W wie Wildnis wagen

Wildnis ist freie Natur – in ihrer Entwicklung uneingeschränkt und unberechenbar. Als Kontrast zur Zivilisationslandschaft brauchen wir solche Flächen, die sich ohne Eingriffe des Menschen entwickeln und die vor der Haustür liegen, also leicht erreichbar sind.

Diesen Handbuch verbindet erstmals wildnisbezogene Umweltbildung mit planerischen wie rechtlichen Aspekten der Wildnisentwicklung in Mitteleuropa.

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Wagnis Wildnis
Wildnisentwicklung und Wildnisbildung in Mitteleuropa
oekom verlag, München 2006

G wie Großschutzgebiete


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oekom verlag, München 2003
Evaluation of Major Threats to Forest Biosphere Reserves: A Global View

Abstract
Forest ecosystems, where natural resource users are potentially in conflict with conservationists, are extremely threatened by various external factors. Resulting loss of forest cover and land-use change can have a great impact on the provision of ecosystem services (such as watershed regulation, biodiversity maintenance). However, little is known on a global scale about the character and distribution of threats to forest biosphere reserves. In view of this knowledge gap, our analysis explores the occurrence of threats and their potential causes. A global telephone survey of UNESCO biosphere reserve managers was conducted. Upon pinpointing climate change (in high-income countries) and illegal activities (in non-high-income countries) as major threats, we identified the group of forest-specific illegal activities (wildfire and its precursors) as an occurrence chiefly predominant in non-high-income countries. Our results show that forest biosphere reserves in non-high-income countries are particularly under extreme threat, as they have to address both climate change and illegal activities, while the latter are less problematic in high-income countries.

Keywords
biosphere reserve, fire, illegal activities, logging, poaching, threat, tourism

Forest Biosphere Reserves under Threat
The world has approximately four billion hectares of forest covering about 30 percent of the world’s land area (FAO 2007). Three percent of the world’s total forest area were lost between 1990 and 2005 – an average decrease of some 0.2 percent per year (FAO 2007). Forest ecosystems provide many life-sustaining goods and services (e.g., biodiversity maintenance, carbon sink, climate and watershed regulation, food production, recreation), without which life as we know it would not be possible. Moreover, about three-quarters of the world population lives in forest ecoregions (Shvidenko et al. 2005), and at least 1.8 billion people are significantly dependent on forest and woodland (IUCN 2007). With only ten percent of the world’s forests in protected areas under biodiversity conservation status (IUCN 2007), it is important to consider not only how to stop forest loss, but also how to sustainably manage forest ecosystems. The Convention on Biological Diversity (CBD), for example, addresses forests directly through the Forest Work Programme (adopted in 2002) with one particular aim of forest biodiversity conservation.1 The biosphere reserve approach is a good concept for meeting both conservation objectives and human needs (UNESCO 1995). Ideally, biosphere reserves serve three functions: biodiversity conservation (mainly in the core zone), support of research and environmental education, and sustainable regional development (buffer and transition zone) (Batisse 1986).2 It is known, however, that many protected forest areas are suffering from a combination of critical threats, including poaching, encroachment, and logging (WWF 2004). Yet no systematic research study has been undertaken to investigate the problems biosphere reserve managers are facing. Therefore, our article aims at investigating the threats to the core zone of forest biosphere reserves, where biodiversity conservation is the primary objective.

1 See www.cbd.int/forest/about.shtml.
2 For an overview of the biosphere reserve concept and zoning scheme see Stoll-Kleemann and Job (2008, in this issue).
In order to understand and describe threats, it is useful to have a classification framework that helps identify underlying causes. According to Worboys et al. (2006), indirect and direct threats can be distinguished by their spatial characteristics arising from outside or within protected areas, respectively. Following the five categories of underlying causes determined by Geist and Lam (2001), economic, policy/institutional, technical, cultural, and demographic factors were identified in regard to forest decline, especially in the tropics. All of the threats might occur legally (e.g., concession-based tree extraction) or illicitly (e.g., illegal slash and burn activities). Forest protection or biosphere reserve status does not hinder the eradication of illegal activities. There are many types of illegal activities in which individuals, groups of individuals, and/or institutions might engage, all of which undermine the governance of forest protected areas (FAO 2001). A sound understanding of the underlying causes and patterns of threats to forest areas, including illegal activities, is critical for developing effective management and protection strategies (IUCN 1999).

For this reason, we interviewed experts in the area of biosphere reserve management. Since there are fundamental discrepancies in sharing data on protected areas and biosphere reserves (Bertzky and Stoll-Kleemann 2008), semi-structured interviews were preferred to ecological monitoring data (e.g., deforestation rate). The subjective response of biosphere reserve managers, based on years of field-level experience, may reflect the realities and complexities of protected areas even better (cf. Hockings 2003). We addressed the following questions:

- What are the major threats to the core zone of forest biosphere reserves?
- What are the potential causes and patterns of such threats?

### Research Method

Between July and December 2006, we conducted a global telephone survey of biosphere reserve management executives. As the data set also serves further analysis, all elements in the population (507 biosphere reserves in 102 countries) were included in the survey. We interviewed managers from 213 biosphere reserves in 78 countries, which corresponds to an overall response rate of 42 percent. In this standardised interview with open questions concerning existing threats and illegal activities, we asked managers and academic staff to describe the current situation at their biosphere reserve. In regard to the analysis, the two answers given for each question were treated equally.

The results of two different open questions explicitly referring to the core zone on threats and illegal activities were coded and combined into groups of threats and illegal activities, respectively, revealing a binary matrix (threat or illegal activity existent: 1, or inexistent: 0). Additional information on the sampled biosphere reserves was used to analyse underlying causes in terms of economic (country income), regional (UN subregion), and demographic (number of biosphere reserve residents) factors. A categorisation in high and non-high-income countries was made in accordance with the categories of the World Bank’s gross national income per capita indicator (World Bank 2007). For regional aspects, the data set was grouped according to the United Nations’ geographical subregion scheme. Each interviewee was also asked about the number of residents living inside the biosphere reserve, as there is no data available for biosphere reserves.

### Table 1: Calculation of the forest specificity index: When the relative frequency of activities is higher for forest biosphere reserves, the activity is referred to as forest-specific. We define activities with an index value higher than 0.80 as forest-specific (in bold letters).

<table>
<thead>
<tr>
<th>activity</th>
<th>all interviewees (n=213)</th>
<th>all forest biosphere reserve interviewees (n=166)</th>
<th>forest specificity index</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>absolute frequency</td>
<td>relative frequency (%)</td>
<td>absolute frequency</td>
</tr>
<tr>
<td>infrastructure</td>
<td>4</td>
<td>1.9</td>
<td>4</td>
</tr>
<tr>
<td>settlement</td>
<td>28</td>
<td>13.1</td>
<td>26</td>
</tr>
<tr>
<td>land conversion</td>
<td>6</td>
<td>2.8</td>
<td>5</td>
</tr>
<tr>
<td>wood forest product collection</td>
<td>63</td>
<td>29.6</td>
<td>52</td>
</tr>
<tr>
<td>drug cultivation</td>
<td>10</td>
<td>4.7</td>
<td>8</td>
</tr>
<tr>
<td>non-wood forest product collection</td>
<td>54</td>
<td>25.4</td>
<td>42</td>
</tr>
<tr>
<td>poaching</td>
<td>115</td>
<td>54.0</td>
<td>88</td>
</tr>
<tr>
<td>disregard of biosphere reserve law</td>
<td>44</td>
<td>20.7</td>
<td>33</td>
</tr>
<tr>
<td>trash deposition</td>
<td>24</td>
<td>11.3</td>
<td>18</td>
</tr>
<tr>
<td>wildfire</td>
<td>19</td>
<td>8.9</td>
<td>14</td>
</tr>
<tr>
<td>inadequate agricultural practice</td>
<td>25</td>
<td>11.7</td>
<td>18</td>
</tr>
</tbody>
</table>

3 Definition: any human activities (e.g., use, transport, processing, trade) that are inconsistent with national (or sub-national and international) laws (Guertin 2003).
4 For the methodology of expert interviews in protected area management see Stoll-Kleemann (2005).
5 A documentation of the survey can be found at www.biodiversitygovernance.de.
6 As of December 2006.
7 For example: “What are the two biggest threats to biodiversity within your biosphere reserve (core zone)?”
in general and developing countries in particular (cf. Bertzky and Stoll-Kleemann 2008). The numbers were grouped in the same order of magnitude as the well-documented biosphere reserves (0, < 100, < 1 000, < 10 000, < 100 000, < 1 000 000, > 1 000 000).

According to the classification of the UNESCO MAB (Man and Biosphere) Programme, a biosphere reserve was classified as forest when the major habitat and land cover type of the reserve was specified as forest. Hence, 166 biosphere reserves out of the 213 were categorised as forested and included in this study. This corresponds to a response rate for forest biosphere reserves (overall 375) of 44 percent. 76 of the 166 biosphere reserves are also designated as national parks. Regarding the regional (per continent) representativeness, only Asia/Australia (27 percent) are below average.

A forest specificity index was calculated for each illegal activity to assess whether the respective activity mainly occurs in forest ecosystems. Therefore, the absolute frequency of stated illegal activities at forest biosphere reserves (n = 166) was divided by the absolute frequency of activities noted for all biosphere reserves (n = 213). To identify “forest-specific” activities, the relative frequency of their being stated (absolute frequency per number of all interviewees and all forest biosphere reserve managers interviewed) was compared. When the percentage for forest biosphere reserves is higher, the activity is referred to as forest-specific (table 1). In our study we define those activities with an index value higher than 0.80 as forest-specific.

The contingency coefficient (Pearson11) was computed to analyse the strength of dependency between occurring illegal activities and UN subregions, income status (high and non-high), and number of residents. The coefficient depicts the occurrence and the strength of the relation, but not the direction. For interpretation of the coefficient for example in terms of regional aspects, a differentiation of Major Threats

ordered relation to South America for instance was interpreted when most frequently answered in this region. Activities without a contingency coefficient depict no relation to either specific or multiple regions and are interpreted as regionally independent.

Our survey of biosphere reserve managers yielded remarkable results in that significant relationships and patterns emerged, indicating that these issues are indeed systematic and reflect consistent underlying causes, rather than the idiosyncratic results of individual reserve managers. To ensure reliability the questionnaire was randomly cross-examined, revealing identical answers for major threats and illegal activities from different interviewees at the same biosphere reserve. Furthermore, this global survey goes beyond existing comparable studies (e.g., WWF 2004, Geist and Lambin 2001) because it contains the broadest sampling of countries (166 forest biosphere reserves in 68 countries) yet undertaken with consistent primary data collection in both high-income and non-high-income countries. This study reflects the expert knowledge of managers, rather than on-ground biodiversity conservation data.

Overall, the most frequently mentioned threat at forest biosphere reserves is illegal activities12 (27 percent, see table 2). In addition, overexploitation (18 percent) and fire13 (17 percent) play a major role. When distinguishing between the answers based on country income, an interesting aspect becomes apparent: There are non-high-income countries that account for ranking illegal activities (44 percent) and overexploitation (21 percent) so highly. In such countries, threats directly impacting natural resources (see also land use: 17 percent) are relevant, whereas in high-income countries global change aspects such as climate change...
change (25 percent), invasive (alien) species14 (23 percent), and tourism (17 percent) are more relevant. However, fire is particularly a threat (but not the most severe) to forest biosphere reserves15 regardless of the country’s income status (17 percent in non-high-income and high-income countries).

In the following discussion, an emphasis is placed on illegal activities, as these are overall the most frequently mentioned threat to forest biosphere reserves and by far the greatest threat in non-high-income countries.

Major Threat to Forest Biosphere Reserves in High-Income Countries: Global Climate Change

In high-income countries the major threats according to biosphere reserve managers are indirect and originate from outside the biosphere reserve. Climate change (25 percent) and invasive (alien) species (23 percent) constitute such threats. As the reality of climate change becomes increasingly accepted, protected area managers in high-income countries are recognising that they must consider potential indirect impacts in the design and management of protected areas (Worboys et al. 2006). For a detailed discussion of climate change and its perception by protected area managers, see Schliep et al. (2008, in this issue).

In contrast to the notion that invasive alien species may be a less a threat to forests than for example freshwater protected areas (WWF 2004), our results illustrate that invasive species are indeed one of the major threats to forest biosphere reserves, particularly in high-income countries. We do not interpret the non-response in non-high-income countries as an absence of this threat, but rather as an overload of other immediate threats such as illegal activities (cf. Schliep et al. 2008, in this issue).

In view of this, all interviewees were asked to state the illegal activities occurring at their biosphere reserve. For further analysis the answers were coded and combined (table 3), and the relationship to regional (UN subregion), economic (country income), and demographic (biosphere reserve residents) factors were analysed (table 4). In regard to forest specificity (table 4), only infrastructure and settlement have a high forest specificity value (1.00, 0.93, respectively), whereas the other forest-specific illegal activities (wood forest product collection, land conversion, and drug cultivation) have a relatively low index value (0.83, 0.83, 0.80, respectively). For comparing the activities among each other, however, a differentiation can be made as displayed in table 1.

Wood forest product collection specifically occurs at forest biosphere reserves and is one of the most frequently mentioned illegal activities (table 4). It is also the only activity mentioned as having a significantly strong relation to all factors region, (non-high) country income, and biosphere reserve residents. Together with settlement, inadequate agricultural practice, wildfire, and infrastructure, it significantly relates to the region (strong to very strong). Except for wildfire and inadequate agricultural practice, all these illegal activities occur specifically in forest ecosystems (table 4). Land conversion and drug cultivation also take place in forest ecosystems, but have no significant relation to any of the three factors, possibly due to the low frequency of answers. As drug cultivation can be one form of illegal land conversion, it will be discussed in the following as one illegal activity: land conversion. Drug cultivation, however, is listed separately in our survey, as it was the only activity exclusively mentioned in the Americas, thus indicating a high relevance in this region.

<table>
<thead>
<tr>
<th>illegal activity</th>
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<tbody>
<tr>
<td>poaching</td>
<td>hunting and fishing activities</td>
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<td>wood forest product collection</td>
<td>logging, tree extraction, deforestation, fire wood collection</td>
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<td>medicinal plants, berries, mushrooms, flowers, water, honey, stones, archaeological pieces, mining</td>
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<td>cultivation of drugs and their traffic</td>
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<tr>
<td>infrastructure</td>
<td>road construction</td>
</tr>
<tr>
<td>settlement</td>
<td>house construction (public and private)</td>
</tr>
<tr>
<td>disregard of biosphere reserve law</td>
<td>road passing, forbidden hunting or fishing techniques, camping, access to core zone, vandalism</td>
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<tr>
<td>wildfire</td>
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</tr>
<tr>
<td>land conversion</td>
<td>change of land use systems for e.g. plantation establishment 4</td>
</tr>
<tr>
<td>trash deposition</td>
<td>garbage dumping, contamination, pollution</td>
</tr>
<tr>
<td>inadequate agricultural practice</td>
<td>illegal grazing, stock-breeding, slash and burn practices</td>
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<td>other</td>
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14 A species occurring in an area outside of its historically known natural range as a result of intentional accidental dispersal by human activities and whose establishment and spread modify ecosystems, habitats, or species (MA Glossary 2005).

15 Fire as a threat at all biosphere reserves interviewed was mentioned less (fifth rank: 14 percent) compared to all forest biosphere reserves interviewed.

Major Threat to Forest Biosphere Reserves in Non-High-Income Countries: Illegal Activities

In non-high-income countries the far greatest threat is direct and stems from within the biosphere reserve, namely illegal activities (44 percent). International surveys (e.g., WWF 2004) confirm the prevalence of different illegal activities as a threat in many parts of the world. Our results show that this is a crucial issue particularly at reserves in non-high-income countries.

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15 Fire as a threat at all biosphere reserves interviewed was mentioned less (fifth rank: 14 percent) compared to all forest biosphere reserves interviewed.
Additionally, disregard of biosphere reserve law and trash deposition are not forest-specific, but are related to economic factors expressed as having a significant medium or weak relation to a (high) country income status.

Poaching and non-wood forest product collection are also not forest-specific, but are two of the most frequently mentioned illegal activities. They have a significant very strong relation to UN subregions, whereas the significant relation to the country income is expressed less.

### Forest-Specific Illegal Activities

Fire is one of the oldest methods used by humans to manage the natural environment due to its effectiveness in clearing forests for agricultural purposes and nourishing poor soils. On the other hand, fire can wreak havoc on forest ecosystems (IUCN 2007). As fire can be a natural phenomenon (some habitats are strictly adapted to fire, while others suffer from it), managers must have a clear understanding of the ecological conditions of their specific biosphere reserve and natural potential resilience or sensitivity to fires (Worboys et al. 2006). The WWF (2004) report on threats to forest protected areas noted fire was featured relatively seldom. Our analysis, however, revealed that fires at forest biosphere reserves were one of the three most profound threats. On the other hand, they do not seem to be extensively caused by illegal fire activities as shown by the rare answers to the question on illegal activities (see table 4). Yet according to Nepstad et al. (2001), all of the forest-specific illegal activities described such as wood forest product collection, infrastructure, land conversion, and settlement, act as precursors and contribute to the increase of forest flammability (figure 1, p. 130). With the exception of infrastructure, all these illegal activities (including inadequate agricultural practice) are linked in our study to the threat fire in such that it is the most or second most frequently mentioned answer given by the interviewees (inadequate agricultural practice: 50 percent, drug cultivation: 38 percent, settlement: 23 percent, land conversion: 20 percent, and wood forest product collection: 17 percent were common answers given on illegal activities).

### Wood Forest Product Collection

Our analysis demonstrates that according to biosphere reserve managers, wood forest product collection (deforestation as well as, for example, fuel wood collection) is significantly related to non-high-income countries and to the number of biosphere reserve residents (the more people, the greater the collection). One possible reason for this might be that poverty and unemployment are known to be critical factors to environmental degradation (Carey et al. 2000). Extraction of timber for local needs (IUCN 1999) and fuel wood collection for subsistence purposes (Abbot and Mace 1999) lead to increased pressure on forest biosphere reserves, as also shown in our survey by the high forest specificity index for wood forest product collection. People have traditionally focussed on income-generating activities through non-sustainable behaviour such as illegal hunting and logging (IUCN 2007), and debt servicing is often achieved by cashing in natural resources like timber (Carey et al. 2000). Although the occurrence of illegal wood forest product collection is concentrated in low-income countries (in South-East Asia, South America, and Middle Africa) where deforestation is known to be a severe problem, for example, Indonesia, Amazon, and the Congo, the underlying cause for this is also closely associated with the timber demand of high-income countries. The WWF (2005) report on Europe’s illegal timber trade, for example, concluded that trade between EU countries and the Amazon Basin, the Congo Basin, East Africa, Indonesia, the Baltic States, and Russia was responsible for the loss of 600,000 hectares of forest each year, which is more than twice the size of Luxembourg. Hence, in our study, economic (commercial and subsistence purposes) and demographic factors (population density), as well as cultural aspects (high consumption level in high-income countries) were identified as underlying causes.
One major consequence of logging activities, regardless of which type (clearing, slash and burn, or selective extraction), is the increased forest flammability due to the forest interior being opened up to sunlight (Holdsworth and Uhl 1997). In such, wood forest product collection, mentioned as an illegal activity by biosphere reserve managers, contributes to the increased forest flammability of biosphere reserves.

**Infrastructure, Settlement**

Our analysis identified illegal infrastructure establishment as a sole occurrence in forest ecosystems, with a significantly strong regional focus in Latin America (Central and South America). Moreover, illegal settlement is related to forest ecosystems with a significantly strong regional relation (focus in Central America and Southern Europe). Schwartzman et al. (2000) identified infrastructure such as illegal road construction to be more significantly related with the issue of deforestation than with that of population settlement. The Amazon’s deforestation, to name one example, can be explained as a direct consequence of the construction of paved roads (Nepstad et al. 2001). In contrast, in temperate zones, illegal deforestation for settlements has a long history and has often resulted in dramatic impacts on biological diversity (Norton 1996). For example, in Western Europe the extent of remaining old growth forests is less than one percent (WWF 1992). Our results demonstrate that illegal settlement activity and infrastructure establishment mainly occur in forest ecosystems and can be seen as a direct driver of deforestation in the tropics as well as in Southern Europe.

**Land Conversion, Inadequate Agricultural Practice**

Land conversion (mainly occurring in Latin America) contributes to forest flammability in such that cleared forests appear to be less well adapted to large fluctuations in moisture (Jipp et al. 1998). Furthermore, it leads to lower precipitation through a reduction in water evaporation from the land (Nobre et al. 1991). In view of underlying causes, a differentiation in commercial and subsistence purposes can be made, as discussed above for wood forest product collection.

Although inadequate agricultural practices such as intensive production systems (e.g., stock-breeding, grazing) and slash and burn activities are not related to forest ecosystems, there is a statistically significant medium relationship to non-high-income countries (see table 4), especially in North and West Africa, and Central America. Besides land conversion, inadequate agricultural practice contributes to the flammability of forest ecosystems. Accidental fires caused by slash and burn activities, for example, damage perennial crops and agro-forestry systems (Nepstad et al. 2001).

All together, these illegal activities end up increasing the susceptibility of forest biosphere reserves to the threat of fire. Our results show that this is not only the case in the Amazonians (as concluded by Nepstad et al. 2001), but that the risk also exists in all forest biosphere reserves, mainly in non-high-income countries (Latin America, South-East Asia, and North, West and Middle Africa) where such illegal activities appear to be most severe and forest-specific. Although fire was not mentioned most frequently as a threat, we do interpret it as major threat to forest biosphere reserves in non-high-income countries because all the illegal activities mentioned can act as precursors and were referred to as being relevant (with the exception of infrastructure) when fire was also stated as a major threat. Every single illegal activity per se, however, can also wreak havoc within biosphere reserves. Underlying causes can be identified on the one hand as demographic factors (population pressure) because wildfire and wood forest product collection appeared to have a significant relation to population density, and on the other hand as economic factors (e.g., poverty) since the occurrence of illegal activities is more predominant in non-high-income countries. A third underlying cause can be attributed to cultural factors such as high consumption levels in high-income countries. For this reason, management responses have to take these findings into account if they are to successfully address the causes and consequences of illegal activities.

Further studies on the topic of fire as a threat in high-income countries are still needed, as was highly evident by last year’s (2007) destructive wildfires in several European countries (Spain/Canary Islands, Italy, and Greece, see figure 2). Because fire was also considered a severe threat in these countries (see table 2), but illegal activities were not, other underlying causes and relations must be responsible for this indication – perhaps a lack of effort in extinguishing fires (especially in Mediterranean countries), in addition to global warming. The latter is at least supported by the fact that climate change is already recognised by biosphere reserve managers in high-income countries as a potential external threat. Deeper investigation, however, is required to gain more insight into this topic.
Non-Forest-Specific Illegal Activities

Poaching, Non-Wood Forest Product Collection

In contrast to the so-called forest-specific, direct threat of fire and its precursors, mainly a problem in non-high-income countries, we identified a group of non-forest-specific illegal activities such as poaching and non-wood forest product collection (see table 4). These two illegal activities are often mentioned together. Both have a significant, very strong relation to different UN sub-regions in the world such as Eastern and Southern Europe, North and Central America, and the entire African continent. The occurrence of these illegal activities is not globally distributed, but is predominant in non-high-income countries, expressed as weak relation to country income (table 4).

In the literature, poaching has been identified as a major issue particularly in the tropics (e.g., van Schaik et al. 1997), whereas our study demonstrates that it is also a crucial issue in other regions of the world. Studies from Africa show that the demand of a growing middle class and intense poverty create a strong incentive for continued hunting. At the same time, a lack of biosphere reserve staff, invading infrastructure, and weak law enforcement patrols makes it virtually impossible to police poaching activity (Carey et al. 2000, Abbot and Mace 1999). Furthermore, underlying causes such as cultural factors can also be identified in high-income countries. High-value trophy hunting as a long-standing hunting tradition amongst wealthy people in some parts of Africa (e.g., elephant ivory) and Asia (e.g., tiger, rhinoceros) is an organised criminal activity (Worboys et al. 2006).

In Europe, a variety of causes are responsible for the widespread occurrence of poaching at biosphere reserves, as poverty in Southern Europe does not play the same driving role as in some parts of Eastern Europe. Structural changes in Eastern Europe related to the collapse of the USSR and vast political, economic, and legal changes have led to increased poverty. In the 1990s a dramatic decrease in the population dynamics for example of Saiga Antelope was observed in Kazakhstan and directly attributed to the poor socio-economic situation there (Fremuth 2003). In the rest of Europe, however, hunting has a long-standing social tradition and has already led to a dramatic decrease in various animal populations in the past (see e.g., WWF 2007, Je-

FIGURE 2 Smoke from wildfires across the Balkans in late July 2007, seen from space.

16 For a detailed discussion on this problem which addresses a form of stricter law enforcement, see Fischer (2008, in this issue).
Conclusions

The aim of this work was to evaluate the major threats within forest biosphere reserves by means of a global survey of experts from the field of biosphere reserve management. Our findings provide evidence that a clear differentiation can be observed depending on country income. In high-income countries, the major threat according to the experts is global climate change (25 percent), whereas in non-high-income countries, illegal activities (44 percent) are most frequently mentioned. Given that illegal activities are a major threat, especially in non-high-income countries, a further differentiation can be made concerning the type of illegal activities. We identified one group of forest-specific illegal activities (precursors of wildfire) and two groups of forest-independent illegal activities:

- Consumptive resource use in form of poaching and non-wood forest product collection. These activities can be found in several regions throughout the world, mostly in non-high-income countries.
- Disregard of biosphere reserve law and trash deposition related to tourism activities mainly occurring in high-income countries.

We interpret wildfire as a major threat to forest biosphere reserves, as most of the illegal activities mentioned (wood forest product collection, infrastructure, settlement, land conversion, and inadequate agricultural practices) act as wildfire precursors and are identified as being relevant where the threat of fire is also significant. This is especially true for non-high-income countries, where these illegal activities appear to be the most severe.

Because forests provide many ecosystem services (carbon sink, watershed regulation), immediate action is needed at two different levels: on a global scale, the issue of worldwide (climatic) changes should be addressed and on a regional/local scale, the threat of illegal activities in non-high-income countries has to be dealt with. Apart from financial support from high-income countries (as concluded in the climate conference on Bali from December 3 to 14, 2007), vital data information and knowledge sharing (as proclaimed by the CBD Work Programme on Forest Biodiversity) would be essential. Our results show that according to biosphere reserve managers, forest biosphere reserves – especially those in non-high-income countries – challenge the target of biodiversity conservation (in the core zone of biosphere reserves) because the occurrence of illegal activities such as wood forest product collection, land conversion, and settlement directly threaten the ecosystem’s integrity. From these findings, the question arises as to why the buffer zone surrounding the core zone is not able to protect the latter from such immediate threats. And what exactly are the factors hindering management from adequately addressing these problems? In particular, forest biosphere reserves in non-high-income countries are extremely threatened since they have to address both climate change and illegal activities. Further studies (satellite images, in-depth interviews with local communities or politicians) at different levels (national, region-
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