1999) termed ‘dimensions’: (1) the threat dimension, (2) the uncertainty dimension, (3) the action dimension, and (4) the command dimension. These formulations can be recast into an if-clause of the following kind, containing these four dimensions:

- *If* there is (1) a threat, which is (2) uncertain, *then* (3) some kind of action (4) is mandatory.

The phrases in the ‘slots’ (1)–(4) vary greatly, of course, but the structure is quite common among existing versions of the precautionary principle. It is reflected, for instance, in the formulation which emerged out of the Wingspread Conference in 1998:

When an activity raises threats of harm to human health or the environment, precautionary measures should be taken even if some cause-and-effect relationships are not fully established scientifically. (Wingspread Statement on The Precautionary Principle 1998)

The precautionary principle is far from uncontroversial, and several arguments have been levelled against it.⁶ There are two relatively common arguments against the precautionary principle which I believe can be illuminated by the analysis.

The argument from risk trade-off

The first argument is that the precautionary principle leads to increased risk taking. This is *the argument from risk trade-off*. Cautiousness in one respect often leads to incautiousness in another, it is claimed. This may happen in different ways. Consider the example of pesticide use in a developing country. Pesticides may be a threat to the environment. Suppose that as a precautionary measure

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they are restricted. That would in some cases lead to an increased risk of crop failure and famine. Substitution of hazardous chemicals poses similar problems. Suppose that regulators decide that as a precautionary measure, potentially neurotoxic chemicals should be replaced with ones that are less so. It is possible that some of the chemicals that replace the potentially neurotoxic ones are in fact less neurotoxic, but at the same time more carcinogenic than the original chemicals. Another possibility is that precautionary measures (for instance regulation) impose new risks through economic mechanisms. Precautionary measures might consume resources that could have been used to reduce even greater risks in other areas, and those measures might therefore in the end lead to worse effects than if they had not been carried out: 'Risk-driven regulation of one industrial sector under one treaty can be a perfect implementation of the precautionary principle, but can also consume resources that cannot be spent on equal or more serious risks in other sectors' (Nollkaemper 1996). This trade-off is hotly debated in the discussion around the precautionary principle,⁷ and it has been proposed as an objection to that principle.⁸

But, as the analysis above showed, a precautionary action can be seen as precautionary only *with respect to* something, and the idea of actions that are precautionary *sans phrase* is bound to cause confusion in discussions of the precautionary principle. I therefore propose the following maxim:

- When presenting a course of action (for instance the introduction of certain regulation) as precautionary, it should be explicitly and precisely stated with respect to what undesirable outcome (x) that course of action is meant to be precautionary.

This does not solve the problem completely, of course. But it puts the framing of the decision (or decision horizon) into focus, something which is not seldom overlooked in the debate on the precautionary principle (Sandin et al. 2002: 203).

The argument from absolutism

The second argument against the precautionary principle which might be illuminated by the analysis is *the argument from absolutism*. According to one author, '[i]n several treaties, the precautionary principle is formulated in absolutist terms. It stipulates that once a risk of a certain magnitude is *identified*, preventive measures to erase that risk are *mandatory*' (Nollkaemper 1996: 73, emphasis added). The argument from absolutism says that the precautionary principle will prohibit *every* action, and thus offer no action guidance whatsoever.

Consider the following (hypothetical) obviously absolutist version of the precautionary principle:

- If an action might lead to damage, then the action must be avoided.

Of course, every activity is associated with some risk of damage. My wearing of a bow tie at a party *might*, for instance, through a highly complex causal chain, result in the end of the World. Far-fetched, but not impossible. Thus, an absolutist interpretation of the precautionary principle would prohibit in principle every action. Since any action, in a sense, might have unforeseen catastrophic consequences the action of carrying it out will be prohibited, and so will the action of *not* carrying it out.⁹

It is obvious that the argument from absolutism bites if an action is thought of as precautionary with respect to *everything*. Another way of putting it is that the argument from absolutism is a reasonable argument against any principle that prescribes globally precautionary acts. Also in this case, we would benefit from following the maxim of explicitly and precisely stating the undesirable outcome *x* with respect to which a course of action is meant to be precautionary. If the precautionary principle is specified in this fashion, the argument from absolutism does not necessarily apply.

ARGUMENTATIVE AND PRESCRIPTIVE VERSIONS OF THE PRECAUTIONARY PRINCIPLE

As we saw above, many versions of the precautionary principle can be recast into an if-clause containing the threat dimension, the uncertainty dimension, the action dimension and the command dimension. This structure is closely related to the everyday concept of precaution as analysed in the present paper. It is about actions aiming at the prevention of something that is undesirable but not certain to occur. It is reasonable to say that the precautionary principle prescribes actions that would be interpreted as precautionary according to the analysis presented above. That is, the precautionary principle goes well with the everyday concept of precaution.

There are, however, other versions of the precautionary principle which cannot be interpreted with the aid of the four dimensional if-clause presented here. Consider, for instance, the version of the precautionary principle found in Principle 15 of the Rio Declaration (UNCED 1993).¹⁰ This version requires that 'lack of full scientific certainty shall not be used as a *reason* for postponing cost-effective measures to prevent environmental degradation' (emphasis added). Thus, it is not a principle prescribing actions, but a principle for what arguments are valid. We may call these versions of the precautionary principle *argumentative* versions, as opposed to the *prescriptive* versions we have hitherto encountered.¹¹ Argumentative versions of the precautionary principle do not seem very demanding. They say little more than that arguments from ignorance should not be used. Arguments from ignorance are generally regarded as fallacious,¹² and it would take some explanation why not admitting them would be

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precautionary, at least if precaution is to be understood in the sense presented in the above analysis.

EVALUATING PROPOSED PRECAUTIONARY MEASURES

Another way in which the analysis might be useful is for evaluation of measures that are presented as being prescribed by or at least in accordance with the precautionary principle. If it can be shown that these measures are not precautionary in the everyday sense of the term as analysed above, there might be reason to discuss their legitimacy, or at least the way in which they are justified. Conversely, if they can be shown to be precautionary in the everyday sense of the term, someone who appeals to the precautionary principle arguably has a stronger case for the proposed measures.

It can be shown that some criticisms of measures introduced with reference to the precautionary principle amounts to questioning, though not necessarily explicitly, whether these measures are precautionary in the everyday sense as analysed above. I will sketch a few examples. I must, however, emphasise ‘sketch’ here. The examples are primarily meant to be illustrative and my account of them is therefore necessarily highly simplified.

The first example concerns the question of the different approaches to the precautionary principle which is arguably found in the US and the EU.

Today it is conventional wisdom that the US is critical of the precautionary principle while the European Union endorse it. This picture is not necessarily correct, but nevertheless widespread. ‘Some observers see a civilized, careful Europe confronting a risky, reckless and violent America [...]. On the other hand, other observers see a statist, technophobic, protectionist Europe trying to rise to challenge a market-base, scientific, entrepreneurial America’ (Wiener and Rogers 2002: 319).

Take for instance the oft-discussed case of hormones in beef. The EU’s ban of growth hormones in beef production in the 1980s was regarded by the US as lacking scientific basis: they argued that use of growth hormones in beef does not present a risk to human health (ibid.: 326). The discussion of this case was focussed around the available scientific evidence and whether it justified the precautionary measure of banning the use of hormones. If we transfer this reasoning to the analysis of the everyday concept of precaution discussed above, we see that it is criterion (3) of the proposed definition, the reasonableness criterion, that is under discussion. More specifically, it is the (a) part of the reasonableness criterion – that the agent have externally good reasons for believing that *x* might occur – that is called into question in this case. Thus it can be said that the US critique, though not explicitly, questions whether the measures are precautionary in the everyday sense. Another way of criticising a proposed measure would be to deny that sub-criterion (3b) is fulfilled – that the agent have externally good

reasons for believing that *a* will in fact at least contribute to the prevention of *x*. This would simply be to question whether there are good reasons for believing in the efficacy of the proposed precautionary measure.

A third way would be to focus upon sub-criterion (3c), that the agent have externally good reasons for not believing it to be certain or highly probable that *x* will occur if *a* is not performed. This is not uncommon. One example can be found in Santillo, Johnston and Langston (2002). Discussing the problem of TBT antifoulants, they note:

It would be difficult to argue, therefore, that any of the actions to address TBT to date have been precautionary, resulting as they have from extensive documentation of ecological impacts. Actions have undoubtedly contributed towards remediating the most severe problems, *but this is not precaution.* (Santillo, Johnston and Langston, 2002: 159, italics mine).

Other criticisms are focused upon another of the three criteria, namely (1), the criterion of intentionality. An explicit example can be found in Miller and Conko (2000), who are highly critical of the precautionary principle in the context of biotechnology. They call the precautionary principle ‘a neologism coined by opponents of technology who wish to rationalize banning or over-regulating things they don’t like’ (p. 95). A few pages later, they claim that regulators acting in their own interest and that “‘erring on the side of caution” is a convenient rationale for excessive, anti-innovative regulation’ (p. 101). Here Miller and Conko are calling the intention of precautionary measures into question. Rather than being intended to prevent the undesirable thing which they are claimed to be intended to prevent (typically, environmental or health effects), the precautionary measures discussed by Miller and Conko are intended to increase regulations and, presumably, regulators’ budgets. It is of course possible that an action might be performed with several objectives. It is also possible that regulators’ actions may be precautionary with respect to their own budgets, but that need not concern us here.

To sum up: Criticisms of proposed precautionary measures are often directed against the different criteria in the analysis proposed in the present paper. In effect, these criticisms question whether such measures are really precautionary in the everyday sense. Identifying which criteria are relevant in such discussions should thus be interesting to adherents of the precautionary principle as well as its critics.

CONCLUSIONS

The precautionary principle is an important element in environmental decision-making. It has, however, been subject to interpretation problems as well as severe criticism. Some of these questions are related to a more fundamental

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question concerning the nature of the concept of precaution. If precautionary actions are analysed in terms of the necessary and jointly sufficient conditions of intentionality, uncertainty and reasonableness, and the maxim of explicitly stating the outcome with respect to which an action is meant to be precautionary, at least two common arguments against the precautionary principle become more manageable. Furthermore, it gives us increased possibilities for evaluating measures proposed with reference to the precautionary principle, and may shed some light on the recent transatlantic discussion of the precautionary principle. Whether this actually will promote environmentally sound decisions is another question.

NOTES

I have received valuable comments from, among others, Sven Ove Hansson, Martin Peterson, John Cantwell and two anonymous referees.

¹ For instance by Charnley (2000) and Greenpeace (2000).

² Bodansky (1991).

³ Of course this is, at the best, an oversimplification. Compare, for instance, Davidson (1980).

⁴ In the following, I will generalise from an individual agent to agents consisting of groups, thus for instance ascribing beliefs and intentions to such agents, for instance a legislating body. I will not dwell upon the particular difficulties of this step here. I will also use 'precautionary measures' and 'precautionary actions' interchangeably.

⁵ See Sandin (1999), Appendix II for an overview of both types.

⁶ For a presentation and discussion of some of the most common of these arguments, see Sandin et al. (2002) and references given therein.

⁷ See, for instance, Nollkaemper (1996). A general treatment of the trade-off problem can be found in Graham and Wiener (1995).

⁸ E.g. Cross (1996). The objection is discussed in Sandin et al. (2002).

⁹ This point was also raised by the National Association of Swedish Fishermen, in their comment on a suggested new Environmental Code. The fishermen's representatives held that the precautionary principle, if applied to fisheries, would mean that no fishing at all could be undertaken. Swedish Government (1997: Section 4.8.1).

¹⁰ It should be noted that the English version of the Rio Declaration does not use the term 'the precautionary principle'. Instead it mentions 'the precautionary approach'. However, versions of the Rio Declaration in some other languages use phrases equivalent to 'the precautionary principle', and Principle 15 is very often quoted in the debate on the precautionary principle (e.g. CEC 2000: 11).

¹¹ Sandin et al. (2002). Other authors also note the distinction but use a different terminology (e.g. Morris 2000 and Soule 2000).

¹² Robinson (1971). Cf., however, Wren (1984) and Walton (1992).

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