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ISWIMAN

Integrated Sustainable Wildlife Management

Principles, Criteria and Indicators
for Hunting, Forestry, Agriculture, Recreation

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ISBN_Online: 978-3-7001-7216-1

DOI: 10.1553/ISWIMAN-2

Vienna, 2013
2nd, improved edition (1st ed. 2012)
ext. German version, 2008: DOI: 10.1553 / ISWIMAB

Supported by the Man and Biosphere (MaB) Programme of the **Austrian Academy of Sciences**

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Acknowledgments
The project team wishes to thank all persons, enterprises and institutions who have supported the project and contributed to putting together the publication, in particular the Austrian Academy of Sciences and Dr. Günter Köck for subsidising the project.

We especially thank the following institutions, enterprises and persons for their crucial support: Austrian Federal Forests (ÖBf-AG, FD Johannes Wimmer); City of Vienna Forestry Office and Urban Agriculture (MA 49); Vienna Woods Biosphere Reserve (Biosphärenpark Wienerwald) Management Ltd.; Office of the Government of Lower Austria (Abt. LF4); Central Office of the Austrian Provincial Hunting Associations (Zentralstelle Österreichischer Landesjagdverbände); Fund for Environmental Studies – Tyrol (Förderungsverein für Umweltstudien, FUST-Tirol, Achenkirch, Austria); Municipality of Alland (Mayor Johann Grundner); local farmers' association Baden (DI Franz Karpf), Mödling and Tulln; Institute for Ecology (E.C.O); Mag. Bettina Jakl-Dresel (Translation).

Special thanks are similarly extended to all those who assisted this project within the framework of the project platform and to the working team of hunt-professionals and those who cooperated with that team ,all participants in the field tests as well as the expert interviews: Herwig Baumgartner (Austrian Tourist Club), Hans-Martin Berg (Nature Conservation), Erwin Chloupek (ASV Section Horse Riding), Michael Gratz (Mountain Biking, Public Relations), Gerhard Gruber (Biosphere Reserve Wienerwald Management), Johann Grundner (Mayor of the Municipality of Alland), Petrus Hakala (Wienerwald Tourism), Franz Hascher (Farmer), Friedrich Holzinger (Austrian State Forests), Andreas Januskovecz (City of Vienna, MA 49), Stephan Jeitler (Forest Management Stift Schotten), Gerhard Jonas (Mayor of the Municipality of Gablitz), Franz Karpf (Farmers' Association of Baden District), Gerfried Koch (Biosphere Reserve Wienerwald Management), Rudolf Konrad (Hunting Organisation), Gernot Kuran (Federal State Government, LF4), Günther Lauscher (City of Vienna, MA 49), Peter Lebersorger (Hunting Association), Patricia Lechner (Austrian State Forests), Günther Loiskandl (Biosphere Reserve Wienerwald Management), Alexander Mayer (Forest Inspection), Michael Neudecker (Austrian State Forests), Franz Nöstler (ARGE Horse Riding Wienerwald), Gerald Oitzinger (Austrian State Forests), Josef Prenner (Austrian State Forests), Florian Ruzicka (Biosphere Reserve Wienerwald Management), Ulrike Schimek (Hunter), Hubert Schöny (Farmer, Innkeeper, Horse Breeding), Hubert Schwarzinger (Federal State Government, LF4), Manfred Steiner (Nature Conservation Association), Christoph Stockert (Private Forest Owner, Hunter), Herbert Weidinger (City of Vienna, MA 49), Marcus Weihs (Hunting Leaseholder), Johannes Wimmer (Austrian State Forests), Ferdinand Winzer (Farmers' Association), Lieselotte Wolf (Farmer, Holiday accommodation, Horses), Simone Wagner (Biosphere Reserve Wienerwald Management).

Title photos
From top: Umweltbundesamt GmbH, I. Drozdowski, F. Reimoser, F. Heckl

ISBN_Online: 978-3-7001-7216-1 DOI: 10.1553/ISWIMAN-2

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ABSTRACT

Wild animals and their habitats are exposed to multiple impacts caused by hunting and many other often overlapping and competing land-use activities within the wildlife habitat. In particular in multiple-use cultural landscapes the interaction between the habitat requirements of wild animals, hunting interests and other land-uses often leads to conflicts that can negatively affect the sustainable conservation of native wild animal species and their habitats, the sustainability of some types of land use and of wider regional development. Stand-alone sectoral approaches to sustainable use are insufficient and often result in unintended adverse effects on other land use sectors and the relevant ecosystems. In contrast, sustainable wildlife management requires that all land-user groups in the wildlife habitat are aware of and consider the effects of their activities on both wildlife resources and other user groups.

With this in mind, concepts and tools for the integrated sustainability assessment of several land-user groups have been developed in the model region “Wienerwald Biosphere Reserve”, using the relationship between wild animals and hunting as an example. The Wienerwald Biosphere Reserve is an intensively used area for a variety of activities (particularly forestry, agriculture, hunting, and a number of leisure activities) sited near to Austria`s capital Vienna, and (as specifically envisaged for biosphere reserves) the main aim is the development and implementation of sustainable land use concepts. Applied and participatory research methods have been used to identify, analyse and evaluate key interfaces and linkages (both antagonistic and synergistic) between wildlife populations, wildlife habitats and different forms of regional land use. The main project outputs are four operational sets of principles, criteria and indicators for integrated sustainable wildlife management, focused on the major regional land-user groups forestry, agriculture, hunting, and recreational management. Hunting can have also a strong recreational aspect, but is seen here as a separate land use activity including professional and recreational hunting as well as consumptive and non-consumptive use of natural resources.

These four assessment sets are harmonised across the land-use sectors and designed as self-evaluation tools; they are to be applied by each of the four land-user groups in order to evaluate their respective influence on the sustainable conservation of wild animal species, their habitats and sustainable hunting. The assessment framework of each group also considers relevant sustainability requirements of other user groups. By focussing on the cross-cutting issue of wildlife management, the step from sector-specific towards cross-sectorally integrated assessment of sustainable use has been taken for the first time. Moreover, recommendations for integrated sustainable wildlife management and for respective monitoring have been elaborated. Project results should contribute to the avoidance, mitigation and resolution of wildlife land-use conflicts and to the integration of wild animals and their management into a sustainable regional land-use system. The land user groups of the model region comprise private, community, and public organizations. The full-length publication of the final project report (in German), including the assessment sets as annexes, is available for download at the homepage of the Austrian Academy of Sciences (Reimoser et.al 2009; http://hw.oeaw.ac.at/ISWIMAB).

1 INTRODUCTION

Background

Hunting on the one hand makes a valuable contribution to society by, for example, providing food markets with high-quality game, regulating problematic wild animal species (game damage, conveying of diseases, etc.) and improving biotopes. Sustainable hunting may contribute to avoidance of damage to agriculture and forestry, as well as to preserving both threatened animal and plant species and traditional cultural landscapes and local traditions.

On the other hand, hunting seems to be increasingly facing opposition from non-hunting societal and interest groups, which sometimes results in strongly contrasted interests and needs. Conflicts arise in particular when wild animals damage private or public goods, or the activities of persons unrelated to hunting are negatively affected by the practice of hunting, e.g. if they are restricted in exercising their urge for “freedom” or “undisturbed wilderness” to the full extent. Major conflicts also arise when hunters, on account of adverse circumstances (which may be provoked to a certain degree also by other interest groups), are not able to regulate the density of deer and similar game to meet local circumstances or wishes. In this case, forest owners are worried about their trees and forest rejuvenation; agricultural managers are threatened with losing part of their harvest and conservationists do not see why the value of rare orchid meadows should be jeopardised by, for example, excessive wild boar populations. Animal lovers and animal rights activists, again, often lack an understanding of the need to integrate wild animal populations into the cultural landscapes, or, occasionally, strongly to reduce their populations.

Hunting and the general interaction (consciously or otherwise) with wild animals (protection, observation, habitat changes, disturbance, etc.) is – along with the use of air – practically the only form of all-encompassing use of resources. Wild animals involve and affect numerous user groups and are thus a complex cross-cutting issue prone to polarise existing interests. This comes to the fore particularly with regard to leisure and recreation management, which most resembles the all-encompassing character of hunting and wildlife management at least in areas close to cities. The divergent claims to one and the same area often result in conflicts that end up negatively affecting wild animals and their habitats as well as the possibility of hunting sustainably. At the same time, they may encroach upon other claims to land use. Under a gradual and often unnoticed process wildlife habitats are tending to become smaller and increasingly fragmented, at which point problems may rapidly become acute.

The ecologically, economically and socio-culturally complex and sensitive issue of “wild animals, wildlife habitats and hunting-related use” elegantly illustrates a cross-sectoral (across land user groups) weave of interdependencies and causes. It clearly reflects that for a certain sector of use (in this case, hunting), sustainable use can only be achieved if the criteria of sustainability are harmonised to a sufficient degree with other sectors of use (even if the sector of use concerned per se meets the sustainability requirements). An isolated sectoral sustainability concept directed merely at hunting-related activities and the influence of game management upon hunting is neither able to safeguard “hunting“ as a mode of use, nor the options for practicing hunting, nor the preservation of wild animal populations and their habitats.

However, as a cross-cutting issue touching upon several interests and subjects, the “wild animals” theme harbours not only a considerable potential for conflict but also a potential for coming together, given that many people feel close to the issue. This is why in the current project, this theme was chosen as a model to exemplify the development of an integrated, cross-sectoral sustainable approach. The aim of harmonising interests between the various different functions of a Biosphere Reserve demands especially high inter-sectoral cooperation. The general aim of applying these research results is to minimise conflicts as well as to establish long-term problem-solving concepts (both preventive and curative). Natural resources have become a precious good, and joint efforts have to be made to preserve

them. In many cases, “green” interests of forest and agricultural managers, hunters and other conservationists are consistent, so that synergistic effects can be achieved (provided all players are aware of interdependencies and interrelationships.) In order for the use of the Wienerwald (at least the use relating to wildlife management) to be as free from conflicts as possible, the inter-sectoral interaction of local interest groups is to be optimised on the basis of an integrated overall sustainability concept, in order to attain sustainable regional development for all sectors involved as well as to contribute to avoiding conflicts and encroachment upon the interests of the various land users by the other land user groups.

Project goal

The ultimate goal of the project is integrated sustainable land use and its evaluation – the development of cross-sectorally harmonised sustainable wildlife management, including wild animals, their habitats and the option of sustainable hunting. The assessment system is to allow for self-examination by those land users who account for a significant impact upon the preservation of wild animal species and their habitats. In developing such a tool, conflict and synergy potentials between sustainable hunting and other regional modes of land use had to be taken into account.

The task was to develop principles, criteria and indicators for hunting and non-hunting related land user groups, with a view to integrated (cross-sectoral) wildlife management. The activities of land user groups had to be evaluated in terms of the lasting preservation of native wildlife species and their habitats as well as sustainable hunting. Therefore, self-examination by regional land user groups including their influence upon wild animals, habitats and sustainability of hunting.

On the basis of existing assessment criteria for sustainable hunting that allowed exclusively for an assessment of hunting-related activities (Forstner et al., 2001; 2003; 2006), the set of criteria was expanded to provide integrated options for assessing the activities of various different land users in terms of the effects of these activities upon the sustainability of hunting and wildlife management. Thus, an “overall sustainability assessment” was developed on the subject of “wild animals, wildlife habitats and hunting.” Existing sustainability criteria for the land use sector of “hunting” have been adapted to the Wienerwald Biosphere Reserve and widened to integrate comparable sustainability criteria for the sectors of use by agriculture, forestry as well as recreation. This allowed, for the first time, for a cross-sectorally harmonised assessment of sustainability.

Significant interfaces – in the sense of interactive fields, antagonisms and synergies relating to sustainability – between wild animals, wildlife habitats and land use sectors with relevance to wild animals were identified. There was then analysis of the degree to which these sectors had to be integrated in order to guarantee sustainable hunting and the preservation of wildlife populations and habitats.

In order to integrate wild animals and hunting into overall sustainable land use in line with the requirements of nature conservation, the terms “integrated sustainable wildlife management” and “sustainable hunting” (including wildlife populations and their habitats) were coined. They were given life and substance through an Assessment Set of Principles, Criteria and Indicators, involving ecological economic and socio-cultural aspects. From these results, recommendations were made for management that was both integrated and sustainable, as well as monitoring that sustainability (Reimoser et al. 2009).

A trans-disciplinary working approach was chosen for the project, closely involving regional stakeholders and land users and using a broad spectrum of participative research methods. (Reimoser et al. 2009). While the results, in terms of methods and procedure, user group opinions, and the definition of Principles, Criteria and Indicators in a Sustainability Assessment Set (PCI-Set) for the four land user groups, targeted the specific area under investiga-

tion (Wienerwald Biosphere Reserve), they may also suit wider application if adequately adapted to the specific region.

2 CONTEXT WITHIN THE CONCEPT OF SUSTAINABILITY

By managing and taking wild animals, hunting has an impact on a certain share of natural resources. It has thus a direct influence on the genetic diversity of individual game species, the composition of game species, and the structure of game populations, as well as an indirect influence on non-huntable animal species, plant species and soil. This influence may have effects upon ecosystems and, in some cases, has a potential for conflicting with the interests of other users of natural resources (e.g. forestry, agriculture, leisure and recreation). Wild animals, their occurrence, behaviour and suitability for hunting, are often also strongly influenced by changes in land use, infrastructure (e.g. roads, railway lines, overhead wires or conduits), and other anthropogenic factors. The present project report analyses and assesses to the greatest extent possible the manifold "non-hunting-related" factors of influence on wildlife species, their habitats and huntability, which frequently strongly limit the possibilities for hunting to be sustainable. The project report not only deals with the effects of agriculture, forestry, and leisure and recreation management upon the sustainable development of wild animal populations, wildlife habitats and hunting, but primarily with huntable wild animal species (i.e. those included in hunting laws even if they have no open season) as well as rare and threatened species.

Towards the end of the 20th century, "sustainable development" became *the* pathbreaking concept for environmental policy and resource management. The results of this project are intended to make a contribution to the implementation of the goals of comprehensive sustainable development as defined at UNCED (UNITED NATIONS CONFERENCE ON ENVIRONMENT AND DEVELOPMENT) in Rio de Janeiro, 1992, and the follow-up processes such as MCPFE (MINISTERIAL CONFERENCE ON THE PROTECTION OF FORESTS IN EUROPE). Furthermore, the sustainable use of the components of biological diversity is one of the three declared objectives of the CBD (CONVENTION ON BIOLOGICAL DIVERSITY). This Convention mainly aims at the conservation of biological diversity of ecosystems, species and populations as well as their natural genetic variability, with the goal of achieving a balance between protection and sustainable use of biological diversity.

Overarching international principles for sustainable use that provide fundamental political guidelines for the sustainable use of wild animals can be derived from the CONVENTION ON BIOLOGICAL DIVERSITY (CBD), in particular from the Ecosystem Approach (UNEP, 2000) and the Addis Ababa Principles and Guidelines (UNEP, 2004) as well as the Declarations of IUCN (2000, 2001) and the European Charter on Hunting and Biodiversity (Council of Europe, 2007). However, for specific practical implementation of the vision of sustainability as it affects the various forms of land use, operational implementation guidelines and adequate tools will be needed for assessment, monitoring and adaptive management. With this in mind, principles, criteria, indicators, standards and certification systems are being developed on an international level for several technical fields, and applied as instruments to steer the development of sustainable use.

The current project is built upon the basis of the foregoing environmental policy agreements and resulting subsequent development stages. Its intention is also in line with the IUCN Policy Statement on the Sustainable Use of Wild Living Resources adopted at the World Congress of the International Union for the Conservation of Nature (IUCN) in Amman/Jordan in 2000 (IUCN, 2000). The IUCN Policy Statement says that the use of wild living fauna and flora, provided it is sustainable, may also be defined as an instrument of nature conservation and may contribute to the preservation of biological diversity. This is also valid for hunting. There is no application to those protected areas, such as wilderness areas, national parks, etc., in which any consumptive use is by definition not admitted in the entire or in parts of the protected area (except e.g. fishing or bee-keeping). The present project also intends to make fundamental contributions to implementing goals of the Convention on the Protection of the Alps (ALPINE CONVENTION, 1991), as contained, for example, in the Protocols on the Con-

servation of Nature and Landscape Management; Regional Planning and Sustainable Development; Mountain Forests, as well as Tourism.

Development may be described as sustainable if it meets the needs of the present without compromising the ability of future generations to meet their own needs (BRUNDTLAND & UNCED, 1988). In general terms, "sustainable use" of natural resources may be defined as a form and intensity of use that

- seeks a balance between protection and use;
- takes into account the limits of ecological carrying capacities and functioning of ecosystems;
- does not exceed the regenerative capacity of renewable biological resources;
- is socially just and balanced;
- allows equal use of resources, qualitatively and quantitatively, by present and future generations.

From an ecological point of view, sustainable use means in particular preventing human action from exerting an irreversible impact on global resources and from exceeding local limits of the resilience of ecosystems. Sustainable use of natural resources has to give preference to maintaining the functioning capacity of an ecosystem in order to guarantee that all material and immaterial services and functions of the natural environment are maintained on a lasting and even basis. Ecologically sustainable hunting should not be focussed on hunting the maximum sustainable yield in terms of population growth. On the contrary, a variety of qualitative aspects ought to be taken into account. In particular, the diversity of species, populations and genetic variability but also of habitats and of the characteristics of natural scenery has to be preserved. Austria, too, has committed itself to integrating the recognised principles of ecological, social and economic sustainability into all fields of social and economic policy and all levels of decision making. (FEDERAL MINISTRY OF ENVIRONMENT, 1995; AUSTRIAN FEDERAL GOVERNMENT, 2002).

In accordance with the "three pillars" of sustainability, this project also intends to take into account the economic and socio-cultural components along with the ecological ones. A fundamental goal is to maintain, for example, the economic profitability of hunting while at the same time preventing potential damage caused by game management. It is also important for hunting to be in conformity with the objectives of the latest standards of animal welfare. The contribution hunting makes to sustainable societal development, as well as its readiness to assume responsibilities need to be reflected in the perception hunters have of their of their own activities. This should also be true of the self-perception of other land user groups which have impacts on wild animals and on hunting.

Criteria and indicator systems are recognised assessment tools that allow an examination of the sustainability of various forms of use as well as of whether sustainability goals have been reached. Assessment approaches of this kind have been developed for application to various sectors of use, such as forestry, agriculture, or fishery. For the sector of hunting, the existing gap was closed by preliminary work in this project (Forstner et al., 2001, 2003, 2006). Sustainable use of wildlife habitats and wild animals can only be successful if all land user groups active in a wildlife habitat are aware of the effects of their activities upon wild animal resources as well as upon other user groups, and if the need for sustainability raised by other user groups are considered to the greatest extent possible by one's own group. This requires integrated, inter-sectorally harmonised approaches to sustainability for an overall sustainable use of land, as well as practical implementation at a regional level. So far, however, hardly any practical cross-sectoral instruments of assessing sustainable use have been available (Hartje et al., 2003), nor have methods for developing cross-sectoral criteria and indicators been established (Linser, 2001).

Thus, it was necessary initially to establish an adequate assessment method. Building on the preliminary works mentioned above, a transparent and (as far as possible) objective assessment system was developed, in close co-operation with the interest groups concerned, for allowing different land users to self-examine their activities regarding wild animals, wildlife habitats and hunting. The present principles, criteria and indicators for integrated sustainable wild animal management have been conceived as a voluntary aid for self-assessment. They are intended to provide an incentive for determining how much one's own position contributes to sustainability as well as for challenging or critically examining one's own way of acting.

3 METHODS

3.1 STUDY AREA

The “Wienerwald Biosphere Reserve” model region is situated in the East of Austria, west of the City of Vienna. It is a hilly mountainous region at an altitude of between 200 and 890 m above sea level. The area comprises the north-eastern Alpine foothills.

Most of the region is forested and subject to forest management. Non-forest regions are agriculturally managed or settlement areas (villages). On account of its proximity to the large City of Vienna, the entire region is highly frequented for recreation.

In the Biosphere Reserve, there are 52 municipalities within seven Lower Austrian administrative districts of about 282,000 inhabitants, as well as seven municipal districts of Vienna with an overall number of inhabitants of about 477,000. The Biosphere Reserve encompasses an area of 1,054 km^2.

Village in Biosphere Reserve Wienerwald (photo: F. Reimoser)

Wildlife management, hunting and wild animals

The land owners are entitled to hunt. They may either lease hunting to other hunters or hunt themselves, provided they have passed a hunters’ examination and own a contingent area of a minimum of 115 ha.

With regard to hunting methods, hunting from stands (seats, butts or other fixed points) is the most frequent method (about 70 %). Stalking is rare. Driven hunts (hunting with dogs, boar drives, etc.) primarily serve the purpose of regulating wild boar populations.

Wild animal species

The relatively high biodiversity of the Wienerwald is reflected in the variety of huntable species (regulated by hunting laws) and other wildlife. Open ranges and large-scale forest areas vary, with the latter providing important cover for wild ungulates (“cloven-hoofed game”). The species inventory ranges from grey partridge (*Perdix perdix*), pheasant (*Phasianus colchicus*) and hare (*Lepus europaeus*) in flat regions to wood grouse (capercaillie) (*Tetrao urogallus*) and chamois (*Rupicapra rupicapra*) in areas with Alpine characteristics. The most important species in terms of hunting management are roe deer (*Capreolus capreolus*), wild boar (*Sus scrofa)*, red deer (*Cervus elaphus*) and chamois, hare, pheasant and Eurasian

woodcock (*Scolopax rusticula*) as well as fox (*Vulpes vulpes*), badger (*Meles meles*) and stone marten (*Martes foina*), with the four cloven-hoofed species being most important in terms of profitability.

Game damage

Browsing damage to young forest trees is caused by deer, roe deer and chamois. De-barking damage by deer occurs in more mature forest and wild boar damage crops.

Forest

About 62 % of the total Wienerwald area is forest (Flesch & Fraissl, 1994). Beech is the most characteristic tree (Mayer, 1974). The largest contingent forest areas are at the centre of the Biosphere Reserve. Toward the edges, the Wienerwald fragments into smaller forest areas. The percentage of forest-covered areas of the Wienerwald municipalities varies widely between 0.3 % (Brunn am Gebirge) and 82.3 % (Klausen-Leopoldsdorf).

Agriculture and open land

The term “open land” refers to surfaces not covered by forest or settlements and comprises mainly arable surfaces and grassland, but also small-scale landscape elements such as hedges, field and path edges, single trees and bushes, planted shrubby strips, slopes, shrub communities along brooks, quarries, or rocks. The forest-covered area accounts for about two thirds of the overall territory of the Wienerwald Biosphere Reserve; almost 30 % of the total area can be characterised as open land, while the remaining area is settled (building and transport surfaces, infrastructure) (AVL/Becker et al., 2004).

Arable farming accounts for slightly more than 50 % of the total agriculturally managed area of the Wienerwald. On about two thirds of the arable land, corn is grown, with winter wheat (about 25 % of the arable land) and maize (about 20 %) dominating. About 8 % of the arable land lies fallow (set-aside). About 40 % of the farmed area is grassland, with mowable meadows accounting for approximately one fifth and extensively used grassland for about one tenth. (Statistics Austria, 2001). Vineyards and orchards taken together make up about 3 % of the agriculturally managed area (ARGE Wienerwald, 2002).

Leisure and recreational use

The Wienerwald has been a traditional area of recreation since the 19th century. On account of population growth in the City of Vienna and many Wienerwald municipalities – about two million people live in the Wienerwald area and its environs – recreational “pressure” upon the Wienerwald has mounted considerably over the last decades. Today, the Wienerwald is characterised by very intense and almost all-encompassing recreational use.

Recreational use is mainly non-motorised and bound to trails and paths. The most common recreational uses are hiking, jogging, bicycling, mountain biking and horse riding, accounting for a high density of marked trails and paths for the user groups mentioned. The average density of paths of the marked network is about 2.1 km/km². Areas larger than 5 km² that are not dissected by paths are rare in the Biosphere Reserve.

3.2 Participatory research methods

Project structure

For the present project, a trans-disciplinary research approach was chosen, with a strong focus on methods and elements of participative and co-operative research, continuously adapted to the course of the project and current developments. The aim was to integrate trans-disciplinary principles into the project design from the outset and to closely involve stakeholders over the entire course of the project.

Figure 1 gives an overview of the course and interplay of key working steps as well as their allocation to thematic working packages (WP):

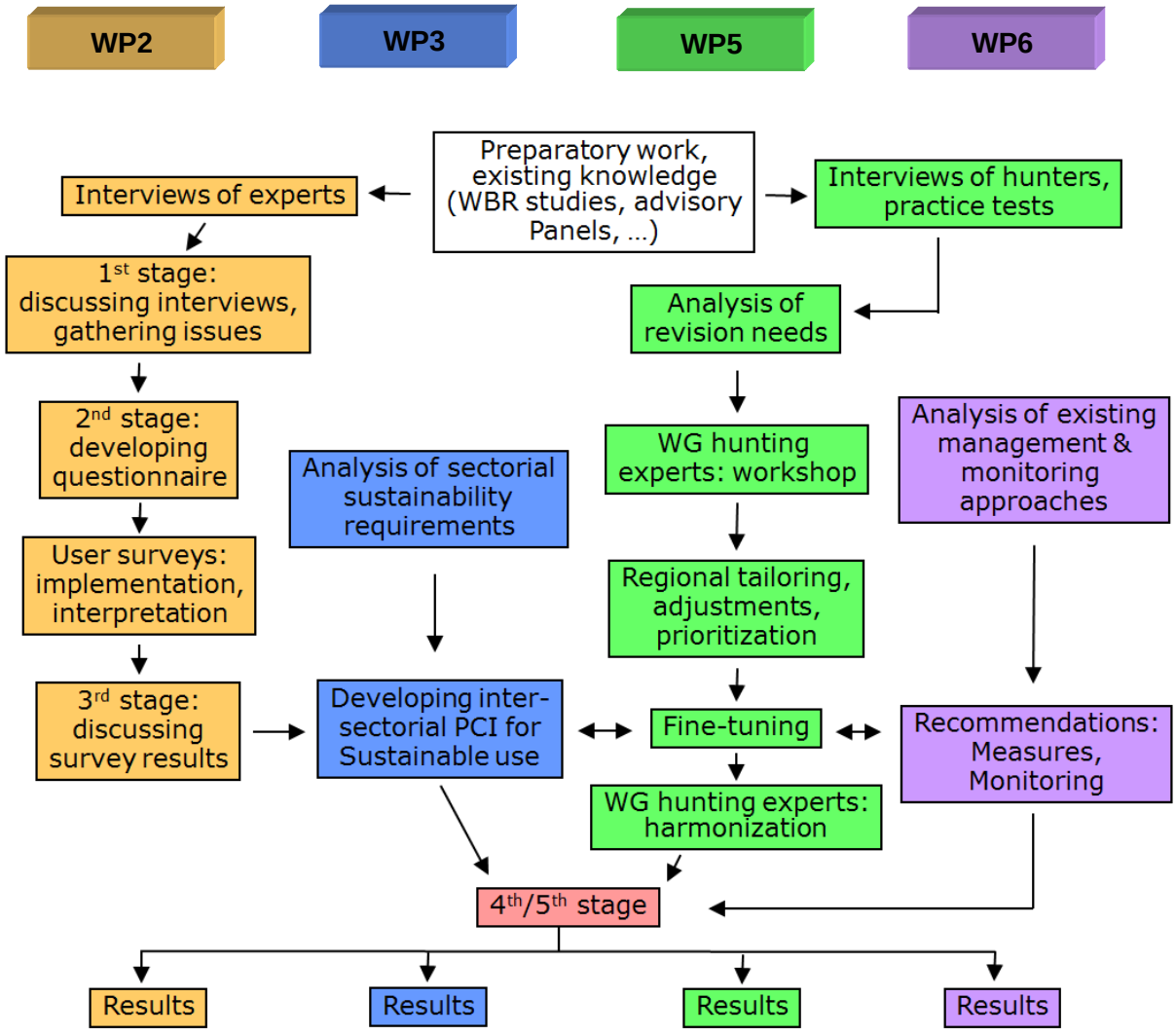

Figure 1: Schematised workflow and interplay of working steps

The understanding of trans-disciplinary research on which this project is based is guided by the relevant literature and rests strongly on recognised “good practice” principles of participation, good governance and procedural fairness (a. o.: Hirsch Hadorn, 2005; Pohl, 2004; Umweltbundesamt, 2006; Arbter et al., 2005; ÖGUT, 2003, 2004a, 2004b; Lexer, 2004; Daniels & Walker, 1997; European Commission, 2001; Ohl et al., 2008; Anand, 2001; Albin, 1993).

In particular sustainable wildlife management must integrate and respect numerous actors (hunters, forest managers, agricultural managers, authorities, NGOs, persons seeking recre-

ation, land owners, etc.) interlinked via a complex social texture and representing different interests. In the area under investigation, the Wienerwald Biosphere Reserve, wild animals, hunters and other land users share a very limited space. The dynamic interaction of these components results in a broad variety of interrelationships. Thus, each "participant" depends on the others. The true challenge of sustainable wildlife management is thus not so much the management of wild animals but the management of human use: "*The real problem of wildlife management is not how we shall handle the animals (…) the real problem is one of human management*" (A. Leopold, quoted in: Manfredo et al., 1996). A sectoral approach to dealing with problems will thus not suffice. A dialogue between all land users and interest representatives as well as high acceptance of management measures is the only way to guarantee wildlife management along sustainable lines.

The participatory process was instrumental in demonstrating options for a better understanding or feeling for the human dimension within management processes relating to the Biosphere Reserve and in finding broad acceptance for voluntary restraint on the part of all land users.

The fact that findings from the participatory process were considered recommendations, rather than legally binding agreements and plans for wildlife management in the Wienerwald Biosphere Reserve, was of key significance for this project. Results can be merely considered by political decision makers and voluntarily applied by political decision makers and land users in the Biosphere Reserve. Negotiations leading to binding agreements between land users and the implementation of results were not within the scope of the present research project.

Interviews of experts

In the course of the project, several hours of exploratory telephone interviews were conducted with the help of interview guidelines. The guidelines primarily served to orient the conduct of the conversation by the interviewer and were flexibly adapted to each situation.

The interviews of experts primarily served the purpose of gathering information. They were conducted with selected representatives of various regional use categories (agriculture, forestry, nature protection, hunting, recreation and tourism, spatial planning and municipal politics) that exert an influence upon sustainable wildlife management.

Interviews of users and visitors

The conception, planning, implementation and interpretation of interviews of users and visitors of the Biosphere Reserve were central to the second project year. The social-empirical investigation concentrated on ascertaining awareness of the issues in general, and on the state of knowledge of the various different users regarding the effects of their actions upon wild animals, habitats and sustainable wildlife management, as well as on registering synergies and conflicts of interest between the various user groups. The aim in interviewing specific user groups was to sharpen, deepen and supplement knowledge on interactive fields ("interfaces") between (i) wild animals / wildlife habitats, (ii) hunting-related wildlife management, and (iii) relevant other user groups of the Wienerwald. The interviews further aimed at ascertaining the respective awareness of group-specific impacts upon wildlife resources and problems relevant to wild animals.

Participative platform associated with the project

A representative regional project forum named “Sustainable Wildlife Management” was chosen as a primary project-related participative organ. It closely involved representatives of relevant regional land user groups, enterprises and land owners in the project (Fig. 1).

The participants in the forum were regionally established key figures with close ties to the project topics. They came from agriculture and forestry, hunting management, tourism and recreational use, nature protection, spatial planning and municipal politics where they fulfilled various roles (managers / land users, land owners / land owners’ representatives, interest representatives, representatives of authorities, science / research). In order to reflect the core subject of the project, the interfaces between wild animals, hunting and other regional modes of land use, the composition of the platform by group affiliation was determined by the interface-oriented conception of the project approach (see Section 3.3).

3.3 DEVELOPMENT OF INDICATORS FOR AN INTEGRATED APPROACH

3.3.1 Nature of the problem

The basic idea underlying the project was that wildlife resources (wildlife habitats, wild animal species, individual wild animals, their distribution and behaviour) as well as their huntability are influenced not only by hunting but also by many other aspects of land use and human activities. The fact that wild animals, hunting and other claims to land have to share one and the same limited space, results in a variety of interactions between and among land user groups as well as between land use and wild animals; this often leads to conflicts, antagonisms and competitive relationships that may have a detrimental effect on sustainability of each land use as well as on the conservation of native wildlife species and their habitats, and on the sustainability of regional land use systems. This is particularly true with regard to multiple-use cultural landscapes such as the Wienerwald Biosphere Reserve.

Concepts of sustainability, including criteria and indicators for their assessment and monitoring of sustainable use, have been developed and applied in recent decades for several sectors of land use. A long-existing gap with regard to hunting was not closed until recently through the development of Criteria and Indicators for Sustainable Hunting in Austria (Forstner et al., 2001, 2003, 2006; Umweltbundesamt, 2005). Regardless of progress in the attempt to define sustainability for various different sectors of land use and render it measurable and traceable, there is still a unmet need for cross-sectoral, integrated approaches to sustainable use. This need results from the experience and recognition that sectoral approaches to sustainability alone are insufficient and may even be mutually counterproductive, if interrelationships, interdependencies and conflicts between the sectors are not taken into account. Efforts toward sustainability by one sector may entail negative effects upon other sectors, or the ecosystem concerned, without the actors even being aware of it. The options for hunting to realise sustainable use of wild animals, for example, are often limited and overlapped by multiple influences of other land user groups upon wildlife resources and their hunting management. Analogously, this applies to influences of hunting upon other claims to use land and their non-hunting-related wildlife management. However, sustainable use of wildlife habitats and wild animals is only likely to succeed if all land user groups acting within a wildlife habitat are aware of the impacts of their activities upon wildlife resources, as well as on other user groups, and if the needs of other user groups are considered to the greatest extent possible in one’s own land use. This requires integrated, inter-sectorally harmonised approaches to sustainability for an overall sustainable use of land, as well as its operationalisation for application on a regional level. So far, however, there have been hardly any practical cross-sectoral instruments for assessing sustainable use (Hartje et al., 2003), nor have

operational methods for developing cross-sectoral criteria and indicators been published to a significant degree (Linser, 2001).

Wildlife resources were particularly suitable for this project because wild animals are a cross-sectoral "matter" that are, so to speak, at the focus of user interests overlapping, competing and often conflicting in one and the same area. Wild animals are thus, from the point of view of many land use requirements, both a conflicting and potentially uniting element, with user conflicts often having highly negative practical impacts upon wild animals.

The integrated assessment system that has been developed provides a basis for integrating wild animals and their management into sustainable land use in a way which is as conflict-free as possible.

3.3.2 Conceptualisation and system delimitation

At the centre of the project were relevant interfaces between wildlife resources, sustainable hunting and non-hunting modes of land use. "Interfaces" in the sense of the project approach were defined as interactive fields, interrelationships, mutual influences and cross-linkages between three significant system components:

i. wildlife resources: wildlife habitats and wild animal guilds (communities of wild animal species, wild animal species, wild animal populations, individuals and genetic variety);

ii. hunting practices;

iii. non-hunting-related sectors of land use and/or user groups whose activities exert an influence upon wildlife resources and the sustainability of hunting (forestry and agriculture, leisure and recreational use, transport, etc.) and may themselves be influenced by hunting and wild animals.

Interfaces in this sense result from activities (measures, actions), or the failure to take action on the part of hunting and non-hunting land users, their impacts upon wild animals and wildlife habitats as well as the interdependencies between all three system components. The interdependencies may be of antagonistic or synergistic nature. It was the interactive fields relevant to sustainability that were of primary interest for the present project. Those interdependencies that potentially influence (limit, prevent or foster) sustainable options of use of the other user groups were especially relevant .

Thus, those interactive fields are project-relevant that have positive or negative effects upon:

- sustainability or options of sustainable use of one or more user activities (hunting, forestry, agriculture, leisure and recreation);
- sustainable preservation and fostering of wildlife habitats and native wild animal guilds rich in species and/or other environmental resources exploited by the land use concerned (forest vegetation, arable crops, etc.);
- overall sustainable development (ecological, economic and socio-cultural) in the region.

In practice, the "*interfaces*" designed in this way are, as a rule, sustainability-relevant problem and conflict fields or synergy potentials regarding the relationships between wild animals, hunting and other sectors of land use in the Wienerwald Biosphere Reserve.

Figure 2 schematically depicts the *Interface Concept* as envisaged by this project.

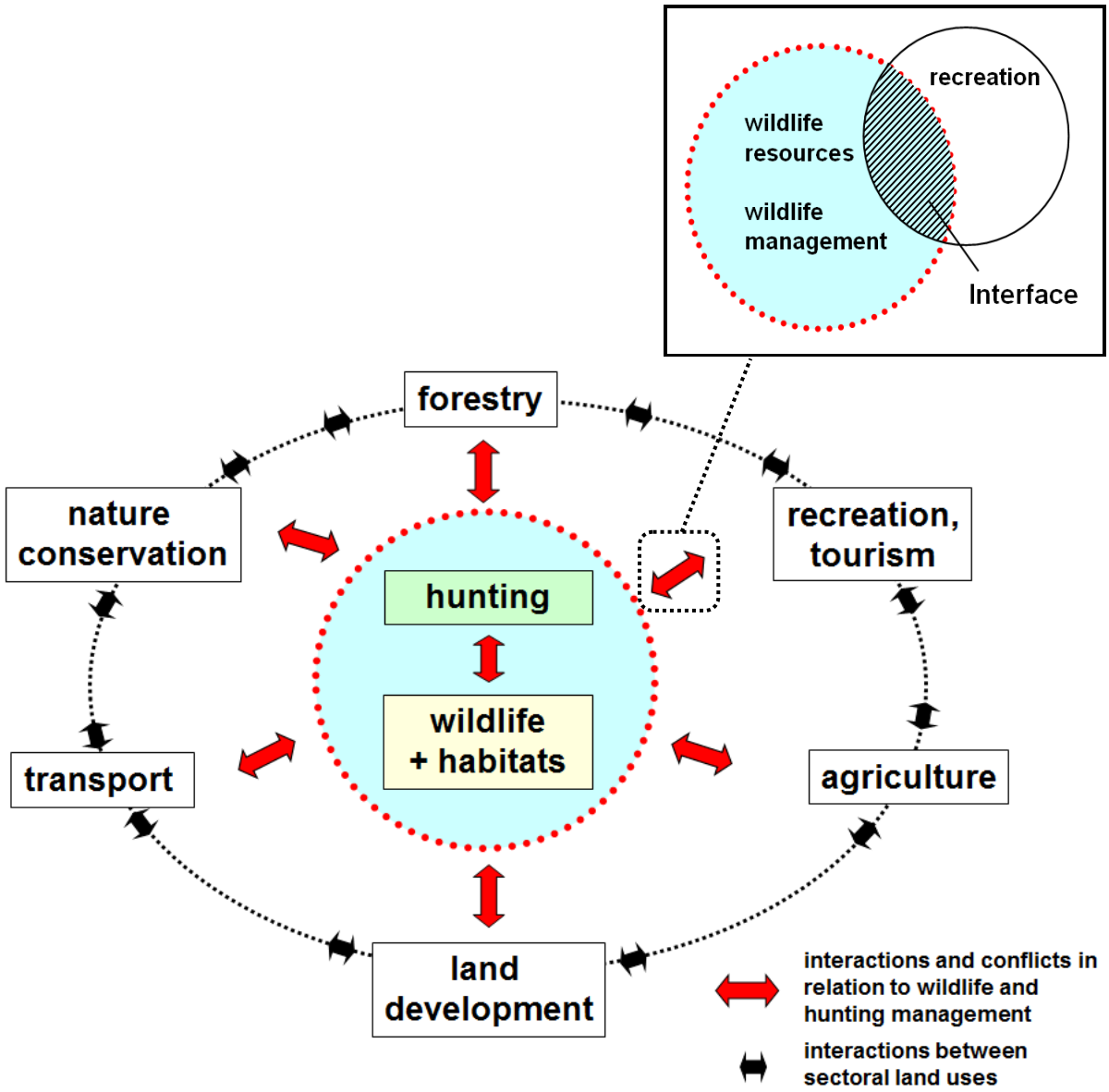

Figure 2: Schematic outline of the Interface Concept

Explanations regarding Figure 2: Project-relevant interactive fields (conflicts, synergies) are symbolised by red double arrows. The topics of the project are the interdependencies of wild animals and wildlife habitats on the one hand, and hunting-related wildlife management on the other; for the mutual influences of this sub-system (central circle in the figure), regionalised indicators for sustainable hunting have been developed. The topics of the project are also the interdependencies between other forms of land use and the sub-system hunting/wild animals. The interdependencies between the non-hunting-related sectors of land use among each other (black arrows) were not explicitly investigated within the scope of this project; the topics of investigation were always interactive fields immediately related to wild animals and/or hunting (red arrows). Indicators were to be developed in the course of the project for

the common intersection of wildlife resources, hunting and one other land user group relevant to wild animals (displayed as examples in the insert box at the top of the figure).

Forestry, agriculture and recreational use turned out to be the activities in the Biosphere Reserve with the strongest conflict potential for wild animals and hunting. This enabled Figure 2 to be simplified; in co-operation with the Project Forum, it was decided to develop cross-sectoral sustainability indicators only for forestry, agriculture and recreation. The system within which cross-sectoral Sets of Principles, Criteria and Indicators were developed is displayed in Figure 3. The Figure is to be interpreted analogously with Figure 2.

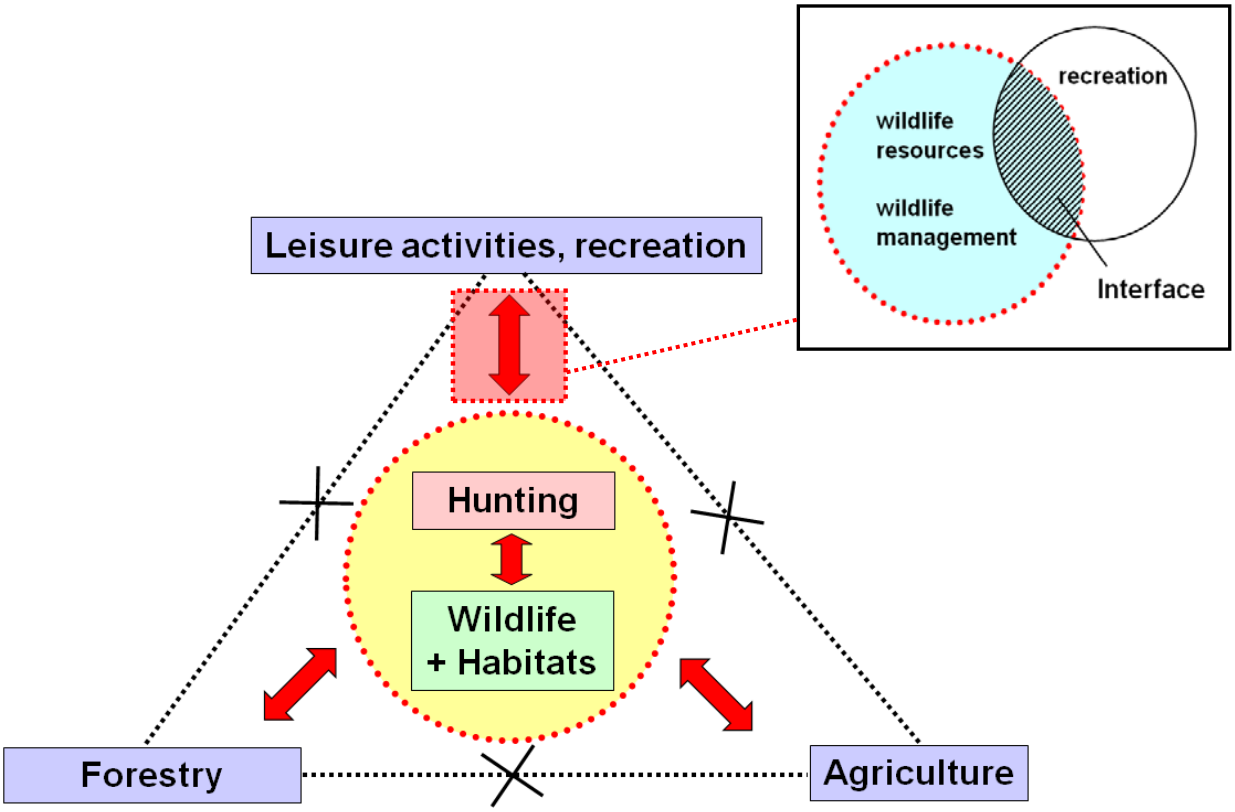

Figure 3: Specific system delimitation for the development of Indicator Sets for cross-sectoral sustainable wildlife management. Red arrows: interdependencies considered. Black crosses: interdependencies not immediately considered.

The interface concept applied for the inter-sectoral development of indicators is further specified in Figure 4. At the centre of the project are those interfaces (mutual influences) that are to be interpreted as the common intersection of i) wild animals and habitats, ii) hunting, iii) activities of other land user groups (forestry, agriculture, leisure and recreation) and iv) regional overall sustainability.

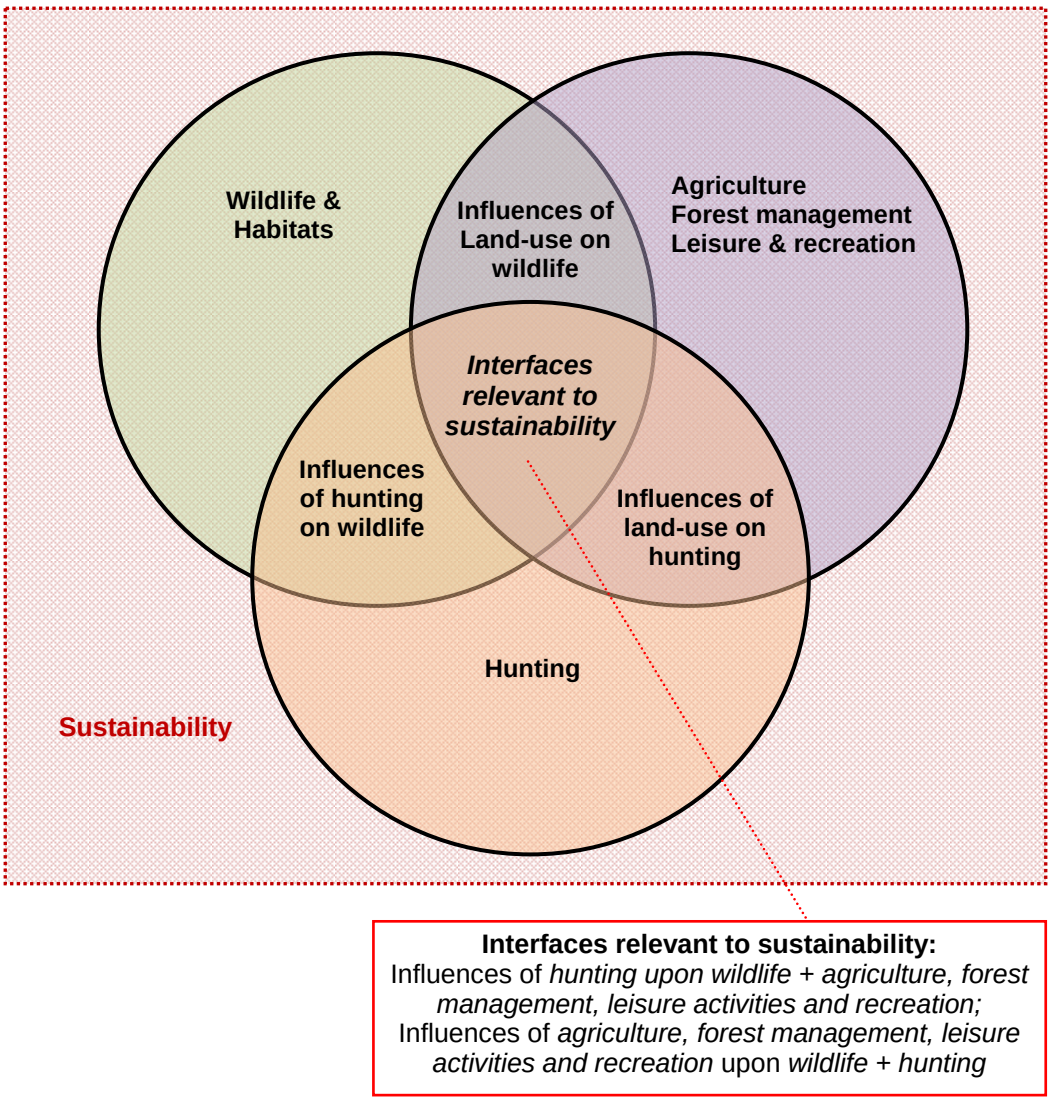

Figure 4: *Schematic outline of ecological, socio-economic and socio-cultural fields of influence as well as interfaces relevant with regard to sustainability*

The following figure 5 is a schematic outline of the **impact model** (interactive fields, interfaces, dependencies, interdependencies) using the example of Hunting – Biological diversity (Figure 5).

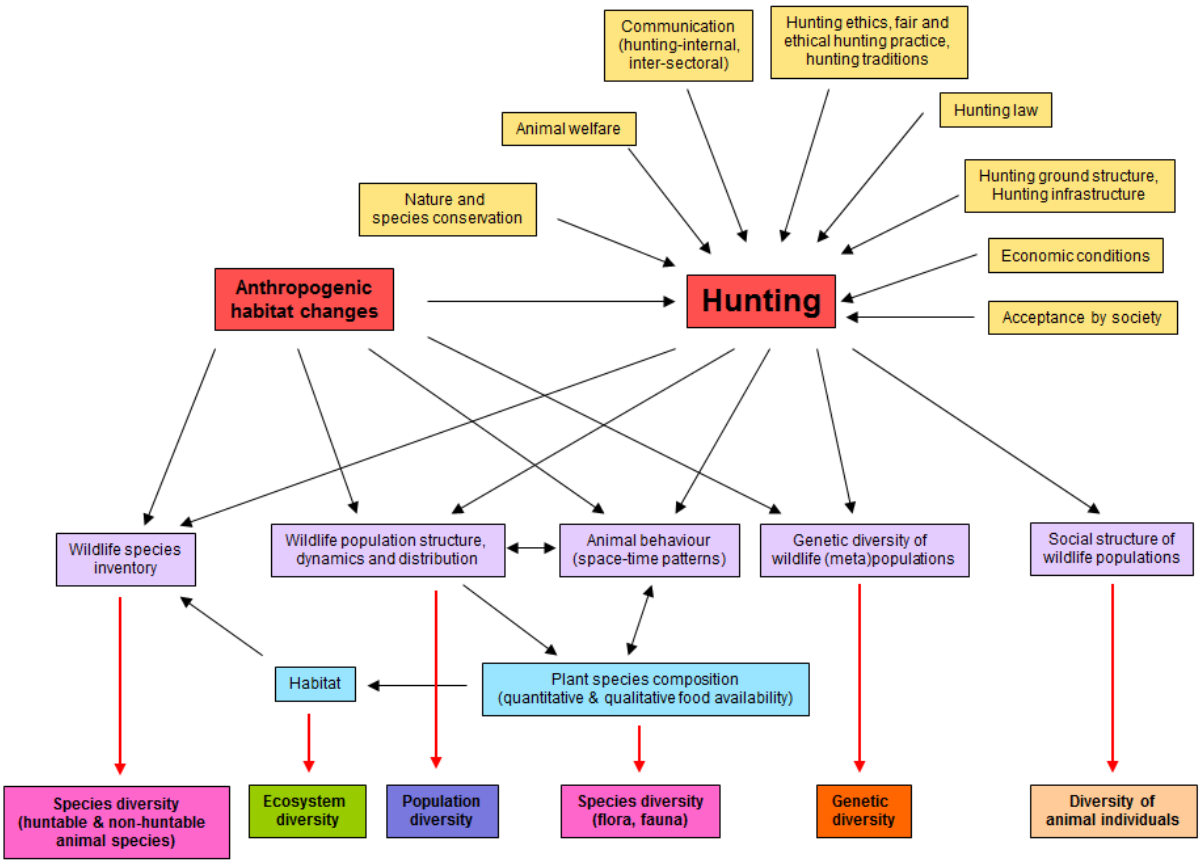

Figure 5: Impact diagram Hunting – Biodiversity (schematic, simplified)

3.3.3 Identification of interface issues

The development of inter-sectoral indicator sets is based on the identification of issues giving rise to interfaces. They comprise key problem areas, as well as conflict and synergy potentials between wild animals, hunting and other land user groups in the Wienerwald.

For the present project, these interfaces were identified mainly on the basis of the following sources of information:

- knowledge in the project team of the investigated area
- literature studies
- results of interviews of experts
- results of user surveys
- discussion with stakeholders in the Project Forum

Interfaces had to fulfil at least the following project definition criteria, of relevance to:

- wild animals and wildlife habitats; these had to be directly or indirectly affected;

- hunting and land use: hunting / hunters and a minimum of one further regional sector of land use had to be directly or indirectly affected (e.g. via the resource used);
- activities: relevance to taking part in or refraining from activities by non-hunting-related regional groups of land users;
- regionally: there must be relevance, at the least as an opportunity or threat;
- to sustainability: there must be actual or potential effects upon the sustainability of one or several sectors involving the use of the (wildlife) resources (for benefits from protection, sustainable use, etc.) and/or on the sustainable regional development as a whole (preventing, limiting or fostering possibilities of sustainable use).

For each of the user groups selected (forestry, agriculture, leisure and recreation), a list of inter-sectoral interfaces and issues was compiled (see Section 4.2).

The interface issues defined from the list of inter-sectoral subjects can be grouped into four thematic categories:

1) Habitat quality

2) Wild animals

3) Game damage

4) Value and practice of modes of use

As the inter-sectoral sets of indicators to be developed display, in the form of a common intersection, the influences and potential influences of land use activities on wild animals and habitats, one key question of the interface analysis is this: How do individual modes of land use and/or user groups influence the sustainability of wild animals and hunting? The following closer definition of the four categories mentioned above helped to specify the question: By way of what changes of what parameters of the four categories – habitat quality, wild animals, game damage as well as value and practice of modes of use – can land use activities influence the sustainability of wild animal populations and hunting?

1) Habitat quality

- Food availability
  - potentially and actually available food
  - seasonal variability
  - spatial distribution (dynamic)
  - quantitative and qualitative food availability
  - natural grazing availability, feeding
- Availability of cover
  - lounge area (where animals are found under average conditions of predation and weather: zones for rest, breeding, social communication and well-being, and avoiding stress)
  - cover (protection against predators / visual cover / shelter against impacts of climate / weather)
  - spatial distribution of cover and grazing areas

- Attractiveness of terrain / habitat
  - sum of available food and cover
- Habitat usability
  - disturbance (anthropogenic: hunting pressure, recreational use, etc.; predators, competitors)
- Homerange (species-specific minimum territories, excursive and interaction areas)
  - effectively usable habitat area
- Habitat permeability
  - fragmentation, artificial barriers
  - accessibility of territory
  - relief, natural barriers to mobility
  - natural and artificially constricted corridors
  - migration routes, migration corridors, game routes (diurnal rhythm, seasonal routes; local / regional / supra-regional routes)
  - measures of newly linking or re-linking up of territories (technical wildlife crossing aids, biotope linking, etc.)
- Habitat qualities
  - obligatory (grazing, water, cover) and facultative partial habitats / resources / other requirements
- Biotic (habitat-dependent) biotope carrying capacity

2) Wild animals

2.1) Individual:

- Spatio-temporal wild animal behaviour
  - space use behaviour
  - activity patterns (seasonal, diurnal)
  - need for security, avoidance of predators, escape reaction, escape distance
  - mortality (natural, by humans, road kills, etc.), reproduction
  - migration
- Hunting influences (disturbance of wild animal behaviour)
- Condition, vitality, health
- Energy balance

2.2) Population:

- Population size, population density
- Social structure (age, sex structure)
- Population dynamics (fertility, reproduction rate, mortality rate, rate of increase)
- Spatio-temporal wildlife distribution
  - diurnal space use behaviour (gaining and leaving cover, etc.)

  - wildlife concentration, core areas
  - source / target areas of migration movements
- Intra-specific social behaviour (mating times, hatching times, etc.)
- Intra-specific competition
  - density-dependence of population dynamics
  - territorial behaviour
- Hunting influences (disturbance of wildlife behaviour)

2.3) Biocenosis:

- Species composition
- Inter-specific competition (resources, area, niches)
- Predation (predator-prey-relationships)
- Parasitism

3) Wildlife damage

- to agriculture and managed forest cultures:
  - economic (damage-dependent) biotope carrying capacity
  - susceptibility or tolerance to game damage (agriculture and managed forestry)
  - changed patterns of spatial and temporal habitat use (on account of disturbance, etc.)
  - changes in spatial-temporal habitat usability (on account of disturbance, etc.)
  - changes in food availability (lack of grazing, feeding, reduced availability of food, etc.)
  - habitat changes
  - changed attractiveness of biotopes (settlement incentive) and distribution of wildlife
  - population growth (increased game damage pressure on account of more game)
  - hunting-induced excessive game densities (insufficient harvesting)
  - increased need for barking / browsing
  - economic goals and goals in terms of regional culture
- to persons and motor vehicles:
  - wildlife accidents (damage to persons, material damage)
- transmission of diseases:
  - wild animals as vectors for diseases of pets and livestock (e.g. excessive densities of wild boars increase the risk of conveying diseases to domestic pigs; avian influenza)
  - wild animals as vectors for human diseases (e.g. ticks, avian influenza)
  - consumption of polluted game (e.g. radioactivity, etc.)

4) Value and practice of modes of use

4.1) General:

- Reduction of quality of land use on account of competition between modes of use and conflicts owing to multiple use and/or overlaps (mutual disturbances)
- Actual limitations of use for one or several modes of land use on account of competing or conflicting claims to using the same areas

4.2) Hunting value and hunting practice (hunting possibilities):

- Disturbance of hunters and hunting operations, or taking account of these, on the part of other forms of use within the hunting territory and in the wildlife habitat
- Limitation of the freedom of hunting practice and hunting possibilities (voluntarily or in terms of private law, sovereign rights) by other use (e.g. avoiding of shooting in core zones voluntarily or by stipulation in hunting leases)
- Non-hunting influences upon huntability of wildlife (hunting success, planning of shooting, time spent on hunting)
- Aesthetic hunting values: dependence of subjective recreational values of hunting on peace and quiet and undisturbed nature
- Material value of hunting: dependence of the market value of a hunting operation on exterior conditions such as disturbance, shaping of the natural hunting-territory conditions and the wildlife habitats through existing non-hunting-related use, infrastructure of the hunting territory, development and accessibility, routes to reach and location of the hunting territory; cost / expenses for game damage compensation, wildlife protection and hunting prevention measures, markers on hunting territories, etc.
- Dependence of the (economic and aesthetic) hunting value on the existing wildlife species inventory, population sizes dependent on wildlife species and possible numbers of animals to be shot, i.e. hunting bags. Adaptation of hunting strategies, methods and techniques to non-hunting-related conditions
- Harmonisation, exchange of information, communication with land owners and other user groups

4.3) Recreation:

- Spatial limitations on recreation (e.g. as a result of obligations to stay on trails/paths, restriction of horse riding and mountain biking to particular trails, re-location of paths in core protection zones, limitation of certain forms of use to marked territories, specific zones reserved for hunting and forest management)
- Temporal limitation of recreational use (e.g. through seasons or times of day for mountain bikers and horse riders, dates for gathering mushrooms, etc.)
- Prohibition of certain leisure activities (e.g. certain motor sports vehicles)
- (Informal / non-binding) rules of behaviour (e.g. with regard to noise, leashing of dogs, etc.)

4.4) Forest management:

- Wildlife damage:
    - lower yield and greater impracticality, or impossibility, of attaining forest management objectives (rejuvenation goals, goals in terms of forest development)
    - higher costs of measures to protect vegetation against browsing or de-barking, to rejuvenate or restore, to cultivate, and to monitor wildlife damage

  - jeopardising or negatively impacting cultural forest functions of regional public interest (aesthetic, religious, educational, health and recreational functions)
- Harmonisation of operational planning, forest management and timber harvest measures with wildlife habitat needs and hunting-related requirements
- Taking into account susceptibility to wildlife damage in forest management (choice of tree species, felling techniques, etc.)
- Monitoring and control of shooting
- Expenditure of time for harmonisation with hunting tenants and wildlife damage negotiations

4.5) Agriculture:

- Wildlife damage:
  - reduction in yield on account of damage from feeding and uprooting
  - costs of wildlife exclusion measures (fences, etc.)
- Harmonisation of agricultural planning and practises with hunting (harvest, mowing, sowing, shooting areas, etc.)
- Taking into account susceptibility to wildlife damage in planning decisions (choice of cultivation and crops, etc.)

4.6) Nature Conservation:

- Hunting management in core conservation zones: potential jeopardising of nature conservation goals through hunting in core zones; limitations on hunting practises in core zones (e.g. shooting sightlines, siting and design of hunting installations, feeding areas, etc.)
- "Ecological" wildlife damage: impairment of natural forest development by excessive wildlife populations, destruction of meadows valuable for nature conservation through grubbing and wallowing by wild boars, destruction of nests and loss of young of species relevant for nature conservation by wild boars and carnivores
- Changes in species composition on account of unbalanced preservation of wildlife species attractive to hunters (cloven-hoofed game, pheasant)
- Introduction of non-native wildlife species, sub-species and races (danger of hybridisation)
- Hunting of protected or threatened wildlife species (Habitats Directive; Birds Directive; IUCN Red List))
- Hunting of game predators and "vermin" (crow family *Corvidae*, etc.)
- Establishment of cultivated deer pastures (grazing land on agricultural land) on areas of value for nature conservation
- Biotope improvement measures disadvantageous in terms of nature conservation (e.g. establishing biotope structures in sensitive habitats)
- Shooting of threatened, rare or protected species owing to insufficient knowledge of species or other confusion
- Application of non-selective hunting measures (permitted or prohibited)
- Use of lead ammunition

3.3.4 Function and application of the PCI-Sets

The guiding principle in developing the Assessment Set was the sustainable conservation of native wildlife species and their habitats by way of integrated, i.e. cross-sectoral sustainable wildlife management. The objective of the Sets is to make the sustainability of regional modes of land use open to scrutiny with regard to their impacts upon wild animals, habitats and sustainable hunting. Taking the example of wild animals and wildlife habitats, integrated sustainable use is divided into three areas: ecological, economic and socio-cultural sustainability. The overriding meaning of "sustainability" is, in this context, that the use of the natural resources of "wild animals and habitats" is possible both now and in the future (for future generations) with the available resources remaining qualitatively equal. The integrated understanding of sustainability that provides the basis of the Assessment Sets demands in particular that sustainability requirements for hunting are not impaired by the sustainability requirements of other land user groups,, and vice versa.

On an individual basis, the Assessment Sets have to fulfil the following tasks:

- enable self-examination of sustainability of one's own activities regarding wild animals, habitats and hunting and/or other land uses;
- support the analysis of individual strengths and weaknesses;
- assist in taking into account one's own influence upon wild animals, habitats and sustainable hunting;
- facilitate the derivation of measures to optimise sustainability;
- measure progress in implementing sustainability requirements (efficiency review);
- allow for monitoring of changes in sustainability;
- provide an incentive to question one's own practice of land use (awareness-building, learning effect).

The task of the Assessment Set is thus to allow for voluntary self-examination of one's own practice of land use and, if necessary, provide aids for decision-making for a more sustainable approach to future land use practices.

3.3.5 Interrelationship of the Assessment Sets

What the four PCI-Sets (Hunting, Forestry, Agriculture, Leisure and Recreational Use) have in common is the potential contributions of each land user group to sustainably preserving and restoring wildlife habitats and wild animals.

The difference is in that the PCI-Set for hunting relates, above and beyond this objective, to interfaces with all of the other three land user groups (forestry, agriculture, leisure and recreational use), while the PCI-Sets for forestry, agriculture and leisure and recreational use each relate exclusively to the interfaces with sustainable hunting (Figure 6).

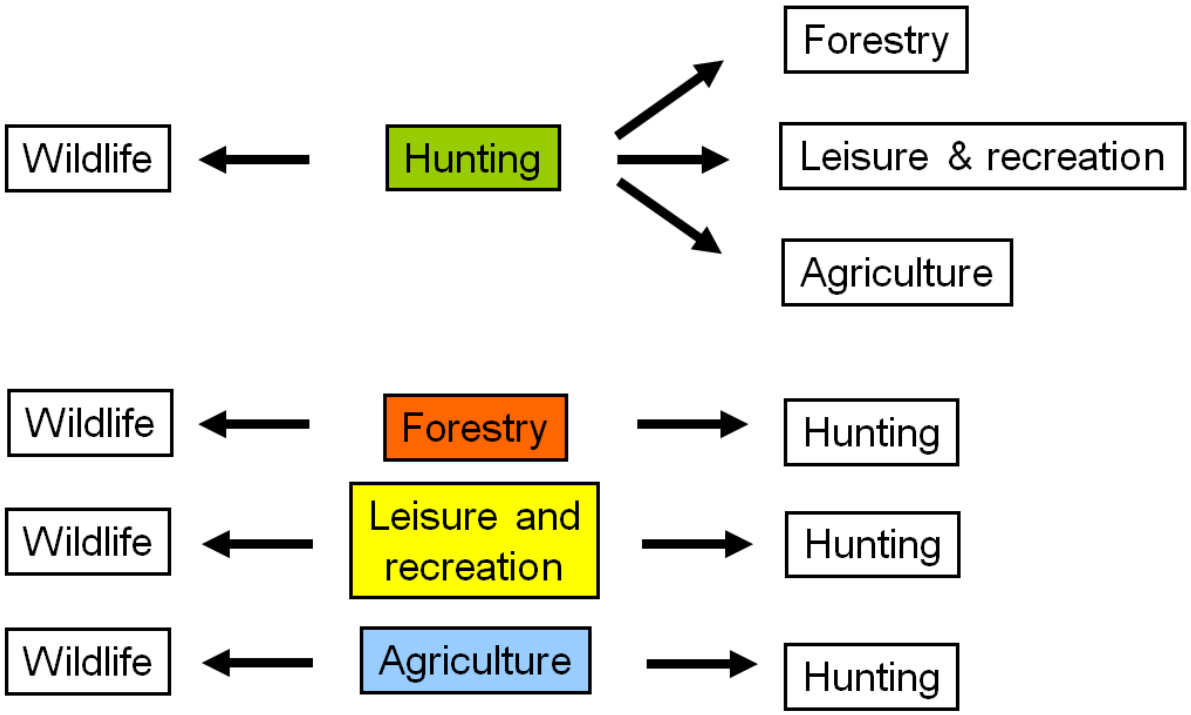

Figure 6: Common features of and differences between the four inter-sectoral Assessment Sets

The further contextual design as well as structure of the four Sets is explained in greater detail in Section 4.2.1, which also contains extensive user instructions.

3.4 GUIDELINES FOR MANAGEMENT AND MONITORING

In the course of the participative development process and involving the project forum, short versions were “extracted” from the full versions of the four Assessment Sets to make it easier for people to become familiar with the assessment procedure and with sustainable management. The short versions comprise about half of the indicators of the respective full version, with particularly important or easy-to-evaluate indicators being selected by majority vote of the working group accompanying the project.

In addition, responding to suggestions by the practitioners, a second way of becoming engaged in the assessment via the PCI-Sets was established. For each of the different groups of users, an additional list of potential measures desirable for guaranteeing sustainability was drawn up. For these measures (or groups of measures), links with the respective indicators and/or indicators for which they might be relevant are given. For those who prefer to become involved in the sustainability assessment via general measures pertaining to their activities, there is thus an option to arrive at the respective indicators of the PCI-Set via the given indicator numbers, and then start the evaluation of their activities relating to the issues of “Hunting, Wild Animals and their Habitats.”

Tables were used to display rules, concepts and instruments which were already being used in the Wienerwald Biosphere Reserve for the management of nature areas and wild animals in the context of sustainability of wildlife and hunting and which provide interfaces for integrating the sustainability criteria developed in the project (at least analogously) or measures resulting from them. The tables give starting points for realising sustainable management

measures, for different groups of users, in the PCI-Sets. Some examples demonstrate possibilities for integrating sustainable management into guidelines and for establishing rule networks. Moreover, building upon existing monitoring instruments in the Wienerwald Biosphere Reserve, there are already opportunities for comprehensive sustainability monitoring (Reimoser et al.2009). These options go beyond monitoring by repeated assessment via the PCI-Sets.

Eventually, special recommendations for sustainable management in the core zones of the Biosphere Reserve were worked out and harmonised with the working group of different land users associated with the project. This was what the project forum in the participative process had intended, given that the PCI-Sets relate to the entire Biosphere Reserve and do not bear separate reference to core zones (about 5 % of the Biosphere Reserve area). In the core zones (nature conservation areas for the protection of natural processes), the PCI-Sets for agriculture and forestry do not apply, as these areas are no longer subject to agricultural or forest management.

4 RESULTS

4.1 INTER-SECTORAL INTERFACES

On the basis of the results of interviews of experts, surveys of users, consultations and discussions within the scope of the Stakeholder Forum, as well as regional and expert knowledge of the project team, significant inter-sectoral interfaces (wild animals / wildlife habitats – sustainable hunting – other land user groups) were identified for further consideration. From the viewpoint of the three user groups of forest management, agriculture, and leisure and recreation management, lists of interface issues were drawn up (for more detail of the conceptual design and methodological aspects of the interfaces, please see Section 3.3).

4.2 PRINCIPLES, CRITERIA AND INDICATORS

4.2.1 Content-related design of the assessment sets and user instructions

Four inter-sectoral Sets of Principles, Criteria and Indicators for Integrated Sustainable Wildlife Management have been developed for application by the user groups of hunting, forest management, agriculture and leisure and recreation management. The Assessment Sets are designed for voluntary self-examination by hunters, forest managers, agricultural managers and persons responsible for the planning and management of leisure and recreational use in the Wienerwald Biosphere Reserve. Their purpose is to allow for examining the respective activities of the four user groups as to the sustainable preservation of native wildlife species and their habitats; the Sets are specifically tuned to covering key interfaces (interactive fields, interdependencies) of sustainable hunting and the claims to sustainability by other groups of users. The assessment extends exclusively to potential influences of one's own respective user group upon sustainable hunting in connection with the sustainable preservation of wild animal populations rich in species and wildlife habitats, taking into account the interests of the respective other land user groups in favour of overall sustainability.

The Annex of the present report contains a full version of each of the four Assessment Sets (see Section 8). In addition, short versions of each Set are given, representing a selection of prioritised indicators highlighted in the Annexes. The full and short versions are thus integrated in the respective Set. The titles of Principles, Criteria and Indicators for the four Assessment Sets are presented as a synoptic overview in Section 4.2.2.

4.2.1.1 Starting kit for the busy reader

The sustainability assessment is made via questions that assign point scores to indicators. If readers/users decide to take a short cut to the indicators, they need to be aware of the content of the criterion which the indicator addresses, as well as of the content of the governing principle, before making an evaluation. Also, they need to be clear to which aspect of sustainability the respective principle, criterion and indicator belongs (ecological, economic or socio-cultural). This is the only way assessment questions for the indicators can be correctly interpreted. Each of the structural levels (principle, criterion and indicator) gives additional information and offers explanations which tend to be important for understanding the assessment questions. For a synoptic table of all principles, criteria and indicators, readers are referred to Section 4.2.2.

The assessment framework presented here addresses itself to hunters, forest managers, agricultural managers and the leisure and recreation management of the Wienerwald Biosphere Reserve, in particular to persons responsible for the management units of the respective user groups. It serves the purpose of a voluntary examination of the sustainability of wildlife management through self-assessment. On the basis of the list of assessment criteria, the degree of sustainability of one's own practice of land use can be evaluated, in order to identify its strengths and weaknesses and to provide assistance for decisions in favour of a more sustainable future practice of land use, if such decisions need to be made.

The assessment considers a variety of activities of the land user group addressed by the respective Set, as well as of wild animals subject to hunting law. In the Sets of the user groups of forest management, agriculture and leisure and recreation management, the assessment further refers to the interfaces with sustainable hunting practice. The Set for hunting also addresses interfaces with the other three sectors. Animal species not subject to hunting laws that closely interact with wildlife species relevant in terms of hunting law are touched upon but are not immediate subjects of the assessment. The prevailing spatial unit assessed is the management area of the respective group. In principle, however, the assessment is also applicable to larger territorial units. The period of assessment is the current or preceding calendar year. In some cases, longer periods of time are chosen. Ideally, the sustainability assessment ought to be based on a management concept existing in writing or in thought (management plan, operating protocol, hunting code of practise, etc.).

For individual indicators which, on account of specific local conditions, may not be applicable to all spatial units, a "neutral" option without score can be allocated. If this option is chosen, the relevant indicator is dropped from the evaluation. However, it is important to note that the calculation of the overall total score for each aspect of sustainability will then be reduced by the highest possible score of the relevant indicator.

4.2.1.2 Range of application and frame of reference

Guiding principle

The guiding principle in developing the four Assessment Sets was the sustainable conservation of wild animal species and their habitats in the Wienerwald Biosphere Reserve through integrated, i.e. cross-sectoral sustainable wildlife management. The four Sets are designed to make sustainability of regional modes of land use examinable as to their impacts upon wild animals, habitats and sustainable hunting practice. Integrated sustainable use on the basis of the example of wild animals and wildlife habitats can be divided into three sectors: ecological, economic and socio-cultural sustainability. "Sustainability" in this context means that the use of the natural resources of "wild animals and wildlife habitats" is possible at the same level for current and future generations. The integrated understanding of sustainability underlying the Assessment Sets implies in particular that the claims to sustainability of hunting are not impaired by other land user groups, and vice versa.

A major objective of the present inter-sectoral Assessment Set is to integrate sustainable hunting (Forstner et al., 2001, 2003, 2006) with the sectoral approaches to sustainability of other types of land use.

What are the activities referred to?

The assessment for each of the four Sets exclusively refers to the activities of the land user group addressed by that Set. The assessment addresses all matters, modes of behaviour, actions and omissions, and their impacts under the direct influence of the respective user group. Influences which user groups other than those addressed by the respective Set exert upon wild animals, their habitats and wildlife management are to be treated as outside the

sustainability examination, even if they strongly overlap the activities and influence of one's own user group.

The activities referred to by the four different Assessment Sets are, as follows:

Hunting: The subject of the assessment is exclusively the sustainability of hunting-related activities (measures, actions, omissions) and their active influence upon the sustainable conservation of native wild animal species and their habitats. The manifold non-hunting-related influences exerted upon wild animals, their habitats and hunting possibilities by agriculture, forestry, leisure and recreational activities, transport, development of settlements, industries, and other forms of land use, which shape the conditions under which hunting takes place and often impose themselves on the influence and scope of hunting, are not subject of the hunting-related sustainability examination. At the core of the assessment are potential contributions by hunters to secure and restore wild animal populations rich in species as well as their habitats, and the economic and socio-cultural sustainability of hunting itself. For an assessment of possible impacts of other user groups (forest management and agriculture as well as leisure and recreation management), separate Sets with their respective principles, criteria and indicators have been developed.

Forest management: The assessment exclusively refers to the active potential of forest-management-related activities (measures, actions, omissions) for influencing the sustainable conservation of native wildlife species and their habitats as well as the sustainability of hunting. The numerous non-forestry-related influences exerted by hunting, agriculture, leisure and recreational activities, transport, construction of settlements, industries and other sectors of land use upon wild animals, their habitats and their huntability, which may often strongly overlap the activities and influence of forest management, are not part of the sustainability examination. Possible contributions of forest managers and forest owners to secure and restore wildlife populations rich in species and their habitats, as well as to promote sustainable hunting are at the core of the assessment. For an assessment of how other user groups (hunting and agriculture as well as leisure and recreation management) may influence the sustainability of wild animals, wildlife habitats and hunting, separate Sets with their respective Principles, Criteria and Indicators have been developed.

Agriculture: The assessment exclusively refers to the active potential of agricultural activities (measures, actions, omissions) for influencing the sustainable conservation of native wildlife species and their habitats as well as sustainable hunting practice. The numerous non-agriculture-related influences exerted by hunting, forestry, leisure and recreational activities, transport, construction of settlements, industries and other sectors of land use upon wild animals, their habitats and their huntability, which may often strongly overlap the activities and influence of agricultural management, are not to be considered in this sustainability examination. Possible contributions on the part of agricultural managers to secure and restore wildlife populations rich in species and their habitats as well as to promote sustainable hunting are at the core of the assessment. For an assessment of how other user groups (hunting and forestry as well as leisure and recreation management) may influence the sustainability of wild animals, wildlife habitats and hunting, separate Sets with their respective Principles, Criteria and Indicators have been developed.

Leisure and recreation management: All recreation other than hunting is here put into one category, covering all seasonal activity and including anglers, gatherers of fungi and plant products, wildlife watchers, riders, dog-walkers and others taking exercise in the country. However, the assessment exclusively refers to the active potential of planning and management measures (actions, omissions) pertaining to leisure and recreational use of influencing the sustainable conservation of native wildlife species and their habitats as well as sustainable hunting practice. The individual behaviour of persons pursuing leisure and recreation, however, is not directly addressed in this context. The numerous other influences exerted by hunting, forestry, agriculture, transport, construction of settlements, industries and other sectors of land use upon wild animals, their habitats and their huntability, which may often

strongly overlap the activities and influence of leisure and recreation management, are not the subject of this sustainability examination. Possible contributions on the part of leisure and recreation managers to secure and restore wildlife populations rich in species and their habitats, as well as to promote sustainable hunting, are at the core of the assessment. For an assessment of how other user groups (hunting, forestry, agriculture) may influence the sustainability of wild animals, wildlife habitats and hunting, separate Sets with their respective Principles, Criteria and Indicators have been developed.

Reference to inter-sectoral interfaces

Inter-sectoral interfaces are defined as interactive fields (interrelationships, interdependencies) between the four sectors of land use selected. The basic character of the reference to inter-sectoral interfaces of the four Assessment Sets is mainly distinguished by the following feature: While the Sets for forest management, agriculture and leisure and recreation management each relate to the interfaces with sustainable hunting, the hunting-related Set takes into account the interfaces with all of the three other land user groups (see Section 3.3.5).

Who are the actors referred to?

The four Assessment Sets apply to each of the following four regional groups of land users in the Wienerwald Biosphere Reserve: hunters, forest managers and agricultural managers, as well as leisure and recreation management. On an individual basis, the four Sets relate to the following groups of actors:

Hunters: The hunting-related Assessment Set refers to hunters and persons concerned with hunting (including land owners/persons owning the right to hunt). The users to which the assessment framework is addressed are primarily the actors within the local assessment unit concerned (hunting ground, “hunting ring”) who are responsible for hunting (e.g. owners of a hunt, owners of a proprietor’s hunt, game tenant, other hunting customers with longer-term contracts, land owners); not so much those hunters who hunt only for a short period of time in the area assessed or who do not have any decision-making capacity regarding sustainable hunting practice (e.g. guest hunters or hunters by permission of land owner/game tenant who pay per day or per bagged animal). The persons responsible for hunting-related activities in the respective territory are responsible for ascertaining that the above-mentioned group of persons practice hunting in accordance with the criteria of sustainability.

Forest managers: The Assessment Set for Forest Management directs itself at forest managers and persons involved with forest management. The user group addressed by the assessment system consists primarily of the actors responsible for forest management in the relevant unit of assessment (forestry operation, forest district or similar forest management unit, private forest property). This comprises all persons responsible for the planning and implementation of forest-management-related measures. These are in general forest managers including the personnel responsible for forest management (forest managers, heads of forest districts), managers of forestry operations and forest owners. Land owners are also addressed, because in the Wienerwald Biosphere Reserve forest management is mostly closely linked with property (as opposed to the systems of timber utilisation permits or forest management permits that are common in e.g. Eastern Europe, North and South America).

In the case of the *owners of small forests or small agricultural lands*, it should be noted that, as a rule, owners of small forests are members of hunting co-operatives. Contracts (lease contracts, etc.) are commonly not concluded by the individual owner of a small forest but by his or her representatives in the hunting co-operative. The unit of assessment is thus, as a rule, not the individual forest owner but the hunting ground or hunting management community. Accordingly, the assessment of sustainability ought to be made by the land owner representatives responsible for the respective hunting ground. Forest owners are, however, free

to examine their own attitude regarding the sustainability criteria assessed in this framework. This may be of particular interest if his or her position is not fully reflected within the hunting co-operative.

Agricultural managers: The Assessment Set for Agriculture applies to agricultural managers and persons involved with agriculture. The user group addressed by the assessment system consists primarily of the actors responsible for agriculture in the respective spatial unit of assessment (agricultural enterprise). This comprises all persons responsible in any way for the planning of agricultural measures and their implementation. These are, as a rule, managers, heads of agricultural operations or owners of agricultural lands or agricultural operations. Land owners are also addressed, since in the Wienerwald Biosphere Reserve, forest management is mostly closely linked with property (as explained above).

With regard to *owners of agricultural lands*, it should be noted that agricultural managers – depending on size and contiguous character of their property – are often at the same time also persons entitled to hunt and lessors of the right to practise hunting. By exercising their responsibility as land owners entitled to hunt, e.g. via the phrasing of lease contracts, farm managers may also contribute to sustainable hunting, in particular in terms of the economic and socio-cultural aspects of sustainability. Owners of smaller plots of agricultural land are, as a rule, members of hunting co-operatives. Contractual regulations in terms of hunting laws (lease contract, etc.) are generally not concluded by the individual small forest owner but by his or her representatives in the hunting co-operative. In this case, the examination of sustainability ought to be made by the land owner's representative responsible for the respective hunting territory; the unit of assessment would then be the hunting territory concerned. Every owner of agricultural land is, however, free to examine his or her own attitude with regard to the sustainability criteria given in this Set. This may be of particular interest if his or her views are not fully expressed or represented by those of the hunting co-operative.

Leisure and recreation management: The Assessment Set for leisure and recreation management relates to persons involved in the planning and management of outdoor leisure and recreation in the Wienerwald Biosphere Reserve. The user group addressed by the assessment system consists primarily of persons responsible for planning and management measures in the respective spatial unit of assessment (the respective area of responsibility of the planners and managers). This comprises persons and organisations representing groups of people that benefit from the recreational use of the Wienerwald Biosphere Reserve. It also includes officials and decision-makers responsible for the planning, regulation and control of leisure and recreational activities. This group of actors includes in particular the Biosphere Reserve management, municipalities, regional managing bodies, tourism federations and associations, alpine associations, sports associations and other representatives of certain recreational user groups (horse riders, mountain bikers, hikers, gatherers of fungi, wildlife watchers, anglers etc.), land owners and representatives of relevant authorities. *Individuals* pursuing leisure or recreational activity are, however, not directly addressed.

Ecological Reference

What the Assessment Sets for all four land user groups have in common is their reference to interactions with wild animals and wildlife habitats. The assessment thus concerns the influences of actions relating to hunting, forest management, agriculture and leisure and recreation management upon wild animals (genes, individuals, populations, species, communities of species) and upon their habitats.

The range of application of the assessment framework covers primarily those wild animal species (mammals, birds) that, on account of hunting laws, fall under the competency of hunting (furred game, winged game). This comprises species with shooting seasons, species with a year-round closed shooting season, as well as potentially other species subject to

hunting law. Unless otherwise indicated, the terms “game” and “wild animals” are used in this sense.

The term “wildlife habitat” is used to describe the “living space” or “site” (habitat) of wild animal populations and/or individuals of a wildlife species. The spatial delimitation of a wildlife habitat is defined by the habitat needs of the wild animals. The wildlife habitat must meet the key habitat functions (food, cover and reproductive space). Wild animals have species-specific requirements regarding habitats, their size and their quality. Environmental factors (such as noise, temperature, light, climate, water, soil, etc.) must not exceed or fail to meet the species-specific tolerance limit of the wild animals. The wildlife habitat may consist of several separate habitat sections (several partial habitats).

However, in ecosystems, all components are directly or indirectly interlinked and interdependent (Heckl et al., 2003). This is why even seemingly insignificant hunting measures may produce unforeseen effects in quite different parts of an ecosystem without the actors being always conscious of the interrelationships (Fig.7). Thus, animal species not subject to hunting law (e.g. small mammals, insects, small birds, amphibians, reptiles, fish, domestic and domesticated animals) as well as plant species are also indirect subjects of this assessment framework, in so far as they are in close ecological interaction with species relevant in terms of hunting laws (predator-prey relationships, competition, etc.) or may otherwise be affected by hunting (e.g. through measures of biotope management or if mistaken for huntable wildlife species of great similarity).

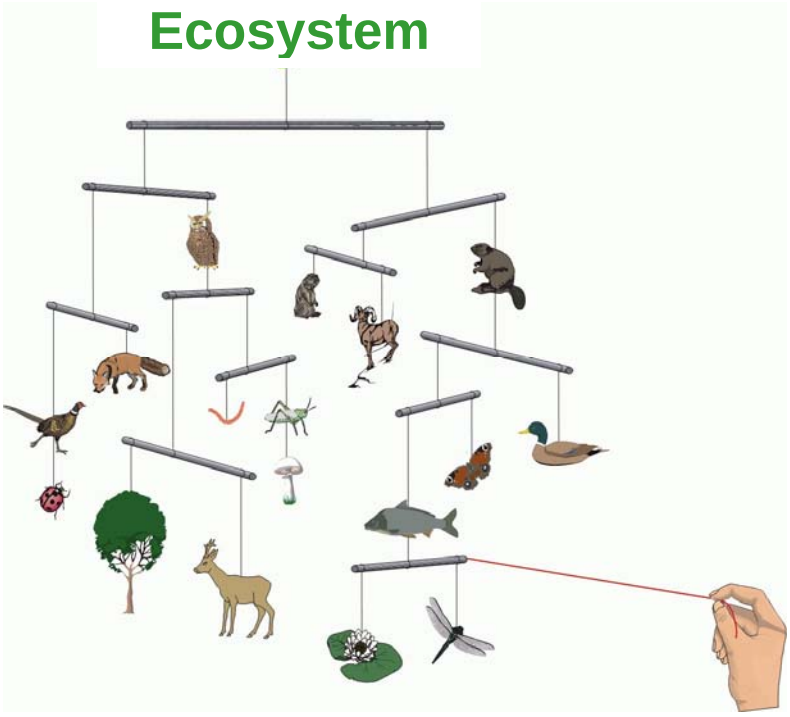

Figure 7: In ecosystems, minor interventions in one place may have major impacts in other places, without the causing actors necessarily being aware of this (Source: Forstner et al., 2006).

Time reference

In terms of time, the assessment refers to the status quo. This is in most cases the current calendar year or, where necessary, the preceding calendar year. Instructions for some indicators may, however, show the need to look at an earlier reference period.

The Set of Criteria and Indicators may also be used as a monitoring instrument which can detect and trace qualitative changes in sustainability over time and thus development trends.

Spatial reference

The spatial units of reference chosen for the assessment are the operative management units for which the user groups addressed have primary responsibility. The concrete spatial units of assessment are as follows:

Hunting: the hunting district (hunting ground, hunting territory, operation) or the "hunting ring" (group of hunting districts with the same goals and management alignments)

Forest management: the forestry operation, forest district or similar forest management units, the forest land owned; for owners of small forests, see "Who are the actors referred to?" (above)

Agriculture: the agricultural operation; for owners of small agricultural lands, see "Who are the actors referred to?" (above)

Leisure and recreation management: the area of responsibility of the relevant planners and managers, ranging from individual municipalities to the entire Biosphere Reserve.

An integration of larger units of assessment is possible in principle and is advantageous.

The *Assessment Set for Hunting-related Activities* can be used as an evaluation instrument across the limits of hunting territories and hunting rings, e.g. on the level of (partial) regions or wildlife-ecologically homogeneous nature areas (valleys, landscapes, etc.). A wider perspective is important in particular for large-scale, contiguous wildlife habitats, and for wide-ranging wildlife species such as red deer, wild boar and brown bear, but also for numerous bird species.

With regard to the *Assessment Set for Agriculture* and the *Assessment Set for Forest Management*, in case of operations whose management areas are not contiguous, an integrated assessment across the limits of the individual management areas may be advisable.

Conditions for Application

A major condition for being able to assess the sustainability of land use, in particular by hunting, forest management and agriculture, is the existence of management concepts, operating plans, etc.

For forestry operations and larger agricultural enterprises, this may be taken for granted in terms of good operational practice. Regarding hunting, too, the existence of a hunting concept is an important prerequisite for assessing sustainability. A hunting concept is to be understood as a tool for planning ahead hunting activities. In most cases, there will be some kind of a hunting concept (often simply in the responsible persons' minds). In order to allow an assessment on the basis of the present indicators as well as in general for a long-term orientation of hunting practice, there should be a written hunting concept that gives clues as to goals and measures regarding the area assessed in terms of sustainable hunting. Drawing up such a hunting concept requires an awareness of factors and measures contained in the Set of Principles, Criteria and Indicators of this Section; its application demands sufficient awareness of the issues which are significant for sustainable hunting.

Limitations of Application: It cannot be ruled out that specific cases of application may occur in which certain conditions that cannot be changed by the person responsible for hunting, or the agricultural and forest manager, etc., make it difficult to meet fully certain examination criteria of the Assessment Set, e.g. specific legal provisions of hunting law. If it is demonstrated that demands of sustainability expressed under certain indicators cannot be imple-

mented on account of existing stipulations of hunting law, these indicators cannot be assessed. It ought to be mentioned in this context that hunting legislation is, like any legal matter, dynamic, and that most hunting laws have not yet been examined as to their compatibility with sustainability criteria.

Individual indicators may not be applicable in all hunting areas and/or not relevant in all cases. The assessment schemes for indicators whose application demands certain conditions (described in greater detail in the explanatory text) have been provided with an additional possibility of valuation: *"x … not applicable, no assessment."* This neutral option is to be chosen if the justification given in brackets applies. In that case, the respective indicator is dropped from the sustainability assessment. At the same time, the score in points achievable within the respective aspect of sustainability (ecology, economy or socio-cultural aspect) is reduced by the maximum score in points achievable for the relevant indicator; this has to be taken into account when calculating the assessment result in accordance with the Type 1 variety of evaluation (cf. Section 4.2.3.1). However, an assessment of the indicators which are not applicable and not counted ought to be made at a higher level of reference (e.g. by summarising several hunting territories or forest districts).

The Criterion of *"Potential natural wildlife species inventory taking into account the current habitat situation*" serves as an example of limited applicability at the level of the individual unit of assessment. Indicator 18, *"Current and potential natural wildlife species list,"* is to be assessed in any case. However, in order to draw up a potential natural wildlife species list, knowledge of regional conditions exceeding the boundaries of a hunting ground is necessary. Such knowledge will not in all cases be available on the hunting-ground level (even though in many cases, they are easily accessible). Thus, an assessment of the two following indicators 19 and 20 will not be possible if the potential natural wildlife species inventory is not sufficiently known. In this case, the neutral valuation *"x … not applicable*" is to be chosen, whereupon the respective indicator is dropped from the assessment.

Especially in the case of the Assessment Set for Hunting-related Activities, the economic aspect of sustainability may in some cases involve differing objectives of the groups carrying out hunting-related activities, be they lessors, land owners and tenants, or hunting customers. This is why individual indicators may end up with differing and sometimes even opposed assessments. In order to avoid this, some indicators are to be assessed only by particular categories of people: thus, Indicator 30, *"Cost/income ratio*" is only for lessors and owners, while Indicator 31, *"Expense/subjective benefit ratio*" applies to game tenants and hunting customers. For similar reasons, the application of Indicator 32, *"Hunting-related measures to increase the market value*" only makes sense for owners and lessors of a hunt (tenants and hunting customers should chose the "neutral" valuation, *"not applicable*").

Self-assessment: Assessment is based on the principle of voluntary self-examination. From the nature of self-assessment systems, a certain amount of subjectivity cannot be avoided. This is also the case in decisions about which influences on indicators to assess.

Indicator 21, *"Giving consideration to the undisturbed life-cycle of wild animals*" in the *Assessment Set for Hunting-related Activities*, serves as an example: who, after all, likes to admit that he or she is a factor of disturbance to wild animals on account of hunting pressure that he or she has caused? A certain amount of readiness to question one's own hunting behaviour and the ability to be self-critical are essential preconditions regarding this assessment. The way users of the Set deal with their subjective discretion eventually determines the validity and conclusiveness of the assessment.

The fact that the credibility of an assessment can be questioned may be interpreted as a disadvantage of the self-assessment approach. However, a major advantage over "objective" external monitoring and/or assessment approaches is in the process of reflection and learning which is meant to be fostered by dealing with the contents of the Assessment Sets. Moreover, self assessment instruments are highly suitable for integrating "soft," qualitative

indicators that do not make high demands on data availability but rather draw on empirical personal experience of land use (Lexer & Reimoser, 2007; Reimoser & Lexer, 2007).

In assessing the individual indicators, one should always be aware of the sectors to which the respective indicator relates (ecological, economic or socio-cultural sector) in order to avoid, for example, an intuitively "economically slanted" assessment of ecological indicators, or vice versa.

4.2.1.3 Structure of the assessment sets

The assessment system is differentiated along a horizontal and a vertical axis. By analogy with the differentiation of three "pillars" or "spheres" of sustainability (Harborth, 1993) a tripartitite division of the concept of integrated sustainable wildlife management into an ecological, an economic and a socio-cultural sector of sustainability is made on the horizontal axis. On the vertical axis, each Set consists of a hierarchically structured package of principles, criteria and indicators. Each indicator has a point score system for the evaluation. Each of the three divisions has an explanatory text, which is phrased to question the sustainability of one's own hunting, comparing it with other hunting territories or larger hunting units and presenting it to an external audience in a comprehensive, auditable manner.

For each of the four Sets, a different overall number of Principles, Criteria and Indicators were defined (see also Synoptic Tables in Section 4.2.2):

Hunting: 14 Principles, 25 Criteria and 56 scored Indicators.

Forest Management: 11 Principles, 18 Criteria and 42 scored Indicators.

Agriculture: 11 Principles, 17 Criteria and 28 scored Indicators.

Leisure and recreation management: 9 Principles, 17 Criteria and 35 scored Indicators.

The assessment framework has the hierarchical structure of a tree with branches which, starting from the level of principles and criteria, increasingly branch out downward to the indicators. Within each sector, principles are made operative with a certain number of criteria, and these in turn through a certain number of indicators (see Fig. 9). Thus, the degree of specificity and targeting of actions increases from the top of the assessment pyramid towards the base (Lexer et al., 2006). The actual assessment is made at the lowest level, that of the indicators, through a system of point scores (see Section 4.2.3).

The individual levels of the Assessment Set fulfil different functions which are explained with some application-oriented hints as follows:

- **Aspects of sustainability:** There are various different angles from which to define sustainable hunting. The aspects from which the sustainability of hunting has been defined here are ecological, economic and socio-cultural. This corresponds to the international structuring of sustainability. It ought to be borne in mind that the sectors are based on different approaches to and motives for practising sustainable hunting, which is why they may be mutually conflicting. One and the same action may have positive effects in terms of the ecological and negative effects in terms of the economic aspect. However, is reflected in the assessment process and ought to be detectable in the results. The analysis of the results thus allows an adequate interpretation of such conflicting assessments.
- **Principles:** For each of these aspects, principles of integrated sustainable wildlife management have been defined for the relevant user group. Principles are over-arching formulations which, taken together, create an ethos for integrated sustainable wildlife management from the point of view of each user group. They are, as a rule, to be seen as axioms or commonly accepted normative statements based upon common values recognised by society (Reimoser et al., 2003). Principles are found in relevant Sets (see Section 8.1. – An-

nex) as second-level headings. For example: Section 1.1, Principle: *"The preservation and improvement of wildlife habitats is an objective of hunting."*

- **Criteria:** The principles are made operative by defining criteria. These describe selected key attributes of sustainable wildlife management, which provide a more detailed definition of the principles and which are suitable for subsequent evaluation by indicators. Criteria are found in the Set as third-level headings (see Section 8.1 – Annex), e.g. Section 1.2.2, Criterion: "*Hunting is oriented according to the behaviour of wild animals."*
- **Indicators:** The criteria are evaluated through indicators. Indicators are designed to define verifiable (observable, assessable, measurable) features of the criteria and to be suitable as statistics. They are found as fourth-level headings (see Section 8.1 – Annex), with consecutive numbering throughout each Set. For example: Section 1.2.2.1, Indicator 21, *"Giving consideration to the undisturbed life-cycle of wild animals."*
- **Evaluation of the indicators:** The examination of whether and to what extent the criteria are met in terms of land use, as well as the relevant assessment as point scores, has a specific framework for each indicator. For this purpose, there are a minimum of two to a maximum of five assessment grades giving between 4 and –4 points. As practical test statistics, the scores reflect the deviation or concurrence of the current *status quo* with the potential *ideal status*.

Fig. 8 depicts the hierarchical structure of the Assessment Set for one randomly chosen Principle from the ecological sector.

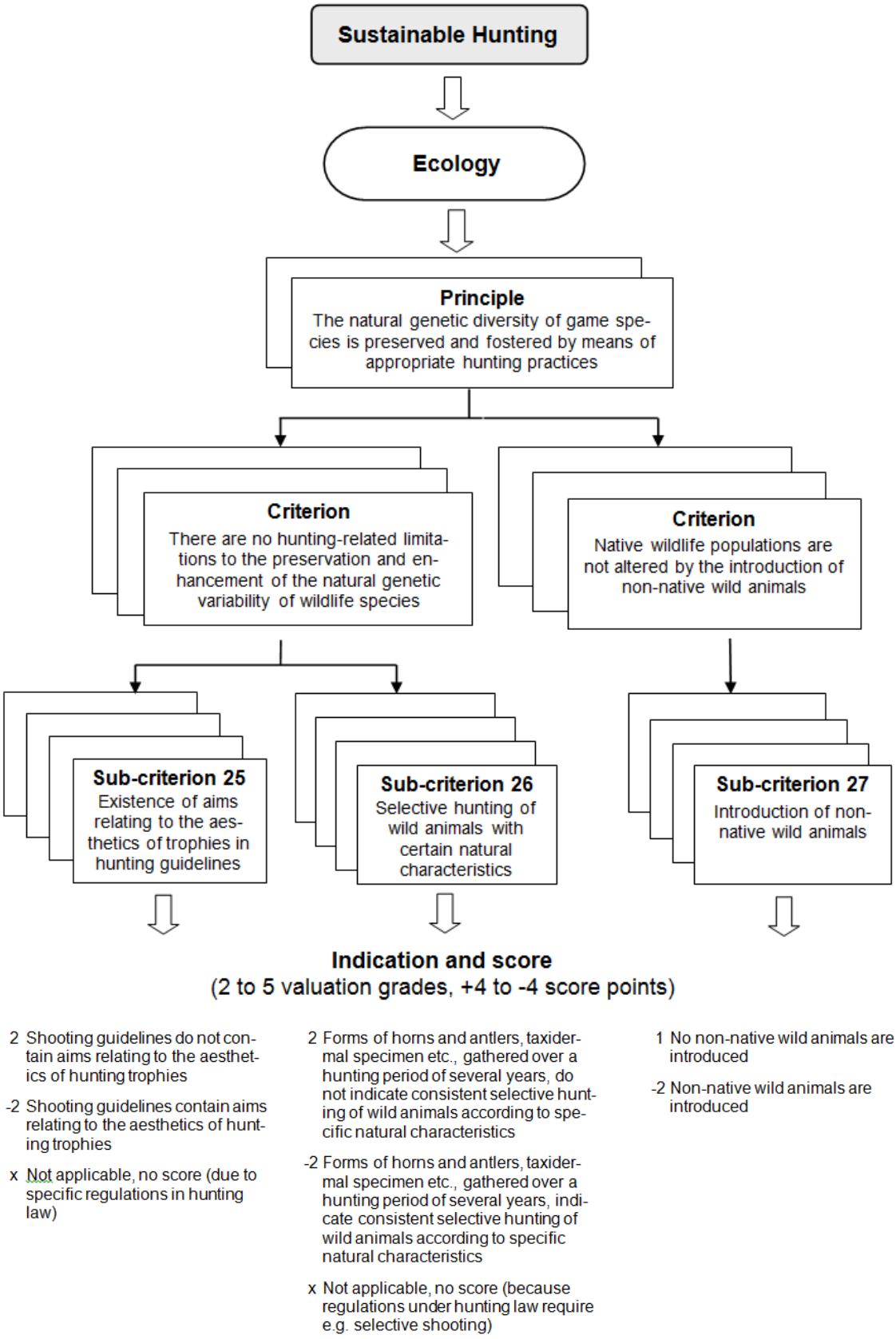

Figure 8: Structure of a typical Assessment Set

4.2.1.4 Definition of terms

The following definitions refer to terms which are frequently used in the Assessment Sets or are important. For reasons of completeness and user-friendliness, however, the terms are also defined separately for each of the four Sets (see Section 8 – Annex).

- The term **forest manager** refers to all persons responsible for the planning and carrying out of forest-related measures. As a rule, these are forest managers and cultivators, including the skilled personnel responsible for forest cultivation and management activities (foresters, heads of forest district/division), forest owners or managers of forest enterprises.
- The term **farmer** refers to persons responsible for the planning and carrying out of agricultural measures on agricultural plots of land. As a rule, they are managers/cultivators or owners of agricultural land or managers of an agricultural enterprise.
- **Leisure and Recreation management** covers persons and organisations representing groups of people that benefit from the recreational use of the Wienerwald Biosphere Reserve. It also includes as stakeholders the officials and decision-makers, responsible for the planning, regulation and control of leisure and recreational activities. This group of actors includes the Biosphere Reserve management, municipalities, regional managing bodies, tourism federations and associations, alpine associations, sports associations and other representatives of certain recreational user groups (horse riders, mountain bikers, hikers, etc.), land owners and representatives of relevant authorities.
- The term **game** refers to those wild animal species (furred game and winged game) which are subject to hunting laws, including species with no open season. Unless indicated otherwise, the terms **game** and **wild animals** are used in the same sense. Conversely, the term wild animal species refers to those wild animal species that are (or were) "huntable" as "game," or otherwise influenced by hunting (e.g. on account of hunting laws, regulations and hunting practise).
- The term **threatened** refers to those wild animal species whose long-term survival within their natural range is endangered to varying degrees. As a rule, these are species threatened with regional extinction, are declining continuously, are particularly rare, or have temporarily disappeared and are now recolonising, and are thus often classified as "protected species" under the nature conservation laws. The degree to which a species is threatened results, as a rule, from various risk factors that interact to varying degrees, and which, when combined, influence the conservation status of the species. If these factors occur, they are to be interpreted as warning signals suggesting that the respective species may be threatened. These risk factors are first and foremost: low population size; continuously declining populations (continuously decreasing number of populations and/or individuals of a species); small or decreasing distribution; specialised habitat requirements of a species; habitat loss, habitat fragmentation, deterioration of habitat quality; direct adverse human influence (e.g. on account of excessive hunting, excessive use, persecution, etc.) pressure by invasive, non-native species (e.g. Zulka et al., 2001; Primack, 1998). In varying combinations and with differing emphasis, most of the factors mentioned account for status of threatened species on red lists as well as their classification as protected species in accordance with nature conservation laws. The degree of endangerment that indicates, so to speak, the probability of survival or risk of extinction of a species in a certain area, is categorised through red listing processes. IUCN Red List categories include "extinct" and "extinct in the wild," followed by categories of "critically endangered", "endangered" and "vulnerable" within which a species is considered threatened with extinction, and the precautionary level of "near threatened" (e.g. Zulka et al., 2001; IUCN, 1994, 1999). If a wild animal species is listed on a relevant red list – e.g. the Red List of Threatened Animals in Austria (Zulka, 2005) and Red Lists of the Federal Provinces – and classified into one of the above categories of endangerment, the respective species is to be

considered a threatened species in the sense of this study[1]. Equally, species protected by Austrian nature protection and conservation laws (species protection regulations), EU community laws (Bird Protection Directive, Flora-Fauna-Habitats Directive) and international species protection agreements (e.g. the Convention on the Conservation of European Wildlife and Natural Habitats – Bern Convention; Convention on the Conservation of Migratory Species of Wild Animals – Bonn Convention) are considered to be threatened species in this document.

- The term **sensitive** refers to those wildlife animal species to which one or more of the above endangerment factors apply, even if the respective species has not (yet) been red-listed as "threatened" or "near threatened." In particular those wildlife species are to be considered sensitive which, on account of specific (population-) biological features such as specialised habitat requirements (including size and quality of habitat), low reproduction potential, low dispersal capacity, are particularly sensitive vis-à-vis additional endangerment factors such as excessive hunting pressure, decreasing distribution, strongly increasing predation and competitive pressure from other species, or rapid changes of environmental conditions. In a hunting context game species are to be classified as sensitive if hunting them sutainably cannot be considered guaranteed in a certain area on account of their unfavourable conservation status or unfavourable trends in the respective species and/or its habitat. These species may often only be taken in small numbers or demand particular consideration on the part of hunters.
- The term **person permitted to hunt** or **owner of a hunt** refers, for the purpose of this study, to the owner or the tenant(s) of hunting rights. Additionally there are those who hunt by permission of land owner/game tenant and owners of stalking districts.
- The term **person owning the right to hunt** refers in Austria to the land owner.
- The term **tenant** refers to the tenant of a proprietor's or co-operative hunt (person permitted to hunt).
- The term **lessor** refers to the owner or representative of the owner of a proprietor's or co-operative hunt.
- **Potential natural wildlife species inventory** is to be understood as the spectrum of wildlife species representing the currently achievable optimum circumstances in terms of biodiversity and near-natural conditions, taking into account the irreversible changes that have occurred in the course of the development of the cultural landscape, as well as the existing economic and socio-cultural impacts on wildlife habitats that cannot be influenced by hunting. The "potential natural wildlife species inventory" is thus the range of wildlife species possible under the current habitat conditions, which pertain to the native spectrum of species (autochthonous, typical for the region) of the respective geographic region. „Native wildlife species" are, in the sense of the potential natural wildlife species inventory:
  - those species that have outlasted the latest Ice Age or have immigrated thereafter and before and/or without human intervention[2];
  - recolonising species that used to be native in a certain area whose populations temporarily ceased to exist and which now are returning to their original ranges either without human intervention (immigration of species, e.g. elk/moose (*Alces alces*), brown bear (*Ursus arctos*), wolf (*Canis lupus*), otter (*Lutra lutra*)), or through re-introduction into their original habitats (e.g. Alpine ibex (*Capra ibex*) and Alpine marmot (*Marmota marmota*) within their original ranges of distribution);

[1] http://www.umweltbundesamt.at/umweltschutz/naturschutz/artenschutz/oasis/oasis_abfrage gives access to an Internet databank compiled by the Federal Environment Agency – Austria that allows queries as to the endangerment classification of individual species on different red lists. With regard to species relevant in terms of hunting, regularly updated information relevant in terms of hunting laws (shooting and closed seasons) on the basis of the hunting laws of the Austrian Federal Provinces is made available.

[2] So-called primary native or indigenous species

- originally native species that have disappeared on account of human influence (eradication, habitat changes).

  As far as today's cultural landscape still has habitat potential for the species mentioned, these species are to be considered part of the potential natural wildlife species inventory.

  This is not to be confused with **"new residents" (alien species, neobiota)**, which have arrived at a certain territory (in this case, Austria) later than 1492 through direct or indirect human influence. With regard to Austria, these are, among huntable wildlife species, e.g. fallow deer, Sika deer, moufflon, wild rabbit, racoon dog, racoon, nutria and wild turkey. These species are *not* considered part of the potential natural wildlife species inventory. Those animal species that had become established under human influence in pre- and early history up to the end of the Middle Ages (1492) (such as, probably, the brown rat) are not relevant in Austria in terms of hunting and thus need not to be considered for the purpose of this study.

- **Hunting management plan (hunting plan)** is to be understood as the planning ahead of any hunting-related activities, in particular in terms of time, area, and personnel. It comprises the goals and measures of hunting management for the respective hunting area and serves the purpose of providing long-term orientation for the hunting practice. Key components are e.g. to ensure that hunting accords with the needs of other land users, to take into account the optimum time and area for hunting the relevant game, and to give consideration to rare, non-hunted species. A hunting plan may exist in thought or in writing; with regard to sustainable hunting practice, however, a written hunting plan is preferable.
- **Hunting bag plan** (as a part of a hunting management plan) is a list of the numbers of each species (sex, age classes) planned to be shot or trapped (hunting bag planned before the hunting season starts).
- **Off-take list** (as a part of the hunting management plan) is a list of the numbers of each species (sex, age classes) really shot/trapped/killed by traffic accidents/ found dead by other reasons (hunting bag documented when the hunting season closes).
- **Culturally unacceptable game impact** is to be understood in this context primarily in terms of the ecologically unacceptable (harmful) influence of game on vegetation. The impact of game on vegetation comprises food intake (grazing, browsing, bark peeling) as well as rubbing to remove velvet from antlers. The concept of "culture" differs from economic considerations. Culture refers from an overall societal perspective to, in the case of forests, the functions beyond that of timber production, including shelter, leisure and recreation for people, but also to the provision of ecological value from other vegetation (e.g. orchid meadows rich in biodiversity). This is the fundamental view represented by the competent authorities on the basis of the respective (Austrian) legislation. The lack of some important natural enemies of our herbivorous wild animals as well as anthropogenic influences on our wildlife habitats (most of all land use) accounts for the fact that they are, seen from a larger perspective, mostly not near-natural environments. This influences local densities and distribution patterns of wild animals, in particular of cloven-hoofed animals, which damage vegetation beyond tolerable limits.
- **Wildlife habitat** is defined as the "living space" or "site" (the habitat) of wild species populations and/or individuals of a wild species. The habitat needs of the wild animals concerned define the area of wildlife habitat they require. The wildlife habitat must meet key habitat functions (food, cover and reproduction area). Environmental factors (such as noise, temperature, light, climate, soil, etc.) must neither exceed, nor fall short of the species-specific limit of tolerance. The wildlife habitat may consist of several separate habitat sectors.

- **Migration** and **Dispersal** are movements of animals. Migration is the repeated movement of animal populations leading to seasonal changes of place and entails a change of range of a species. As well as seasonal habitat change (e.g. passing from summer to winter habitat in red deer) there may also be migration to breed. Dispersal is the lasting movement of individuals away from a natal area or subsequent point of settlement, and is often omnidirectional unless constrained in particular directions by topography . It plays a significant role in terms of the necessary gene flow within and among populations of a species, and thus in terms of the preservation of the species, its distribution, the colonisation or recolonisation of habitats. In the absence of regular genetic exchange via such ”gene flow corridors,“ the risk of species and populations becoming regionally extinct will increase.
- Landscape sectors in which migration or dispersal primarily happens are termed **migration axes (routes)**.
- **Wildlife corridors** are bottlenecks within a migration axis or the habitat of wildlife species caused by barriers or an unfavourable environment. A salient characteristic of a corridor is its favourable structure compared to the surrounding environment, allowing for a link between separate habitat sections.
- The term **constricted corridor** is used to describe a constriction of a wildlife corridor or wildlife route on account of natural or anthropogenic barriers to a minimum width without any possibility of bypassing it locally, i.e. wildlife species are forced to adhere to the corridor as a consequence of specific topographic conditions (forest corridors, steep slopes, canyons, water courses, etc.) or artificial obstacles (fences, road barriers, walls, settlements, etc.) which create local bottlenecks.
- **ÖPUL** is the “Austrian Agri-Environmental Programme.” The initials refer to the promotion of agriculture that is appropriate to the environment, extensive and favourable for nature. The programme is supported through the European Agricultural Fund for Rural Development as well as the Rural Development Programme of Austria. Along with ÖPUL, there are other publicly subsidised **agri-environmental measures** pursuing similar goals (e.g. the Ecopoint Programme).
- **Use** is to be understood in the comprehensive sense of the IUCN Policy Statement on the Sustainable Use of Wild Living Resources (IUCN, 2000); it includes all forms of consumptive and non-consumptive use of natural resources. Sustainable hunting and/or sustainable hunting-related use includes shooting certain animal species without the animals that are killed having to be used in a consumptive way (e.g. red fox (*Vulpes vulpes*), if its population increases on account of anti-rabies vaccination and thus endangers the population of other species).

4.2.2 Overview of the sets of principles, criteria and indicators

Preliminary remark: For reasons of clearness and comprehensibility, the assessment schemes that go along with each indicator are not given in the following overview tables (Section 4.2.2.1 to Section 4.2.2.4). The complete Sets of Principles, Criteria and Indicators are contained in Section 8 (Annex). For a definition of the terms “Principles,” “Criteria,” and “Indicators” as well as the methodological basis underlying the assessment, users are referred to explanations in Section 4.2.1.3.

4.2.2.1 PCI-Set for Hunting

Table 1: Synoptic table PCI Hunting, including full version and a minimum version (grey background)

Principles, criteria, indicators for integrated sustainable wildlife management in the Wienerwald Biosphere Reserve				
Sector	**Principle**	**Criterion**	**No.**	**Indicator**
ECOLOGY	**The preservation and improvement of wildlife habitats is an objective of hunting**	Hunting and its interrelationship with other forms of land use	1	Existence of a hunting bag plan, and list of the actual "off-take"
			2	Structure of a hunting bag plans, and off-take lists
			3	Meeting official cull requirements for game species that need to be controlled
			4	Existence of a strategy to harmonise hunting with other forms of land use
		Giving consideration to the influence of game on vegetation	5	Existence of exclosures to monitor game impact on vegetation
			6	Using forest monitoring to estimate wildlife impact
			7	Management takes account of the shelterproviding function of the forest
			8	Preventing game impact unacceptable in terms of regional culture
			9	Accommodating population fluctuations
		Preservation and creation of linking biotopes	10	Giving consideration to existing wildlife habitat fragmentation
			11	Registration and mapping of important migration routes, wildlife corridors and other essential wildlife routes
			12	Increasing the attractiveness of important migration routes, corridors and other essential routes
		Giving consideration to habitat quality and capacity	13	Active preservation and management of the wildlife habitat
			14	Handling of wildlife feeding
			15	Limitations on providing baits
			16	Avoiding increased competitive pressure upon threatened and sensitive animal species from strongly increasing game populations
			17	Annual productivity of game

	The practice of hunting shall within its range ensure the preservation and improvement of the diversity of game species through protection and use/regulation	Potential natural wildlife species inventory taking into account the current habitat situation	18	Current and potential natural wildlife species list
			19	Dealing with recolonising species (in accordance with the potential natural wildlife species inventory)
			20	Dealing with wildlife species not contained in the potential natural wildlife species inventory
		Hunting is sensitive to the behaviour of wild animals	21	Giving consideration to the undisturbed life cycle of wild animals
			22	Limiting hunting of wildlife during the night ("night hunting")
			23	Giving consideration to the reproductive biology of threatened and sensitive game species
			24	Coordination of hunting practices across hunting grounds
	The natural genetic diversity of game species is preserved and enhanced by means of appropriate hunting practices	There are no hunting-related limitations to the preservation and enhancement of the natural genetic variability of wildlife species	25	Existence of aims relating to the aesthetics of hunting trophies in hunting guidelines
			26	Selective hunting of wild animals with certain natural characteristics
		Native wildlife populations are not altered by the introduction of non-native wild animals	27	Introduction of non-native wild animals
ECONOMY	**Securing and/or improving the profitability of hunting is an objective of hunting**	The profitability of hunting is secured over a medium term	28	Existence of a marketing strategy for hunting in the Biosphere Reserve
			29	Marketing of regional game products
			30	Cost/income ratio (applies to lessors and owners)
			31	Expense / subjective benefit ratio (applies to hunting tenants and hunting customers)
		The value of hunting is maintained and/or increased by the practice of hunting	32	Hunting-related measures to increase the market value
	Efficiency and minimum disturbance of wildlife species is an objective of hunting	Existence of a time- and area-specific hunting strategy	33	Existence of an economically sound, time- and area-specific hunting plan
	Preventing damage to agriculture and forestry is an objective of hunting	Hunting is oriented according to the susceptibility of agricultural land and forestry to game damage	34	Giving consideration to susceptibility to game damage

	Creating synergies with other economic activities is an objective of hunting	Hunting economically conforms with other anthropogenic forms of use ("economic unity")	35	Confirming a common policy
		Interdisciplinary optimising of planned changes in the wildlife habitat	36	Commitment of hunters to interdisciplinary wildlife-ecological spatial planning (WESP)
			37	Commitments of hunters regarding plans and projects that have an impact upon wildlife habitats
SOCIO-CULTURAL ASPECTS	**Hunters take into account the interest of the local population in using land for hunting**	By way of involving local hunters, hunting enjoys a balanced position within the local community but also takes into account the interests of non-resident hunters	38	Reconciling the interests of local hunters permitted to hunt and local hunters not permitted to hunt locally
			39	Adequate consideration is given to non-resident hunters
	Offering local jobs in the field of hunting is an objective	Hunting contributes to securing employment by creating jobs	40	Providing jobs in the field of hunting
	Hunting should find broad acceptance among the population	Hunting is oriented to the aims of the Biosphere Reserve	41	Taking into consideration the guiding principles and management goals of the Biosphere Reserve
			42	Design and distribution of hunting-ground installations
		Paying attention to the interests of the local population	43	Documentation of disagreements byt the local authority
			44	Active involvement and information of local stakeholder and land user groups not directly related to hunting
			45	Conflict management strategies
		Hunting is connected with society at large	46	Social commitment of hunters and regular communication with the non-hunting populations
			47	Taking into account the opinion of the public at large
	Hunting is oriented to the welfare of game	Hunting is practised with as little impairment to the natural behaviour of wildlife as possible	48	Habituated behaviour of wild animals
		Hunting is practised with as little pain for the animal as possible	49	Violations of legal provisions concerning animal welfare
			50	Training in hunting
			51	Avoiding use of poison as part of the hunting practice
	Hunting is of wild animals breeding naturally in the wild	No wild animals raised in breeding or other enclosures are hunted	52	Not selling (transferring) wild animals from enclosures or aviaries for the purpose of hunting
			53	Not releasing animals from enclosures and aviaries for the purpose of hunting

	Hunters are aware of the effects of their activities upon other land users' interests	Hunters are aware of and give thought to the effects of their measures upon the interests of other land users	54	Improvement of knowledge and awareness of the effects of hunting-related measures upon other forms of land use
	The way hunting traditions are dealt with is characteristic of the socio-cultural sustainability of hunting	Hunting traditions are cultivated and passed on to new generations of hunters	55	Preserving hunting culture
		Traditional rules of hunting behaviour are being further developed and brought up to date	56	Examining modes of hunting behaviour by regularly updating knowledge

4.2.2.2 PCI-Set for Forest Management

Table 2: Synoptic table PCI Forestry, full version, short version (gray background)

Principles, criteria, indicators for integrated sustainable wildlife management in the Wienerwald Biosphere Reserve				
Sector	**Principle**	**Criterion**	**No.**	**Indicator**
ECOLOGY	**The preservation and improvement of wildlife habitats is an aim of forest management**	Forest management relates to wild animals and hunting	1	Obligation of hunting tenants and long-term hunting customers to draw up species-specific hunting bag plans and structured off-take lists
			2	Definition of shooting requirements of wildlife species that need to be reduced, for which no hunting bag plans are prescribed by the authorities (e.g. wild boars, non-native species)
			3	Inspection of bags
			4	Existence of a strategy to harmonise forestry measures with hunting
		Giving consideration to the influence of game on vegetation	5	Existence of fenced-in control areas to monitor game influence upon forest regeneration
			6	Using forest monitoring to estimate game impact on forests
			7	Preventing game impacts which are unacceptable in terms of regional culture
		Preservation and creation of linking biotopes	8	Registration and mapping of important migration routes, wildlife corridors and other essential wildlife routes
			9	Increasing the attractiveness of important migration routes, wildlife corridors and other essential routes
		Giving consideration to habitat quality and capacity	10	Active preservation and management of the wildlife habitat
			11	Giving consideration to habitats when planning forest development
	Forest management should endeavour to preserve and improve the diversity of wildlife species by protection and use	Forestry favours potentially natural forest vegetation	12	Knowledge and documentation of potentially natural and current forest types and tree species compositions
			13	Proportion of the forest area with potentially natural tree species composition and near-natural forest structure
			14	Management plans for near-natural forest– operative goals, planning and practice

		Forest management accommodates the habitat needs of wild animals	15	Giving consideration to the habitat needs of threatened, sensitive and recolonising wildlife species
			16	Giving consideration to the reproductive biology and life-cycle of threatened and sensitive wild animal species
			17	Existence of far-reaching agreements regarding the sustainable management and development of wildlife habitats
ECONOMY	**Securing and/or improving the profitability of hunting is an objective of forest management**	Contributing to the profitability of hunting in the medium term	18	Existence of a marketing strategy for hunting in the Biosphere Reserve
			19	Marketing of regional game products
		The value of hunting is preserved and/or improved by forest management	20	Forestry measures to improve the market value of hunting
			21	Support of hunting ground installations and equipment
	Accommodating efficient game hunting is an objective of forest management	Creating scope for hunting in forests	22	Establishing an adequate number of hunting areas
			23	Giving consideration to scope for hunting when choosing forest management methods
		Giving consideration to wildlife and scope for hunting in terms of space and time	24	Giving consideration to wildlife in terms of space and time when it comes to forestry-related measures
	Contributing to avoiding game damage is an objective of forest management	Forest management takes into account the forest's susceptibility to game damage	25	Reduction of the susceptibility of forests to browsing damage
			26	Giving consideration to the forest's susceptibility to bark-peeling damage
	Forest management aims to benefit from synergies with hunting	Forestry forms an economic unit with hunting	27	Confirming a common policy
			28	Giving consideration to hunting in forest development
			29	Existence of wildlife management stragegy across hunting territories linked to leases and/or hunting contracts
			30	Drafting of leases and hunting contracts to reflect the criteria of sustainable hunting
			31	Setting hunting territory boundaries
		Optimising planned changes in wildlife habitats	32	Commitment of forest owners / managers to interdisciplinary wildlife-ecological spatial planning (WESP)
			33	Commitments of forest owners / managers in planning and projects with impacts on wildlife habitats

SOCIO-CULTURAL ASPECTS	**The hunter-related interests of the local population are given consideration by landowners / forest managers**	The landowner / forest manager actively supports a balanced regional approach by adequately involving local hunters	34	Giving consideration to territory for local hunters
			35	Giving adequate consideration to non-resident hunters
	Local people should be given preference in terms of hunting-related job opportunities	Forest management / the landowner contributes to providing hunting-related jobs in the region	36	Providing jobs in the field of hunting
	Forest managers / landowners have a regular exchange of information with hunting-related interests, contribute to avoiding conflicts and help settle conflicts	Contact, exchange of information and avoiding and settling of conflicts with local stakeholders	37	Exchange of information with local hunting interests
			38	Conflict management strategies
			39	Training in public relations, communication and conflict management
	The landowner / forest manager supports hunting that favours wild animals reproducing naturally in the wild	No animals raised in breeding or enclosures are made available for hunting	40	Not selling animals from enclosures or aviaries for the purpose of hunting
			41	Not releasing wild animals raised in enclosures or aviaries for the purpose of hunting
	Forest managers are aware of the effects of their activity on wild animals, their habitats, and hunting	Forest managers consciously deal with the effects of their activities on wildlife,habitats and hunting	42	Improvement of knowledge about wildlife-ecological and hunting-related effects of forest management measures

4.2.2.3 PCI-Set for Agriculture

Table 3: Synoptic table PCI Agriculture, full version, short version (grey background)

Principles, criteria, indicators for integrated sustainable wildlife management in the Wienerwald Biosphere Reserve				
Sector	**Principle**	**Criterion**	**No.**	**Indicator**
ECOLOGY	**The preservation and improvement of wildlife habitats is an objective of agricultural activities**	Agricultural activities relate to wild animals and hunting	1	Support for meeting hunting requirements for wildlife species that need to be reduced
			2	Existence of a strategy to harmonise agricultural measures with hunting
			3	Giving consideration to potential harmful effects on wild animals from chemical pesticides e.g. for plant protection
		Giving consideration to the influence of game on vegetation	4	Preventing game damage which is unacceptable in terms of regional culture
		Preservation and creation of linking biotopes	5	Measures to improve and preserve biotope linkage for wild animals
			6	Giving consideration to important migration routes, wildlife corridors and other essential routes
		Specific preservation and improvement of wildlife habitats	7	Participation in agri-environmental measures to improve and preserve habitats
			8	Diverse habitat components on agricultural land
			9	Change in wildlife habitats on account of changes in land use
	Agricultural activities should endeavour to preserve and enhance the diversity of species	Agricultural measures improve and preserve habitats to accommodate the potential natural wildlife species inventory of the region	10	Taking into account a current and potential natural wildlife species list
		Agricultural measures accommodate the habitat needs of wild animals	11	Giving consideration to the habitat needs of threatened, sensitive and recolonising wildlife species
			12	Giving consideration to the reproductive biology and life-cycle of threatened and sensitive wild animal species

ECONOMY	**Securing and/or improving the profitability of hunting is an objective of farm management**	Contributing to the profitability of hunting in the medium term	13	Supporting the marketing of regional game products
		The value of hunting is preserved and/or improved by farm management	14	Agricultural measures to improve the market value of hunting
			15	Support of hunting ground installations
	Accommodating efficient game hunting is an objective of farm management	Creating scope for hunting on agricultural lands	16	Establishing sufficient hunting areas
			17	Harmonising agricultural measures with hunting
	Contributing to avoiding game damage is an objective of farm management	Farm management takes into account the susceptibility of agricultural crops to game damage	18	Giving consideration to the susceptibility of agricultural crops to game damage
	Farm management aims to benefit from synergies with hunting	Agriculture forms an economic unit with hunting	19	Confirming a common policy
		Optimising planned changes in wildlife habitats	20	Commitment of agricultural managers to interdisciplinary wildlife-ecological spatial planning (WESP)
			21	Commitments of agricultural managers in planning and projects with impacts on wildlife habitats
SOCIO-CULTURAL ASPECTS	**The hunting-related interests of the local population are given consideration by landowners/farmers**	The owner of agricultural land actively supports a balanced regional approach by adequately involving local hunters	22	Giving consideration to terrirory for local hunters
			23	Giving adequate consideration to non-resident hunters
	Agricultural managers / landowners have a regular exchange of information with hunting interests, contribute to avoiding conflicts and help settle conflicts	Contacts, exchange of information and avoidance and settlement of conflicts with local stakeholders	24	Exchange of information with interest groups hunting locally
			25	Conflict management strategies
	Agricultural activities give consideration to game welfare	Agricultural activities cause as little pain for wild animals as possible	26	Avoiding management-induced losses of wild animals
	The landowner/manager supports hunting that favours wild animals reproducing naturally in the wild	No animals raised in breeding or enclosures are made available for hunting	27	Not selling of animals from enclosures or aviaries for hunting
	Agricultural managers are aware of the effects of their activity on wild animals, habitats, and hunting	Agricultural managers consciously deal with the effects of their actvities on wildlife, habitats and hunting	28	Improvement of knowledge about wildlife-ecological and hunting-related effects of agricultural measures

4.2.2.4 PCI-Set for Leisure & Recreation Management

Table 4: Synoptic table PCI Leisure and Recreational Use, full version, short version (grey background)

Principles, criteria, indicators for integrated sustainable wildlife management in the Wienerwald Biosphere Reserve				
Sector	**Principle**	**Criterion**	**No.**	**Indicator**
ECOLOGY	**The management of leisure and recreational activities gives consideration to the preservation and improvement of wildlife habitats**	Leisure and recreational use relates to wild animals, their habitats, and to hunting	1	Support for meeting hunting requirements for wildlife species that need to be reduced
			2	Existence of guidelines for harmonising leisure and recreational activities with the habitat needs of wild animals and hunting
			3	Checking whether the guidelines for recreation seekers are being observed
		Giving consideration to the influence of game on vegetation	4	Giving consideration to the shelter-providing function of the forests
			5	Giving consideration in leisure and recreation management to game impacts which are unacceptable in terms of regional culture
		Preservation and creation of linking biotopes	6	Giving consideration, in terms of planning and management of leisure and recreational activities, to biotope linkage that benefits wild animals
			7	Giving consideration to important migration routes, wildlife corridors and other essential routes
		Specific preservation and improvement of wildlife habitats	8	Environment assessment for projects in wildlife habitats
			9	Active preservation of wildlife habitats
	Leisure and recreational activities and their management should endeavour to preserve and enhance the diversity of species	Leisure and recreation management is oriented according to the potential natural wildlife inventory of the region	10	Taking into account a current and potential natural wildlife species list
		Leisure and recreation management accommodates the habitat needs of wild animals	11	Giving consideration to the habitat needs of threatened, sensitive and recolonising wildlife species
			12	Giving consideration to the undisturbed life cycle of wild animals
			13	Giving consideration to the reproductive biology of threatened and sensitive wildlife species
			14	Existence of biosphere reserve-wide leisure and recreation strategies co-ordinated between different recreational activities

ECONOMY	**Leisure and recreation management should give consideration to securing and improving the value of hunting**	Contributing to the profitability of hunting in the medium term	15	Support for marketing regional game products
		The value of hunting is given consideration when managing leisure and recreational activities	16	Measures on the part of leisure and recreation management to preserve the market value of a hunting operation
	Accommodating efficient game hunting is an objective of planning and managing leisure and recreational activities	Minimising impediments to hunting opportunities	17	Leisure and recreation management gives consideration to the scope for hunting game
	Contributing to avoide game damage is an objective of leisure and recreation management	Management of leisure and recreational activities takes into account the susceptibility of agricultural crops and forests to game damage	18	Leisure and recreation management gives consideration to avoiding game damage
	Leisure and recreation management aims to benefit from synergies with hunting	Leisure and recreation management forms an economic unit with hunting	19	Confirming a common policy
		Optimising planned changes in wildlife habitat	20	Commitment by leisure and recreation managers to interdisciplinary wildlife-ecological spatial planning (WESP)
			21	Co-operation of leisure and recreation managers with hunters regarding plans and projects that change wildlife habitats

SOCIO-CULTURAL ASPECTS	**Leisure and recreation management contributes to the mutual acceptance of recreation seekers and hunting interest as well as to avoiding or defusing conflicts**	Planning and management of leisure and recreational use is oriented toward the objectives of the Biosphere Reserve	22	Giving consideration to guiding principles and management goals of the Biosphere Reserve
		Contact, exchange of information, and avoidance and settlement of conflicts with local stakeholders	23	Documentation of disagreement by the local authority
			24	Respecting hunting ground installations
			25	Existence of efficient communication channels within groups engaging in leisure and recreation activities
			26	Existence of institutionalised communication structures between leisure and recreation management and hunting- interests
			27	Regular exchange of information with hunting- interests
			28	Conflict management strategies
			29	Training in public relations, communication and conflict management
	Leisure and recreation activities give consideration to game welfare	Leisure and recreation activities impair the natural behaviour of wildlife minimally	30	Minimising stress for wild animals
			31	Active and public information on rules of conduct for recreation seekers
		Leisure and recreational activities cause as little pain as possible to wild animals	32	Violations of animal welfare provisions
			33	Responsible wildlife watching
	Management of leisure and recreation is aware of the impacts of their activities on wild animals, their habitats and hunting	Rules of conduct for recreation seekers, as well as other management measures, are continuously developed and updated	34	Improvement of knowledge about wildlife-ecological and hunting-related impacts of leisure and recreational activities
			35	Monitoring and evaluating compilance with regulations for leisure and recreational activities
			36	Improving the status of knowledge on technology for planning recreational infrastructure and for visitor information and guidance

4.2.3 Evaluation scheme

The inter-sectoral Assessment Sets consist of three sectors of sustainability (ecological, economic and socio-cultural) and a varying number of principles, criteria and indicators within each. The assessment is made at the level of the indicators. The indicators have numerical scores that describe the extent to which each criterion is met in terms of the practice to be assessed. As the range of indicator scores varies for each criterion, we have an implicit weighting. The weighting of the significance of each indicator corresponds to the grade of possible influence of the respective land user group upon the respective sustainability aspect. There is no weighting of indicators beyond this level. These weightings were determined as part of the participatory process accompanying the project, in co-operation with the stakeholders (Lexer et al., 2006; Reimoser et al, 2003). The evaluation is completed by simply adding the point scores for all indicators. However, the addition does not go beyond the level of each of the three sustainability sectors. An aggregation of results across the three sectors of sustainability, as an "overall sustainability index", would not entail additional information for the user but could mask contradictory relations between the ecological, economic and socio-cultural sectors (e.g. actions with a positive effect upon ecological sustainability may not necessarily contribute to economic sustainability, and vice versa).

Based on Forstner et al. (2006) and the interactive Internet Platform on Sustainable Hunting (Umweltbundesamt, Federal Environment Agency 2005) of the Austrian Clearing House Mechanism on the Convention on Biological Diversity, two different evaluation display options are proposed. Both options are based on the point scores and have proved practical for sustainability assessment of hunting.

The maximum attainable scores range between 4 and –4 points per indicator. If a certain action clearly infringes against principles of sustainability, minus values (–1 to –4) are attributed; otherwise, the values range between 0 and 4. Presenting the score for each indicator creates a transparent assessment process and results which can be reconstructed at any time. This also facilitates interpreting the result as well as working out measures to optimise sustainability. Thus, point thresholds (minimum requirements) or 'knockout' (KO) criteria can be determined for individual principles, criteria or indicators if sufficiently justified; however, they are not foreseen in the present version of the Sets.

A combination of the two different evaluation options displays an overall balance and deficiencies within each sector of sustainability. Differences in regional conditions become apparent and relevant conclusions can be drawn. The decision not to apply more complicated assessment algorithms makes the evaluation scheme more transparent and easier to handle. The two evaluation display options are as follows.

4.2.3.1 Evaluation – Type 1

This display option aggregates assessment scores within each sector of sustainability and transforms them into a qualitative scale. Results are calculated separately for each of the three aspects of sustainability (ecology, economy, and socio-cultural aspects). The scores are added within each sector and converted into percentage values of the possible maximum point score. The resulting percentage value is attributed to one of five assessment bands. These bands range from "very good" (76 % to 100 %), through "good" (51 % to 75 %), "intermediate" (25 % to 50 %), and "bad" (0 % to 24 %) to "very bad" (less than 0 %). The purpose of the five assessment bands is to facilitate an evaluation of current hunting practices and future direction.

The two colour graphs below demonstrate the Type 1 display. Figure 9 shows the Assessment Set for Hunting-related Activities. Figure 10 is an example of a fictitious evaluation.

Ecology	**1 very good**	**2 good**	**3 average**	**4 bad**	**5 very bad**	**max. point score**	**min. score**
	sustainable				not sustainable		
	76 % to 100 %	51 % to 75 %	25 % to 50 %	0 to 24 %	negative value	60	–63
Economy	**1 very good**	**2 good**	**3 average**	**4 bad**	**5 very bad**	**max. point score**	**min. point score**
	sustainable				not sustainable		
	76 % to 100 %	51 % to 75 %	25 % to 50 %	0 to 24 %	negative value	26	–14
Socio-cultural aspects	**1 very good**	**2 good**	**3 average**	**4 bad**	**5 very bad**	**max. point score**	**min. point score**
	Sustainable				not sustainable		
	76 % to 100 %	51 % to 75 %	25 % to 50 %	0 to 24 %	negative value	29	–37

Figure 9: Type 1 display for Assessment Set: Hunting with results for separate aspects of sustainability

Ecology	**1 very good**	**2 good**	**3 average**	**4 bad**	**5 very bad**	**max. point score**	**min. point score**
	sustainable				not sustainable		
			47% (28 points)			60	–63
Economy	**1 very good**	**2 good**	**3 average**	**4 bad**	**5 very bad**	**max. point score**	**min. point score**
	sustainable				not sustainable		
				23 % (6 points)		26	–14
Socio-cultural aspects	**1 very good**	**2 good**	**3 average**	**4 bad**	**5 very bad**	**max. point score**	**min. point score**
	Sustainable				not sustainable		
		62% (18 points)				29	–37

Figure 10: Type 1 display for Assessment Set: Hunting with a fictitious evaluation example

The evaluation results of all three groups of aspects of sustainability are not summed. Doing so would remove information and flatten the evaluation result. A separate evaluation for each of the aspects of sustainability facilitates the analysis of strength and weaknesses.

Moreover, if a low score in points is achieved for the economic aspects, while at the same time, the score in the two other groups of aspects is high, one should bear in mind that the persons involved in hunting might be refraining from a stronger economic orientation of the hunt for reasons that go beyond mere economic considerations (high aesthetic value of hunt-

ing activities, improvement of the ecological and socio-cultural sustainability of hunting). In such a case, economic sustainability, evaluated in terms of the selected objective criteria, may be low on the rating scale or not exist at all. This, however, is not to be interpreted as an argument against hunting itself, as long as the hunting operation or the hunter is able to afford the expenses.

The authors would also like to add that in some hunting areas, the maximum points score cannot be reached because some indicators are not applicable in that area. This would, for example, be the case in a hunting territory for small game consisting exclusively of agriculturally dominated open land, without a forest whose function is mainly one of shelter – the indicator relating to woodland shelter could thus not be applied. Indicators only applicable under certain local or regional conditions were to be assigned a “neutral” score (see Section 3) if adequately justified. Thus the respective indicator is dropped and, as a consequence, the maximum achievable score reduced. If indicators cannot be assessed, the overall maximum point score of the relevant sustainability aspect should be reduced by the maximum point score of the omitted indicators. The maximum point score for each of the three aspects of sustainability may thus vary between assessment units but serve as a reasonable basis for the calculation of comparable percentage values in the assessment tables.

4.2.3.2 Evaluation – Type 2

This evaluation displays the indicator profiles of all individual indicators separately and in juxtaposition, resulting in a complete evaluation profile of a spatial assessment unit. To achieve this, the individual assessment results of all indicators are represented in colour along a sustainability scale. This indicator-by-indicator mode of representation allows individual strengths and weaknesses in terms of sustainability to be identified in detail at a glance. Thus, problems and where to address them to improve sustainability can be rapidly detected.

White lines reflect the possible score span of the respective indicator, i.e. the range within which individual assessments may be made. The green buttons represent the respective assessment in accordance with their position on the white score span lines, i.e. the individual point score. They thus illustrate the degree of sustainability assessed on the “sustainability scale.” For better visibility and descriptive quality, the scale is coloured in a progressive transition from red (“not sustainable”) to green (“sustainable”). The idea was to enable swift interpretation of the results.

Colour graph 11 shows results illustrated with display Type 2 using a fictitious evaluation example for the Assessment Set: Hunting.

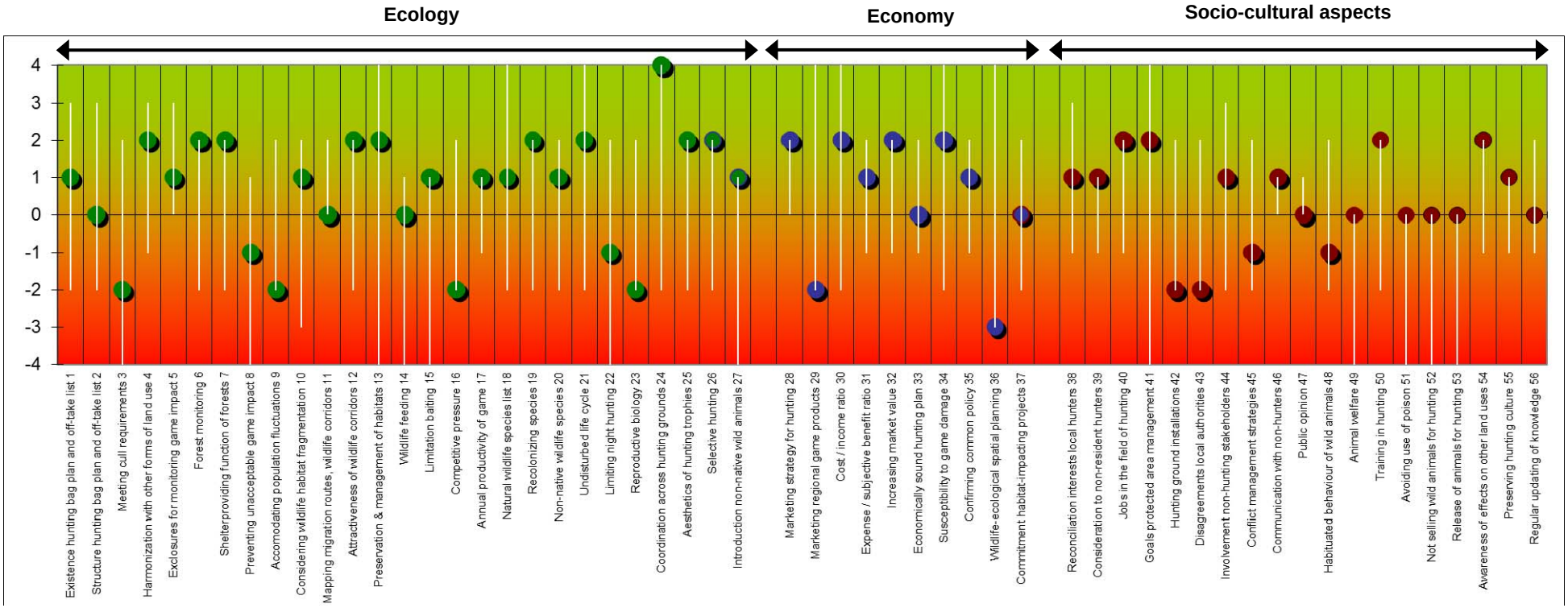

Figure 11: Type 2 display (fictitious example for Assessment Set: Hunting): individual indicator profiles for one assessment unit.

5 CONTEXTS FOR INTEGRATED MANAGEMENT OF HABITAT AND WILDLIFE

To avoid, reduce and solve potential wildlife-related conflicts s as well as to improve inter-sectoral co-operation and make better use of synergy potentials, assessment and examination catalogues (PCI Sets) adapted to the Wienerwald region have been developed for the four user groups (hunting, agriculture, forest management and leisure and recreation management) involved with conservation and use of wild animals and wildlife habitats. These Sets are designed to establish auditable indicators for inter-sectorally harmonised sustainable use (ecological, economic and socio-cultural sustainability) with wild animals and wildlife habitats as a common point of reference. Sustainable use of wildlife habitats and wild animals can only be achieved if all land user groups active in the wildlife habitat are aware of the impacts of their activities upon wildlife resources as well as upon the relevant other user groups, and if needs of other use groups are given best possible consideration within one's own land use practises.

Perspectives of sustainability of individual interests may be highly subjective. The prime focus of the present project was therefore to develop comparable, PCI-Sets for self-assessment by the different land user groups in terms of their support for integrated sustainable wildlife management, including sustainable hunting, with least possible conflict.

Overview, interrelationships

Up to now, it has very rarely been possible to solve conflicts between wild animals and human use in cultural landscapes on a large and permanent scale. This is due to the fact that demands for increased shooting, more and better food, more fencing, more peace and quiet, etc., can rarely be treated in isolation. More often than not, there is a lack of awareness of an overall picture, which includes not merely improved planning and implementation of shooting, or even giving added consideration to wild animals in terms of agricultural and forestry measures, but also considering landscape, transport and tourism planning (conscious habitat management). The direct and indirect interrelationships mostly existing in some form between landscape structure and wild animals should be given greater attention. This suggests a continuous awareness among all land users of the fact that their activities may have significant impacts upon habitat quality and other causes of wildlife damage (Reimoser et al., 2006).

The framework within which wildlife management occurs contains three main components that are inextricably linked: habitat, wildlife population and damage tolerance (Fig. 12). These components steer the preservation and use of wild animals in cultural landscapes. A harmonious equilibrium should be established within this "tripod". If one leg is short the others must be re-adjusted if problems are to be avoided. While hunters are primarily responsible for actively controlling wildlife populations, the responsibility for habitat status lies with a number of other land user groups (agriculture and forestry, leisure activities, transport, housing, hunting, nature protection, etc.), while damage tolerance is mostly determined by the land owners and the authorities. Wildlife management compatible with regional culture thus depends upon the harmonious tuning of the habitat – wildlife population – damage tolerance tripod. This calls for a holistic, synoptic view.

Even though simple solutions to this problem hardly seem possible, there is hope that the situation of wildlife – environment – humans might improve on a permanent basis with the help of regional analyses of causes and adjustment of measures. A pre-condition is that common ground can be found among land users as a result of improved training and education and greater awareness on the basis of the present integrated sustainability criteria. These represent a consensus on sustainable wildlife management compatible with landscape, forest and wildlife needs, and of agricultural and forest management policies more in

line with wild animals' well-being, as well as of better managed biotope use for the purpose of leisure activities, all within the scope of ecologically oriented spatial planning. The common objective for all these aspirations is to achieve an integration of wild animals, our natural heritage, into cultural landscapes used by man, in this case with regard to the anthropogenically shaped Wienerwald Biosphere Reserve. Large wild animals need large habitats if we want to conserve them in the longer term. Where problems can be defined, context-specific measures can be derived (Reimoser et al. 2009).

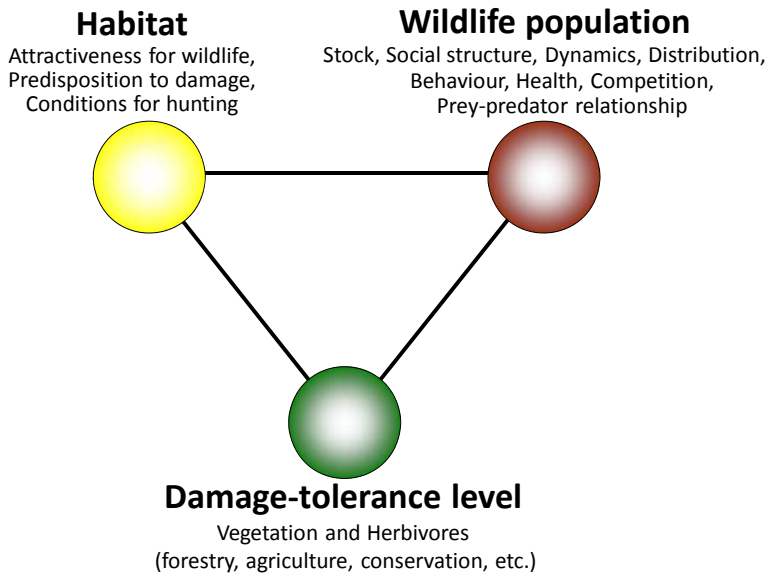

Figure 12: Linking of the main components of the societal dimension of wildlife management: habitat, wildlife population and damage tolerance. The human dimension within which wildlife management is undertaken comprises three interconnecting components, and proper wildlife management depends on harmonization of all three. If one of the three components is altered, the others will tend to react, and may in turn have to be appropriately adjusted to maintain the desired balance.

Linking of contexts and assessment sets

Along with international agreements pertinent to sustainability and national implementation strategies, the general ecological and socio-economic interdependencies provided the basis for the Principles, Criteria and Indicators (PCI Sets) developed in this project. In order to provide a second, easier entry into the PCI Set for practical use, a *List of Potential Contexts* was drawn up for the various land user groups to be addressed. For these contexts, links with relevant indicators have been provided. By finding the relevant indicator in the PCI Set of the respective user group, the user is able to assess their land use against relevant sustainability requirements and, if necessary, change to a more sustainable approach.

Persons who prefer to enter the sustainability assessment via the contexts "typical" for their range of activities thus have an option of arriving at the corresponding indicators of the PCI Set from the different contexts of the respective user group by way of an indicator number and then to assess their activity relating to the subject matter of "hunting, wild animals and their habitats." (cf. German full version of the study, Reimoser et al. 2009).

6 OUTLOOK

The cross-sectoral Principles, Criteria and Indicators (PCI) for sustainability assessment of the fields of hunting-related activities, agriculture, forestry, leisure and recreation management and their interaction with wild animals, wildlife habitats and hunting are to be made available on the Internet for practical application. The management of the Wienerwald Biosphere Reserve is offering to place the PCI Sets on the Biosphere Reserve's webpage to this effect. Given adequate funding by interested subsidising bodies, there is in principle the possibility of creating an Internet-based option for interactive electronic self-assessment modelled on the existing "Sustainable Hunting" Internet platform (www.biodiv.at/chm/jagd/ and www.biologischevielfalt.at/nachhaltige-nutzung/nachhaltige-jagd/). We continue to collect comments and proposals for improvement in order to allow for future adjustments of the Set and thus keep it "alive". Our focus will remain on greatest possible practical applicability and conclusiveness of the Sets.

The methodology for evaluating sustainability chosen for this project mainly prompts local actors to use the Assessment Set of Principles, Criteria and Indicators for self-assessment. This cannot replace the development of additional monitoring systems potentially necessary for a large-scale objective external assessment of sustainability. What should be targeted is self-assessment by hunters, forest managers, agricultural managers, leisure and recreation management and land owners, in combination with statistically robust monitoring of developments in wild animal populations and their habitats (e.g. in a network of representative areas). This would also allow populations or population trends of huntable and of threatened wildlife species to be related to findings on supra-regional developments in order to be able to integrate them into future management planning. Supra-regional comparisons are ideally carried out within the scope of internationally harmonised and agreed programmes, depending on the individual wildlife species (e.g. populations, migration flyways).

The project results are meant to raise general awareness of the need for integrated management of sustainable use of natural resources, and to establish links and connections between ecological, economic and socio-cultural aspects. This requires public relations work and the systematic transfer of results to organisations for the respective user groups as well as the integration of project results into the existing regulatory framework for the Wienerwald Biosphere Reserve. The close integration of stakeholders in the region (enterprises and operations, landowners, land user representatives, Biosphere Reserve management, etc.), particularly within the scope of the project-related participatory forum, provide favourable continuing conditions for this objective.

A continuation of the "Inter-sectoral Forum for Conflict Management," a stakeholder platform established in the course of the ISWI-MAB project, is recommended.

A MAB follow-up project (IESP) contributes to the further development of this approach to sustainability as well as to the practical implementation of the results on the basis of actual problem scenarios in the Wienerwald Biosphere Reserve.

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8 ANNEX: Four co-ordinated Sets of Principles, Criteria and Indicators for Integrated Sustainable Wildlife Management

1. Hunting (full and short version)
2. Forest Management (full and short version)
3. Agriculture (full and short version)
4. Leisure and Recreation Management (full and short version)