# Advancing technologies: IPAM Toolbox 2.0 for planning and management of Conservation Areas (MCA)

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## ABSTRACT

The paper introduces an online tool for integrated management of conservation areas (CAs). The IPAM Toolbox 2.0 is an interactive web application that enables self-assessment of the planning or management status of a CA.

The toolbox is built upon the framework of the lifecycle of CAs. Accordingly, the lifecycle can be represented in four phases, I Planning and designating a site, II Managing a site for the long term, III Repeal and termination, and IV Management beyond boundaries. The phases can be divided into 29 Fields of Activity (FoAs). This structure is supported by literature and empirical evidence.

Currently, the toolbox is available at the technology readiness level of a demonstrator (TRL 7). It is used for research and educational purposes. In a further step, it will be made available to planners, managers, consultants, and decision-makers in CAs worldwide.



## KEYWORDS

- Kunming-Montreal Global Biodiversity Framework (GBF)
- European Restoration Law
- Management of Conservation Areas
- management effectiveness
- lifecycle of conservation areas


### Zukunftsweisende Technologien: IPAM Werkzeugkiste 2.0 für die Planung und Management von Schutzgebieten (MCA)


#### *ZUSAMMENFASSUNG*

*Der Artikel stellt ein Online-Tool für das integrierte Management von Schutzgebieten (conservation areas, CAs) vor. Die IPAM Toolbox 2.0 ist eine interaktive Webanwendung, die eine Selbsteinschätzung des Planungs- oder Managementstatus eines CA ermöglicht.*

*Die Toolbox basiert auf dem Konzept eines Lebenszyklus von CAs. Entsprechend kann der Lebenszyklus in vier Phasen dargestellt werden: I Planung und Ausweisung eines Schutzgebietes, II Laufendes Management eines Schutzgebietes, III Aufhebung und Beendigung des Schutz-Status und IV Management jenseits der Grenzen des Schutzgebietes. Die Phasen können in 29 Fields of Activity (FoAs) unterteilt werden. Diese Struktur wird durch Literatur und empirische Befunde unterstützt.*

*Aktuell ist die Toolbox auf dem technologischen Reifegrad eines Demonstrators verfügbar. Sie wird für Forschungs- und Bildungszwecke genutzt. In einem weiteren Schritt wird sie Planern, Managern, Beratern und Entscheidungsträgern von CAs weltweit zur Verfügung gestellt werden.*


## INTRODUCTION

The biodiversity of planet Earth is under threat [1]. This is caused by various factors, including large-scale land use changes from agriculture and forestry. Scientists consider the appropriate and judicious designation of Protected and Conserved Areas as an effective measure for long-term safeguarding of biodiversity and ecosystem services [2]. The network of Protected and Conserved Areas has become increasingly dense in recent decades. As of August 2024, about 309,400 sites have been designated, accounting for 17.5% of the Earth's land surface and 8.5% of its sea surface [3]. Significant resources and functional institutions are required for management of conservation areas (CAs). This raises questions about how management effectiveness and efficiency of these areas can be ensured.

Area-based protection of biodiversity and ecosystems can be established under various legal frameworks. First and foremost, the International Union for Conservation of Nature (IUCN) defines protected areas (PAs) across six categories according to various criteria [4]. These categories relate to site management objectives. Areas covered by OECMs (other effective area-based conservation measures) [5] and Indigenous and community conserved areas [6] are considered towards meeting CA network goals (Table 1). The legal status of a site is assigned exclusively at the national level. However, national-level legal

instruments are implemented and used differently across geographic regions, depending on political and administrative culture, society, economy, and natural conditions. Beyond legal designations, corridors between CAs and countries can affect the state of biodiversity and ecosystems.

Tab. 1

| | Acronym | Title | Definition | Source |
|---|---|---|---|---|
| CAs - General term as used by the IPAM toolbox | PAs | Protected Areas | A clearly defined geographical space, recognized, dedicated and managed, through legal or other effective means, to achieve the long-term conservation of nature with associated ecosystem services and cultural values. | [4] |
| | OECMs | Other Effective Area-Based Conservation Measures | A geographically defined area other than a Protected Area, which is governed and managed in ways that achieve positive and sustained long-term outcomes for the in-situ conservation of biodiversity, with associated ecosystem functions and services and where applicable, cultural, spiritual, socio-economic, and other locally relevant values. | [7] |
| | ICCAs | Territories of Life | Territories and areas governed, managed and conserved by custodian Indigenous peoples and local communities under specific criteria. | [8] |
| | IDAs | Internationally Designated Areas | Areas which are internationally recognized through global or regional designations, including, for example, sites listed under the Ramsar Convention, the World Heritage Convention, UNESCO's MAB Programme, and the International Geoscience and Geoparks Programme, regardless of whether any of these areas fully or partially overlap. (*) (**) | [9]; respective definitions |
| | MIDAs | Multi-Internationally Designated Areas | Areas which have a combination of two, three or four international designations provided under the Ramsar Convention, the World Heritage Convention, UNESCO's MAB Programme and/or the International Geoscience and Geoparks Programme, and which fully or partially overlap. (*) (**) | [9]; respective definitions |
| | OAWCs | Other area without conservation regime | Areas without specific delineation or conservation measures, but with particular functions related to conservation areas. These functions may include serving as corridors, non-designated buffer zones, or other roles supporting the preservation of biodiversity and ecological integrity. | Own definition |
| | | | (*) Definition also applies to other designations than mentioned (e.g., Peace Park, Dark Sky Area, etc.) and national designations. | Comment |
| | | | (**) UNESCO Global Geoparks, UNESCO World Heritage Site and UNESCO Biosphere Reserves may also be summarized as UNESCO designate sites. | [9] |

**Table 1:** Typologies and categories of conservation areas (CAs). In the context of the IPAM Toolbox 2.0, the term 'Conservation Areas' is used as an umbrella term for various types of areas. These are compiled in the table along with their respective definitions. Source: Compiled based on the specified sources

***Tabelle 1:*** *Typologien und Kategorien von Schutzgebieten (conservation areas, CAs). Im Rahmen der IPAM-Toolbox 2.0 wird der Begriff „Schutzgebiete" als Oberbegriff für verschiedene Arten von Gebieten verwendet. Diese sind in der Tabelle mit ihren jeweiligen Definitionen zusammengestellt. Quelle: Zusammengestellt auf der Grundlage der angegebenen Quellen*

CA designations may be subject to national or international obligations (e.g., UNESCO Biosphere Reserve, Ramsar Wetlands of International Importance, Peace Park, European Diploma, etc.). The international obligations are linked to national legislation in multiple and ambiguous ways. Furthermore, different designations may be combined, leading to Multi-Internationally Designated Areas, or MIDAs [9].
As an overarching term encompassing these various forms of legal protection at national or international levels, this article refers to the acronym CAs (see Table 1). All CAs share the common goal of biodiversity conservation and employ comparable approaches in planning and management on being just, equitable, and inclusive [2].

### Emerging demands for structured knowledge

With the Kunming-Montreal Global Biodiversity Framework (GBF), the 196 signatories agreed in 2023 to expand the area-based protection of biodiversity [10]. According to "one of the most ambitious environmental agreements of the 21st century" [11], 30% of the oceans and 30% of the earth's surface are to be protected and conserved by 2030. These targets explicitly address OECMs as well. However, the global efforts require new capacities and instruments in planning and management, all of which must be systematized, supported and accompanied by scientific and technical achievements.
The European Biodiversity Strategy creates a corresponding basis for biodiversity conservation in Europe. According to this, 30% of European land area is to be designated as PAs, and 10% as "strict" PAs [12]. In previous years the Habitats Directive and Birds Directive were gradually transposed into the national laws of member states, sometimes enforceable only via a process in the European Court of Justice that could take decades. High-intensity conflicts have occurred and are not yet finally resolved. It is to be expected that the recently enacted European Restoration Law will impose new requirements on the responsible institutions. Further professionalization and digitalization of the sector is required. In any case, it is important to "make global biodiversity information useful to national decision-makers" [13].

### Research questions

Structured access to knowledge plays an important role for the planning and management of CAs. In consideration of the diversity of CA categories and social, economic, or natural conditions of the site, this information must be generalized. In this context, an existing toolbox for planning and managing conservation areas, called IPAM Toolbox [14], was revisited and re-launched. The following research questions were relevant for this effort:

- What common issues and problems occur during the planning and management of CAs?
- How can general principles be identified, structured, and put into practice?
- How can existing experiences be shared in a systematic way with key stakeholders?

The goal of the current study is therefore to identify universal organizational principles that are independent of specific conditions, such as the natural environment, the CA category, or socio-cultural, economic or political situation.

## METHODS

In order to address the research questions, an extensive selection of generally applicable literature, theory-based materials, studies, and qualification papers was consulted. This literature analysis incorporates several hundred documents and is intended for separate publication.

Based on the literature analysis, the previous version of the toolbox underwent restructuring, necessitating the reorganization, naming, and description of activities, phases, and contents. This facilitated updating the toolbox to include up-to-date information and practices. In a subsequent step, a demonstrator was developed by implementing the self-assessment environment on the browser application.

## "Lifecycle" as structuring framework

The development of an organization proceeds in distinct phases, a well-documented concept in literature and practice. This extends to CAs, which can be characterized as public institutions. The different phases of development of a CA include planning, establishment and ongoing operation. This ongoing operation is usually described as a lifecycle [15].

Wagner *et al.* [14] made a pioneering attempt to systematically capture these phases and divide them into discrete consecutive steps described as Fields of Activity (FoAs) [14]. A FoA describes a functional element in management of conservation areas (MCA) that must be addressed and "worked through" in the planning and management of protected areas. FoAs make it possible to plan concrete work steps, to specify them in the results and to track the respective processing status. This framework has formalized an assessment mechanism of the management status within the CA, facilitating the allocation of necessary tools, experiences, and technologies. The IPAM Toolbox (Integrated Protected Area Management) is an interactive system for expert use available in 14 languages and was developed to assist implementation of FoAs. It remained online for over ten years. While the user base was small, it allowed for gradual refinement through real-world application. A significant expansion occurred with the PANet Toolbox (Protected Area Networks), enabling the application of FoAs in the collaboration of multiple CAs, and was also available online [16].

Jungmeier [17], [18] provided further theoretical elaboration, and the concept was applied on a national level by example of Türkiye [19], [20]. While the collection of materials continued to be updated, the online toolbox could not be maintained or further developed. Significant obstacles arose from the updates of various software components. Additionally, the multitude of languages used made updates impractical, ultimately leading to both IPAM Toolbox and PANet Toolbox being taken offline. However, the Master's Program in Management of Conservation Areas at Carinthia University of Applied Sciences – formerly Management of Protected Areas at Alpen-Adria University of Klagenfurt – continues to utilize the concept.

## Overview of tools for managing CAs

There are numerous tools and frameworks for managing biodiversity in general and CAs in particular. Many of these tools are supported by project funding and therefore become quickly outdated. A compilation of existing tools shows some of the most recent and popular management effectiveness and governance tools (Table 2). The compilation demonstrates that the IPAM Toolbox is a complementary extension to existing solutions. Over the past two decades, the IPAM Toolbox has been continuously updated, expanded and improved to ensure its long-term applicability, particularly in the education sector.

**Tab. 2**

| Management Effectiveness Tools | Description |
|---|---|
| IMET (Integrated Management Effectiveness Tool) | IMET is a planning, monitoring, and evaluation tool for CAs aimed at enhancing management effectiveness and conservation outcomes, providing support to managers [21]. |
| METT (Management Effectiveness Tracking Tool) | METT was designed to measure progress in management effectiveness at specific sites over time, reflecting the IUCN WCPA framework for CA management effectiveness [22]. |
| RAPPAM (Rapid Assessment and Prioritization of Protected Area Management Methodology) | RAPPAM is a widely used system for assessing CA management effectiveness globally, aiding in reporting to the CBD and enabling prioritization, resource allocation, and adaptive management at a systemic level [23]. |
| Marine Protected Areas (MPAs) Management Effectiveness | The MPAs guidebook offers a flexible approach with various natural and social indicators for MPA management effectiveness, assisting MPA managers in assessing performance and making necessary improvements to achieve conservation goals [24]. |
| Enhancing our Heritage (EoH) Toolkit | The EoH Toolkit comprises twelve practical tools for assessing the management effectiveness of World Heritage sites. It helps to develop comprehensive management frameworks and targeted monitoring strategies, focusing on user-friendliness, flexibility, and adaptability to local conditions [25]. |
| Visitor Management Assessment & Strategy Tool (VMAST) | The VMAST is the newest addition to the UNESCO World Heritage Sustainable Tourism Programme and Toolkit [26]. |
| CCF project evaluation tool | The CCF tool aims to address common challenges in assessing the effectiveness of conservation interventions by providing a standardized framework. It helps conservation practitioners clarify their objectives, manage information effectively, and identify key outcomes [27]. |
| Miradi | Miradi is a program that enables conservation professionals to design, manage and learn from projects by integrating analysis tools and examples that align with conservation standards. It provides a centralized platform for efficient project management that connects various tools to ensure consistent conservation planning [28]. |
| Management Effectiveness of Protected and Conserved Areas (MEPCA) Indicator | The MEPCA indicator is designed to assess the management effectiveness of protected and conserved areas and serves as a complementary tool to monitor progress in implementing the Global Biodiversity Framework [29]. |
| IBEX Rapid Assessment for IUCN Green List | The IUCN Green List aims to promote successful nature conservation globally through its Sustainability Standard, offering expert guidance tailored to local contexts to ensure fair and effective conservation outcomes in protected and conserved areas. By adhering to this standard, the IUCN Green List seeks to ensure the survival, flourishing, and value creation of wildlife and ecosystems for communities worldwide [30]. The progress of management towards the Green List is measured by the Green List-IBEX score. |

**Table 2:** Overview of tools frequently used for assessing and managing conservation areas (CAs). The table shows that a significant number of different instruments are available for the planning and management of CAs. The list is not exhaustive. Source: Compiled based on the indicated sources

***Tabelle 2:*** *Überblick über häufig verwendete Instrumente zur Bewertung und Verwaltung von Schutzgebieten (conservation areas, CAs). Die Tabelle zeigt, dass für die Planung und das Management von Schutzgebieten eine große Anzahl unterschiedlicher Instrumente zur Verfügung steht. Die Liste erhebt keinen Anspruch auf Vollständigkeit. Quelle: Zusammengestellt auf der Grundlage der angegebenen Quellen*

**Tab. 2 (cont'd)**

| Governance Tools | Description |
|---|---|
| Site-level Assessment of Governance and Equity (SAGE) | The SAGE initiative aims to improve governance and equity in protected and conserved areas through a simple, cost-effective tool. It makes it easier for stakeholders to assess governance status, plan improvement actions and monitor progress. SAGE is in line with global conservation goals that emphasize equitable governance [31]. |
| Social Assessment for Protected and Conserved Areas (SAPA) | SAPA is a tool developed to empower stakeholders to assess the social impacts, governance, and equity of conservation efforts, aiming to enhance positive impacts while promoting equity. Through a multi-stakeholder approach, SAPA facilitates assessments, interpretation of results, and action planning, contributing to the institutionalization of social impact, governance, and equity assessment in CAs [32]. |
| Governance Assessment for Protected and Conserved Areas (GAPA) | The GAPA tool was developed to assess the quality of governance at protected or conserved areas, aiming to ensure equitable management and effective decision-making processes. By applying a multi-stakeholder approach, GAPA helps to assess, interpret results and develop action plans, thereby strengthening the credibility and legitimacy of governance assessments [33]. |

## Development and technical implementation

While the conceptual solution draws from the approaches of the IPAM Toolbox and the PANet Toolbox, a new web application demonstrator replaces the outdated expert system. IPAM Toolbox 2.0 is based on up-to-date technologies known for their stability and security. The web application's micro-services architecture reflects modern web application design.

An overview of the high-level IPAM Toolbox 2.0 architecture is provided in Figure 1. A PostgreSQL database running in a docker container can be only accessed by the Java Spring application, which in turn runs in a separate docker container. The web access to the Java Spring application is enabled with the use of an nginx web server. Due to the responsive app design, it can be used not only on desktops and laptops, but also on any mobile device.

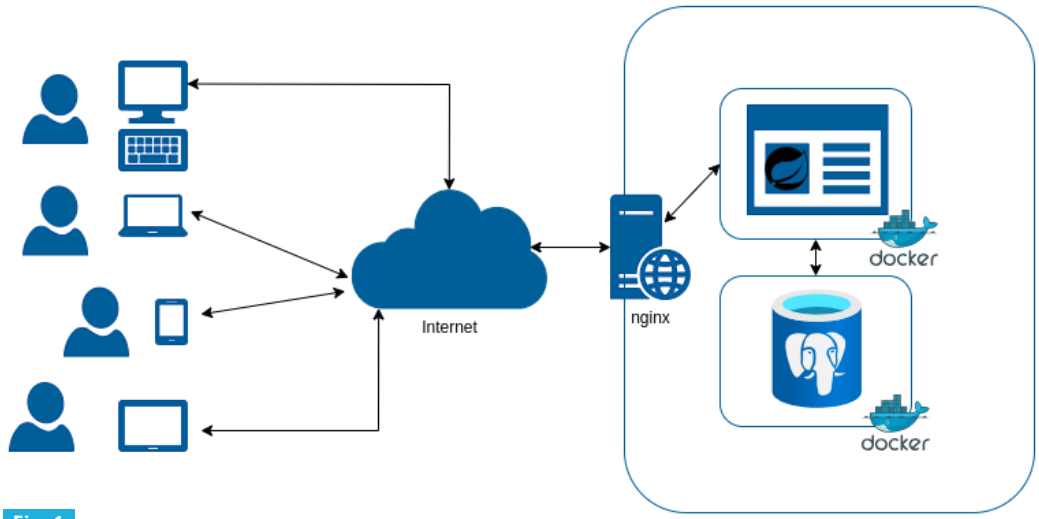


Fig. 1

**Figure 1:** Overall architecture of the IPAM Toolbox 2.0. The figure indicates the overall architecture of the system.
Source: Own figure

***Abbildung 1:*** *Gesamtarchitektur der IPAM Toolbox 2.0. Die Abbildung zeigt die Gesamtarchitektur des Systems. Quelle: eigene Abbildung*

A guided self-assessment process is available only to registered users of IPAM Toolbox 2.0. To register, one needs to provide an email address, choose a strong password, and activate the account by clicking on a link in the email message that is automatically sent to the provided email address. Data security protocols are considered to address privacy concerns. After this, one can perform self-assessments and store them in the web application database for later access.

## RESULTS – THE IPAM TOOLBOX 2.0

IPAM Toolbox 2.0 is now available as a demonstrator version [34]. Behind the technical self-assessment instrument as outlined above, the explanation of the FoAs is maintained on the platform as an unpublished living document and can be accessed under the following link: http://ipam.mca.tools/. Essential elements of the following text, as well as the graphics, are derived from the toolbox, as per August 2024 [34], [35].

Phases in the Management of CAs

The FoAs are structured into four phases that form a lifecycle (Figure 2). These phases vary significantly in terms of tasks, organization, and involved stakeholders. Therefore, it is important to initially distinguish between the different phases.

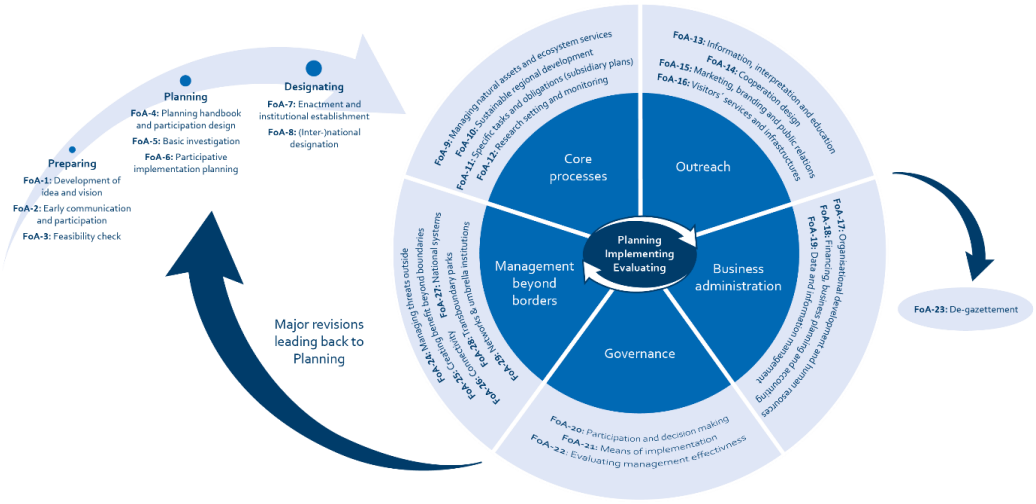


Fig. 2

**Figure 2:** Phases and FoAs. According to the concept of adaptive management of a conservation area, the processes are organized cyclically; thus, planning, implementation and evaluation alternate. The chart also shows the assignment of the individual FoAs to the individual core activities. Source: own figure (http://ipam.mca.tools/, as per August 2024)

***Abbildung 2:*** *Phasen und FoAs. Entsprechend dem Konzept des adaptiven Managements eines Schutzgebietes sind die Prozesse zyklisch organisiert, d.h. Planung, Umsetzung und Evaluation wechseln sich ab. Die Grafik zeigt auch die Zuordnung der einzelnen FoAs zu den einzelnen Kernaktivitäten. Quelle: eigene Abbildung (http://ipam.mca.tools/, Stand: August 2024)*

- **I Planning and designating a site (FoAs 1-8).** This phase begins with the first initiative of establishing a CA. The phase ends by definition of the legal and institutional establishment of the site. This phase consists of consecutive steps that essentially build on each other. There are three main tasks to be fulfilled in this phase: preparing, planning and designating the site. This phase is designed and conducted by a temporary planning team or unit. Since conservation areas can be hundreds of square kilometers in size, the planning of a conservation area is spatially one of the largest planning projects in a modern society; the corresponding steps must therefore be taken in a systematic manner.
- **II Managing a site for the long term (FoAs 9-22).** Most CAs are established "forever" without a time limit. This makes ongoing management a long-term process, which by definition begins with gazetting and designation. Ongoing management tasks include core processes, outreach, business administration, governance, and management beyond boundaries. The individual areas have different tasks and focuses, and some tasks may be excluded as necessary. In the following sections, however, all tasks are treated and presented. Each individual task has a rolling management cycle that

includes planning, implementation, evaluation, and renewed planning. Usually, the planning strategy is established in pre-existing management plans with annual, five-year or ten-year terms. The management cycle can be interrupted if a significant change occurs, for example changes in site size, PA category, or the legal framework. In this case, Phase I must be revisited in whole or in part. It is also conceivable that the protection status of the site will be revoked or greatly weakened. The day-to-day management of the area is implemented by a permanent management team, usually accompanied and supported by various boards and committees.

- **III Repeal and termination (FoA 23).** In rare circumstances, CAs need to be officially degazetted. It is important that degazettement is made transparent for decision-makers and partners alike. A creeping process of PA downgrading, downsizing, and degazettement (termed PADDD) is often observed, which ultimately leads to de-facto termination of management at the site [36]. There are examples that during this process, the responsible institution can no longer function.
- **IV Management beyond boundaries (FoAs 24-29).** This phase groups together activities that are outside the spatial scope of the CA. Such activities could include management of negative impacts affecting the CA environment (e.g., neobiota, emissions, light pollution, etc.), the establishment of buffer zones and corridors, and the integration of the CA into large-scale green infrastructure. Activities outside the CA require special attention that sometimes go beyond the mandate of the CA. Incoming stakeholders should be provided opportunities for involvement. Additional professional or technical questions and challenges may arise through such external management inputs.

## Fields of Activity (FoAs) in MCA

Within the framework of the CA lifecycle, FoAs represent small entities that serve as functional elements. An overview of the 29 FoAs is depicted in Figure 3. Accordingly, the development of a CA will traverse all or most phases. Each individual FoA should be addressed; depending on the category, size, and characteristics of the CA, handling specific FoAs can vary significantly in terms of effort and may also require the use of different tools. The toolbox requests the following information for each individual FoA: 1.) FoA number and title, 2.) Assignment of FoA to task and phase, 3.) Relevance and context, 4.) Objectives and expected results, and 5.) Methods and tools selection. The proposed tools are intended to enable planners and managers to effectively and successfully implement the respective FoA.

| |
|---|
| **Planning and designating a site** |
| **Preparing** |
| **FoA-1:** Development of idea and vision |
| **FoA-2:** Early communication and participation |
| **FoA-3:** Feasibility check |
| **Planning** |
| **FoA-4:** Planning handbook and participation design |
| **FoA-5:** Basic investigation |
| **FoA-6:** Participative implementation planning |
| **Designating** |
| **FoA-7:** Enactment and institutional establishment |
| **FoA-8:** (Inter-)national designation |
| **Managing meta-structures** |
| **Core processes** |
| **FoA-9:** Managing natural assets and ecosystem services |
| **FoA-10:** Sustainable regional development |
| **FoA-11:** Specific tasks and obligations (subsidiary plans) |
| **FoA-12:** Research setting and monitoring |
| **Outreach** |
| **FoA-13:** Information, interpretation and education |
| **FoA-14:** Cooperation design |
| **FoA-15:** Marketing, branding and public relations |
| **FoA-16:** Visitors´ services and infrastructure |
| **Business administration** |
| **FoA-17:** Organizational developement and human resources |
| **FoA-18:** Financing, business planning and accounting |
| **FoA-19:** Data and information management |
| **Governance** |
| **FoA-20:** Participation and decision making |
| **FoA-21:** Means of implementation |
| **FoA-22:** Evaluating management effectivness |
| **Repeal and termination** |
| **FoA-23:** De-gazettement |
| **Management beyond borders, buffer zones, corridors, networks** |
| **Working beyond boundaries** |
| **FoA-24:** Managing threats outside |
| **FoA-25:** Creating benefit beyond boundaries |
| **FoA-26:** Connectivity |
| **Managing meta-structures** |
| **FoA-27:** National systems |
| **FoA-28:** Transboundary parks |
| **FoA-29:** Networks and umbrella institutions |

Fig. 3

**Figure 3:** Overview of Fields of Activity (FoAs). FoAs are a framework for structuring all conservation area management activities. The starting point is the individual site. The steps apply to sites of all conservation categories, although the steps may vary. The activities from FoA-24 to FoA-29 describe management beyond the boundaries of the conservation area and cooperation with other sites, respectively. Source: Own figure http://ipam.mca.tools/, as per April 2024, based on Wagner et al. [14]

***Abbildung 3:*** *Überblick über die Fields of Activity (FoAs). Die FoAs bilden einen Rahmen für die Strukturierung aller Aktivitäten des Schutzgebietsmanagements. Der Ausgangspunkt ist das einzelne Gebiet. Die Schritte gelten für Gebiete aller Schutzkategorien, wobei die Schritte variieren können. Die Aktivitäten von FoA-24 bis FoA-29 beschreiben das Management über die Grenzen des Schutzgebiets hinaus bzw. die Zusammenarbeit mit anderen Gebieten. Quelle: Eigene Abbildung http://ipam.mca.tools/, Stand: April 2024, basierend auf Wagner et al. [14]*

## Assessment of management state in MCA

By subdividing management tasks into FoAs, it is possible to evaluate the current state of management within the CA. The toolbox allows activities to be categorized as 'not started,' 'in progress,' 'finished,' and recurring tasks as 'outdated' (equivalent to 'not started'). The user interface regarding this feature is illustrated in Figure 4. The toolbox is capable of generating a progress report based on the sum of these inputs. This report provides an overview of all management activities, revealing which steps are to be taken next (Figures 5 and 6). Thus, planners, managers, decision-makers, and interested stakeholders have the opportunity to generate a structured overview (http://ipam.mca.tools/, as per August 2024).

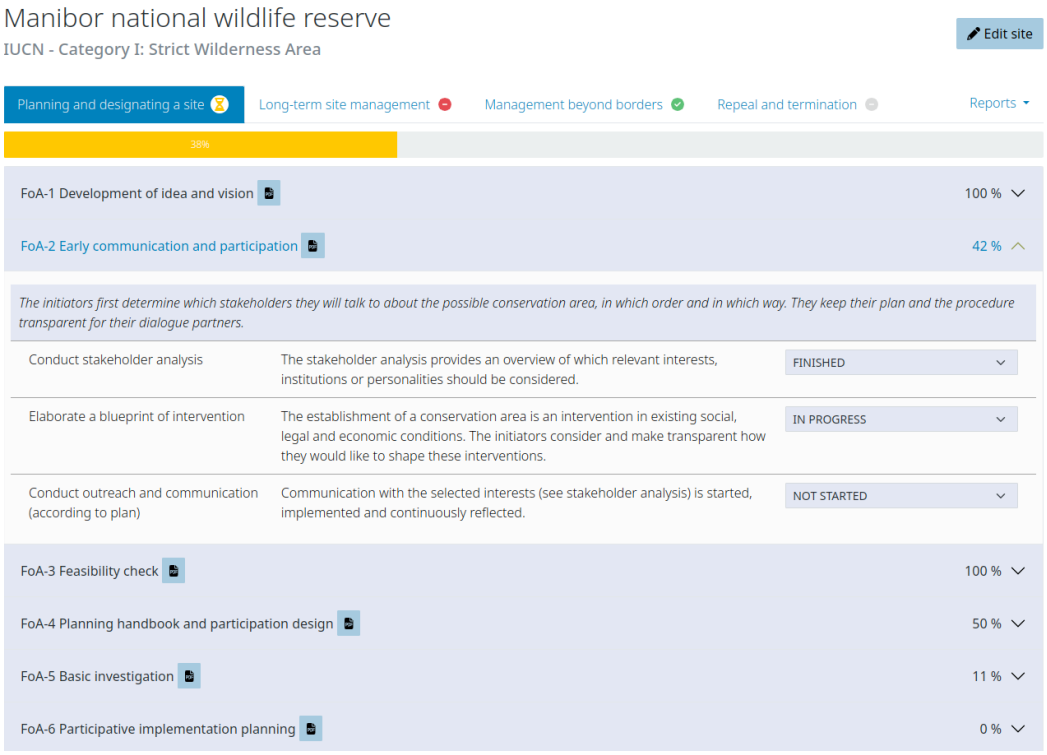


**Fig. 4**

**Fig. 5**

**Figure 4:** IPAM Toolbox 2.0 – Assessment of management status. Presentation of functionality by example of the fictitious Manibor national wildlife reserve. Source: Screenshot from toolbox (http://ipam.mca.tools/)

***Abbildung 4:*** *IPAM Toolbox 2.0 - Bewertung des Managementstatus. Darstellung der Funktionalität am Beispiel des fiktiven Manibor National Wildlife Reserve. Quelle: Screenshot aus der Toolbox (http://ipam.mca.tools/)*

**Figure 5:** Concise progress report of the IPAM Toolbox 2.0. Presentation of functionality by example of the fictitious Manibor national wildlife reserve. Based on the selected status for each task, the progress is dynamically calculated as a percentage for each FoA and each phase. Color-coding of the progress bar and the tab status icons provide further visual help in assessing the completeness of site evaluation. Source: Screenshot from toolbox (http://ipam.mca.tools/)

***Abbildung 5:*** *Kurzer Fortschrittsbericht der IPAM Toolbox 2.0. Darstellung der Funktionalität am Beispiel des fiktiven Manibor National Wildlife Reserve. Basierend auf dem gewählten Status für jede Aufgabe wird der Fortschritt dynamisch als Prozentsatz für jedes FoA und jede Phase berechnet. Die Farbcodierung des Fortschrittsbalkens und die Symbole für den Status der Registerkarten bieten eine weitere visuelle Hilfe bei der Beurteilung der Vollständigkeit der Standortbewertung. Quelle: Screenshot aus der Toolbox (http://ipam.mca.tools/)*

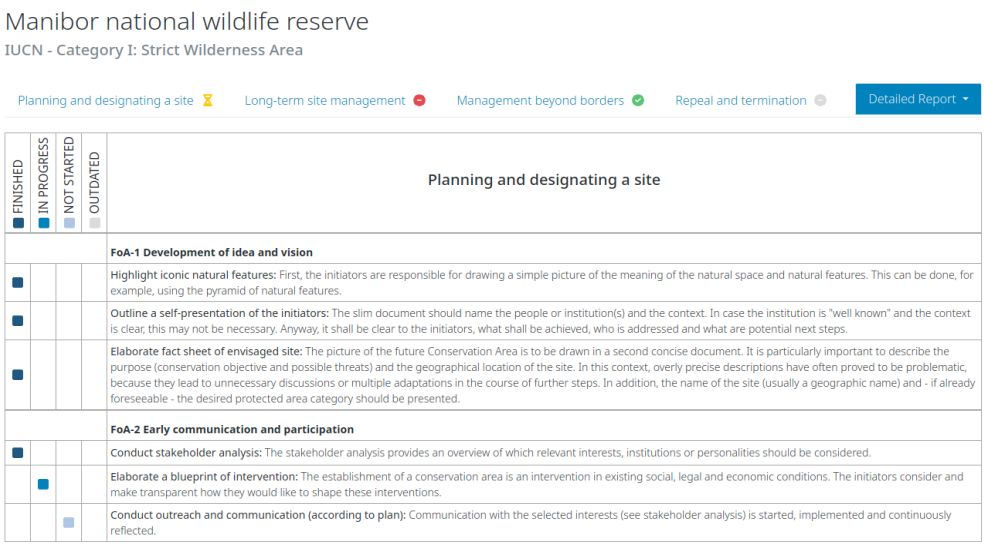


Fig. 6

**Figure 6:** Detailed progress report of IPAM Toolbox 2.0. Presentation of functionality by example of the fictitious Manibor national wildlife reserve. This analysis step reveals the specific next actions as they emerge from the assessment. Source: Screenshot from toolbox (http://ipam.mca.tools/)

***Abbildung 6:*** *Detaillierter Fortschrittsbericht der IPAM Toolbox 2.0. Darstellung der Funktionalität am Beispiel des fiktiven Manibor National Wildlife Reserve. Dieser Analyseschritt zeigt die spezifischen nächsten Maßnahmen, die sich aus der Bewertung ergeben. Quelle: Screenshot aus der Toolbox (http://ipam.mca.tools/)*

## DISCUSSION AND CONCLUSION

"[Protected area] literature is still rather fragmented and incoherent" [37]. This finding carries particular weight as planning and managing CAs are significantly hindered by three factors.

- **Complexity:** The establishment and management of a CA relates to a specific area and aims to have a positive impact on its biodiversity, ecosystems and other natural resources. It entails a paradigm shift in the orientation of the area. Problems, objectives, and measures vary from area to area and depend on numerous factors. Thus, setting up and managing a CA constitutes an intervention into complex societal practices regarding land uses and land stewardship.
- **Conflicts:** In the context of CAs, and in addition to tangible conflicts of use and interests, different values, perceptions about nature, and worldviews may clash. Discussions about CAs frequently revive old conflicts between communities, political parties, or individuals and families due to many different underlying causes.
- **Dynamics:** Many societal and political processes have accelerated due to social media. In planning processes, especially in situations of conflict, swift and thoughtful decisions or communication pathways are necessary to deal with problems or unexpected events.

The IPAM Toolbox 2.0 aims to provide a tool that offers guidance and structure in the complex, conflicting and dynamic sector of CA establishment and management. Currently, the toolbox is only available as a demonstrator, meaning it can be used for testing and trial runs in the context of research and education. For broader global implementation, several technical features are still missing. These include support services to advise and assist users, as well as comprehensive presentation of tools with examples from around the world.

Test runs of IPAM Toolbox 2.0 will indicate whether the platform is broadly applicable to serve as a general framework for managing all types of CAs, as envisaged in its original concept. The authors are currently exploring opportunities to initially test the toolbox in Carinthia and subsequently on an international scale. This will involve examining whether and to what extent the toolbox offers opportunities to integrate currently discussed concepts in area-based conservation. This includes approaches such as "elegant conservation" [38], "convivial conservation" [39], area categories such as Dark Sky Parks, or different trans-European instruments.

IPAM Toolbox 2.0 can be utilized by site managers themselves. In supported workshop settings, this assessment can be conducted in a half-day session. The toolbox can be applied to various categories and types of CAs. By uniformly calculating values, areas can be aggregated and compared at the local, national, or international level. This opens up new possibilities for a global assessment of management practices.

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## ACRONYMS

CA: Conservation Area (definition see Table 1), plural CAs
ERL: European Restoration Law
FoA: Field of Activity (definition see text), plural FoAs
GBF: (Kunming-Montreal) Global Biodiversity Framework
IPAM: Integrated Protected Area Management
MCA: Management of Conservation Areas
OECM: Other Effective Area-Based Conservation Measures

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