

# Adaptive Protected Area Management

POSITION PAPER



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# **Adaptive Protected Area Management**

**Creating and maintaining resilient social and  
ecological communities for people and planet**

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## ABSTRACT

To create and maintain resilient social and ecological systems, protected area management (PAM) must be adapted to rapidly changing environmental conditions. First, this paper explores PAM strategies for resilient social and ecological communities, as well as challenges to their implementation. Second, Adaptive Management (AM) and Adaptive Co-Management strategies are critically examined to complement and improve current management practices. Finally, the paper will give recommendations on integrating different approaches and perspectives on adaptive PAM for resilient social and ecological systems.

Healthy forest ecosystems fulfil key social and ecological functions but are also facing significant challenges. The focus of this paper is on forest management in Central and Eastern Europe — a region often facing particular challenges in sustainable forest management (UN News, 2006).



# 1. INTRODUCTION

## 1.1. Biodiversity: Where are we now?

Currently, the world is facing significant social and ecological challenges. The decline of biodiversity is among the major contemporary problems: according to the WWF's Living Planet Index (LPI), there has been a 68 % decrease in the population sizes of mammals, bird, and fish between 1970 and 2016 (WWF, 2020).

The establishment of protected areas (PA) has long been an important strategy to tackle these issues. As a result of ongoing efforts, around 17 % of Earth's land areas, and around 10 % of sea and marine areas are assigned as PAs (Secretariat on the Convention of Biodiversity, 2020). Nevertheless, biodiversity keeps declining as a result of inadequate management practices and a lack of connectivity (*ibid.*). A meta-analysis of 6200 PAs by Leverington *et al.* (2010) for instance found that around 42 % of these areas had major deficiencies in management.

To ensure the resilience of ecosystems, it is thus essential to critically assess and improve current management practices.

## 1.2. Current Management Practices

**Protected area management (PAM)** is key to the maintenance of healthy ecosystems, which have many social and ecological benefits. Not only does the creation and maintenance of resilient protected areas protect biodiversity and landscapes, but it also benefits people by providing essential ecosystem services (European Commission, 2021a).

Ecosystem management has greatly improved over recent decades, and more action has been taken to tackle the loss of biodiversity and valuable ecosystems. For instance, the establishment of Natura 2000 sites throughout Europe has contributed to the protection of many vulnerable habitats and species (European Commission, 2021a). Since many ecosystems throughout Europe require



management — for instance grazing and moving (Batáry *et al.*, 2015) — it is important to consider the role of people in ecosystem maintenance. The inclusion of a wide range of stakeholders in the management of Natura 2000 areas is thus an important step towards Protected Area Management (PAM) methods that consider both humans and their environment (European Commission, 2021a).

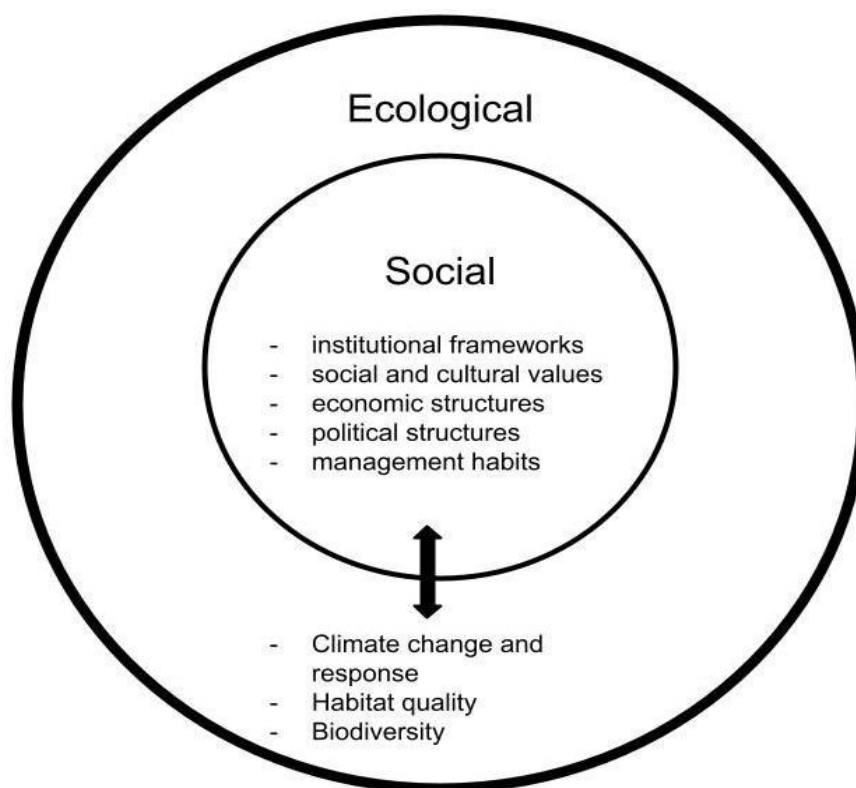
However, factors like social, political, and economic structures often restrict the implementation of PAM methods (Yakusheva, 2019). To improve current management practices, it is essential to analyse the factors hindering the implementation of successful PAM, and to improve current management practices to benefit both people and their environment.



## 2. IMPORTANT CONCEPTS

### 2.1. Social-Ecological Systems (SES)

Humans and their environment are inextricably linked, with ecological factors influencing social factors and vice versa (Júnior *et al.*, 2015). This paper will refer to **social-ecological systems (SES)** as systems that encompass both humans and their natural environment, emphasising that social and ecological issues are inextricably linked (Armitage *et al.*, 2009).



*Figure 1. Socio-ecological systems (SES) consist of interlinked social and ecological factors mutually influencing each other. Some examples are provided in the figure, but obviously many more factors could be included.*

Droughts for instance often have negative economic, health and social effects due to their considerable negative impact on the agricultural sector (Edwards, Gray and Hunter, 2019). On the other hand, social patterns like rural abandonment and the loss of traditional management practices often have negative environmental impacts (European Commission, 2021b). For instance,

the loss of traditional fire prevention practices might increase the risk of wildfires, which are a major threat to people and nature (ibid.).

Considering both social and ecological factors within the SES is therefore key to resilient PAM, benefiting both humans and nature. Functional redundancy — or the existence of distinct species being able to fulfil an important function — is hereby key to resilient SES (Júnior *et al.*, 2015). Per definition, this means that biodiversity contributes to the resilience of SES by ensuring functional redundancy.

## 2.2. Resilience

**Resilience** is a frequently used concept in PAM and is central to maintaining ecosystems. However, it can have multiple meanings and objectives, which must be clarified prior to developing strategies for resilience.

Most importantly, *resilience* is different from ecosystem *stability*: whilst resilience acknowledges the importance of fluctuations and changing patterns in ecosystems, stability assumes that the system is in an equilibrium state without much fluctuation (Holling, 1973). This paper focuses on resilience — the ability of ecosystems to recover from disturbance — since it is now widely accepted that ecosystems are constantly in flux, and never in a perfect equilibrium (Júnior *et al.*, 2015).

Further concerns include whether resilience is defined by a social-ecological system maintaining its *functions* or its *structure* (ibid.). This is important because it affects how resilience is understood and measured. For instance, if the focus is on *structure*, changes in forest composition after a disturbance will negatively affect the resilience indicators. However, if the focus is on the maintenance of *functions*, a changed forest composition would have a less significant effect on system resilience since the ecosystem may still remain functional.



Before identifying management objectives and designing PAM strategies, it is therefore important to define what it would mean for the ecosystem to be resilient. Some of the important questions to answer include:

- Is the management goal to maintain a forest with its current species composition and *structure*, or is the goal to maintain its *functions*, even if that means a change in structure?
- How is resilience measured? Is there more focus on the ability of a system to *resist* disturbances, or to *recover* from them?

It is important to clarify these goals and concepts prior to developing and implementing management plans.

Especially considering climate change, it is important to consider which approach to resilience is most adequate to tackle social and ecological issues.



## 3. CHALLENGES

### 3.1. Ecological Issues

Climate change is among the main drivers of many processes threatening the structure and functioning of social-ecological systems.

Land and sea use change, pollution, species overexploitation, climate change, and invasive species and disease are among the major factors resulting in the loss of biodiversity and well-functioning ecosystems (WWF, 2020). For instance, climate change contributes to an increase in threats like forest fires, which are further exacerbated by social issues like rural abandonment and urban expansion (European Commission, 2021b).

Forests are especially vulnerable to the effects of climate change, partly due to the long lifespan of trees (Frischbier, Profft and Hagemann, 2014). Further factors limiting the adaptive capacities of forests are land use changes and limited genetic and structural diversity (ibid.). For instance, monoculture forests with little variation in stand height are more vulnerable to events like storms (ibid.) and wildfires (European Commission, 2021b.), since the disturbance is likely to affect all trees to a similar extent. These disturbances in turn can have detrimental impacts on social and economic systems, threatening lives and livelihoods.

This highlights the importance of resilient PAM, and the links between social and ecological factors: management decisions significantly impact ecosystems, whilst these in turn have significant social and economic effects.

### 3.2. Structural Issues

To achieve resilient SES, it is key to consider social, political, and economic factors as well.



Especially issues like economic underdevelopment in rural areas and rural abandonment result in the loss of important ecological knowledge and practices that are key to maintaining resilient and healthy ecosystems (European Commission, 2021a). Traditional harvesting techniques like coppicing, pollarding, woodland grazing, and selective cutting for instance contribute to the maintenance of biodiverse semi-natural forests by creating mosaic habitats. These complex forest habitats — with varying stand densities, openings of various sizes, a mix of tree sizes and ages, and the presence of shrubs and meadows — are central to the maintenance of biodiversity and more resilient forests (North, Miller and Wright, 2018). However, the loss of traditional methods means that forest composition is more uniform, which in turn results in less ecological niches and a decline in biodiversity (European Commission, 2021a). This is therefore an example for the ways in which social and ecological factors are inextricably linked: economic problems can contribute to biodiversity decline due to traditional knowledge loss.

Political and legal factors often hinder the successful implementation of resilient protected area management methods too. For instance, Yakusheva (2019) found that long-lasting tensions between local people and the authorities impeded the implementation of PAM in Natura 2000 sites. The distrust in authorities — based on negative past experiences — can mean that people are less keen on collaborating with authorities on protected area management (*ibid.*).

On the other hand, existing environmental protection “habits” can be hard to overcome. Relatively novel management methods like Adaptive Management (AM) or increased stakeholder involvement are often not implemented as some conservation authorities prefer to rely on established, older methods (Wilke and Rannow, 2014).



To improve and expand PAM methods, it is thus important to critically assess social, economic, and political factors too; they are inextricably linked to ecological systems.

### 3.3. Funding

**Funding** is also an essential aspect of resilient PAM and must always be considered in the development and implementation of management strategies. Especially since funding is often a key factor hindering the implementation of sustainable and resilient PAM methods (Herrick *et al.*, 2012), it is key to assess funding needs and secure funding sources for PAM.

In the EU, **Prioritised Action Frameworks (PAF)** are important for planning measures and resources needed to support the Natura 2000 network, specifying funding needs and linking projects to the appropriate EU funding programmes (European Commission, 2021d). Further financing options include international sources like NGOs, national-level mechanisms such as National environmental funds, and site-level mechanisms like user fees and donations (IUCN, 2000).<sup>1</sup> Hereby, it is essential to not only increase the amount of funds available, but also ensure they are used efficiently. This can be done by involving a wider range of stakeholders in PAM like private landholders and local communities, and by improving financial management (Emerton, Bishop, and Thomas, 2006).

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<sup>1</sup> For a more detailed discussion of funding opportunities and best practice for protected area managers see the guidelines issued by the IUCN: [https://www.iucn.org/downloads/pag\\_005.pdf](https://www.iucn.org/downloads/pag_005.pdf)



## 4. BEST PRACTICE SOLUTIONS: ADAPTIVE FOREST MANAGEMENT

### 4.1. Adaptive Management (AM)

**Adaptive Management (AM)** is one of the management methods proposed to deal with the uncertainties and shifts brought about by climate change. AM is based on the concept of “learning by doing”: Based on management goals, management interventions are implemented, recorded, and their impact closely monitored (Schoeman *et al.*, 2014). After each cycle of planning-implementation-monitoring-analysing, management methods are continuously adjusted and adapted (Herrick *et al.*, 2012). Awareness raising and communication are hereby key first steps to successful AM, followed by constant cooperation with stakeholders to explore and monitor climate change impacts (Prutsch *et al.*, 2010). Based on this, all the adaptation options can be explored, implemented, and constantly monitored (*ibid.*).

AM has been suggested as one of the strategies of responding to climate change whilst guaranteeing the maintenance of functional forest ecosystems (Wilke and Rannow, 2014). To maintain functional forests in an increasingly hot and dry climate for instance, AM might involve the use of distinct species suited to these climates or moving seeds from the same tree zone uphill (North *et al.*, 2018). However, the use of non-native trees for instance is often an important issue contributing to habitat change and impairment (Frischbier *et al.*, 2014), meaning that it is key to consider possible unintended consequences and trade-offs prior to taking these management decisions.

In drastically changing climatic conditions, it might not be sufficient to simply restore forests to their original state. Instead, it is important to account for the reality of a changing climate like increasing occurrence of “hotter droughts.” A



gradual transition of forest types can guarantee they maintain key functions, preventing a complete ecosystem collapse (North *et al.*, 2018).

However, there are significant criticisms of AM. Firstly, ambiguous definitions and the complex implementation and monitoring plans make AM a confusing concept, which might be inaccessible to some stakeholders (Schoeman *et al.*, 2014). Moreover, the lack of systems for integrating and sharing monitoring data often means that AM is not adequately monitored and data is incomplete (Herrick *et al.*, 2012). The lack of data collection and monitoring means contributed to the issue of few projects completing more than one cycle of AM (*ibid.*). As a result, there is often little adaptation and knowledge gain, despite this being the main aim of AM in theory. Finally, institutional barriers like ingrained institutional norms and practices sometimes prevent more novel approaches to management, like AM, from being implemented (*ibid.*). In some cases, AM has also been used as a justification for undertaking actions with uncertain outcomes (Herrick *et al.*, 2012), which might not actually have environmental benefits.

## 4.2. Complementing Adaptive Management

To overcome some of the aforementioned limitations, it is essential to acknowledge that AM is embedded in broader social, political, and institutional systems, which must be considered in management decisions (Rist *et al.*, 2013). Critically assessing some of the external factors hindering the implementation of AM — like ingrained institutional barriers, or a lack of consistent data collection — can minimise some of AM's shortcomings.

In any case, management decisions will involve trade-offs, for instance between different stakeholder objectives, and short- versus long-term goals (*ibid.*). Involving of a wide range of stakeholders, evaluating a variety of available data, and taking a more interdisciplinary approach to PAM can serve to improve and adapt management methods.



Considering different scientific perspectives can improve the understanding of ecological processes and efficient management of protected areas. For instance, historical ecology can give useful insights into ecosystem management too, for example by highlighting how past ecosystems have responded to environmental changes (Beller *et al.*, 2020). Combining findings from longer-term data and shorter-term data can give a more holistic understanding of management objectives and strategies. Even though relying solely on historical conditions as a guideline for management decisions is often insufficient in light of climate change (North *et al.*, 2018), past SES responses are nevertheless important for understanding present and future SES dynamics. For instance, combining historical examples of how an ecosystem responded to a certain disturbance in the past (*ibid.*) and how an ecosystem responded to a management decision as part of AM (Braatz, 2012) can give a deeper understanding of SES dynamics on both longer and shorter timescales. If data from the specific location are not available, it might also be useful to consider data from similar ecosystems, which might give insights into some of the key ecological and/ or social processes.

However, even though combining findings from different scientific disciplines and theories is important, it is also essential to consider the perspectives of a wide range of stakeholders. Private landowners and local communities for instance are often directly influencing PAM decisions and are also impacted by them.

### 4.3. Collaboration and co-Creation

Involving a wide range of stakeholders is key to resilient PAM - intensive stakeholder involvement is key to adaptive management practices. For instance, a close stakeholder dialogue at all stages of the management process contributes to harmonising agricultural and conservation goals and maintaining the social and ecological benefits of healthy SES (Malatinszky *et al.*, 2014).



Communication and awareness raising is the key first step towards ensuring people understand and support the management objectives and methods necessary for creating resilient SES (European Commission, 2021b). However, a lack of effective communication often hinders adaptive PAM objectives and strategies (Rannow and Neubert, 2014). To avoid this, it is important to ensure that local communities are aware of the function and benefits of management practices such as prescribed burning (European Commission, 2021b).

Even though awareness raising is an important first step in ensuring closer stakeholder involvement, it is not sufficient to ensure that people fully support and contribute to adaptive PAM. A common issue in science communication is the “information deficit”: the assumption that people will automatically change their opinions and actions when presented with new (scientific) information (Schoeman *et al.*, 2014). However, people are also influenced by a wide range of complex factors like beliefs, culture, history, and life experiences (*ibid.*). It is therefore not enough to simply present new information to stakeholders: it is important to also appeal to people’s values and morals to communicate PAM objectives, findings, and strategies.

**Adaptive co-management** is one of the frameworks suggested to deal with uncertainty, supporting inclusive and resilient PAM (Armitage *et al.*, 2009). By combining AM and co-management, adaptive co-management builds on learning and collaboration. It involves a wide range of stakeholders and knowledge holders, from technical and scientific experts to local communities and traditional knowledge holders co-designing management objectives and plans, who evaluate and learn from management outcomes collaboratively (*ibid.*). The goal of adaptive co-management is to enable all stakeholders to actively take part in and evaluate management (Fabricius and Currie, 2015). This can have many social and environmental benefits, for instance by creating employment and income to rural communities, a more detailed understanding



of ecosystems from different perspectives, and improved communication and collaboration between different stakeholders (Armitage *et al.*, 2009).

#### 4.4. The Importance of Traditional Ecological Management

Traditional ecological management methods are key to resilient PAM, and offer a way to foster stakeholder dialogue, integrating different peoples' knowledge and perspectives. Management methods like *selective cutting*, *coppicing*, *pollarding*, and *woodland grazing* for instance maintain biodiversity and important ecosystem functions in semi-natural forests (European Commission, 2021a). Traditional ecological management methods support both forest *resistance* and *resilience*: Biodiverse forests with high tree age variety and species diversity for instance are less vulnerable to storms; if there is a high diversity of trees, it is more likely that some of these will be able to resist external threats, whilst also recovering quicker (North *et al.*, 2018).

Traditional ecological practices are also key to reducing forests' susceptibility to threats like wildfires, which are becoming more frequent due to climate change (European Commission, 2021b). *Forest grazing* and *prescribed burning* for example reduce fuel loads, hereby decreasing wildfire risk. Moreover, forest grazing by different animals also contributes to the maintenance of a mosaic landscape, which in turn supports biodiversity and maintains forest resilience (*ibid.*).

*Agroforestry* — another traditional forestry practice integrating forestry and agricultural practices — has also many social and ecological benefits. It has been found that agroforestry systems sequester carbon, conserve biodiversity, enrich soils, and improve water and air quality whilst also alleviating poverty (Jose, 2009) and increasing food security (Waldron *et al.*, 2017).



## 4.5. Case Studies

A Natura 2000 project in Germany's black forest is a good example for successful stakeholder involvement, forest restoration, and species conservation (European Commission, 2021d). The traditional Grinden (mountain heaths) in the Grindenschwarzwald and Feldberg forests provide crucial habitat for the endangered capercaillie and the hazel grouse. However, the loss of traditional, active uses of the highland areas resulted in the loss of the mosaic habitats needed by capercaillie and other woodland species.

To find solutions to these issues, management authorities collaborated with tourism and forestry stakeholders to find ways of integrating the capercaillie's needs into daily activities in the forest. By involving a wide range of stakeholders and considering different perspectives, this project ensured that affected individuals and communities are actively involved in supporting the conservation of capercaillie, which is central to adaptive PAM (ibid.). This project is also a good example for the ways in which PAM practices can support the resilience of forests by maintaining functionally important habitats which are able to resist disturbances.



*Intensive stakeholder involvement was key to identifying and protecting functionally important habitats, which were key to the success of the Natura 2000 project in Germany's black forest. (Source: European Commission, 2021d).*

Agroforestry is another important strategy for the creation of resilient SES. The European project **AGROMIX** for example supports agroforestry projects and research, which in turn have numerous social and ecological benefits, for instance by creating additional incomes, capturing carbon, regenerating soil, and increasing biodiversity (AGROMIX, 2021a). For example, on the **OIKOS farm in Poland**, supported also by the Polish Agroforestry Association (OSA), biodiverse crops are grown, partly in agroforestry systems (OIKOS Tree Crops, 2021; AGROMIX, 2021b). This is a good example for integrating social and ecological benefits to achieve SES *resilience*: The diversity of crops supports human health and protects livelihoods and provides additional sources of income whilst also sequestering carbon and protecting biodiversity.



*Integrating agriculture and forestry is a socially and ecologically beneficial solution to overcoming agriculture/conservation conflicts and creating more resilient SES. (Source: AGROMIX, 2021b).*

**GrazeLIFE**, an EU-supported project supporting forest grazing is an example for how PAM can have both social and ecological benefits whilst also contributing to forest resilience (GrazeLIFE, 2021a). Forest grazing can contribute to wildfire prevention, climate adaptation, and conservation, hereby maintaining healthy and functional ecosystems (ibid.). In the **Rhodope Mountains, Bulgaria**, for instance, herbivores like shorthorn cattle and Konik horses have been reintroduced to the landscape to create valuable mosaic habitats, hereby supporting biodiversity and ecosystem *resilience* (GrazeLIFE, 2021b). These projects also have the potential to bring many social benefits, for instance by creating jobs and improving environmental quality (GrazeLIFE, 2021a). Importantly, grazing with large herbivores also substantially increases forest *resistance* to wildfires, hereby helping to avoid the disastrous socio-economic and ecological consequences associated with wildfires (GrazeLIFE, 2021c; Rouet-Leduc *et al.*, 2021). In short, integrating socially and ecologically sustainable PAM methods contributes to increased forest *resilience* and *resistance*.



Grazing with Konik horses and shorthorn cattle in the Rhodope mountains, Bulgaria, has many social and ecological benefits, and is a strategy to increase PA resistance and resilience. (Source: GrazeLIFE, 2021b).



## 5. Recommendations

The first key step towards adaptive PAM is **acknowledging the realities of climate change and environmental degradation**, and the need to tackle these problems. Recognising that **social and ecological systems are inextricably linked** is of utmost importance: management decisions are both influenced by, and themselves influencing, both social as well as ecological structures.

**Communication and awareness raising** are thus key first steps towards creating and maintaining resilient social and ecological communities. The implementation of management methods like Adaptive Management can **complement and improve already existing management practices** — however, it is important to **consider possible trade-offs and unintended consequences** too. **Exchange** of experience, and information is also central to more holistic and resilient PAM: communication with stakeholders, political authorities, scientists, NGOs, as well as with public and private organisations is a valuable source of knowledge. Finally, it is also important to **consider structural limitations** (like funding, institutional requirements, and resources) when planning and implementing PAM.

Combining different strategies and multiple perspectives, as well as implementing holistic PAM strategies supports social and ecological resilience, maintaining healthy social and ecological systems in the present and future.

The table below summarises some of the recommendations explored in this paper: both more established PAM recommendations (in yellow) (sources: Beller *et al.*, 2020, North *et al.*, 2018, Secretariat of the Convention on Biological Diversity, 2020, European Commission, 2021a), and additions by different AM methods (in green) (sources: Armitage *et al.*, 2009, Rist *et al.*, 2013, Malatinszky *et al.*, 2014, Herrick *et al.*, 2012).



Conserve native species and original habitats	Establish PAs, incorporate conservation into related policies (i.e., agriculture)
Active management	Prescribed burning, controlled grazing
Increase ecological connectivity	Connect ecological habitats, support green corridors
Protect and/or restore habitat remnants/ areas of persistence	Establish and maintain PAs, environmental restoration
Adapt management to changing environmental conditions	Evaluate climate impacts, use AM
Support more traditional ecological management methods	Forest grazing, prescribed burning, agroforestry methods
Actively involve wide range of stakeholders	Knowledge- sharing meetings/ discussions, workshops
Be aware of structural limitations	Consider already existing management structures and institutions, resource availability, social and political structures
Expand range of data, disciplines, and timescales used	Consider short and long timescales, consider different disciplines
Monitor management efficiency	Control management outcomes, record and share data, modify management

It is, of course, difficult to implement all recommendations for resilient PAM to the same degree, and it is important to adjust these depending on local conditions. Nevertheless, even implementing just one or a few of these strategies can already contribute to the creation of more resilient social and ecological communities in PAs.



## 6. Conclusion

People and planet depend on healthy ecosystems. However, these ecosystems are threatened by climate change and environmental degradation, which have many disastrous social and ecological consequences. Unprecedented extinction rates, droughts, wildfires, and floods are just some of the challenges requiring urgent action to prevent a natural and humanitarian catastrophe in this century (IPCC, 2021).

To mitigate the worst impacts of climate change and environmental degradation it is of utmost importance to create and maintain resilient social-ecological systems. PAs especially are key to protecting biodiversity and healthy ecosystems, which have many social and ecological benefits. To adapt to a rapidly changing world, it is key to critically examine and rethink PAM — “business as usual” will not be enough. Rethinking management methods and integrating new approaches to PAM is thus key to create and maintain resilient social and ecological systems.

Adaptive PAM to create and maintain resilient social and ecological systems cannot be done alone: collaboration and knowledge exchange with stakeholders, partners, and experts from all relevant disciplines is key. This dialogue is central to improve PAM, overcoming challenges and working for a healthy planet for everyone together.

Some of the PAM recommendations explored in this paper might just be the first steps on the long way towards resilient social and ecological systems. Even if some of them might be small, they are vital for adapting to rapidly changing environmental conditions, protecting people and planet.



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