

Fire Management To Conserve Biodiversity And Protect Communities

A Global Perspective From A Conservation Organization

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Abstract

There is reasonable evidence to suggest that fire regimes are changing in many parts of the world. People, rather than natural causes, are increasingly responsible for starting fires and human activities are altering the potential of fires to cause serious impacts on the well-being of local human communities and biological diversity.

The implications of changing fire regimes on economic, social and ecological systems are not well understood by policy makers or indeed in some cases by fire management authorities. As a consequence, there is a tendency to over rely on fire-fighting to provide the solution to harmful fires. Yet, it is apparent that ‘a continued emphasis on the emergency response side of the wildfire problem will only result in future large and damaging fires’ (FAO, 2001) More attention needs to be paid to addressing the underlying causes of fires (Jackson and Moore, 1998).

This paper considers the role of the ‘ecosystem approach’ in linking fire management objectives to broader land use decisions and concludes that this approach may assist fire management authorities to find ways to both protect communities and conserve biological diversity. It also examines the role of international conservation organisations, including IUCN – The World Conservation Union, in the discourse on wildland fires and in promoting co-operative fire research and management programmes.

Introduction

Conserving biodiversity¹ and protecting human communities from wildfires are sometimes seen as incompatible objectives. As a consequence, fire management authorities can tend to overemphasise fire suppression and the use of fuel reduction burning to protect communities, sometimes to the detriment of biodiversity conservation objectives. But are these objectives necessarily incompatible? This paper begins with the assumption that inappropriate fire regimes can threaten both communities and biodiversity. It considers whether fire management strategies can be modified to better balance biodiversity conservation and protection of communities and considers the role of international conservation organisations in fire management. It concludes by proposing 10 steps to address the impacts of harmful fires.

In trying to make sense of the role of fire management in conserving biodiversity and protecting communities, two key problems can be identified:

- **Complexity** – the impact of fire on ecosystems and people varies immensely from one location to another and the nature and extent of this impact can change over time. Accordingly, general statements about fire regimes are not very useful as fire management

¹ The Convention on Biological Diversity (CBD) defines biological diversity as the variability among living organisms from all sources including, *inter alia*, terrestrial, marine and other aquatic ecosystems and the ecological complexes which they are part; this includes the diversity within species, between species and of ecosystems (CBD, article 2).

strategies need to be tailored to unique local conditions and be capable of adaptation over time; and

- **Lack of reliable information** – although the inter-relationship between humans, fire and ecosystems has been the subject of many studies and reports, knowledge of the current and historical impact of fire and of the underlying causes of harmful fires is often inadequate for fire management authorities to develop well-informed fire management strategies.

Changing fire regimes

In some ecosystems, including tropical savannas and temperate and boreal forests, fire is a crucial ecological process, in others, such as tropical moist forests and peat swamps, it can be highly destructive. The impact of fires on an ecosystem varies depending on the sensitivity of the vegetation to fire as well as on the area burnt and the frequency, distribution (or patchiness), intensity and timing (the season in which fires occur) of the fires (IUCN, 2002). These elements combine to produce a *fire regime*.

Fire regimes can and do change over time, either through natural causes or as a result of changes in the degree and nature of human intervention. In many areas it is likely that fire regimes have been altered by hundreds, and in some cases thousands, of years of human influence.

Over thousands of years human-caused fires may have played an important role in expanding the prairies and reducing the woodlands and forests in North America (Pyne, 1982; Axelrod, 1985). Poffenberger et al. (1998) argued that: ‘Aboriginal peoples throughout pre-European contact Canada and the United States used extensive burning to increase the grazing area, stimulate grass production, and move herds to facilitate hunting.’

According to Fairhead and Leach (1996), fire management practices employed by villagers have assisted the maintenance of the forest savanna mosaic in the northern regions of West Africa. While in the humid and densely populated southern regions, fire management practices have assisted the succession from savanna to forest vegetation.

In his analysis of the historical role of people, fire and wild cattle in south east Asia, Wharton (1966) noted that ‘fire in the northern plains of Cambodia has aided in the degradation of some soils and most of the vegetation cover over the area originally clothed by sub-humid climax forests. Fire seems, however, to be an essential factor in maintaining suitable large areas of savanna forest exploitable by both herbivores and by a very small population of hardy Cambodians.’

In her thought provoking analysis of environmental issues and indigenous peoples in northern Australia, Langton (1998) concluded that the ‘prevalence of fire-tolerant species over much of northern [Australian] savannas may be the result of millennia of systematic burning. The species composition of the earlier vine forests around coasts of Cape York Peninsula seems to have been heavily influenced by human settlement with dense stands of fruit trees occurring in the vine forests around the edge of old camp sites. It is also the case that rainforest enclaves were protected from the incursion of fire-tolerant species by buffer zones created by Aboriginal burning.’

In most of the examples given above, contemporary fire regimes differ from historical ones. Failure to understand the relationship between an ecosystem and its fire regime and the role that humans have played in altering fire regimes, sometimes over millennia, can lead to fire management strategies that reduce biodiversity and in some cases will increase the severity of fires by allowing large accumulations of fuels (Jackson and Moore, 1998).

There is reasonable evidence to suggest that fire regimes are changing around the world (FAO, 2001; ISDR-IATF, 2002), that people rather than natural causes are increasingly responsible for

causing fires and that human activities and land-use practices are altering the potential of uncontrolled fires to threaten human communities and biodiversity (Dudley, 1997; IUCN, 2002). Humans alter natural fire regimes by changing the frequency and intensity of fires, by excluding or suppressing fires and by changing the nature of the landscape so that a naturally occurring fire does not behave in the same way it would have in the absence of human influence.

Changes in fire regimes are not universally the same around the world. In their summary of wildfire trends in the 1980s and 1990s, The Food and Agriculture Organisation of the United Nations (FAO, 2001) concluded that 'some areas suffered more fires due to increasing land-use intensity. Other forest regions have become more susceptible to larger and more damaging fires as a result of long-term fire exclusion.'

Changes to fire regimes can involve complex shifts in frequency, intensity and season of burning which, in turn, can affect biodiversity by:

- **Reducing genetic diversity**, for example by killing individuals and thereby removing them from the breeding population, disrupting reproduction cycles and isolating populations;
- **Diminishing species diversity**, for example through changes in disease patterns and insect populations, by altering plant succession and by the introduction of alien invasive species (Gill, 1994; Stanton, 1994; Gill et al., 1999); and
- **Disrupting ecosystem functioning**, for example by increasing the rate of soil erosion and changing the infiltration capacity of soils, creating changes in groundwater and altering soil nutrition and water quality and quantity (Jackson and Moore, 1998).

Habitat loss, including as a result of fires, is the main threat to wild species. The 2002 IUCN Red List of threatened species reports more than 11,000 species threatened with extinction - 25% of mammal species, 12% of bird species and more than 30% of listed reptiles, amphibians and fish (IUCN, 2002).

Fire can also alter the functioning and condition of ecosystems. Increasing the frequency of fires can favour plant species which are able to regenerate quickly and changes in the composition and abundance of plant species can, in turn, lead to changes in the populations of animal species which rely on these plants for food or habitat. In areas that are burnt regularly, some plant species may never reach sufficient age to reproduce, and they may eventually become locally rare or extinct. Conversely, decreasing the frequency of fires can result in loss of species that rely on fire to regenerate.

Fire managers are often hard pressed to explain the impact of fire regimes on biodiversity, particularly in relation to the impact of fire over long periods of time on species and vegetation patterns. Despite a considerable body of scientific, traditional and local knowledge on fire, the effect of past and present fire regimes and the nature of underlying causes of forest fires are often poorly understood (see, for example Langton, 1998). All fires have a direct cause, either natural or human. Human-caused fires also have underlying causes such as perverse economic incentives, inequitable land tenure and access to resources, failure to enforce the rule of law and to recognise and respect customary law, lack of economic opportunities, weak or under-resourced government institutions and inappropriate land use (IUCN, 2002). Unfortunately, few governments have shown the willingness to address underlying causes of fires (IUCN, 2002). This, plus a lack of reliable and useable knowledge on fire tends to encourage inappropriate fire management strategies and an over reliance on fire-fighting as the primary means of dealing with fires. This situation is often worsened when communities are allowed to settle in areas that are prone to periodic severe fire behaviour which places them at high risk.

According to FAO (2001) 'a continued emphasis on the emergency response side of the wildfire problem will only result in future large and damaging fires' (FAO, 2001). Thus, there is a need to move beyond the over-reliance on fire-fighting and relatively unsophisticated approaches to fuel reduction burning, to an approach that addresses the underlying causes of forest fires and better balances biodiversity conservation and community protection (see, Jackson and Moore, 1998). Only when sustainable land use practices and emergency preparedness measures complement each other will long-term natural resource benefits accrue for society (FAO, 2001).

Balancing biodiversity conservation and community protection

To better balance biodiversity conservation and community protection, fire managers need to consider the following four questions:

- What is the level and nature of risk presented by current fire regimes to local communities?
- What species and ecosystems are threatened by current fire regimes?
- What is the role of local communities in causing and managing fires?
- What changes in fire management and land use practices can be put in place to alter fire regimes to better balance community protection and biodiversity conservation?

While some fire management authorities have a good understanding of how to assess the risks of wildfire to communities, very few know how to determine the likely impact of fire regimes on species and ecosystems. FAO (2001) concludes that 'Managing fire to achieve beneficial effects and avoid unwanted results poses a complex challenge for natural resource managers (Brown and Smith 2000). Even attempts to eliminate harmful fire can cause long term undesirable consequences, such as increased risk of damaging fire and declining ecosystem health (Covington et al. 1994; Mutch et al. 1993).'

Lack of relevant knowledge to guide the development of fire management strategies is one of the key problems. Many countries lack even basic data on the historical abundance and distribution of biodiversity, are unable to differentiate between changes that have been brought about by fire and other causes such as grazing and have little reliable knowledge on the impact of historical human-induced fire regimes. There is an urgent need to undertake more research and analysis that improves the understanding of fires, and their associated costs and benefits, and to develop simple and robust indicators to assess the impact of fire regimes on species and ecosystems.

In many countries, local communities are emerging as increasingly important players in fire management as authority for the management of natural resources is decentralised. In some cases communities causes fire problems, but more often they can be part of the solution. Local communities can often support fire management by providing a fire warning system, reducing fire hazards by managing vegetation, controlling fire ignition sources, providing local knowledge on fire ecology and local fire management systems and protecting forests against external forces (Jackson and Fisher, 2001).

Seeking to balance community protection and biodiversity conservation requires a more comprehensive framework to guide fire management strategies. Such a framework needs to recognise that people and ecosystem are part of the same system, with the components of the system being interconnected. By adopting a broad 'landscape' level of planning that recognises mosaics of land use, fire managers should be able to better address multiple objectives and adapt strategies as new knowledge comes to light.

One such framework is the *ecosystem approach* – a strategy for the integrated management of land, water and living resources that promotes conservation and sustainable use in an equitable way (CBD, 2000). Put simply, the ecosystem approach seeks to organize human activity so that the use of ecosystem goods and services is at a level that ecosystems can sustain while also

maintaining their capacity to conserve biodiversity (Pirot et al., 2000). The 12 principles of the ecosystem approach are shown in Annexe 1.

The ecosystem approach has considerable international support including having been adopted by a number of multilateral environmental agreements including the Convention on Biological Diversity (CBD), the World Heritage Convention, and the Convention to Combat Desertification. These agreements represent international consensus between governments on what needs to happen to conserve biological diversity. Many countries are signatories to these agreements and accordingly land use and fire management decisions at national and sub-national levels should be in accordance with the principles of these agreements.

The ecosystem approach recognises that all ecosystems have boundaries, but these often do not coincide with administrative, political, social or economic boundaries. This is precisely the situation that most fire managers face – a complex array of land uses and tenurial arrangements. In this respect, FAO (2001) notes that the ‘current emphasis on ecosystem management calls for the maintenance of interactions between ... disturbance processes and ecosystem functions. It is incumbent, therefore, on resource managers and fire managers to understand the historic frequency, intensity and areal extent of past fires. Such knowledge provides a frame of reference for prescribing appropriate management practices on a landscape scale.’

Recognizing the need for landscape-level planning, some countries are beginning to realize that inter-sectoral coordination of land use policies and practices is an essential element in reducing wildfire losses (FAO, 2001). In the state of Victoria, Australia, State Government agencies responsible for fire management have recently developed ecologically-based fire regimes for key vegetation types across the state (Fire Ecology Working Group, 2002). Elsewhere, many fire management agencies have included elements of the ecosystem approach in their work.

A more comprehensive framework for guiding landscape level fire management planning is still some way from being fully and routinely implemented around the world. However, fire management authorities could play a key role in testing and demonstrating more comprehensive frameworks to fire management by *inter alia*:

- Promoting policies, laws, institutional arrangements and tools for managing complex environmental, social and economic variables that face fire management authorities;
- Ensuring that fire management strategies take into full consideration societal concerns, seeking to balance community protection and biodiversity conservation. This requires a participatory approach to planning that seeks the views of all key stakeholders;
- Varying fire regimes across the landscape to maintain ecosystem structure and function, in order to maintain ecosystem services and biodiversity. As Woinarski (1998) notes for Northern Australia, but relevant world-wide for temperate areas, ‘maintaining biodiversity is largely about maximising environmental heterogeneity. More than almost any other factor which can affect landscape patchiness, fire is a flexible tool, and fire management should aim to impose a gamut of regimes (other than the unreasonably extreme) across most of the landscape, at an appropriate scale’;
- Planning for the long term, but adapting fire management as new information becomes available. Ecosystem processes are characterized by long term, sometimes permanent changes, and effects of fire regimes on ecosystems are often slow to be realized. Objectives for fire management should, therefore, be set for the long term and such objectives should include ecologically-based fire regimes for key vegetation types (see Fire Ecology Working Group, 2002);
- Continuously improving understanding of:

- The vulnerability of communities to harm from existing fire regimes;
- The ecological circumstance of and the role of fire in the area to be managed;
- The historical and current interactions of people, fire and ecosystems that have led to the present, and will influence options for future, fire regimes.

by developing, measuring and analysing key biodiversity indicators, by seeking scientific, historical, indigenous and local knowledge and by promoting improved information and data management to enable better decision making.;

- Improving co-ordination among responsible agencies and people (including land-use planning authorities), particularly in relation to better managing trade-offs between community protection and biodiversity conservation, ensuring that fire managers take into consideration the effects of their activities on ecosystems and that planning departments better consider the risks to communities posed by inappropriate land use planning and settlement development; and
- Involving local communities and indigenous peoples in decision making. In many cases the use and management of fires affects the livelihoods of communities and indigenous peoples. Women in developing countries, because of their reliance on natural resources, are particularly vulnerable to changes in ecosystems. It is only reasonable that local communities have some control over the decisions about ... fire management in order to minimize negative consequences and optimize benefits for the community (Jackson and Fisher, 2001).

In summary, fire management requires a more balanced approach that differentiates between those fires that have positive ecological and socio-economic impacts and those that are harmful. A framework such as the ecosystem approach may provide a practical mechanism for managing the inevitable trade-offs that fire managers face when trying to balance community protection and biodiversity conservation.

The role of international conservation organisations in fire management

Over the past 20 years non-governmental and intergovernmental organisations concerned with biodiversity conservation have flourished. Most of these organizations do not directly manage land, but instead promote the generation and sharing of conservation knowledge, build capacity of civil society and promote improved conservation policies and laws and institutional reforms.

International conservation organisations have played an important role in supporting national governments and United Nations agencies to improve their understanding and response to harmful fires. For example, conservation organisations have a long history of collaboration with the FAO on fire issues as well as with the Global Fire Monitoring Centre, that provides an early warning, monitoring and general information system for disaster management or other fire-related tasks.

In 1998, IUCN – The World Conservation Union and WWF – The World Wide Fund for Nature joined forces with the European Commission, the US Forest Service and the Centre for International Forestry Research to develop *Project Firefight* – a programme for strengthening national, regional and international networks for forest fire prevention and management, world-wide. Project Firefight South East Asia, for example, has analysed and collated information and data on community based fire management, and on legal, regulatory and economic aspects of forest fires.

Using its UN General Assembly Observer status and its vast network of environmental lawyers and other expertise, IUCN has also contributed to the understanding of complex environmental issues related to fires, such as the impact of climate change on fire regimes and the role of international and national policy and legal regimes in fire management.

Another major fire programme is The Nature Conservancy's (TNC) *Fire Initiative* which is striving to alleviate the serious problems caused by the alteration of natural fire cycles across the globe, working with a wide range of government and civil society partners to restore ecosystems and make communities safer. TNC brings together land management partners, community leaders, landowners, experts, scientists, non-profit partners and policy makers to exchange information and expertise, find solutions to common problems, share best practices and provide a voice for fire management.

Lastly, IUCN, TNC and WWF have recently come together to work proactively with multi-lateral agencies, governments, private sector and local communities to develop integrated for management approaches that address underlying causes and develop long-term sustainable solutions (Moore et al., 2003).

If fire management agencies are to adopt an ecosystem approach then international conservation organisations can play an important supportive role through:

- Promoting co-operative fire research and management programmes;
- Generating, collecting and sharing knowledge on fire management, biodiversity conservation and the ecosystem approach;
- Convening civil society, private sector and government dialogues on relevant issues;
- Building awareness and capacity to implement the ecosystem approach for fire management; and
- Promoting supportive policies, laws, institutions and financing mechanism at international and national levels.

Conclusions

In conclusion, fire management strategies need to be adapted to better balance community protection and biodiversity conservation, but this requires an approach that differentiates between those fire regimes that have positive ecological and socio-economic impacts and those that do not. In this respect, IUCN and WWF (2002) argue the need for a more comprehensive framework to guide fire management strategies and a greater emphasis on dealing with the underlying causes of fires. They have proposed the following 10 steps (slightly amended by the author):

1. Support research and analysis that improves the understanding of fires and their associated costs and benefits. Resources must be allocated towards an improved understanding of the country-specific, underlying and direct causes of fires as well as their ecological and socio-economic impacts;
2. Build awareness among policy makers, the public and the media as to the underlying causes of fires, their associated costs and the importance of addressing these in a systematic fashion across broad landscapes;
3. Mandate and equip managers to prepare and implement integrated fire management plans that promote a balance between fire prevention, response and restoration, and discourage strategies that rely too heavily on fire-fighting as the primary means to deal with fire;
4. Involve key stakeholders (especially local communities and land managers) in land-use and fire management planning and, where appropriate, implementation. If necessary, assist these stakeholders to obtain the knowledge, skills and resources they need to participate effectively;
5. Develop and enforce compatible and mutually reinforcing land-use laws that provide a legal basis for the sensible use of fire but discourage reckless use, and that take account of social

equity, community welfare and human rights issues. The review of laws and economic incentives that directly result in harmful fires is an important step;

6. Discourage inappropriate forest management and land-use practices that predispose areas and local communities to harmful fires;
7. Promote fire management strategies that mimic natural fire regimes as far as practicable and avoid manipulating natural or well-established and indigenous fire regimes as a means of meeting international climate change obligations;
8. Put in place reliable fire monitoring and recording systems that provide early warning of high fire danger and the occurrence of fires, and include evaluation of the ecological and human impacts of fire;
9. Prevent further loss and degradation of biodiversity from recurrent fires through investing in ecologically appropriate restoration of affected areas; and
10. Integrate fire management considerations when planning to maximise resilience and adaptability of biodiversity to climate change, and include these measures in national strategies for sustainable development.

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Annexe 1 Principles of the ecosystem approach

The following 12 principles are complementary and interlinked:

- Principle 1: The objectives of management of land, water and living resources are a matter of societal choice.
- Principle 2: Management should be decentralised to the lowest appropriate level.
- Principle 3: Ecosystem managers should consider the effects (actual or potential) of their activities on adjacent and other ecosystems.
- Principle 4: Recognising potential gains from management, there is usually a need to understand and manage the ecosystem in an economic context. Any such ecosystem-management programme should:
- (a) Reduce those market distortions that adversely affect biological diversity;
 - (b) Align incentives to promote biodiversity conservation and sustainable use;
 - (c) Internalise costs and benefits in the given ecosystem to the extent feasible.
- Principle 5: Conservation of ecosystem structure and functioning, in order to maintain ecosystem services, should be a priority target of the ecosystem approach.
- Principle 6: Ecosystems must be managed within the limits of their functioning.

- Principle 7: The ecosystem approach should be undertaken at the appropriate spatial and temporal scales.
- Principle 8: Recognising the varying temporal scales and lag-effects that characterise ecosystem processes, objectives for ecosystem management should be set for the long term.
- Principle 9: Management must recognise that change is inevitable.
- Principle 10: The ecosystem approach should seek the appropriate balance between, and integration of, conservation and use of biological diversity.
- Principle 11: The ecosystem approach should consider all forms of relevant information, including scientific and indigenous and local knowledge, innovations and practices.
- Principle 12: The ecosystem approach should involve all relevant sectors of society and scientific disciplines.