Conservation Biology

Conservation Focus: *Priorities for Policy-Relevant Conservation Research: a View from SCB Regional Sections*

Conservation Focus on Europe: Major Conservation Policy Issues That Need to Be Informed by Conservation Science

ANDREW S. PULLIN,* ANDRÁS BÁLDI,†§§ OZGUN EMRE CAN,‡ MARTIN DIETERICH,§ VASSILIKI KATI,** BARBARA LIVOREIL,†† GABOR LÖVEI,‡‡ BARBARA MIHÓK,§§ OWEN NEVIN,*** NURIA SELVA,††† AND ISABEL SOUSA-PINTO‡‡‡

*Centre for Evidence-Based Conservation, SENR, Bangor University, Bangor, Gwynedd LL57 2UW, United Kingdom, email a.s.pullin@bangor.ac.uk
†Animal Ecology Research Group, Hungarian Academy of Sciences
‡Department of Biology, Middle East Technical University, Ankara, Turkey
§Institut für Landschafts- und Pflanzenökologie, Universität Hohenheim, 70593 Stuttgart, Germany
**Department of Environmental & Natural Resources Management, University of Ioannina, Seferi 2, Agrinio GR 30100, Greece
††Centre for Research and Conservation of Chelonians, SOPTOM, BP 24, 83590 Gonfaron, France
‡‡Aarhus University, Department of Integrated Pest Management, Flakkebjerg Research Centre, DK-4200 Slagelse, Denmark
§§Hungarian Natural History Museum, Ludovika tér 2, Budapest, Hungary
***Centre for Wildlife Conservation, National School of Forestry, University of Cumbria, Penrith CA11 0AH, United Kingdom
†††Institute of Nature Conservation, Polish Academy of Sciences, Mickiewicza 33, 31-120 Kraków, Poland
‡‡‡Centre for Marine and Environmental Research, and Department of Botany, FCUP, University of Porto, R. dos Bragas, 289, Porto, Portugal

Abstract: *Europe is one of the world's most densely populated continents and has a long history of human-dominated land- and seascapes. Europe is also at the forefront of developing and implementing multinational conservation efforts. In this contribution, we describe some top policy issues in Europe that need to be informed by high-quality conservation science. These include evaluation of the effectiveness of the Natura 2000 network of protected sites, implications of rapid economic and subsequent land-use change in Central and Eastern Europe, conservation of marine biodiversity and sustainability of fisheries, the effect of climate change on movement of species in highly fragmented landscapes, and attempts to assess the economic value of ecosystem services and biodiversity. Broad policy issues such as those identified are not easily amenable to scientific experiment. A key challenge at the science–policy interface is to identify the research questions underlying these problem areas so that conservation science can provide evidence to underpin future policy development.*

Keywords: evidence-based conservation, knowledge exchange, policy-relevant science, science–policy interface

Enfoque de Conservación en Europa: Temas Mayores de Políticas de Conservación que Requieren Información de la Ciencia de la Conservación

Resumen: *Europa en uno de los continentes más densamente poblados y tiene una larga historia de paisajes terrestres y marinos dominados por humanos. Europa también está a la vanguardia en el desarrollo e implementación de esfuerzos de conservación multinacionales. En esta contribución, describimos algunos temas políticos relevantes que requieren información basada en ciencia de la conservación de alta calidad. Estos incluyen la evaluación de la efectividad de la red Natura 2000 de sitios protegidos, implicaciones*

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del acelerado cambio económico y el subsecuente cambio de uso de suelo en Europa Central y Oriental, conservación de la biodiversidad marina y la sustentabilidad de las pesquerías, el efecto del cambio climático sobre el movimiento de especies en paisajes muy fragmentados e intentos para estimar el valor económico de los servicios del ecosistema y de la biodiversidad. Temas políticos como los identificados no son fácilmente abordados por experimentos científicos. Un reto clave en la interfaz ciencia-política es la identificación de las preguntas de investigación que subyacen en estas áreas para que la ciencia de la conservación pueda proporcionar evidencia para sustentar el futuro desarrollo de políticas.

Palabras Clave: ciencia relevante para la política, conservación basada en evidencia, intercambio de conocimiento, interfaz ciencia-política

Introduction

Europe is the most densely populated of continents with a very long and complex cultural history. This is reflected in a tremendous variety of so-called cultural landscapes and their associated biodiversity. No strictly "natural areas" and very few "pristine areas" remain, and these relatively undisturbed areas are largely confined to the northern fringe of Scandinavia, Russia and associated Arctic coastal waters, the highest mountain tops of the Alps, and remote mountain ranges in the Balkans and in Eastern Europe. In many respects, up to the first half of the 20th century, traditional low-intensity land use was a precondition for the existence of associated species richness and biodiversity. Industrialization in Europe, as elsewhere, has been fed by exploitation of natural resources from within the continent and beyond. Industrialization of the agricultural sector has resulted in tremendous changes in land-use patterns and rapidly transformed whole landscapes in Western Europe. Seminatural, unproductive habitats and their associated species have rapidly declined as a result of intensification or abandonment. Export of such agricultural practices to European Union (EU) accession countries in eastern and central Europe is expected to pose a major threat to biodiversity in the near future. Beyond agriculture, rapid urban encroachment and the exponential growth of linear infrastructures have fragmented the landscape. Additionally, overexploitation and appropriation of freshwater resources is a big concern in southern Europe, especially in the context of climate change. Industrialization of marine fisheries has also led to overexploitation and depletion of fish stocks and fundamentally altered the ecological dynamics of some marine areas.

Because few natural areas remain, conservation effort is focused on seminatural habitats in cultural landscapes (e.g., traditionally grazed Mediterranean shrubland, species-rich grasslands, managed woodlands). Conservation action is largely undertaken by continuing traditional agricultural or silvicultural practices or by mimicking such practices with modern equipment.

Europe has been at the forefront in establishment of most multinational conservation efforts in existence today. The Bonn Convention on the Conservation of Migratory species of Wild Animals, the Bern Convention on the protection of European wild plants and animals and their habitats, and the EU Birds Directive were all passed in 1979. In 1992 legal conservation efforts were complemented by the EU Habitats Directive targeted at habitats and species not covered under the Birds Directive. The Habitats Directive establishes the legal foundation of the Natura 2000 network of protected sites now covering almost 20% of EU territory. In addition, the Habitats Directive provides for strict protection of endangered species throughout the EU. In addition to delimitation of protected areas, in 1998, the European Commission adopted a European Biodiversity Strategy (EC 1998) and associated action plans that focus on the integration of biodiversity concerns into different sectoral policies (EC 2001).

The Society for Conservation Biology, Europe Section (SCB-ES) is currently engaged in a number of initiatives with the EU that aim to identify the research needs to underpin current policy developments. One example of such interaction is the European Platform for Biodiversity Research Strategy, a platform that brings together scientists and policy makers in six monthly meetings, each of which addresses the research needs of a specific policy issue (Nesshover et al. 2008). In addition, the SCB-ES hosted the first European Congress of Conservation Biology in Eger, Hungary, in 2006. This meeting brought together scientists and policy formers to discuss the major conservation issues facing Europe. Against this background, we describe here some top policy issues in Europe that we believe need to be informed by high-quality conservation science.

The Policy Issues

Effectiveness of the Natura 2000 Network of Protected Sites

The NATURA 2000 network of protected sites is a pillar of European action to halt biodiversity loss. It consists of Special Protection Areas (SPAs) and Special Areas of Conservation (SACs) selected according to the Birds and Habitats Directives (EEC 1979, 1992). Under these

directives, NATURA 2000 sites should be protected from deterioration and the status of species and habitats should be regularly monitored and reported. The network currently covers approximately 850,000 km^2 and more than 100,000 km^2 marine areas (EC 2007*a*) and is being enlarged through updates and expansion of EU political borders. As the network-designation process reaches its conclusion, the real challenge now lies in achieving appropriate management.

Conservation science can support effective implementation of NATURA 2000 by integrating global change and current science into the present legal frame, producing sound management and monitoring guidelines, educating stakeholders, raising public awareness, assessing funding requirements, and by promoting ecocertification of funding based on scientific expertise. The latter is an important but often neglected aspect of the scientific evaluation of conservation directives (e.g., Donald et al. 2007).

Conservation scientists should be engaged in fully coordinated research across Europe addressing key issues such as effectiveness of the NATURA network in conserving unfragmented natural areas, ecosystem services, habitats, and characteristic species (e.g., Maiorano et al. 2007). Important steps are the establishment of standard protocols for effective biodiversity monitoring and assessment of "favorable conservation status;" preservation of biodiversity outside Natura 2000; measurement of the comparative impact of different management practices on biodiversity; and provision of science-based, pragmatic solutions that will reduce further biodiversity loss.

Implications of Rapid Economic Change in Central and Eastern Europe

Modern industrialization affected different parts of Europe differently. This, together with the north–south and northwest–southeast diversity gradients in Europe, means that today much of Europe's biodiversity, including those inhabiting unique biogeographic zones (e.g., Pannonian, Steppic), is held by the less-industrialized east-central and southern regions. These regions still have a few pristine habitats, for example, forest remnants in the Carpathians that may serve as baseline research areas for ecology (Wesolowski 2007). Moreover, the restricted areas along the former Iron Curtain remained basically undisturbed for nearly 50 years. These areas harbor a high level of biodiversity, indicating a high potential for restoration.

These same regions, however, currently are undergoing rapid, large economic changes. Such changes are reflected, for example, in the fluctuation of pesticide use with resulting changes in pollution levels (Báldi & Faragó 2007). Agriculture in the Eastern European, formerly socialist, countries was as intensive (at least in the use of fertilizers) as in other developed European countries in the 1970–1990s. After 1989 the collapse of socialist economies caused drastic changes. Political changes have also created new environmental problems. The collapse of large, state-managed agricultural enterprises resulted in a decrease in cultivation intensity, which had positive effects on farmland biodiversity. Nevertheless, grasslands suffered because of the abandonment of grazing, and forests suffered because of intensive logging. Even large, protected forests such as the famous Bialowieza Forest were not immune from felling concessions (Wesolowski 2005).

The recent EU membership of these countries has many potential benefits for conservation. The agri-environment schemes can provide increased funding. In Hungary, there was €280 million available for agri-environment schemes in 2006, which is approximately 15 times more than the state-allocated support of the Nature Conservation Authority. If EU regulations, and the resources behind them, can be used efficiently for nature conservation, then accession countries could retain much of their biodiversity because such large-scale policy drivers have the potential to change trends in biodiversity (Donald et al. 2007).

It remains to be seen whether the more solid legal environment in the EU will be sufficient to protect biodiversity from deterioration. There are already interesting conflicts, such as the highway construction through the protected Biebrza marshes and Rospuda Valley and the illegal timber harvest in the Bialowieza area in Poland.

We believe that a focus on research support and policy pressure can have beneficial effects on biodiversity in these countries, despite the rapid economic growth. It is worth mentioning that in the newly joined countries, there is a body of well-trained experts with a wealth of natural-history knowledge. If provided with the necessary financial and infrastructural support, this cadre of professionals could better assist in reaching the aim of halting biodiversity loss.

Conservation of Marine Biodiversity and Sustainability of Fisheries

In European maritime affairs, the new focus has been on integration of sectoral policies in the new Marine and Maritime Policy (EC 2007*a*), which is complemented by a Marine Strategy Directive (MSD), its environmental pillar (EC 2007*b*), and includes a Marine Research Strategy that is now being prepared by the EU. But the main threat to marine biodiversity today is still the direct and indirect impacts of fisheries, which in Europe are regulated by the EC through the Community Fisheries Policy (CFP) (EC 2002). The use of the ecosystem approach to fisheries management included in the new CFP has the aim of developing sustainable fisheries and aquaculture in Europe. But much research needs to be done to improve efficiency of fisheries management and decrease the devastating effect of fishing on biodiversity.

The effects of climate change on marine biodiversity are also of great concern. Management measures to decrease climate-change impacts include management of fisheries, but also establishment of marine protected areas (MPAs) to decrease pressure on some ecosystems. But the effects of climate-change mitigation and adaptation measures, such as construction of coastal defenses, setting up of wind, wave, and tidal energy schemes, and storage of CO_2 in deep waters, are measures that can have large impacts on marine biodiversity. Plans to start using ocean iron fertilization to promote CO_2 uptake or growing algae for biofuels should also be followed closely. Marine spatial planning is now being promoted to address issues of alternative use of marine areas and should be informed by conservation science.

The EU Habitats Directive requires the establishment of Natura 2000 sites for marine habitat types (e.g., reefs) and species (e.g., porpoises, dolphins). These sites are now being delimited, and management plans are being prepared by governments. Input from conservation biology is crucial because much more needs to be known to design and manage a network of MPAs that effectively protects marine biodiversity and helps to maintain sustainable fisheries. The MSD of December 2007 aims to achieve "good environmental status of the EU's marine waters by 2021 and to protect the resource base upon which marine-related economic and social activities depend" by establishing European Marine Regions on the basis of geographical and environmental criteria. Conservation science can make important contributions to discussions of what "good environmental status" is and how it can be attained.

Climate Change and Movement of Species in Highly Fragmented Landscapes

The EU is leading global efforts to protect the environment and is a signatory of the Kyoto Protocol on Climate Change, the U.N. Montreal Protocol on Ozone Depletion, and a member of the U.N. Framework Convention on Climate Change. The European Commission launched the First European Climate Change Programme in 2000 and created the EU Emissions Trading Scheme and EU Greenhouse Gas Emission Trading Scheme, the first international trading system for greenhouse gases in the world. The commission launched the Second European Climate Change Programme, reviewed implementation of climate-change-related EU policies and mitigation measures, and identified new opportunities for emission reductions. With a Kyoto target of 8% CO_2 reductions by 2012, an EU summit recently endorsed proposals to undertake 20% reduction in greenhouse gas emissions by 2020 (EC 2007*d*).

Habitat fragmentation is one of the main current drivers of biodiversity loss, whereas climate change is expected to become increasingly important in the near future (Walther et al. 2002; Hulme 2005; Sutherland et al. 2006). Urbanization, agricultural intensification, and transport infrastructures have been fragmenting Europe for centuries, with the subsequent loss of landscape connectivity (EEA 2002). As a consequence, many plant and animal populations have become isolated and have lost opportunity to move or disperse. This is of special concern for Europe in the context of climate change. Species are expected to track global warming by shifting their distributions towards higher latitudes or higher elevations. Nevertheless, species with restricted ranges, specific habitat requirements, and limited dispersal abilities may be unable to migrate and colonize new areas in such a fragmented landscape, thus increasing their extinction risks. The spread of invasive species and epidemic diseases may occur faster due to climate change (Walther et al. 2002; Hulme 2005)

Enhanced by the threat of climate change, fragmentation is constraining the achievement of many EU's nature-conservation objectives (e.g., halting biodiversity loss by 2010) and effectiveness of the Natura 2000 network. One of the objectives of the EU Biodiversity Action Plan is to support biodiversity adaptation to climate change and ecological coherence of the Natura 2000 network. Guidance has been provided to maintain landscape connectivity and resilience (Kettunen et al. 2007) and the first policy document on adapting to the impacts of climate change was adopted in 2007 by the European Commission. Some related initiatives have been launched in the energy and transport sectors. For example, European transport policy advocates an optimal use of existing infrastructures before creating new ones and, at least on paper, the European transport network (TEN-T) tries to integrate environmental and conservation concerns into transport policies.

More ecological research and long-term monitoring are needed to reveal the effects of climate change on distribution of species in a highly fragmented landscape. The efficiency of dispersal corridors and stepping-stone habitats in increasing landscape connectivity should be thoroughly evaluated. We urgently need to inform policy makers and stakeholders about the importance of keeping the remaining large natural areas unfragmented to provide ecosystem and species resilience and counteract the possible effects of climate change.

Impact on Biodiversity of Rapid Land-Use Change

Although there are many drivers of rapid land-use change, two demand special attention in the European context: recreation and tourism and biofuels production.

The global recreation and tourism industry is growing with approximately 10% of world GDP now being spent in this market (Berrittella et al. 2006). This growth is likely to continue. Transportation policies that aim to reduce impacts of travel on global climate may slow growth in

the long-haul sector but may increase domestic and intraregional travel.

The Mediterranean region is one of the world's prime tourist destinations and a hotspot for biodiversity (Myers et al. 2000). Over several decades, this region has seen consistent land-use change with declines in natural and agricultural land-cover types and concurrent increases in urban and artificial land cover (Falcucci et al. 2007). The coastal plain has seen the highest rates of urbanization with, for example, 34% of the Spanish Mediterranean coast (Serra et al. 2008) and 43% of the Italian coastline (Rigoni 2003) becoming urbanized. Land conversion and increased water demand associated with tourism have a substantial negative impact on biodiversity conservation in this region (Amelung & Viner 2006).

Although global climate-change models predict increasing water stress, increasing summer temperatures are predicted to reduce tourism in the region (Berrittella et al. 2006). These models do not, however, take into account recent social and economic constraints on long-haul travel that may increase intraregional travel in Europe. Reductions in long-haul travel have the potential to positively affect the value of forested and wild land in the eastern and mountainous regions of Europe because ecotourists, typically well educated, informed, and relatively wealthy travelers (Wight 2001), may choose to travel to these regions rather than historically popular intercontinental destinations. This sector of the tourism industry, although small, is increasing faster than traditional tourism at rates of 10–30% per annum (Mehmetoglu 2006) and can have substantial localized impacts on land valuation and therefore conservation and land-use planning.

Across Europe land-use projections show large reductions in agricultural land area used for food production and increases in land used for bioenergy production (Rounsevell et al. 2006). With EU biofuel targets of 5.75% of all diesel and gasoline transport fuels by 2010 and at least 10% of all diesel and gasoline transport fuels in the EU by 2020 (EC 2003) and growth in demand currently outstripping growth in domestic supply, projections for a sustainable supply of biofuel rely not only on technological advances, but also on 1–2% per annum increases in yield over current feedstocks (EC 2007*c*). Attaining these increased yields will require further intensification in production, use of genetically modified (GM) crops, or both. European consumers remain hostile to GM crops (Verbeke 2007); therefore, further intensification of arable production, especially in agroecosystems that are currently less intensively managed, is likely. Conservation scientists must investigate the impacts this will have on biodiversity conservation and should ask how best to maintain and enhance biodiversity in bioenergy crop systems while maintaining carbon efficiency of the production system.

Along with increased arable land area devoted to biofuel production, increases in forested land area are predicted (Rounsevell et al. 2006). Nevertheless, unlike agricultural policy, which is EU dominated, forest policy is strongly national and subnational in character (Kankaanpää & Carter 2004). Therefore, it is likely that changes in forestland will differ between regions of Europe and vary through time (Rounsevell et al. 2006). The use of small round wood as an energy crop and short-rotation forestry is likely to increase as is demand for carbon-lean construction materials. The inclusion of shipping emissions in post-Kyoto climate agreements will have a major impact on forest management and related biodiversity impacts in the timber-importing countries of Europe. As with arable bioenergy systems, conservation scientists should engage industry personnel in discussions of how best to balance the often opposing needs of biodiversity conservation and efficient production.

The Value of Ecosystem Services and Biodiversity

Connected to the International Mechanism of Scientific Expertise on Biodiversity (IMOSEB) initiated by the French president Jaques Chirac in 2005, the German government during the G8 + 5 meeting in 2007 introduced the Potsdam Initiative on Biodiversity. The first task of this initiative is an assessment of the economic significance of biodiversity loss.

During an expert workshop in Brussels in March 2008, the European Commission, in close cooperation with the German government, launched a study, The Economics of the Global Loss of Biological Diversity. But can biodiversity really be valued in economic terms?

Empirical results from studies on the impact of biodiversity on ecosystem productivity are contradictory (Hooper et al. 2005). There is no clear evidence that biodiversity will increase economic yield from ecosystems (productivity). There is, however, evidence that biodiversity will increase the resilience of ecosystem processes (short-term adaptability), and there is agreement that biodiversity provides the raw material for long-term adaptability and thus productivity in changing environments through evolution.

Market-based economics seems to not be well suited to provide appropriate value of future commodities (future ecosystem productivity) even if the contribution of biodiversity to future ecosystem productivity could be appropriately quantified. In addition, market-based approaches are probably ill suited to attach a true value to common goods that are not really marketable. Therefore, attributing an economic value to biodiversity is difficult, highly subject to controversy, only going to capture direct (productivity) or indirect (recreation) material values, and thus is necessarily going to underestimate real value. Considering the difficulty of value assessment, not surprisingly, the Brussels workshop focused on improved approaches to putting value on ecosystem services as a surrogate for biodiversity. Considering the low economic

value generally attributed to biodiversity, a study such as the one launched by the European Commission may be a first step to generate awareness that biodiversity has an economic value that surpasses short-term income to be generated from development and unsustainable exploitation. More than any other policy issue, biodiversity evaluation needs to be informed by conservationists with expertise in social sciences and economics.

Discussion

The above examples are summaries of significant policy issues that pose both threats and some opportunities for biodiversity conservation. The key challenge is how can conservation science inform such large and complex policy issues? Science will always be challenged to provide the basic understanding of natural systems. But in an applied context, it is frequently the case that studies in conservation are too narrow in focus and too short-term to be of direct significance to the policy community. Add to this the inaccessibility (in terms of both location and language) of much scientific literature, and it should not be surprising that science has little influence on policy. Policy formation is influenced by many factors, of which scientific evidence is only one. Just as policy needs to be "joined up" so does conservation. Large policy commitments such as the Water Framework Directive and the Common Agricultural Policy recognize the integrated nature of human livelihoods, landscape, and use of natural resources. Conservation must similarly be integrated where it is currently segregated, for example, in terms of activities inside and outside protected areas or in terms of biological and socioeconomic perspectives.

Those who wish conservation science to count must choose their targets and, just as importantly, choose their communication tools carefully. Targets for research can be identified by unpacking the big policy issues and identifying what elements of the policy should be further underpinned by scientific evidence. An example of this might be the assumption that landscape connectivity influences the ability of species to track their climate envelope in a period of rapid climate change. It is important that "big" policy does not use this assumption as a cornerstone (or use a dumbed-down assumption such as corridors promote species movement) when the evidence is clearly equivocal and requires further research. The communication tools to deliver the information with impact are even more difficult to resolve. Scientific research often appears conflicting and wracked with uncertainty. Scientists often appear to be communicating only among themselves. Drawing conclusions from the above examples, conservation science can best influence policy by understanding the uncertainties that are relevant to policy. These uncertainties often concern pragmatic issues (often not biological), such as choosing key measures and indicators of environmental change, measures of effectiveness (or not) of policy interventions, and measures of indirect impacts of socioeconomic, transport, and energy policy on biodiversity.

In Europe the key to doing the right conservation science may rest on the ability of the policy and science communities to interact effectively to identify the questions of greatest concern. The policy community can usually identify the issues on which scientific input is required but finds it difficult to translate these into scientific questions. Conservation scientists can readily identify a range of questions of interest to them, but often lack the ability to prioritize in terms of policy relevance. Better understanding and knowledge dialogue across the science–policy interface promises major improvements in the impact of conservation science on policy development in Europe.

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Literature Cited

Amelung, B., and D. Viner. 2006. Mediterranean Tourism: exploring the future with the tourism climatic index. Journal of Sustainable Tourism **14:**349–366.

Báldi, A., and S. Faragó. 2007. Long-term changes of farmland game populations in a post-socialist country (Hungary). Agriculture, Ecosystems and Environment **118:**307–311.

Berrittella, M., A. Bigano, R. Roson, and R. S. J. Tol. 2006. A general equilibrium analysis of climate change impacts on tourism. Tourism Management **27:**913–924.

Donald, P. F., F. J. Sanderson, I. J. Burfield, S. M. Bierman, R. D. Gregory, and Z. Waliczky. 2007. International conservation policy delivers benefits for birds in Europe. Science **317:**810–813.

European Commission (EC). 1998. Communication from the Commission to the Council and the European Parliament on a European Community biodiversity strategy. EC, Brussels, Belgium.

European Commission (EC). 2001. Communication from the Commission to the Council and the European Parliament—biodiversity action plans in the areas of conservation of natural resources, agriculture, fisheries, and development and economic co-operation. EC, Brussels, Belgium.

European Commission (EC). 2002. Council regulation (EC) 2371/2002 of 20 December 2002 on the conservation and sustainable exploitation of fisheries resources under the Common Fisheries Policy. EC, Brussels, Belgium.

European Commission (EC). 2003. Directive 2003/30/EC of 8 May 2003 on the promotion of the use of biofuels or other renewable fuels for transport. Official Journal **L123:**42–46.

European Commission. 2007*a*. Natura 2000 barometer. Nature Newsletter **23:**11–12.

European Commission (EC). 2007*b*. Financing Natura 2000 guidance handbook. EC, Brussels, Belgium.

European Commission (EC). 2007*c*. The impact of a minimum 10% obligation for biofuel use in the EU-27 in 2020 on agricultural markets. EC, Brussels, Belgium.

European Commission (EC). 2007*d*. Presidency conclusions 7224/1/07 REV 1. EC, Brussels. Available from: www.consilium.europa.

eu/ueDocs/cms_Data/docs/pressData/en/ec/93135.pdf (accessed March 2008).

European Economic Community (EEC). 1979. Council directive 79/409/EEC of 2 April 1979 on the conservation of wild birds. Official Journal **L103:**1–25.

European Economic Community (EEC). 1992. Council directive 92/43EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora. Official Journal **L206:**7–50.

European Environment Agency (EEA). 2002. Paving the way for EU enlargement, Environmental issue report 32. European Environment Agency, Copenhagen, Denmark.

Falcucci, A., L. Maiorano, and L. Boitani. 2007. Changes in land-use/land-cover patterns in Italy and their implications for biodiversity conservation. Landscape Ecology **22:**617–631.

Hooper, D. U., et al. 2005. Effects of biodiversity on ecosystem functioning: a consensus of current knowledge. Ecological Monographs **75:**3–35.

Hulme, P. E. 2005 Adapting to climate change: is there scope for ecological management in the face of a global threat? Journal of Applied Ecology **42:**784–794.

Kankaanpää, S., and T. R. Carter 2004. An overview of forest policies affecting land use in Europe. The Finnish Environment 706. Finnish Environment Institute, Helsinki.

Kettunen, M, A. Terry, G. Tucker, and A. Jones. 2007. Guidance on the maintenance of landscape features of major importance for wild flora and fauna – guidance on the implementation of Article 3 of the Birds Directive (79/409/EEC) and Article 10 of the Habitats Directive (92/43/EEC). Institute for European Environmental Policy, Brussels.

Maiorano, L., A. Falcucci, E. O. Garton, and L. Boitani. 2007. Contribution of the Natura 2000 network to biodiversity conservation in Italy. Conservation Biology **21:**1433–1444.

Mehmetoglu, M. 2006. Typologising nature-based tourists by activity—theoretical and practical implications. Tourism Management **28:**651–666.

Myers, N., R. A. Mittermeier, C. G. Mittermeier, G. A. B. da Fonseca, and J. Kent. 2000. Biodiversity hotspots for conservation priorities. Nature **403:**853–858.

Nesshover, C., R. Muessner, K. Henle and I. Sousa Pinto 2008. Linking biodiversity research and policy in Europe. Ambio **37:**138–141.

Rigoni, A. 2003. Erosion of the Mediterranean coastline: implications for tourism. Parliamentary Assembly, Council of Europe, Strasbourg. Available from http://assembly.coe.int/Documents/WorkingDocs/doc03/EDOC9981.htm (accessed April 2008).

Rounsevell, M. D. A., et al. 2006. A coherent set of future land use change scenarios for Europe. Agriculture, Ecosystems and Environment **114:**57–68.

Serra, P., X. Pons, and D. Saurí. 2008. Land-cover and land-use change in a Mediterranean landscape: a spatial analysis of driving forces integrating biophysical and human factors. Applied Geography **28:**189–209.

Sutherland, W.J. et al. 2006. The identification of 100 ecological questions of high policy relevance in the UK. Journal of Applied Ecology **43:**617–627.

United Nations Environment Programme (UNEP). 2006. Migratory species and climate change: impacts of changing environment on wild animals. UNEP Secretariat of the Convention on the Conservation of Migratory Species of Wild Animals (CMS), Bonn, Germany.

Verbeke, W. 2007. Consumer attitudes toward genetic modification and sustainability: implications for the future of biorenewables. Biofuels, Bioproducts and Biorefining **1:**215–225.

Walther, G.-R., E. Post, P. Convey, A. Menzel, C. Parmesank, T. J. C. Beebee, J.-M. Fromentin, O. Hoegh-Guldberg, and F. Bairlein. 2002. Ecological responses to recent climate change. Nature **416:**389–395.

Wesolowski, T. 2005. Virtual conservation: how the European Union is turning a blind eye to its vanishing primeval forests. Conservation Biology **19:**1349–1358.

Wesolowski, T. 2007. Primeval conditions—what can we learn from them? Ibis **149**(Suppl 2):64–77.

Wight, P. 2001. Ecotourists: not a homogenous market segment. Pages 37–62 in D. B. Weaver, editor. Encyclopedia of ecotourism. Centre for Agricultural Bioscience International (CABI), Oxon, United Kingdom.