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The Norwegian Nature Index: Expert evaluations in precautionary approaches to biodiversity policy

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The Norwegian Nature Index is a comprehensive effort to 'make nature visible' in communications between policymakers and the general public. To ensure that appropriate 'early warnings' for biodiversity loss are made available as a basis for precautionary approaches to sustainability and biodiversity policy, different knowledge sources need to be applied, such as the Red List for threatened species and the Nature Index, which gives a comprehensive overview of biodiversity. The article shows how the Nature Index can be supplemented with 'early warnings' of biodiversity from involved scientific experts, who were asked to assess the situation in 2020 for the indicators, in view of all available knowledge. They also assessed the uncertainty in their forecasts and their considerations of the need for and difficulty of implementing management measures to maintain biodiversity at the current level. Particularly for the major ecosystems considered to have a poor state, namely forests and open lowlands, experts indicated that urgent action was needed to improve the state of many indicators and that such management action would be possible. The findings indicate potential for eliciting experts' formal and informal knowledge in assessing the need and potential approaches to biodiversity policy.

Keywords: *biodiversity, expert evaluation, nature index, precaution*

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Introduction

The urgency of the biodiversity crisis and the cost of policy inaction are increasingly recognized by (Braat et al. 2008). The irreversibility of biodiversity loss and fundamental uncertainties of ecosystem functioning call for precautionary approaches. In Norway, the ambitious Nature Diversity Act of 2009 explicitly takes into account a precautionary principle: If there is a risk of serious or irreversible damage to nature diversity, lack of knowledge should not be used as a reason for postponing or not introducing management measures (Ot.prp. nr. 52 (2008–2009), 93, 463).

This article aims to improve the knowledge base for the application of precautionary approaches in biodiversity policy in terms of the recently developed Norwegian Nature Index (Nybø 2010; Certain et al. 2011, Nybø et al. 2012; Skarpaas et al. 2012). The Norwegian Nature Index is a framework for integrated biodiversity measurement, with a similar conceptual basis to the Natural Capital Index, the GLOBIO Index, and the Biological Intactness Index (ten Brink et al. 2002; Scholes & Biggs 2005; Alkemade et al. 2009). The aim of the Nature Index, initiated by the Norwegian Government, is to measure progress towards the aim of stopping the loss of biodiversity as stated in international agreements, communicate the quantity and quality of Norwegian nature in a transparent way, give early warnings of changes in nature, and increase the understanding of the importance of mapping and monitoring biodiversity (Nybø 2010).

The Nature Index is a comprehensive scientific effort, through which a large number of the most experienced biological and ecological researchers in Norway, from several research institutions and the Directorate for Nature Management, have cooperated on selecting biodiversity indicators, choosing reference states, and interpreting and discussing the results. The researchers have also agreed on a common approach to make expert evaluations and report uncertainties. The Nature Index project has demonstrated the potential for a large number of scientific experts and research institutions to cooperate on the common goal of providing an overview of how the biodiversity of major ecosystems has changed over the last 20 years, since the early 1990s.

By discussing early warnings in the context of the Nature Index, we attempt to show in this article the potential of extending the use of this new tool for biodiversity management. In practice, precautionary approaches need to build on all available information sources, in particular the Red List, which is intended to give indications of biodiversity loss by assessing the risk of extinction. However, the comprehensive overview given by the Nature Index gives an opportunity to consider more informal forecasts about biodiversity's future development in the context of the total body of knowledge held by leading experts.

The method and results of the Nature Index are discussed in detail in two companion articles (Nybø et al. 2012; Skarpaas et al. 2012). Here, we only briefly summarize some of the main points needed for the discussion of this article. The Nature Index summarizes the state of biodiversity in nine major ecosystems (biomes), comprising terrestrial and marine ecosystems: ocean bottom, ocean pelagic, coast bottom, coast pelagic, open lowland (which represents the cultural landscape of extensively used agricultural areas), mires and wetlands, freshwater, forest, and mountain. For each major ecosystem, a set of indicators has been selected

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according to the following criteria (Nybø 2008a; 2008b; Nybø et al. 2008; Certain & Skarpaas 2010):

1. Taxonomically representative
2. Represents common and rare species, including Red List species
3. Includes keystone species representing significant ecological processes and functions
4. Complementarity with regard to human impact factors, i.e. indicators should be responsive to different impact factors and together cover all of the most important impacts.
5. Represent different nature types within the major ecosystem, i.e. mainly habitat specialists rather than ecological generalists (and not introduced species), although some species are present in more than one major ecosystem.
6. Geographically representative, i.e. represent the different regions of Norway (but not including long-range migratory birds largely impacted by conditions abroad).

The set of indicators should cover as homogeneously as possible all aspects of biodiversity, and any addition of a new indicator should result in the addition of information. Species that are present in more than one major ecosystem are allocated between ecosystems according to their ecological specificity to that ecosystem. For example, Atlantic cod (*Gadus morhua)* is allocated with 40% in ocean pelagic and 60% in ocean bottom.

Responsiveness to human impact factors, a useful criterion for environmental management, is thus one among several criteria for selection of indicators. Many species are sensitive to several impacts factors. It is important to ensure sufficient representation of habitat specialists, as often they will respond more strongly to human impact factors than ecological generalists. The most typical 'indicator species' are selected for each type of impact. The indicator set should reflect a balance between indicators meeting the different criteria. For threatened species and other species evaluated in the context of the Red List, the same impact factors are used in the Nature Index as in the Red List. For other indicators, impact factors are assessed by expert judgements. The impact factor categories are pollution, climate change, land use change, harvesting, and alien species.

The Nature Index represents the state of more than 300 biodiversity indicators, assessed by 125 experts. Indicators are mostly species, supplemented by some indirect indicators representing a large number of species, such as dead wood. All indicators are scaled according to the reference state, which means that all indicator values range from 0 to 1, where 0 reflects a seriously degraded state, and 1 shows that the indicator is at the reference state (Skarpaas et al. 2012), which is supposed to represent an intact ecosystem, as discussed in the companion articles (Nybø et al. 2012; Skarpaas et al. 2012). For open lowland – the cultural landscape of extensively used agricultural areas of grassland and coastal heathland – the reference state is conditional upon maintaining traditional agricultural practices. The semi-natural meadows, pastures, and coastal heathlands have a high and/or characteristic biodiversity of species, nature types, and ecosystems, and the reference state represents the state when the biodiversity of those areas is still maintained by traditional agricultural practices. The experts involved in the Nature Index project recorded on an Internet database data for each of the years 1950 (if available), 1990, 2000, and 2010, for each municipality, for their indicator(s) (or in the case of major seas, the ocean indicators), and the reference states.

The Nature Index represents a novel approach to synthesizing and communicating information on the state of biodiversity in Norway, thus improving the knowledge base for sustainable development indicators. However, to address early warning signs of imminent threat to biodiversity, it was necessary to supplement the Nature Index approach by asking the experts additional questions about the indicators. Hence, a qualitative survey was carried out at the same time as the experts were recording data for the Nature Index, where the same experts were asked to give a forecast of the state of their respective indicators in 2020, relative to the state in 2010. They were also asked to assess the uncertainty of the forecast and consider the need for and difficulty of implementing management measures to maintain biodiversity at the current level. In particular, for many of the indicators of the major ecosystems considered to have a poor state, such as forests and open lowlands, the experts indicated that urgent action was needed to improve the state of many indicators and that such action would be possible. For these two major ecosystems, many of the indicators are strongly impacted by land use change and harvesting practices, which may explain why experts see that changes in management action are possible. Further, in the other major ecosystems, many indicators were assessed as in need of urgent action; however, the scope for management action may be considerably less when the impact is due, for example, to climate change. The fairly strong emphasis on the urgency of action for many indicators of forest and open lowland suggests a potential for eliciting experts' formal and informal knowledge in assessing the need and potential for precautionary management and policy action.

In this article, we report and discuss the findings of the qualitative survey of the experts' assessments of the future state of their indicators in terms of their value as early warning signs of negative changes in biodiversity and thus their relevance to precautionary approaches in biodiversity policy. The purpose of the survey was to identify the warning signs of biodiversity loss that are perceived as the most threatening and thus require more attention from policymakers and the implementation of new environmental management measures.

Precautionary approaches to biodiversity policy

The core of the precautionary approach is that scientifically plausible warnings of imminent or potentially irreversible environmental harm should lead to immediate political action, even if there is lack of full scientific certainty about cause-effect relationships or of future trends.

Applying precautionary approaches requires forward-looking and policy-relevant indicators for 'early warnings'.

Several formulations of the precautionary principle have been suggested, with a distinction between weak and strong versions. Weak versions of the precautionary principle are often grounded in utilitarian ethics, and its application involves risk or cost-benefit analysis. An example is the Rio Declaration, Principle 15:

> In order to protect the environment, the precautionary approach should 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. (United Nations 1992)

Strong versions of the precautionary principle are often founded on intrinsic values of nature and duty-based concerns for non-human beings. The Bergen Declaration is an example of a strong version of the precautionary principle:

> 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 scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation. (Cameron & Abouchar 1991)

A version of the precautionary principle, emphasizing the obligation to act, is suggested by UNESCO (2005): 'When human activities may lead to morally unacceptable harm that is scientifically plausible but uncertain, actions shall be taken to avoid or diminish that harm.' Weak and strong versions of the precautionary principle generally differ in their demand for scientific evidence about uncertainty or lack of knowledge, in the ethical significance of uncertainty and irreversibility, and in the obligation to take immediate policy action (Myhr 2010). The precautionary principle as expressed in the Norwegian Nature Diversity Act is framed in terms of 'lack of knowledge' and calls for action: 'If there is a risk of serious or irreversible damage to biological, geological or landscape diversity, lack of knowledge shall not be used as a reason for postponing or not introducing management measures' (Ot.prp. nr. 52 (2008–2009), 463) (Textbox 1).

Textbox 1. The precautionary principle in biodiversity policy in Norway

Since the government report in 2001 on biodiversity policy, cross-sectoral responsibilities and coordination (St.meld. nr. 42 (2000–2001)), Norway has had the precautionary principle as one of its most important management principles in avoiding threats against and loss of biodiversity. In the new Nature Diversity Act from 2009 this is explained in a separate paragraph, § 9:

'When a decision is made in the absence of adequate information on the impacts it may have on the natural environment, the aim shall be to avoid possible significant damage to biological, geological or landscape diversity. If there is a risk of serious or irreversible damage to biological, geological or landscape diversity, lack of knowledge shall not be used as a reason for postponing or not introducing management measures' (Ot.prp. nr. 52 (2008–2009), 463).

In the legal proposition it is underlined that applying the precautionary principle involves a duty to act. Applied to biodiversity this implies a demand for a sufficient basis for decision-making based on well-founded scientific criteria or solidly based experience for assessment of critical values and trends.

The framework suggested by the European Environment Agency's report *Late Lessons from Early Warnings* is a set of precautionary strategies that can be used by policymakers, environmental managers, the scientific community, and the general public, as reminders of emerging uncertainties, gaps in knowledge, and conflicting interests (EEA 2001). It may be fruitful to envision an extended science-policy communication whereby scientists provide their advice about early warnings and contribute to increase political attention to biodiversity policy, and develop the knowledge base for implementing precautionary approaches (Funtowicz & Strand 2007, Aslaksen et al. 2012). For policy applications of the precautionary principle, the question raised concerns what type of knowledge can provide the 'early warnings' required to inform the need for precautionary action. Indicators based only on past trends may not detect emerging uncertainties.

In Norway, sustainable development indicators are presented annually by the Ministry of Finance in the national budget, and the Nature Index is now included as an official biodiversity indicator. Although the Nature Index may show a favourable development or no change in selected indicators for biodiversity, there may still be serious warning signs that are not captured. Other sources of ecological information may not reach the attention of policymakers. Applying the Nature Index in a precautionary approach requires knowledge about the risk of large negative changes and the uncertainty of the assessments. However, the uncertainty pertaining to the aggregated index and the individual indicators is often so large that it may not be sufficient to use a projection based on past trends in order to assess whether the warning signs are of a precautionary character. Therefore, it is crucial to supplement the aggregated information of the Nature Index with other information, such as expert evaluations of the future state of biodiversity, in order to be able to adjust environmental management in time, before it is very difficult or impossible to avoid biodiversity loss.

By addressing the comprehensive scientific knowledge and extensive background experience of the experts involved in developing the Nature Index, we have sought to uncover their overall knowledge in order to capture early warning signs. The experts' forecasts for the future state of biodiversity, reflected in the different indicators forming the Nature Index, can be combined with their views on the uncertainty relating to the assessments and how serious the different outcomes could be. Ixn line with the precautionary approach, this is followed up by questions concerning the assessment of possible management actions that can counteract a potentially serious development.

The forecasts for 2020 are not the only relevant 'early warning' indicators in this context. For many of the indicators, long-term data series exist, as well as other information that can point to declines in species abundances over time. Hence, it may be appropriate to apply the trends from 1990 to 2010, or the indicator values for 1990, as recorded in the Nature Index, as important 'early warnings', as this data point represents existing quality data and moreover, low values in 1990 indicate that scientists were well aware of signs of biodiversity loss at that time.

However, the combined approach of considering available historic data and previous early warnings as well as adopting a forward-looking view and searching for new early warnings may be the most fruitful. To the extent that there is consistency between the development since 1990 and the forecast for 2020, an issue we explore in the comparison of the 2020 forecasts and time series for indicators for each major ecosystem, the early warning sign is indeed strengthened. The question of whether negative trends can be turned and the 2010 situation re-established, further challenges the experts to reflect on the development of the indicators over time in a consistent way.

One critique of our approach may be that it is not sufficient to seek to return to the state in 2010 for indicators where a negative trend is expected towards 2020, and that a more ambitious suggestion for environmental policy would be to increase the state as much as realistically possible towards the reference state of 1 representing an intact ecosystem. However, in the context of environmental policy, it may not be realistic to aim for the reference value, and it is crucial to distinguish between reference state and management target. The deviation between the reference value and the management target can be interpreted as a measurement of the trade-off accepted by society between the indicator value in intact ecosystems and other uses of nature as required by society at large. For example, a protected forest area may have a management target for biodiversity close to the reference state, whereas an area with active forestry could have a substantially lower management target. It may not always be a policy target to return to the reference state 1. For freshwater ecosystems, the distinction between the reference state and the management targets is in accordance with the interpretation of objectives for the ecological status of water bodies within the European Water Framework Directive (EC 2000).

Experts' forecasts for the state of biodiversity indicators in 2020

By asking about forecasts for the state of biodiversity indicators in 2020, we have been able to draw upon the comprehensive scientific knowledge and experience of the experts, challenging them to extrapolate the data they recorded for the Nature Index.

Survey questions and level of response

The aim of the survey was to ask the experts recording data for the Nature Index to express their views about a future situation, in order to capture early warning signs in a manner that could provide a basis for management and policy action. Each expert expressed forecasts only about the indicators that they themselves had assessed in the Nature Index. Prior to the formulation of the survey questions, comprehensive discussions took place with the researchers responsible for evaluating the major ecosystems freshwater, forest, and open lowland, and with the social science researchers who had designed the survey. It was agreed that the questions should be specific but as simple as possible. The questions were tested on a sample of researchers in the Norwegian Institute for Nature Research (NINA) and experts in the Directorate for Nature Management.

While developing the Nature Index, data for the indicator values in 1990, 2000, and 2010 were recorded by the experts on an Internet database, and it was therefore natural to query the expected situation in 2020. It was specified that the situation in 2020 should be assessed based on a continuation of the present management practice. In total, five questions were posed, all demanding qualitative answers (Textbox 2). A scale of response alternatives ranging from '1' to '5' was primarily used, as well as 'Do not know'. Question 3 required a yes or no response.

Textbox 2. Survey of biodiversity 'forecasts' for 2020

1. *How do you assess the indicator value in 2020 compared to 2010, given today's management?*
Much lower, lower, unchanged, higher, much higher

2. *How certain is the above statement?*
Very uncertain, uncertain, medium certain, certain, very certain

3. *If the answer to Question 1 is 'Lower' or 'Much lower', do you think it is possible to re-establish the 2010 situation through management actions?*
Yes, no, do not know

4. *If the answer to Question 3 is 'Yes', how urgent is it to implement management actions?*
Not very urgent, hardly urgent, medium urgent, urgent, very urgent

5. *If the answer to Question 3 is 'Yes', how difficult is it to implement management actions?*
Very easy, easy, medium difficult, difficult, very difficult

A large share of the experts answered the questions about how they view the future development of their indicators in the period 2010–2020. The questions about the future were answered for 63% of the indicators in total (Table 1).

The response rate was lowest for the marine ecosystems and highest for mountain and forest ecosystems. The total number of indicators with a response for the state in 2020 was 246 out of a total of 393 indicators across all the major ecosystems (taking into account that some of the 308 indicators belong to more than one major ecosystem).

The situation in 2020 compared to 2010

For c.40% of the indicators for which there were answers, the experts reported either an increase or a decrease in the indicator value (the extreme values 'much higher' and 'much lower' were seldom used). In this context, 'higher' and 'lower' are interpreted as a better and worse state for the respective indicators.

The distribution of answers to the main question – whether the experts expected a higher, lower, or unchanged value in 2020 compared to 2010 – indicated large differences between the main ecosystems (Fig. 1). For most of the main ecosystems, more than 50% of the indicators were

Table 1. Share of all indicators for which the experts responded to questions about the situation in 2020 for each main ecosystem

Main ecosystem	Response (percentage)	Number of indicators
Ocean pelagic	42	17
Ocean bottom	55	17
Coast pelagic	28	10
Coast bottom	58	28
Freshwater	76	32
Open lowland	58	33
Forest	81	58
Mires and wetlands	72	29
Mountain	82	23
Total	63	247

considered likely to be unchanged in 2020, the exception being open lowland, for which 49% of the indicators were expected to be unchanged.

The assessments for ocean bottom and coast bottom suggested that a large share of the indicators would be higher in 2020, compared to the share assessed to be lower in 2020. For freshwater, a similar share of indicators was expected to be higher or lower in 2020. For ocean pelagic, mires and wetlands, forest, and mountain, a slightly larger share of the indicators was assessed to be lower rather than higher in 2020. For coast pelagic, 30% of the indicators were assessed to be lower in 2020, and none assessed to be higher. For open lowland, a total of 39% of the indicators were assessed to be lower in 2020, compared to 12% assessed to be higher.

The experts' opinions generally suggested that a larger share of the indicators for ocean bottom and coast bottom would show a better state (higher values) rather than a worse state (lower values) in 2020. For the remaining major ecosystems, the experts assessed the development as more or less negative, judged by the share of indicators with estimated lower values in 2020. Open lowland had the largest share of indicators with lower values, suggesting that the development of this ecosystem gives the greatest cause for concern.

From the classification of the different indicators, based on taxonomic groups of species and indirect indicators (referred to as indexes), we also see differences in the experts' assessments of the situation in 2020 (Fig. 2). For fungi, plants, and insects (and amphibians, i.e. great crested newt), a larger share of the indicators was assessed to have lower values in 2020. For the remaining animal groups and indirect indicators, a larger share of the indicators was assessed to have higher values in 2020. This may imply that the experts were more concerned about the development of fungi, plants, insects, and amphibians than for indirect indicators (indexes), other invertebrates, fish, birds, and mammals.

The development 2010–2020 compared to previous trends

The experts assessed which indicators they expected to have higher or lower values in 2020 compared to 2010. Their assessments may be related to the trends in the indicator values for 1990–2010, since the same experts provided data for this previous period. Below, we have examined these trends for each ecosystem for the indicators judged to have higher or lower value in 2020. An overview of indicators is given in Appendix 1.

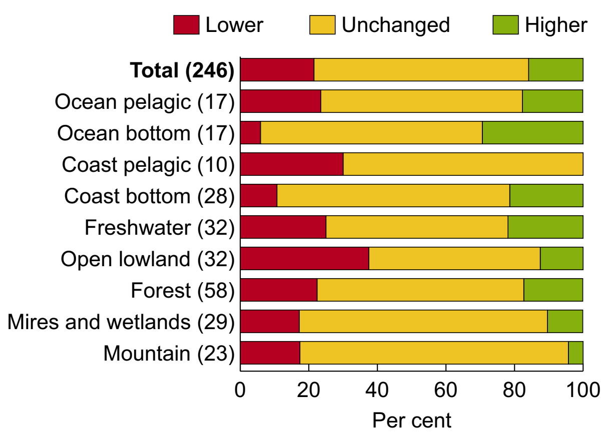

Fig. 1. The share of indicators for each main ecosystem, and in total, for which experts estimate will have lower, unchanged and higher values in 2020, compared to 2010

The numbers in parentheses indicate the number of indicators that are assessed (summed for each main ecosystem); indicators that have an expected higher (or lower) value in 2020 for at least 20% of the assessed geographical areas are classified as higher (or lower); the remaining are classified as unchanged (higher or lower includes much higher and much lower, respectively); each indicator is weighted equally, regardless of the number of geographical areas included

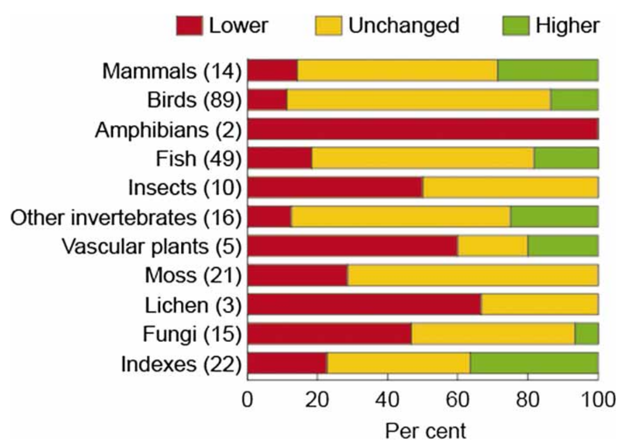

Fig. 2. The share of indicator types that experts expect will have lower, unchanged, and higher values in 2020 compared to 2010

An index is a composite indicator of species communities or measures of environmental conditions; the numbers in parentheses are the number of indicators assessed (added for each group of indicators); the indicators given a higher (or lower) value in 2020 for at least 20% of the assessed geographical areas are classified as higher (or lower); the remaining are classified as unchanged (higher and lower includes much higher and much lower, respectively); each indicator is weighted equally, regardless of the number of geographical areas included; some indicators represent more than one nature type and are included more than once

Ocean pelagic: Among the 17 indicators for ocean pelagic, three were judged to have higher values in 2020 (Greenland halibut (*Reinhardtius hippoglossoides*), sperm whale (*Physeter macrocephalus*), and the index for zooplankton), whereas four were believed to have lower values (saithe (*Pollachius virens*), Atlantic cod (*Gadus morhua*), silver smelt (*Argentina silus*), and guillemot (*Uria aalge*)). All indicators judged to be higher in 2020 compared to 2010 have also increased since 1990. The indicators expected to decrease from 2010 to 2020 show less coherence with the trends from 1990. Some have decreased (Atlantic cod, silver smelt, and guillemot), whereas the indicator for saithe has increased since 1990. The expected reduction for Atlantic cod from the period 2010–2020 cannot, however, be interpreted as a warning sign, as it has been at high levels in its natural cycle and is thus expected to decline (Fig. 3).

Ocean bottom: Of the 17 indicators for the main ecosystem Ocean bottom, five were judged to have higher values in 2020 (Greenland halibut, blue ling (*Molva dypterygia*), onion-eye grenadier (*Macrourus berglax*), angler fish (*Lophus piscatorius*), and Iceland scallop (*Clamys islandica*)). Only Atlantic cod was expected to have lower values in 2020. Three of the indicators with an expected increase from 2010 to 2020 also had an increase from 1990 to 2010, whereas the other two declined (blue ling and angler fish, although the latter had weak improvement from 2000 onwards) (Fig. 4).

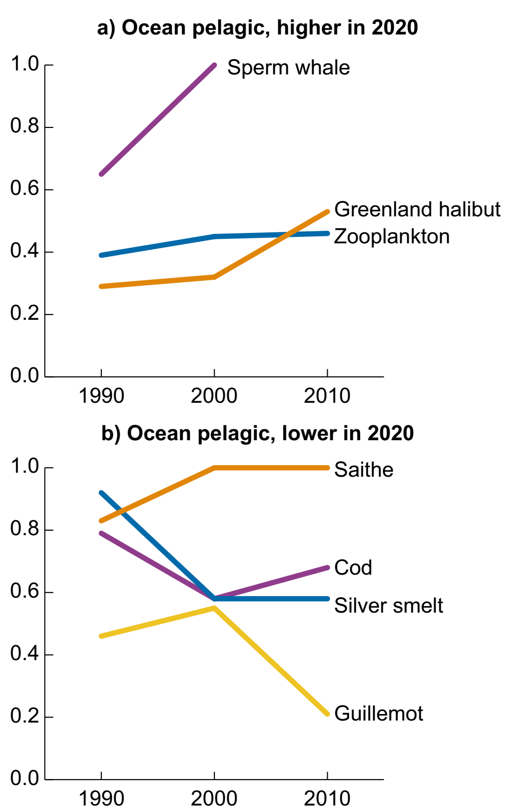

Fig. 3. The trends 1990–2010 for the indicators for ocean pelagic which experts believe will have higher or lower values in 2020 compared to 2010

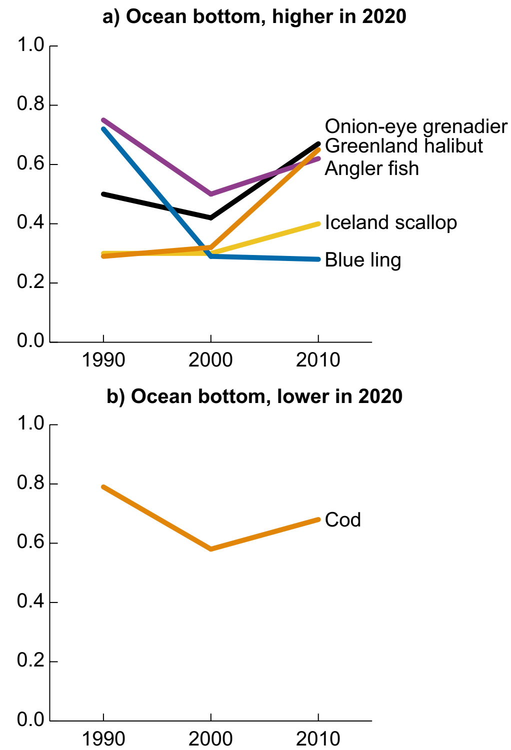

Fig. 4. The trends 1990–2010 for the indicators for ocean bottom which experts believe will have higher or lower values in 2020 compared to 2010

Coast pelagic: The situation in 2020 was assessed for 10 indicators for the main ecosystem coast pelagic. None of these were expected to have higher values in 2020 (for at least 20% of the assessed geographical areas), and three (Atlantic cod, saithe, and guillemot were estimated to have lower values in 2020. Atlantic cod and guillemot exhibited a decrease since 1990, whereas saithe increased (Fig. 5).

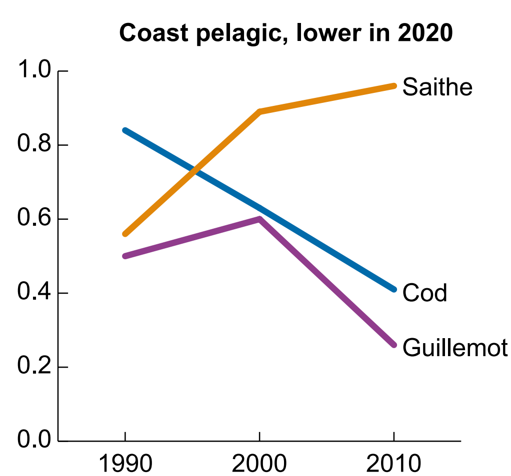

Fig. 5. The Nature Index trends 1990–2010 for the indicators for coast pelagic which experts believe will have lower values in 2020 compared to 2010
No indicator is estimated to have a higher value in 2020 for coast pelagic

Coast bottom: A considerable number of indicators (28) were assessed for coast bottom in terms of future development. Six of these (corkwing wrasse (*Symphodus melops*), goldsinny (*Ctenolabrus rupestris*), angler fish, Iceland scallop, king scallop (*Pecten maximus*), and European lobster (*Homarus gammarus*)) were judged to be higher in 2020 (for at least 20% of the geographical areas assessed), whereas three (European eel (*Anguilla anguilla*), Atlantic cod, and Atlantic ditch shrimp (*Palaemonetes varians*)) were estimated to have lower values in 2020. Most of the indicators with an expected increase from 2010 to 2020 also showed an increase from 1990. The exception is angler fish, which had a lower value in 2010 than in 1990, but an increase from an even lower level in 2000. All indicators with an expected lower level in 2020 than in 2010 have also experienced a clear decline since 1990 (Fig. 6).

Freshwater: For freshwater, the situation in 2020 was assessed for 32 indicators. Seven of these (osprey (*Pandion haliaetus*), horned grebe (*Podiceps auritus*), whooper swan (*Cygnus cygnus*), Eurasian coot (*Fulica atra*), the Atlantic salmon variant Bleke (*Salmo salar*), and indexes for zooplankton composition and eutrophication for bottom fauna were expected to have higher values in 2020. Eight indicators (common gull (*Larus canus*), black-throated loon (*Gavia arctica*), red-throated loon (*Gavia stellata*), common sandpiper (*Actitis hypoleuca*), dipper (*Cinclus cinclus*), European eel, noble crayfish (*Astacus astacus*), and index for macrofauna (bottom fauna) in rivers) were predominantly judged to have lower values in 2020.

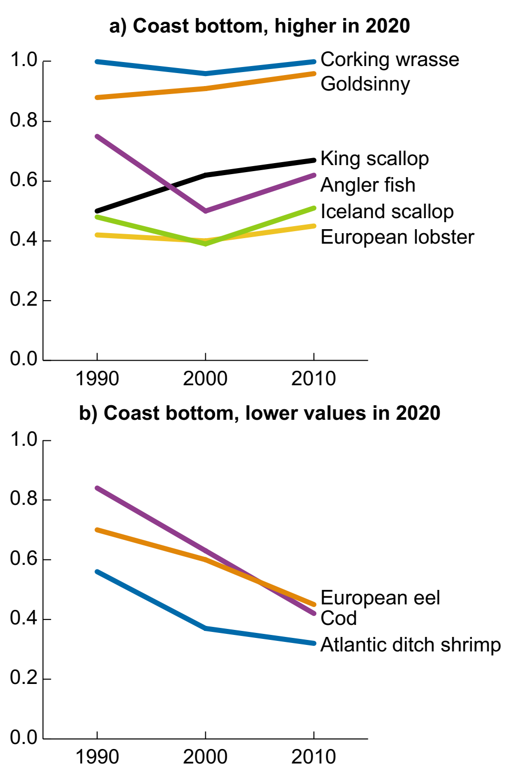

Fig. 6. The Nature Index trends 1990–2010 for the indicators for coast bottom which experts believe will have higher or lower values in 2020 compared to 2010

The majority of the indicators with higher values reported for 2020 than in 2010 indicated a rise in indicator values from 1990. The exception is horned grebe, which declined from 1990 to 2010. For the indicators with expected lower values in 2020 than in 2010, trends since 1990 were less clear: the index for macrofauna (bottom fauna) in rivers and red-throated loon (and black-throated loon) had an estimated increase in indicator values since 1990, whereas European eel, common gull, dipper, and especially common sandpiper had estimated reductions. The value for noble crayfish was unchanged from 1990 to 2010 (Fig. 7).

Forest: A total of 58 indicators were assessed in 2020 for forest. For 10 of these, the value in 2020 was expected to be higher than in 2010: 4 indicators for habitats/substrates for threatened species from the National forest Inventory (old deciduous tree successions, old trees, dead wood logs, and snags), as well as the fungus *Artomyces pyxidatus*, oak fern (*Gymnocarpium dryopteris*) in alpine birch forest, mistle thrush (*Turdus viscivorus*), moose (*Alces alces*), red deer (*Cervus elaphus*), and European roe deer (*Capreolus capreolus*). A total of 13 of the forest indicators were expected to have lower values in 2020: the fungi *Gomphus clavatus*, *Amylocystis lapponicus*, and *Sarcodon* species, the lichens *Hypogymnia physodes* and *Melanelia olivacea*, *Lobaria* species, bay willow (*Salix pentandra*), the beetles *Nothorhina punctata* and *Harminius undulatus*, goshawk (*Accipiter gentilis*), lesser spotted woodpecker (*Dendrocopos minor*), as well as great crested newt (*Triturus cristatus*) and small rodents. Goshawks are habitat specialists that often

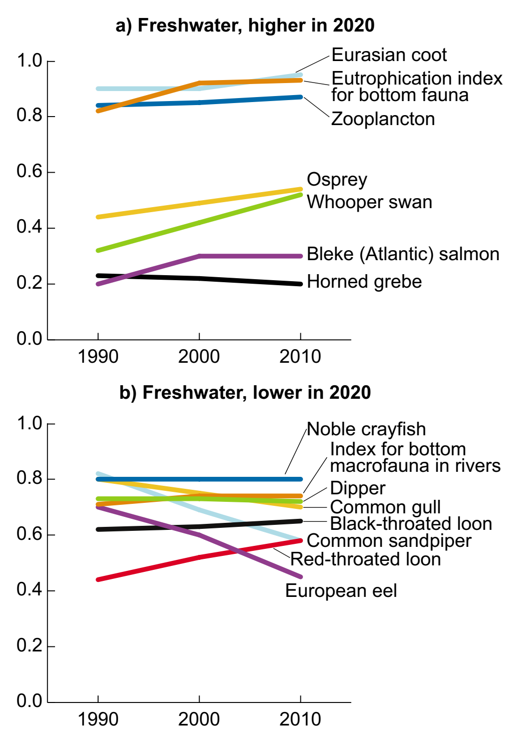

Fig. 7. The Nature Index trends 1990–2010 for the indicators for freshwater which experts believe will have higher or lower values in 2020 compared to 2010

will respond negatively to habitat fragmentation due to intensive forestry.

For the four indicators based on habitats/substrates for threatened species from the National Forestry Inventory, no data were available for the period 1990–2010. For the remaining indicators with expected higher value in 2020, mistle thrush, moose, and European roe deer improved after 1990, whereas red deer varied. The fungus *Artomyces pyxidatus* was estimated to have a weak improvement since 1990, whereas oak fern in alpine birch forest has fallen considerably. Seven of the indicators with estimated lower values in 2020 than in 2010 have also fallen compared to 1990 (*Gomphus clavatus*, *Amylocystis lapponicus, Sarcodon* species, *Lobaria* species, bay willow, great crested newt, and goshawk), whereas the lichen *Hypogymnia physodes* and the beetles *Nohtorhina punctata* and *Harminius undulates* are reported as having been stable throughout the period, and small rodents have had a varied development. The lesser spotted woodpecker has had a weak increase, and the lichen *Melanelia olivacea* has experienced a clear increase since 1990. The assessment of lower value in 2020 for the lichen *Hypogymnia physodes* may be unexpected, as the value for the period 1990–2010 is near the reference value 1. However, the reference value is technically set at the 1990 value within this particular monitoring programme and has been revised in the calculation of the Nature Index. Moreover, *Hypogymnia physodes* is sensitive to acidification and competition under forest successions, and is thus assessed to be subject to a negative trend in some areas (Fig. 8).

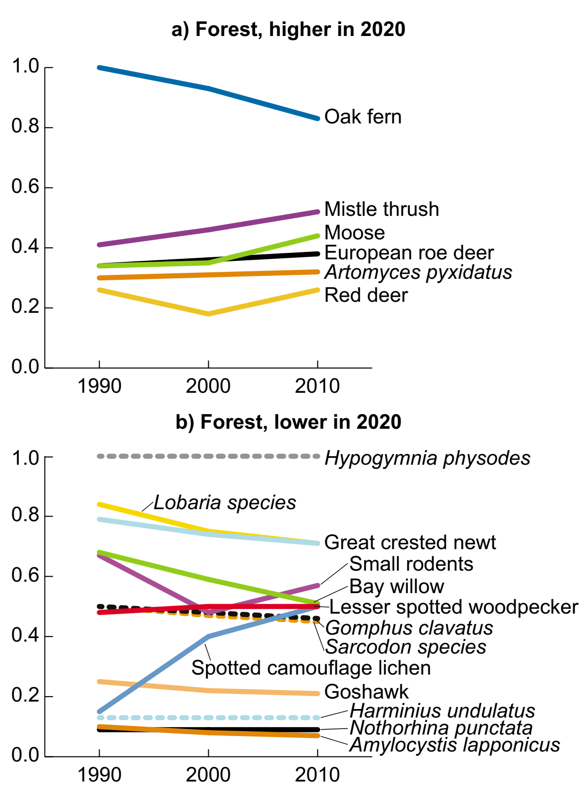

Fig. 8. The Nature Index trends 1990–2010 for the indicators for forest which experts believe will have higher or lower values in 2020 compared to 2010

Open lowland: The indicators for open lowland consist of typical representatives of the extensively used agricultural areas of grassland and coastal heathland, with biodiversity maintained by traditional agricultural practices, as well as some birds that breed in open lowland, particularly near the coast. Such birds include the peregrine falcon (*Falco peregrinus*) and Eurasian eagle owl (*Bubo bubo*), which are favoured by open lowland landscapes, but are not considered among typical birds of the cultural landscape, which include northern lapwing (*Vanellus vanellus*), skylark (*Alauda arvensis*), common starling (*Sturnus vulgaris*), and Eurasian curlew (*Numenius arquata*). The birds typical of coastal mountains are mostly allocated to the major ecosystems ocean and coast.

The situation in 2020 was assessed for 32 indicators for the major ecosystem open lowland. Four of these (Eurasian eagle owl, red-throated pipit (*Anthus cervinus*), peregrine falcon, white-tailed sea eagle (*Haliaeetus albicilla*)) were assessed to have higher indicator values in 2020 than in 2010, whereas 12 indicators were judged to have lower values in 2020. These include the conditions for coastal heathland and semi-natural grasslands, four fungi species, four moss species, Arnica (*Arnica montana*), and the dor beetle (*Geotrupes stercorarius*) (a selection of these indicators are shown in Fig. 9).

Two of the indicators with higher values in 2020 (white-tailed sea eagle and peregrine falcon) indicated a clear increase in value since 1990. The other two indicators with

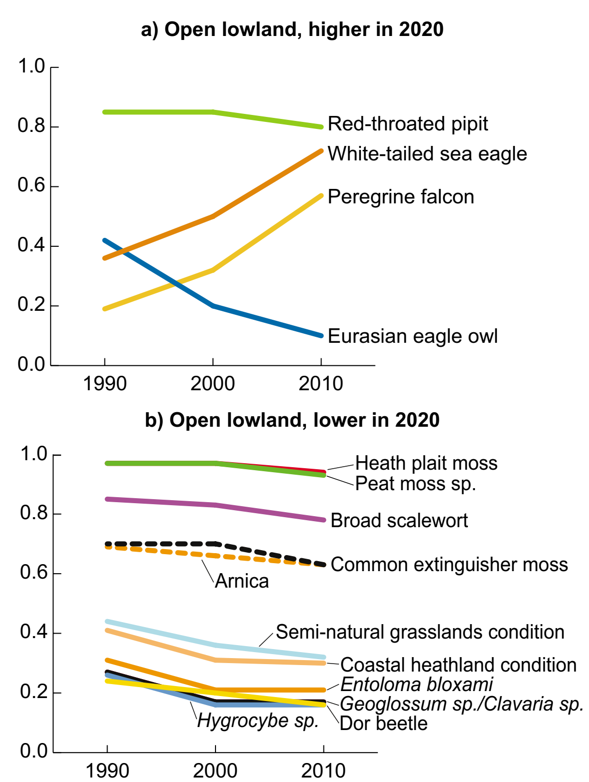

Fig. 9. The Nature Index trends 1990–2010 for the indicators for open lowland which experts believe will have higher or lower values in 2020 compared to 2010

higher values in 2020 (Eurasian eagle owl and red-throated pipit) declined during the period 1990–2010, especially in the case of Eurasian eagle owl. All indicators with an expected lower value in 2020 than in 2010 show a more or less clear decline during the period 1990–2010.

Mires and wetlands: Of the 29 indicators for mires and wetlands for which future values were assessed, three indicators (bar-tailed godwit (*Limosa lapponica*), common crane (*Grus grus*), and in part broad-bill sandpiper (*Limicola falcinellus*)) were assessed to have higher values in 2020 than in 2010, whereas five indicators (palsa mire area, dune tiger beetle (*Cicindela maritime*) and dark-legged Elaphrus (*Elaphrus uliginosus*), great crested newt, and dipper) were given lower values in 2020 (Fig. 10). For the indicators with expected lower values in 2020, the reduction since 1990 was strongest for palsa mire, but also great crested newt and dipper fell during this period. The two beetles have experienced only a minor decrease (*Cicindela maritima*) or remain unchanged (*Elaphrus uliginosus*).

Mountain: For mountain, the situation in 2020 was assessed for 23 indicators. Only one of these (willow shrub area) was assessed to have a higher value in 2020, but also the lichens (*Cladonia & Cetraria spp.*) and Arctic fox (*Vulpes lagopus*) were assessed to have higher values in some geographical areas (< 20%). Four of the indicators (the mosses *Scapania nimbosa* and *Anastrophyllum joergensenii*, the flower glacier crowfoot (*Beckwithia glacialis*), and small rodents) were expected to have lower values in 2020 (Fig. 11). The value

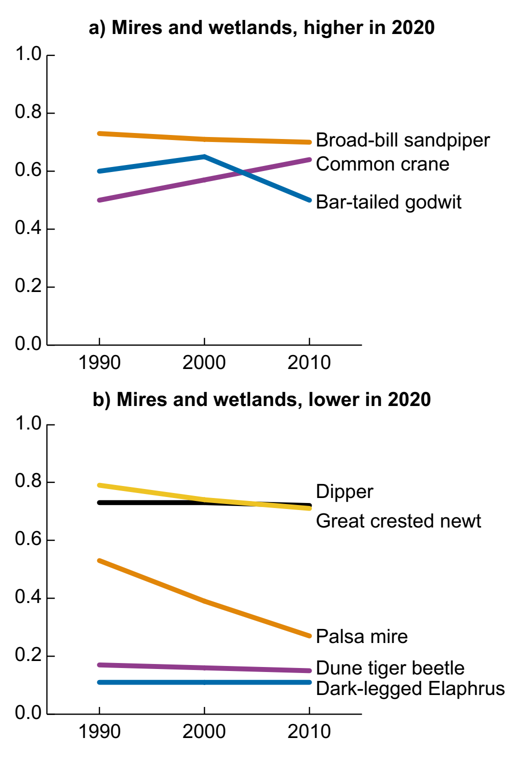

Fig. 10. The Nature Index trends 1990–2010 for the indicators for mires and wetlands which experts believe will have higher or lower values in 2020 compared to 2010

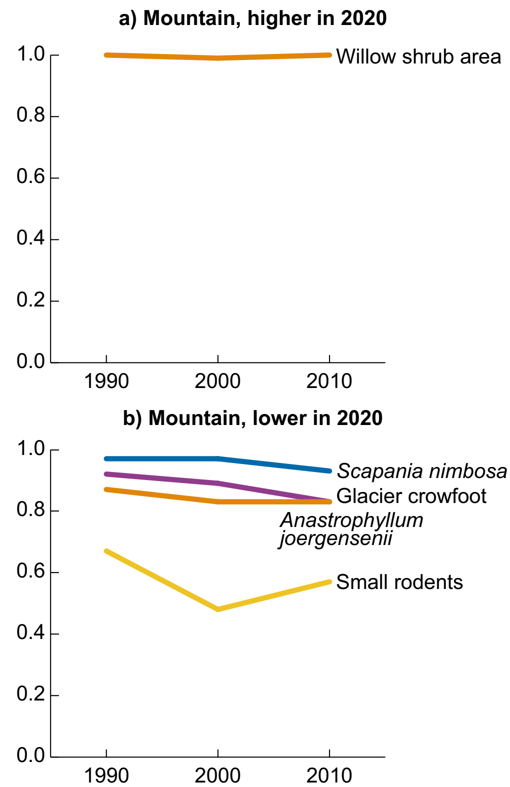

Fig. 11. The Nature Index trends 1990–2010 for the indicators for mountain which experts believe will have higher or lower values in 2020 compared to 2010

for willow shrub area during 1990–2010 was very high and more or less stable (0.99–1). For the indicators with lower values in 2020, the trends since 1990 for the three plant species were weakly negative, whereas small rodents varied somewhat during this period (and were lowest in 2000).

Future assessments of states and uncertainty

The experts were also asked how certain they were about the development of each individual indicator from 2010 to 2020. The degree of uncertainty was considerable and very few answered 'certain' or 'very certain' (Table 2). The experts were most certain about indicators for Open Lowland. For the marine ecosystems, the experts judged the situation in 2020 as very uncertain in at least 30% of cases, yet marine ecosystems was also only the category for which the response 'very certain' was given.

For most of the major ecosystems, the experts were more certain about the trend when it was perceived as negative (Table 3). However, for ocean bottom and mountain, the assessments of the indicators with unchanged or higher levels in 2020 were viewed as more certain. For forest, there seemed to be little difference in the assessments of certainty pertaining to indicators with lower or unchanged/higher values in 2020. For the marine ecosystems, the development of the indicators with an expected decrease from 2010 to 2020 were only assessed as certain or very certain for guillemot (ocean pelagic) and cod (coast bottom, only for the county of Nordland).

Table 2. The experts' assessments of how certain they were about the statements on the indicators' level in 2020 compared to 2010 (percentage of all assessed indicators and geographical areas for each main ecosystem)

Main ecosystem	No response	Very uncertain	Uncertain	Medium certain	Certain	Very certain	Number of indicators
Ocean pelagic	0	34	25	28	6	6	17
Ocean bottom	0	32	34	32	3	0	17
Coast pelagic	0	59	31	3	2	5	10
Coast bottom	0	37	39	21	0	3	28
Freshwater	1	0	40	45	13	0	32
Open lowland	0	2	48	26	24	0	33
Forest	1	20	51	25	4	0	57
Mires and wetlands	1	3	74	17	5	0	29
Mountain	0	4	37	57	3	0	23

None of the indicators with a higher value in 2020 for Freshwater was considered certain. Among the indicators for mires and wetlands, bar-tailed godwit and broad-bill sandpiper were reported as certain for higher values in 2020 (for broad-bill sandpiper, only in the county of Finnmark), whereas the indicators with (in part) lower values in 2020 were to a large degree also considered certain (palsa mire area, dune tiger beetle, and dipper, but not great crested newt).

For open lowland, none of the indicators with expected higher values in 2020 was considered certain. Among the indicators with lower expected values in 2020, only four fungi species and the indexes for semi-natural grasslands and coastal heathland condition were judged as certain. Of the indicators for forest with estimated lower values in 2020, only the decline in bay willow, in the counties of Nordland and Troms, was regarded as certain. None of the indicators for mountain with higher or lower values in 2020 was regarded as certain, only those with unchanged values.

Apparently, indicators influenced mainly by often unpredictable natural dynamics, such as in marine ecosystems, tended to be considered uncertain. The exception may be cases where the indicator had a very high value in 2010 and most likely will decline towards 2020. Indicators affected by direct human interventions, such as harvesting or land use, may be seen as more predictable, except where there is uncertainty about future management or policies. The experts' assessment of uncertainty will also be influenced by whether or not they feel they understand the mechanisms influencing the dynamics of the indicators.

Is a return to the state in 2010 possible?

Unexpectedly, in many cases where the experts anticipated lower values for indicators in 2020, they also believed that a return to the state in 2010 is possible (Table 4). For the marine ecosystems, the experts considered it possible to return to the 2010 state for guillemot, saithe, and Atlantic ditch shrimp, whereas they believed this to be possible only for cod along the coast and not in the ocean (about which the experts were uncertain). For European eel, the experts did not consider it possible to re-establish the 2010 state. Among the freshwater indicators, the experts considered it possible only to re-establish the state in 2010 for the index of bottom macrofauna in rivers. For noble crayfish (in the county of Akershus) and European eel, they believed it would not be possible to re-establish the situation, whereas they reported they did not know whether the situation could be re-established for the respective bird species. For the indicators for mires and wetlands with lower values in 2020, the experts believed it to be possible to recreate the state for the dune tiger beetle, dark-legged Elaphrus, and great crested newt. However, they believed it to be impossible to reach the 2010 state for palsa mire area, and did not know whether the 2010 state could be reached for the dipper.

For open lowland, the experts considered it possible to re-establish the 2010 state for all indicators, with an expected decrease in 2020 (except in some local areas for certain indicators). In addition, for most of the indicators for forest, the experts believed it to be possible to return to the 2010 state. The exceptions were small rodents and the lichen *Melanelia olivacea*, for which a return was not considered

Table 3. Share of experts that responded they were certain or very certain about the assessments of indicators in 2020 (Question 2), compared to whether the indicator would be lower or unchanged/higher in 2020 compared to 2010 (percentage of all assessed indicators and geographical areas for each main ecosystem)

Main ecosystem	Lower/much lower in 2020 than in 2010	Number of indicators	Unchanged or higher/much higher in 2020 than in 2010	Number of indicators
Ocean pelagic	33	4	8	15
Ocean bottom	0	1	3	17
Coast pelagic	28	4	0	8
Coast bottom	17	4	0	27
Freshwater	48	9	1	26
Open lowland	49	13	0	23
Forest	4	16	4	55
Mires and wetlands	30	6	2	28
Mountain	0	4	3	21

Table 4. The experts' responses on whether would be possible to return to the 2010 state, given that they expected the state in 2020 to be lower than in 2010 (percentage of all assessed indicators and geographical areas for each main ecosystem)

Main ecosystem	Yes	No	Do not know	Number of indicators
Ocean pelagic	80	0	20	3
Ocean bottom	0	0	100	1
Coast pelagic	100	0	0	4
Coast bottom	87	10	2	4
Freshwater	40	5	56	9
Open lowland	99	1	1	13
Forest	72	8	20	16
Mires and wetlands	70	7	23	6
Mountain	44	55	1	4

possible, and lesser spotted woodpecker, for which the experts did not know whether a return would be possible. For mountain, the experts believed it to be possible to re-establish the 2010 state for the mosses *Anastrophyllum joergensenii* and *Scapania nimbosa*, but not for small rodents. For the flower glacier crowfoot, the experts gave a mixed response of both positive and negative assessments.

Apparently, the experts assessed it possible to affect the harvesting regime for harvestable species in the coastal zone, but to a lesser degree in the ocean, where presumably more large-scale natural dynamics affect the indicators. Moreover, it seems that the indicators that are especially sensitive to changes in land use in open lowland and forest, and physical developments in freshwater, provide better possibilities for re-establishing the 2010 state, than, for example, indicators that are particularly affected by climate change. However, to some extent, individual experts appear to have judged the possibilities of influencing the respective effects of land use and climate change differently (e.g. the effects of climate change on mosses and rodents in mountain).

What is the need for management action, and how urgent and difficult would it be?

The experts were also asked to judge how urgent the need for action is in order to re-establish the 2010 state for indicators with an expected decline in 2020, and assess how difficult this would be (Table 5). For the marine ecosystems, the experts judged the need for action as very urgent in the case of guillemot and saithe, and assessed it to be 'medium difficult' and 'difficult', respectively.

The indicators for freshwater were barely assessed, as the experts considered that management action would be effective for only one indicator, the index for bottom macrofauna in rivers, for which experts considered measures to be very urgent and easy to achieve. For mires and wetlands, the experts considered dune tiger beetle and dark-legged Elaphrus as needing urgent attention and that management action would be medium difficult. For great crested newt it is very urgent with action in parts of the assessment areas, but this is regarded as easy to bring about.

For open lowland, the experts considered the need for management action to be very urgent or extremely urgent for a large share of the indicators, and in many cases it was assessed to be only medium difficult, such as the fungi, the mosses, *Arnica*, and indicators for semi-natural grasslands and coastal heathland condition.

For forest, the experts regarded the need for action as very urgent or extremely urgent and that it would be medium difficult to implement (i.e. for a number of fungi species, goshawk, bay willow) or difficult to implement (i.e. for the lichen *Hypogymnia physodes*). For the great crested newt, there was an urgent need for action in parts of the assessments area, and the measures were regarded as easy to carry out.

For mountain, the experts gave a rather limited assessment of the need for action. For the moss *Anastrophyllum joergensenii*, action was regarded as slightly urgent and as medium difficult to implement. For the flower glacier crowfoot, the need for urgent action varied and it was regarded as difficult to extremely difficult to implement, probably because the changes are primarily related to climate change.

Apparently, the experts primarily considered there is an urgent need for management action for indicators with a strong negative development caused mainly by direct human intervention in the form of harvesting, pollution, or land use. Their assessment of the difficulty of such management actions seems to be linked mainly to their perception of the technical possibilities of implementing such actions, not to any economic or political constraints.

Table 5. The experts' assessments of how urgent it is to act in order to improve the situation for the indicators that are expected to have a lower value in 2020 than in 2010, and where management action may return indicator values to their 2010 state, and how difficult this would be to implement (percentage of all assessed indicators and geographical areas for each main ecosystem)

	How urgent is it?			How difficult is it to do something about it?				
Main ecosystem	Very	Extremely	Number of indicators	Very easy	Easy	Medium difficult	Difficult	Very difficult
Ocean pelagic	100	0	2	0	0	50	50	0
Ocean bottom	0	0	0	0	0	0	0	0
Coast pelagic	20	0	3	0	0	95	5	0
Coast bottom	28	0	3	0	0	96	4	0
Freshwater	100	0	1	0	100	0	0	0
Open lowland	30	50	13	0	1	79	20	0
Forest	50	2	14	7	9	66	18	0
Mires and wetlands	20	0	4	0	18	82	0	0
Mountain	12	0	3	0	0	40	27	33

Summary of dialogues with experts

The survey of forecasts for indicator states in 2020 was followed up by meetings with the lead authors of the chapters on each major ecosystem, in order to discuss the interpretation of the responses to the survey questions. In particular, it was important to clarify to what extent the lower values in 2020 can be interpreted as genuine 'early warnings' or whether they are anticipated trends in natural cycles and thus give no particular reason for immediate concern, such as cod in the ecosystem ocean pelagic declining from cyclical high levels. The follow-up meetings with the experts indicated that the survey questions opened up for different interpretations of the scope for re-establishing indicator states at the 2010 level, a matter that is important to clarify should similar questions be posed in the future. The experts' reflections on the relevance of the survey of expected future trends will provide useful feedback for a similar survey of future trends in the next version of the Nature Index and for application of the Nature Index in biodiversity policy.

The lead authors generally agreed that the process of giving forecasts for 2020 is useful and contributes to reflections on the assessment process itself and the use of the Nature Index by society. However, when preparing for the next Nature Index update it will be necessary to have sufficient time to ensure that all involved experts have a common understanding of the questions. A closer link is needed between the forecasts and the ordinary indicator values of the Nature Index, and it was suggested that the discussion of future trends should be integrated in the chapters on each major ecosystem. For marine ecosystems, it should be clarified that the future trends are crucially dependent on resource management.

The dialogues with the lead authors revealed that there are distinctly different reasons for non-response. First, there are ecological reasons, because the natural fluctuations of species populations make it difficult to provide a forecast. Second, there are practical reasons, namely lack of time and lack of communication. Several experts suggested this as the most important reason for non-response, particularly as this was the first time that a nature index had been established in Norway and they were unfamiliar with the knowledge-generating process. Third, and finally, there are science-policy reasons, reflecting the multiple roles of the experts as scientific advisers in resource management or as more independent academic researchers. In particular, the role of experts in giving scientific advice on marine ecosystems implies a particular consideration of the economic importance of the fishery industry.

The experts pointed to the ambiguity of interpreting whether 'difficulty of action' should be perceived in terms of technical constraints or political constraints. For Open Lowland, there was an unexpectedly broad response that implementation of required management action would be possible and relatively easy. Biodiversity loss due to, for example, land-use or agricultural policy was perceived as 'easy' to counteract, in contrast to changes in biodiversity due to, for example, climate change. The experts also pointed to the ambiguity of whether 'urgency' should be interpreted in terms of avoiding extinction or re-establishing satisfactory conditions.

Important impact factors include land use change, pollution, climate change, eutrophication, harvesting, forest management, alien species, and hydrological changes. In principle, the identification of important impact factors by the experts may contribute to explain the expected indicator values in 2020. However, the question of how to assess the development of current impact factors when assessing the future value of the indicators, as well as the effect of new and unknown impact factors, remains to be considered.

Conclusions

A large number of experts responded to questions about the future state of biodiversity in Norway. Their forecasts suggest that a large share of the indicators for marine ecosystems will show an improved state in 2020. For the terrestrial ecosystems, the experts' forecasts were most negative for open lowland and forest, in accordance with the results from the Nature Index values for the period 1990–2010. Open lowland has the greatest share of indicators with lower values in 2020, suggesting that the state of this ecosystem gives the most cause for concern, due to the abandonment of traditional agricultural practices that previously maintained the biodiversity of extensively managed grasslands and coastal heathlands.

In many cases where the experts expected a negative development, they also believed that a return to the state of biodiversity in 2010 would be possible. For open lowland, they generally considered it possible to re-establish the 2010 state for all indicators with an estimated decrease in 2020, assuming that management action is implemented immediately. For most of the indicators for forest, the experts also believed it to be possible to return to the 2010 state. However, they regarded the processes affecting the biodiversity indicators for mountain as less responsive to human intervention, as many of the indicators in this ecosystem are expected to be particularly affected by long-term climate change.

The uncertainty pertaining to the estimates of indicator levels in 2020 was in general perceived as large by the experts. They were most certain about open lowland, freshwater, and ocean pelagic. For these main ecosystems, the experts underlined that the need for action is particularly urgent. It is uncertain whether they judged only technical possibilities in implementing measures, or whether they assessed the economic and political challenges related to such implementation.

The experts' ability and willingness to provide forecasts for their indicators, combined with their assessment of uncertainty relating to the forecasts, suggests that there is reason to focus on certain indicators with a high risk of future negative development. Such indicators may provide a basis for precautionary approaches. However, only a small number of indicators were assessed in terms of required management action, and there was considerable variation in the assessments of different indicators within the same major ecosystem. This implies the risk that measures based on the precautionary perspective would be based on a somewhat arbitrary selection process. Improving the assessment of management measures demands that the experts are able to access more information on the background and framework for such assessments, are granted more time for making judgments, and are provided with explicit criteria and examples of trade-offs in difficult cases. This should be part of the research and management reporting processes that exist for the main ecosystems, thereby creating the potential for more extensive participation by experts, and improved calibration of assessments in order to achieve more robust results.

A simple forecast of observed, evaluated, or estimated trends for the Nature Index indicators could provide a basis for evaluating future development, but this would only to a limited extent be able to capture critical changes before they became clearly evident that one could hardly describe it as a precautionary perspective. Such forecasting would also fail to reflect possible critical changes that may lead to another development than that of the historical trend. Considering how the scientists may apply the Nature Index framework in order to improve the knowledge base required for precautionary approaches to biodiversity policy, it would be useful to follow up and further explore the issue of forward-looking warning signs of biodiversity loss.

It seems reasonable to conclude that the experts have only had a limited opportunity to evaluate whether new impact factors can influence the indicators significantly during the next 10 years. In the next version of the Nature Index, it will be useful to include a specific question on whether current impact factors and management practices and policies most likely will be the most important ones also over the next 10-year period, or whether it is more reasonable to consider other impact factors and policies, and if so, which ones. This question could be part of a more extensive dialogue with the experts, in order to ensure a higher degree of common understanding of the questions than was possible to achieve during the development and implementation of the Norwegian Nature Index.

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Appendix A: Overview of indicator names in Figs. 3–11 (indicator type also shown in Fig. 2)

Indicator	Scientific name	Norwegian name	Indicator type
Amylocystis lapponicus	*Amylocystis lapponicus*	Lappkjuke	Fungus
Anastrophyllum joergensenii	*Anastrophyllum joergensenii*	Nipdraugmose	Moss
Angler fish	*Lophus piscatorius*	Breiflabb	Fish
Arnica	*Arnica montana*	Solblom	Vascular plant
Artomyces pyxidatus	*Artomyces pyxidatus*	Begerfingersopp	Fungus
Atlantic cod	*Gadus morhua*	Torsk	Fish
Atlantic ditch shrimp	*Palaemonetes varians*	Brakkvannsreke	Other invertebrate
Bar-tailed godwit	*Limosa lapponica*	Lappspove	Bird
Bay willow	*Salix pentandra*	Istervier	Vascular plant
Black-throated loon	*Gavia arctica*	Storlom	Bird
Bleke (Atlantic) salmon	*Salmo salar*	Byglandsbleke	Fish
Blue ling	*Molva dypterygia*	Blålange	Fish
Broad scalewort	*Porella obtusata*	Glansteppemose	Moss
Broad-bill sandpiper	*Limicola falcinellus*	Fjellmyrløper	Bird
Clavaria spp.	*Clavaria spp.*	Køllesopper	Fungus
Common crane	*Grus grus*	Trane	Bird
Common extinguisher moss	*Encalypta vulgaris*	Småklokkemose	Moss
Common gull	*Larus canus*	Fiskemåke	Bird
Common sandpiper	*Actitis hypoleuca*	Strandsnipe	Bird
Corkwing wrasse	*Symphodus melops*	Grønngylt	Fish
Dark-legged Elaphrus	*Elaphrus uliginosus*	Sumpløper	Insect
Dipper	*Cinclus cinclus*	Fossekall	Bird
Dor beetle	*Geotrupes stercorarius*	Engtordivel	Insect
Dune tiger beetle	*Cicindela maritime*	Elvesandjeger	Insect
Entoloma bloxami	*Entoloma bloxami*	Praktrødskivesopp	Fungus
Eurasian coot	*Fulica atra*	Sothøne	Bird
Eurasian eagle owl	*Bubo bubo*	Hubro	Bird
European eel	*Anguilla anguilla*	Ål	Fish
European lobster	*Homarus gammarus*	Hummer	Other invertebrate
European roe deer	*Capreolus capreolus*	Rådyr	Mammal
Geoglossum spp.	*Geoglossum spp.*	Jordtunger	Fungus
Glacier crowfoot	*Beckwithia glacialis*	Issoleie	Vascular plant
Goldsinny	*Ctenolabrus rupestris*	Bergnebb	Fish
Gomphus clavatus (Violet chantarelle)	*Gomphus clavatus*	Fiolgubbe	Fungus
Goshawk	*Accipiter gentilis*	Hønsehauk	Bird
Great crested newt	*Triturus cristatus*	Storsalamander	Amphibian
Greenland halibut	*Reinhardtius hippoglossoides*	Blåkveite	Fish
Guillemot	*Uria aalge*	Lomvi	Bird
Harminius undulatus	*Harminius undulatus*	Smeller	Insect
Heath plait moss	*Hypnum jutlandicum*	Heiflette	Moss
Horned grebe	*Podiceps auritus*	Horndykker	Bird
Hygrocybe spp.	*Hygrocybe spp.*	Praktvokssopper	Fungus
Hypogymnia physodes	*Hypogymnia physodes*	Kvistlav	Lichen
Iceland scallop	*Clamys islandica*	Haneskjell	Other invertebrate
King scallop	*Pecten maximus*	Kamskjell	Other invertebrate
Lesser spotted woodpecker	*Dendrocopos minor*	Dvergspett	Bird
Lobaria species	*Lobaria species*	Lobaria-arter	Lichen
Mistle thrush	*Turdus viscivorus*	Duetrost	Bird
Moose	*Alces alces*	Elg	Mammal
Noble crayfish	*Astacus astacus*	Edelkreps	Other invertebrate
Nothorhina punctata	*Nothorhina punctata*	Reliktbukk	Insect
Oak fern	*Gymnocarpium dryopteris*	Fugletelg	Vascular plant
Onion-eye grenadier	*Macrourus berglax*	Isgalt	Fish
Osprey	*Pandion haliaetus*	Fiskeørn	Bird
Palsa mire	*NA*	Palsmyr areal	Index
Peat moss sp.	*Sphagnum strictum*	Heitorvmose	Moss
Peregrine falcon	*Falco peregrinus*	Vandrefalk	Bird
Red deer	*Cervus elaphus*	Hjort	Mammal
Red-throated loon	*Gavia stellata*	Smålom	Bird
Red-throated pipit	*Anthus cervinus*	Lappiplerke	Bird
Saithe	*Pollachius virens*	Sei	Fish
Sarcodon species	*Sarcodon species*	Storpigg-arter	Fungus
Scapania nimbosa	*Scapania nimbosa*	Torntvebladmose	Moss
Silver smelt	*Argentina silus*	Vassild	Fish
Sperm whale	*Physeter macrocephalus*	Spermhval	Mammal
Spotted camouflage lichen	*Melanelia olivacea*	Snømållav	Lichen
White-tailed sea eagle	*Haliaeetus albicilla*	Havørn	Bird
Whooper swan	*Cygnus cygnus*	Sangsvane	Bird