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EFICÁCIA DA GESTÃO DE UNIDADES DE CONSERVAÇÃO DA NATUREZA DO
ESTADO DO RIO GRANDE DO SUL, BRASIL

SÃO LEOPOLDO- RS

2025

PATRÍCIA BERNARDES RODRIGUE WITT

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Tese apresentada ao Programa de Pós-Graduação
em Biologia da Universidade do Vale do Rio dos
Sinos (UNISINOS) para obtenção do título de
Doutora em Biologia.

Área de concentração: Diversidade e Manejo de Vida Silvestre

Orientador: Larissa Rosa de Oliveira
Coorientador: Helder Henrique de Faria

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“No começo, pensei que estivesse lutando para salvar seringueiras, depois pensei que estava lutando para salvar a Floresta Amazônica. Agora, percebo que estou lutando pela humanidade”. – Chico Mendes.

RESUMO

A implantação de áreas protegidas, em especial Unidades de Conservação (UCs) da natureza, é uma estratégia de conservação reconhecida mundialmente. No entanto, esses territórios requerem uma gestão eficiente para atingir seus objetivos de conservação. Quando a gestão das UCs é deficiente, acarreta prejuízos aos seus próprios objetivos, afetando a biodiversidade e os processos ecológicos, além de causar impactos sociais e econômicos. Este estudo teve como objetivo avaliar de forma quali-quantitativa a eficácia da gestão e as ameaças que incidem em 11 Unidades de Conservação da natureza do grupo de Proteção integral, no estado do Rio Grande do Sul, no sul do Brasil. Esta avaliação foi feita por meio de entrevistas com os gestores com aplicação dos parâmetros, concomitantemente com a revisão dos documentos oficiais de cada UC. Para esta análise, utilizou-se o método adaptado de Efetividade da Gestão de Áreas Protegidas (EMAP) por meio da escala Likert com cinco níveis, oito escopos, 73 indicadores e 65 cenários de avaliação. Das UCs avaliadas no sul do Brasil, 91% apresentaram resultados que indicaram que sua eficácia oscilou entre média a muito insatisfatória com baixa efetividade de manejo. Já 18% das UCs tiveram qualidade de manejo muito insatisfatória, 37% insatisfatória; 36% medianos e apenas 9% satisfatórios. Desta forma, constatou-se que os objetivos principais para os quais foram criadas as áreas protegidas, não estão sendo cumpridos de forma eficaz. Para avaliação quanto à incidência de 23 fatores de variáveis de ameaças nas UCs, foi adotado atributos tais como: magnitude, abrangência, permanência, dinâmica, probabilidade de concretizar e ações de mitigação. A valoração dos atributos foi mensurada por meio de escalas de *Likert* com cinco níveis. Quanto maior o percentual obtido, menor o risco ou gravidade de ameaças, e quanto menor o percentual obtido, maiores são as ameaças avaliadas, ou seja, alerta de gravidade. Os fatores de ameaças foram selecionados considerando levantamento de informações de campo, planos de manejo, realidade das áreas protegidas e suas características, com base em outros métodos que analisaram ameaças para a eficácia de gestão em UCs. Os resultados obtidos demonstraram que existem fatores de ameaças em todas as 11 UCs analisadas, com diferentes níveis de gravidade. O Parque Estadual Delta do Jacuí (PEDJ) apresentou o maior valor (gradiente) de ameaças (42,21%), seguido do Parque Estadual do Tainhas (PETA) (59,96%) e Parque Estadual Espigão Alto (PEA) (68,48%), considerados com valor de ameaça médio. Outras sete UCs obtiveram valores de ameaças baixos: Parque Estadual de Itapeva (PEVA) 72,46%; Parque Estadual de Ibitirí (PEIB) 72,64%; Parque Estadual do Espinilho (PEESP) 74,28%; Parque Estadual de Itapuã (PEIT) 80,98%; Parque Estadual do Turvo (PETU) 81,88%; Estação Ecológica de Aratinga (EEA) 84,24% e Reserva Biológica Serra Geral (REBIOSG) 84,96%. Apenas a UC Refúgio de Vida Silvestre Banhado dos Pachecos (RVSBP) apresentou valores muito baixos de ameaças (89,13%). De uma maneira geral recomendam-se ações a serem implementadas pela gestão para o cumprimento dos objetivos das UCs: a adoção de um modelo de avaliação quali-quantitativo; aumento do quadro de funcionários; treinamento de equipes e gestores; melhoria da infraestrutura, materiais e equipamentos; previsão orçamentária e rubricas direcionadas de forma regular; regularização fundiária, implantação de conselhos consultivos; atualização dos planos de manejo e a implantação de sistemas de monitoramento das ameaças sobre as UCs estaduais.

Palavras-chave: Biodiversidade, Conservação, Manejo de Áreas Protegidas, Escala Likert, Plano de Manejo, EMAP; Ameaças.

ABSTRACT

The implementation of protected areas, especially Conservation Units (CUs), is a globally recognized conservation strategy. However, these territories require efficient management to achieve their conservation objectives. When the management of CUs is deficient, it harms their own objectives, affecting biodiversity and ecological processes, in addition to causing social and economic impacts. This study aimed to evaluate, in a qualitative and quantitative way, the effectiveness of management and the threats that affect 11 Conservation Units of the Full Protection group, in the state of Rio Grande do Sul, in southern Brazil. This evaluation was carried out through interviews with managers with application of the parameters, concomitantly with the review of the official documents of each CU. For this analysis, the adapted method of Effectiveness of Management of Protected Areas (EMAP) was used through the Likert scale with five levels, eight scopes, 73 indicators and 65 evaluation scenarios. Of the CUs assessed in southern Brazil, 91% presented results that indicated that their effectiveness ranged from average to very unsatisfactory, with low management effectiveness. In 18% of the CUs, the quality of management was very unsatisfactory, 37% unsatisfactory; 36% average and only 9% satisfactory. Thus, it was found that the main objectives for which the protected areas were created are not being met effectively. To assess the incidence of 23 threat variables in the CUs, attributes such as magnitude, scope, permanence, dynamics, probability of materialization and mitigation actions were adopted. The valuation of the attributes was measured using Likert scales with five levels. The higher the percentage obtained, the lower the risk or severity of threats, and the lower the percentage obtained, the greater the threats assessed, that is, severity alert. The threat factors were selected considering field information surveys, management plans, the reality of protected areas and their characteristics, based on other methods that analyzed threats to the effectiveness of management in protected areas. The results obtained demonstrated that there are threat factors in all 11 analyzed protected areas, with different levels of severity. The Delta do Jacuí State Park (PEDJ) presented the highest value (gradient) of threats (42.21%), followed by the Tainhas State Park (PETA) (59.96%) and Espigão Alto State Park (PEA) (68.48%), considered to have a medium threat value. Seven other protected areas obtained low threat values: Itapeva State Park (PEVA) 72.46%; Ibitiriá State Park (PEIB) 72.64%; Espinilho State Park (PEESP) 74.28%; Itapuã State Park (PEIT) 80.98%; Turvo State Park (PETU) 81.88%; Aratinga Ecological Station (EEA) 84.24% and Serra Geral Biological Reserve (REBIOSG) 84.96%. Only the Banhado dos Pachecos Wildlife Refuge (RVSBP) presented very low threat values (89.13%). In general, actions to be implemented by management to achieve the objectives of the CUs are recommended: adoption of a qualitative and quantitative assessment model; increase in staff; training of teams and managers; improvement of infrastructure, materials and equipment; budget forecasting and headings directed on a regular basis; land regularization, implementation of advisory boards; updating of management plans and implementation of threat monitoring systems for state CUs.

Keywords: Biodiversity, Conservation, Management of Protected Areas, Likert Scale, Management Plan, EMAP; Threats.

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1 APRESENTAÇÃO

O documento apresentado tem como fundamentação a importância da avaliação dos processos de gestão em unidades de conservação da natureza, especificamente o caso de 11 unidades (UCs) do grupo de Proteção Integral, de acordo com a Lei 9.985/2000 do Sistema Nacional de Unidades de Conservação da Natureza (SNUC), que possuem Planos de Manejo homologados, geridas pelo estado do Rio Grande do Sul. O estudo objetivou avaliar quanto ao planejamento compatível às categorias de manejo e o cumprimento dos objetivos de conservação da biodiversidade e complexos ecológicos para os quais foram criadas, a fim de aprimorar as etapas futuras para planejamento dinâmico e eficaz das áreas protegidas.

Para proceder da avaliação de efetividade de gestão das unidades de conservação, foi utilizado o método EMAP/WWF-CATIE (Cifuentes; Izurieta; Faria 2000), Efetividade do Manejo de Áreas Protegidas (do espanhol *Medición de la Efectividad del Manejo de Áreas protegidas* com adaptações, o que permite o método.

Esta tese está disposta em quatro capítulos. O primeiro capítulo é introdutório, trazendo o marco teórico referencial sobre o tema do estudo, embasando o conhecimento a ser discutido nos capítulos seguintes. Por fim, um quarto capítulo apresenta as considerações finais do estudo.

O segundo capítulo intitulado “Management Effectiveness of Nature Conservation units in southern Brazil” é apresentado no formato de artigo, o qual foi publicado na revista *Neotropical Biology and Conservation* 18(3): 209–230 (2023) DOI: 10.3897/neotropical.18.e103019, (Fator de Impacto 1,6). Este capítulo tem como o enfoque a avaliação do desempenho de gestão de unidades de conservação da natureza, no estado do Rio Grande do Sul. O estudo foi realizado por meio de análises quali-quantitativas, através do método EMAP/WWF-CATIE, com adaptações. A aplicação dos parâmetros de avaliação para as 11 unidades de conservação se deu por meio de validação e construção de cenários dentro de oito âmbitos, que são os indicadores de maior hierarquia, 47 indicadores e 65 variáveis com parâmetros e/ou cenários de avaliação com escalas de valoração de cinco níveis Likert.

O terceiro capítulo intitulado “Ameaças à biodiversidade em Unidades de Conservação Estaduais, Rio Grande do Sul, Brasil, foi editado na forma de artigo para a revista *Neotropical Biology and Conservation*”. Neste capítulo, foi feita uma análise as ameaças que incidem à biodiversidade em 11 unidades de conservação. Foram previamente selecionados 23 fatores de ameaças com bases dos estudos de eficácia de gestão e

características gerais da região, onde estão inseridas as UCs no Estado do Rio Grande do Sul. O quarto capítulo, apresenta as considerações finais e recomendações do presente estudo.

2 CAPÍTULO 1 – INTRODUÇÃO GERAL - EFETIVIDADE DA GESTÃO DE UNIDADES DE CONSERVAÇÃO DA NATUREZA NO SUL DO BRASIL

Desde a Revolução Industrial, grandes transformações nas paisagens naturais têm ocorrido ao longo do planeta, prejudicando diversos habitats e sua biodiversidade (Geldmann *et al.*, 2020). A perda de habitat tem sido uma das maiores causas da diminuição da diversidade biológica (Primack; Rodrigues, 2006).

A pecuária, a poluição por pesticidas nas lavouras e a contaminação das águas, bem como poluição atmosférica, extração de madeira e ocupações humanas de áreas naturais, têm contribuído de forma significativa para a degradação dos ecossistemas naturais e a perda de diversidade biológica. Além disso, questões correlacionadas às mudanças climáticas e a alteração da dinâmica natural das espécies e a superexploração dos recursos naturais, também vem contribuindo para a perda de habitat e diversidade (Primack; Rodrigues, 2006).

A introdução de espécies vegetais exóticas, principalmente aquelas consideradas invasoras, também é uma ameaça à diversidade biológica, competindo por espaço e nutrientes com espécies nativas (Zenni *et al.*, 2016). Além disso, a fauna invasora tem causado danos severos, devido à transmissão de patógenos em reservatórios silvestres, especialmente em mamíferos (Jorge *et al.*, 2010; Curi *et al.*, 2016). A caça de espécimes selvagens e o atropelamento também tiveram impactos diretos na redução da biodiversidade (Sillero-Zubiri *et al.*, 2004; Haag *et al.*, 2010; Beisiegel *et al.*, 2013; García-Rangel; Pettorelli, 2013; Dobrovolski *et al.*, 2013; Schuette *et al.*, 2013; Queirolo *et al.*, 2014; Oriol-Cotterill *et al.*, 2015; Wolf; Riplee 2016; Wolf; Riplee, 2017). Neste contexto de perda de biodiversidade e habitat natural, diversos países têm investido na criação de Áreas Protegidas (APs), terrestres ou marinhas, com foco na proteção dos recursos naturais e da biodiversidade em regiões específicas (Schulze *et al.*, 2018).

As Áreas Protegidas (APs) como são reconhecidas internacionalmente, ou Unidades de Conservação da Natureza (UCs), são espaços territoriais especialmente protegidos, sendo estes fundamentais para a conservação da biodiversidade (Tossulino *et al.*, 2006). As APs representam grandes esforços de gestão para reduzir pressões antrópicas em áreas naturais (Schulze *et al.*, 2018). O termo “área protegida” no mundo pode ser traduzido em ‘protected area’ (inglês) assim como de ‘área protegida’ (espanhol) ou ‘aire protégée’ (francês). No Brasil, uma das tipologias de áreas protegidas são as ‘unidade de conservação’ (UCs) (Maretti, *et al.*, 2015), além das terras indígenas, áreas de preservação permanente e reservas legais, em propriedades rurais, as quais se diferem em percentuais em cada bioma brasileiro

(Brasil, 2012). As UCs, de acordo com a Lei Federal 9.985/2000, Sistema Nacional de Unidades de Conservação da Natureza (SNCU), são espaços territoriais especialmente protegidos (APs), compreendendo seus recursos ambientais, incluindo águas jurisdicionais detentoras de características naturais relevantes, em três esferas: Federal, Estadual e Municipal. As unidades de conservação possuem metas de conservação e limites definidos, que são regidos por sua respectiva administração, aplicando garantias de proteção (Brasil, 2000). Um sexto da superfície terrestre mundial está sob a forma de áreas protegidas (Geldmann *et al.*, 2019). Contudo, de acordo com Butchart *et al.* (2015), esse valor seria ainda menor, com apenas aproximadamente 15% da superfície terrestre coberta por áreas protegidas. Dessa forma, esses autores sugeriram a necessidade de um aumento de 660 milhões de hectares de áreas protegidas para assegurar a conservação da vida silvestre nos diferentes biomas e regiões de sítios importantes. Houve um aumento globalizado de 629.262 km² da cobertura de áreas protegidas e conservadas tanto terrestre quanto águas interiores, assim como um aumento de 1,77 milhão de km² no âmbito marinho e costeiro deste 2020. Além disso, desde 2021 estão sendo estabelecidos planos de ações nacionais para Biodiversidade, a fim de se cumprir as metas do Aichi Biodiversity Target 11, conforme acordos firmados na convenção da Diversidade Biológica. O progresso global direciona-se ao elemento de cobertura de 30% da Meta 3 e de 17,58% das áreas terrestres e de águas interiores, e 8,44% das áreas marinhas e costeiras (CDB, 2024). As Partes da Convenção sobre Diversidade Biológica chegaram a um acordo histórico em dezembro de 2022 em relação à perda de biodiversidade, adotando o Quadro Global de Biodiversidade de Kunming-Montreal. O acordo teve apelo aos governos, empresas e sociedade para que tomem medidas urgentes até 2030 em relação à crise da biodiversidade. O Relatório Planeta Protegido de 2024 apresenta progresso global ao compromisso mundial, destacando a Meta 3 do Quadro Global de Biodiversidade de Kunming-Montreal, que tem por objetivo a salvaguardar a biodiversidade mundial por meio de áreas protegidas e conservadas (Protected Planet, 2024).

O Brasil é o país que abriga a maior diversidade biológica do mundo, constituindo em mais de 20% do total de espécies do planeta, em torno de 116.839 espécies da fauna e mais de 46.355 espécies vegetais, conhecidas e distribuídas nos seis biomas terrestres, assim em três ecossistemas marinhos em ambientes terrestres e aquáticos (MMA, 2024). Conforme dados científicos apresentados pelo Ministério do Meio Ambiente, a biodiversidade encontra-se em diferentes zonas climáticas por regiões em diversos biomas, destacando a floresta Amazônica, uma das maiores zonas tropicais úmidas do mundo, a Caatinga e o Pantanal, além das

florestas semiáridas, campos dos Pampas, a Mata Atlântica e o Cerrado, esses dois últimos biomas estão entre os 34 *hotspots* de biodiversidade do mundo (Myers *et al.*, 2000).

Acredita-se que a Mata Atlântica é o segundo bioma mais ameaçado de extinção no mundo (Myers *et al.*, 2000; SEMA/RS, 2009). De acordo com Galindo-Leal e Câmara (2005), a Mata Atlântica é considerada o segundo *hotspots* de biodiversidade mais ameaçado do mundo, com perda em torno de 70% de sua cobertura vegetal original. Além de formações florestais variadas, o bioma da Mata Atlântica abrangendo campos naturais, restingas, manguezais e outras formações vegetacionais características (Oliveira; Engel, 2017).

A diversidade de ecossistemas e climas no Brasil abriga mais de 20% do total de espécies do planeta, incluindo ambientes terrestres e aquáticos, destacando a Amazônia, bioma que abriga mais de 2.500 espécies de árvores e 30.000 plantas, sendo este o maior bioma brasileiro; o Cerrado que perfaz 5% da biodiversidade sendo a savana de maior biodiversidade do mundo; a Caatinga que abriga em torno de 1.457 espécies da fauna silvestre e está localizada em 10 estados do Brasil. Destaca-se o percentual de Biomas que estão localizados em APs incluindo os grupos de Proteção Integral e Uso Sustentável: 42,2% em território Amazônico, 3,0% Caatinga, 6,8 Cerrado, 0,3% Pantanal, 4,7% Mata Atlântica, 0,2% Pampa e 37,8% em ambientes Marinhos e Costeiros (SNIF, 2024). Já o bioma do Pantanal é um dos maiores no mundo, no tocante a existências de áreas úmidas (Alho *et al.*, 2019; MMA, 2024); o Pampa com uma diversidade em suas paisagens de campos, com serras, planícies, ambientes rupestres e coxilhas (Boldrini, 2009); a Mata Atlântica conhecida como patrimônio nacional, ocupa 15% do território brasileiro (Campanili; Prochnow, 2006).

A perda da biodiversidade do Bioma Pampa está ameaçada por ações exploratórias, sobretudo, as de cunho agropecuário e agrícola, praticadas de forma inadequada, levando ao comprometimento do potencial de desenvolvimento sustentável da região (Echer *et al.*, 2016; Overbeck, 2023) Neste sentido, para que se possam preservar frações significativas de cada bioma brasileiro, torna-se fundamental que os estados e os municípios do país possam criar e gerir APs em suas diversas categorias, principalmente aquelas de Proteção Integral, que permitem a conexão entre áreas naturais, para cumprimento do seu importante papel na conservação de ecossistemas, processos ecológicos e espécies.

A criação de espaços territoriais especialmente protegidos tem sido considerada como uma das melhores estratégias para a conservação da biodiversidade, sendo uma ação necessária frente às ocupações humanas crescentes e processos de simplificação dos recursos naturais de forma predatória (Bensusan, 2006). Contudo, estas ações não têm se mostrado eficientes para proteger a biodiversidade em muitos países do mundo, já que muitas APs

continuam a sofrer severas ameaças e pressões antrópicas, bem como deficiências nos processos que envolvem a gestão e cumprimento dos objetivos destas áreas (Faria, 2007; Laurance *et al.*, 2012; Geldmann *et al.*, 2013; Geldmann *et al.* 2020).

Além disso, é importante destacar que as APs, em especial as UCs, apresentam uma série de conflitos históricos, tais como regularização fundiária, falta de funcionários e de infraestrutura básica e até mesmo ausência de fiscalização. Todas estas questões muitas vezes são agravadas pela ausência de Planos de Manejo, que após sua criação, torna-se o documento primordial das normas, regras e programas para a gestão de uma Unidade de Conservação (Pontes; Melo, 2013). Outros problemas relacionados com a gestão de UCs são as dificuldades enfrentadas pelos gestores, que perpassam os problemas ambientais, destacando aspectos de cunho econômico, social entre outros, tais como aqueles relacionados às pautas de ordem política e governamental (Brito, 2008; Witt *et al.*, 2023). Diante de tais conflitos, surge a necessidade de priorizar ações contínuas de gestão para conservação das áreas protegidas em cumprimento dos objetivos e efetividade de gestão (Faria, 1995).

Neste contexto, torna-se necessário conhecer e avaliar a eficácia das Unidades de Conservação da Natureza (UCs), do atual Sistema Nacional de Unidades de Conservação da Natureza (SNUC), Lei Federal 9.985 (BRASIL, 2000) e se elas estão legitimamente mitigando as pressões antrópicas e preservando os processos ecológicos (Geldmann *et al.* 2019).

A importância de se estabelecer um sistema de avaliação do manejo das UCs reside na necessidade de atingir plenamente seus objetivos de manejo e conservação (Witt *et al.*, 2023). A partir da década de 1990, alguns estudos foram realizados para avaliar a eficácia e o manejo de áreas protegidas com base em diferentes metodologias sistemáticas, desenvolvidas especificamente para atender às necessidades de diferentes regiões e habitats, de acordo com a realidade de cada UC (Faria, 1993; 1995; 1997; 2004; 2006; Izurieta, 1997; 1999; Mesquita 2002; Hockings, 2003; Parrish, *et al.*, 2003; Faria, 2004; Lima *et al.*, 2005; Hocking *et al.*, 2006; Medeiros; Pereira, 2011; Schacht; Rocha, 2015; Schulze *et al.*, 2018; Ho e Tetto, 2017; Geldman *et al.*, 2019; 2020).

Estes métodos são qualitativos e quantitativos instrumentos desenvolvidos para “medir” a eficácia da gestão nas UC, de forma a permitir a melhoria nos processos de gestão garantindo a eficácia e sucesso destas áreas protegidas na conservação da biodiversidade e cumprimento dos objetivos (Cifuentes *et al.*, 2000).

Esses estudos apontaram como o processo de gestão é conduzido e como os resultados alcançados foram condizentes com o cenário da UC estudada. Com base nesses resultados,

seria possível sugerir práticas, regulamentações e monitoramentos de forma sistemática que promovam melhorias e aumento da eficiência nos processos de gestão das UCs (Chape *et al.*, 2008).

A avaliação da eficácia da gestão inclui três componentes principais: (1) questões de projeto relacionadas a sítios individuais e ao sistema de área protegida, (2) adequação dos sistemas e processos de gestão e (3) cumprimento dos objetivos da área protegida (Hockings, 2000). Uma abordagem genérica da Comissão Mundial de Áreas Protegidas (WCPA) propôs avaliações de 27 metodologias, que identificaram dois tipos de dados: quantitativos derivados do monitoramento e qualitativos derivados da pontuação pelos gerentes (Hockings, 2003).

A WCPA desenvolveu a metodologia de “Avaliação Rápida e Priorização da Gestão de Áreas Protegidas (do inglês *Rapid Assessment and Priority of Protected Area Management* (RAPPAM) (www.wwf.org.br), que já foi amplamente aplicada pelo Fundo Mundial para a Natureza (= *World Wildlife Fund* - WWF) em 150 países (Ervin, 2003), sendo este um dos métodos mais utilizados para avaliar o manejo e a eficácia no mundo (Hockings, 2006; ICMBio, 2011). Por outro lado, o método de maior projeção e aplicação na América Latina nos anos 2000 foi a Medição da Eficácia da Gestão de Áreas Protegidas (EMAP) (do espanhol *Medición de la Efectividad del Manejo de Areas Protegidas* – Cienfuentes *et al.* 2000). Outro método é o *Management Excellence* (MEG), que considera ferramentas de aprendizagem e organização: *Plan, Do, Execute, Check, Action* (PDCA) (Rodrigues, 2014).

Segundo Hockings (2003), os métodos RAPPAM e EMAP são semelhantes, pois obedecem a seis princípios ou componentes de gestão na avaliação da eficácia: contexto, entradas, planejamento, processo, saídas, resultados. Outro método de avaliação da eficácia da gestão de Áreas Protegidas é o *Management Effectiveness Tracking Tool* (METT), desenvolvido em parceria entre o WWF e o Banco Mundial, e aplicado em oito países da Europa, Ásia, África e América Latina. Esse método permite identificar as necessidades e restrições das UCs, priorizando o desenvolvimento de ações para melhorar a eficácia da gestão (Stolton *et al.*, 2007; Júnior; Agra Filho, 2015).

O Sistema de Indicadores Socioambientais de Unidades de Conservação (SISUC) foi criado em 2008, também é uma metodologia de avaliação da gestão de UCs que utiliza indicadores socioambientais, tendo como temas centrais a economia, sociocultural, meio ambiente e gestão (Marinelli, 2011), que foi inicialmente usado no norte do Brasil (Silva, 2016).

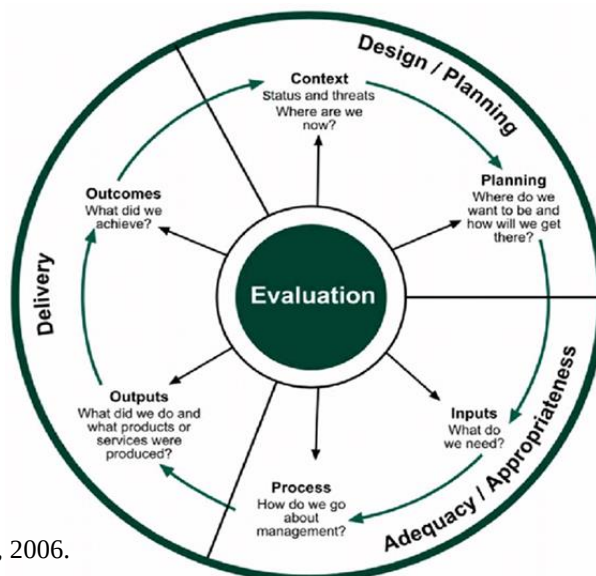
Recentemente, o programa “Lista Verde de Áreas Protegidas e Conservadas” foi proposto pela União Internacional para a Conservação da Natureza (IUCN) em 2017 como

um método de avaliação, no qual combina questões relacionadas ao meio ambiente e à situação socioeconômica, integrando os 17 Objetivos de Desenvolvimento Sustentável (ODS) da agenda 2030 da ONU.

Apesar da existência de diversas metodologias para mensurar a efetividade do manejo de unidades de conservação, nenhuma avaliação foi feita em UCs do sul do Brasil, quanto à eficácia de gestão. Assim, neste estudo objetivamos avaliar a eficácia da gestão de UCs do grupo de Proteção Integral no RS, utilizando a metodologia adaptada EMAP (Cifuentes *et al.* 2000).

A escolha deste método teve como base a sua aplicação em outras UCs do Brasil, o que permite comparar os resultados com o presente estudo, e também porque o método EMAP é adaptado as diferentes realidades das áreas protegidas, considerando as vocações regionais e características ambientais, desta forma permitindo a construção de matrizes com diferentes cenários. Com base nos resultados de cada capítulo, foram discutidas e propostas possíveis estratégias de melhorias, para alcançar maior eficácia nos processos de gestão e conservação da biodiversidade, com vista ao planejamento em longo prazo para as UCs estudadas. Espera-se que as sugestões feitas possam auxiliar a gestão das áreas protegidas em busca do cumprimento dos objetivos e propósitos legais deste território, seguindo as premissas do marco conceitual da Comissão Mundial de Áreas Protegidas e da União Internacional para a Conservação (Figura 1).

Figura 1 – Fluxograma do marco conceitual da Comissão Mundial de Áreas Protegidas (CMAP) da União Internacional para a Conservação (IUCN), indicadas para avaliação e monitoramento da efetividade de gestão de UCs



Fonte: Hockings *et al.*, 2006.

2.1 Objetivo geral

Este estudo tem como objetivo principal analisar e avaliar a situação atual das Unidades de Conservação da Natureza (UCs), Áreas Protegidas (APs) pertencentes ao grupo de Proteção Integral, as quais possuem Planos de Manejo publicado, geridas pelo órgão Estadual Ambiental do Rio Grande do Sul. As AP's foram avaliadas quanto à eficácia de gestão, com o propósito de realizar o diagnóstico, mediante resultados obtidos, a fim de construir proposições de melhorias, para atingir a eficácia nos processos de gestão e conservação da biodiversidade, cumprindo seus objetivos e propósitos legais vigentes as categorias de manejo em pauta.

2.2 Objetivos específicos

1. Mensurar a eficácia por meio do método reconhecido mundialmente (EMAP/WWF-CATIE) Cifuentes, Izurieta e Faria (2000), com adaptações da metodologia as especificidades deste estudo para quantificação;
2. Avaliar o cenário atual em que se encontra a gestão das UCs, de acordo com os processos de manejo em andamento;
3. Realizar a análise de comparação do cenário presente, ou seja, o manejo atual, com vistas a identificar falhas e/ou deficiências nos processos de gestão e eficácia, ao cenário ideal para cumprimento dos objetivos de conservação e legais vigentes;
4. Mediante os resultados obtidos, propor ações as AP's, para a melhoria nos processos de gestão e eficácia no manejo e cumprimento dos objetivos das categorias de manejo em estudo.

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3 CAPÍTULO 2 – MANAGEMENT EFFECTIVENESS OF NATURE CONSERVATION UNITS IN SOUTHERN BRAZIL



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Research Article

Management effectiveness of Nature Conservation Units in southern Brazil

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Abstract

The implementation of protected areas, in particular, nature Conservation Units (CUs), is a conservation strategy recognised worldwide. However, these territories require efficient management to achieve their conservation goals. When the management of CUs is deficient, it results in damage to their own goals, affecting biodiversity and ecological processes, as well as causing social and economic impacts. In this context, we evaluated the management effectiveness of 11 integral Conservation Units of nature in the State of Rio Grande do Sul, southern Brazil, through interviews, visits to these CUs and a review of their official documents. For this analysis, we used the adapted method of Effectiveness of Management of Protected Areas (EMAP), which was analysed using a Likert scale with five levels, eight scopes, 73 indicators and 65 evaluation scenarios. Ninety-one percent of the CUs assessed in southern Brazil by the EMAP method oscillated from average to very unsatisfactory efficacy and low management effectiveness: 18% of the CUs had a very unsatisfactory quality of management, 37% unsatisfactory, 36% average and only 9% high or satisfactory. Moreover, the CUs did not fulfil the main objectives for which they were created. In this context, we recommended a series of actions to be applied for CU improvement, such as the adoption of a quali-quantitative evaluation model for the units, through a mathematical model; increase in staff; training teams and managers; improvement of CU infrastructure and inputs; regular budget allocation; land regularisation, implementation of consultative councils and urgent review of management plans.

Key words: biodiversity, conservation, effectiveness of management of Protected Areas, Likert scale, management plan, Protected Areas, Rio Grande do Sul

Introduction

The Protected Areas (PAs), as they are internationally recognised or nature Conservation Units (CUs), are special territories that are fundamental for the conservation of biodiversity (Tossulino et al. 2006). PAs represent major

management efforts to reduce anthropogenic pressures in natural areas (Schulze et al. 2018) and currently one-sixth of the world's land surface is within a Protected Area (Geldmann et al. 2019). Conservation units are important for the economy since they provide environmental services and are fundamental areas for scientific research studies, environmental education practices and sustainable tourism, being essential for maintaining all life forms, including humans. In Brazil, PAs for Integral Protection and Sustainable Use are found in all Biomes: 42.2% in the Amazon, 3% in the Caatinga, 6.8% in the Cerrado, 0.3% in the Pantanal, 4.7% in the Atlantic Forest, 0.2% Pampa and 37.8% in Marine and Coastal environments (Sistema Nacional de Informações Florestais 2021).

The State of Rio Grande do Sul, southern Brazil, shows a great diversity of native fauna and flora distributed in two important Brazilian biomes: the Atlantic Forest and the Pampa, the latter also known as Campos Sulinos, as well as important transition zones between the two biomes.

The Atlantic Forest consists of three basic formations: the dense and open rainforest, mixed rainforest and seasonal and semi-deciduous forest, besides abundant transition zones (Galindo-Leal and Câmara 2005) with varied forest formations, such as natural fields, restingas (dried coastal biome), mangroves and other local characteristic vegetation formations (Oliveira and Engel 2017). Native species of both fauna and flora in this biome are highly threatened, according to official lists, as a consequence of habitat fragmentation, hunting and fauna illegal trade, as well as human occupations and local economic exploitation, according to State Decrees No. 53,902/2018 and State Decree No. 54,171 /2018.

The Pampa Biome in Rio Grande do Sul State is perhaps more impacted than the Atlantic Forest due to a lack of knowledge and its very specific ecological characteristics related to the southwest and south regions of Brazil (Oliveira and Engel 2017). This biome corresponds to 63% of the State territory and 2.07% of the Brazilian territory. It is the least representative biome in the National System of Conservation Units (SNUC), with 0.4% of the Brazilian territory protected in the form of CUs (Ministério do Meio Ambiente 2021).

In order to preserve significant portions of each Brazilian biome, states and municipalities must be able to create and manage PAs in their various categories, especially those belonging to the Integral Protection group, which allows the connection between natural areas to fulfil the role in ecosystems conservation, ecological processes and species. The creation of specially protected areas has been considered one of the best strategies for biodiversity conservation and represents a necessary action to deal with increasing human occupations and the simplification of natural resources in a predatory way (Bensusan 2006).

However, these actions have not been efficient in protecting biodiversity in many countries worldwide, as many PAs continue to face severe threats and anthropogenic pressures, as well as deficiencies in the management processes and in fulfilling the purposes for which they were created (Faria 2007; Laurance et al. 2012; Geldmann et al. 2013; Geldmann et al. 2021). Additionally, it is worth highlighting that PAs present a series of historical conflicts, such as land regularisation, lack of employees and basic infrastructure and even lack of inspection.

All these issues are often aggravated by the absence of Management Plans, which, after their creation, become the primary official document of norms, rules and programmes for CU management (Pontes and Mello 2013). Other

problems related to PA management are the difficulties faced by managers, which pervade environmental problems, highlighting economic and social aspects, amongst others, such as those related to political and governmental agendas (Brito 2008). Given these conflicts, there is a need to prioritise continuous management actions for PA conservation to effectively fulfil its goals (Faria 2006).

The CUs, according to Federal Law 9.985/2000, National System of Nature Conservation Units (SNCU), are protected territorial spaces (= Protected Areas (PA)), comprising environmental resources, including jurisdictional waters of relevant natural characteristics, in three government spheres: Federal, State and Municipal. The CUs have conservation goals and defined limits, which are governed by their respective administration, applying guarantees to protect these areas (Brasil 2000). In this sense, it is essential to assess the effectiveness of CUs in protecting biodiversity and whether they are legitimately mitigating anthropogenic pressures and preserving ecological processes (Geldmann et al. 2019).

The importance of establishing an evaluation system for PA management lies in fully achieving its management and conservation goals. From the 1990s on, some studies were carried out to assess the effectiveness and the management of protected areas, based on different systematic methodologies, specifically developed to meet the needs of different regions and habitats, according to the reality of each PA (Faria 1993, 1995, 1997, 2004, 2006, 2007; Izurieta 1997; Mesquita et al. 2000; Parrish et al. 2003; Hockings et al. 2003, 2006; Medeiros and Pereira 2011; Schacht and Rocha 2016; Schulze et al. 2018; Geldmann et al. 2019, 2021).

These methods are qualitative and quantitative and were developed as instruments to “measure” the management effectiveness in a CU to enable improvement in management processes and ensure the effectiveness and success in these areas (Cifuentes et al. 2000). These studies have indicated how the management process is conducted and how the achieved results were consistent with the CU scenario. Based on these results, it would be possible to suggest practices, regulations and monitoring in a systematic way that promote improvements and an increase in efficiency within the PA management processes (Chape et al. 2008).

The assessment of management effectiveness includes three main components: (1) design issues related to individual sites and the protected area system, (2) adequacy of management systems and processes and (3) delivery of protected area objectives (Hockings 2000). A generic approach of the World Commission on Protected Areas (WCPA) proposed evaluations of 27 methodologies, which identified two types of data: quantitative derived from monitoring and qualitative derived from scoring by managers (Hockings et al. 2003).

Overall, all the methods to conduct the analyses and evaluation of the effectiveness of management of protected areas (PAs) are based on analytical-descriptive studies because the descriptors of indicators have numerical scales for the qualification and quantification of the level of effectiveness of management, such as the Likert scale (Cifuentes et al. 2000; Azevedo et al. 2016). This scale applies closed-ended questions with five possible answers and can be used for questions associated with more nuanced possible responses because it measures the level of effectiveness of management for each issue.

The response options range from 0 as ineffective to 4 as extremely effective in relation to each question (Cifuentes et al. 2000) (see Table 2 and Suppl. material 1 for details). Moreover, these methods can use averages and percentages to quantify the results. All the ways to present the results by each method can be adapted to their respective indicators and goals.

The WCPA has developed the Rapid Assessment and Priority of Protected Area Management (RAPPAM) methodology, which has been widely applied by the World Wildlife Fund (WWF) in 150 countries (Ervin 2003), this being one of the most used methods to assess management effectiveness in the world (Hockings et al. 2006; ICMBio 2011).

On the other hand, the method of greatest projection and application in Latin America in the 2000s was the Measurement of the Effectiveness of the Management of Protected Areas (EMAP) (from the Spanish: “Medición de la Efectividad del Manejo de Areas Protegidas” – Cifuentes et al. (2000)). Another method is Management Excellence (MEG), which considers learning and organisation tools: Plan, Do, Execute, Check, Action (PDCA) (Rodrigues 2014). According to Hockings et al. (2003), the RAPPAM and EMAP methods are similar, as they comply with six management principles or components in evaluating effectiveness: Context, Inputs, Planning, Process, Outputs, Outcomes.

Another method of evaluating the effectiveness of PA management is the Management Effectiveness Tracking Tool (METT), which was developed in partnership between WWF and the World Bank and was applied in eight countries in Europe, Asia, Africa and Latin America. This method allows identifying the needs and restrictions of PAs, prioritising the development of actions to improve management effectiveness (Stolton et al. 2007; Júnior and Agra Filho 2014).

The System of Social and Environmental Indicators of Conservation Units (SSEICU, in Portuguese SISUC) was created in 2008 and is a methodology for evaluating the management of PAs that uses socio-environmental indicators, having as central themes economy, sociocultural, environment and management (Marinelli 2011) and was initially used in northern Brazil (Silva 2016).

The method developed by the Chico Mendes Institute for Biodiversity Conservation (ICMBio), named the Management Analysis and Monitoring System (SAMGE), is based on management panels and spatialisation of information. It aims to evaluate compliance with public policy for biodiversity conservation, through the PAs, resulting in a diagnosis of a set of information that enables the construction of indicators of effectiveness. This is a tool of fast application with immediate results applied annually.

In 2017, the “Green List of Protected and Conserved Areas” programme was proposed by The International Union for Conservation of Nature (IUCN) as an evaluation method that combines environmental and socioeconomic issues, integrating the 17 Sustainable Development Goals (SDGs) of the UN 2030 agenda. However, according to the Expert Assessment Groups Green List’ (EAGLs), the Green List method is still an experimental protocol for the Brazilian territory and maybe with unattainable criteria for the local scenario, with no validation until this moment. The design for the Brazilian reality is currently in progress and only for some Amazonian areas as candidates for this certification in 2023.

Despite the existence of several methodologies to measure the effectiveness of PA management, no evaluation was made with CUs in southern Brazil. Thus, in this study, we aimed to evaluate the effectiveness of management of Full

Protection PAs in the state of Rio Grande do Sul using the adapted methodology EMAP (Cifuentes et al. 2000). Moreover, this method was chosen because it was already applied in other CUs from Brazil, which allow us to compare the results with the present study and it was adapted to different realities in protected areas, allowing the construction of matrices of scenarios. Based on the results, potential improvement strategies were discussed to achieve greater effectiveness in the processes of biodiversity management and conservation, in the long term, to fulfil the objectives and legal purposes of this territory.

Methods

Study area: assessed Conservation Units

In this study, 11 of the 23 CUs existing in Rio Grande do Sul, southern Brazil (Secretaria Estadual do Meio Ambiente e Infraestrutura 2021) were evaluated (Fig. 1) (Table 1). They are all terrestrial PAs, but with different management categories: eight State Parks (Itapuã, Espigão Alto, Itapeva, Delta do Jacuí, Espinilho, Ibitirí, Tainhas and Turvo), one Biological Reserve (Serra Geral Biological Reserve), one Ecological Station (Aratinga Ecological Station) and one Wildlife Refuge (Wildlife Refuge of Banhado dos Pachecos). The criteria to select these CUs were: being a territory of a full protection area and having a management plan (official technical management document, according to Federal Law 9.985/2000) in the Biomes of Atlantic Forest and Pampa. The CUs studied are located in different municipalities and were concentrated in the northern and north-eastern parts of the State (Fig. 1).

Data sampling, indicators and analysis

Data were sampled through review and analysis of the Management Plans, other official documents of the CUs, as well as through the application of questionnaires during face-to-face interviews with managers in the CUs. In general, the visits to the CUs to conduct the interviews with their respective managers lasted approximately two days and were carried out between March and July 2022. To assess the management effectiveness and processes of these 11 CUs, an adaptation of the method known as Measurement of the Effectiveness of the Management of Protected Areas (EMAP) proposed by Cifuentes et al. (2000) of a quali-quantitative nature was used, whose development was based on the original principles of the ISO 10004 standard, dedicated to evaluating the quality of services offered by public and private companies.

In this adaptation, eight scopes were analysed, which are the indicators with the highest hierarchy, 73 indicators with evaluation parameters and/or scenarios measured using quantitative numerical scales with five assessment levels (Likert 1932) (see details of the questionnaire with scopes, indicators and scenarios in Suppl. material 1). The scopes, selected for this study with the EMAP method, received numerical scores, based on the Likert scale, with five levels between 0 and 4 (Likert 1932) (Table 2), to qualify the evaluation of CUs management effectiveness (Faria 2004). For example, an indicator of CU size will receive a score of 4 points (corresponding to the highest standard) when the CU has around 90% of its total surface in optimal state of conservation and zero

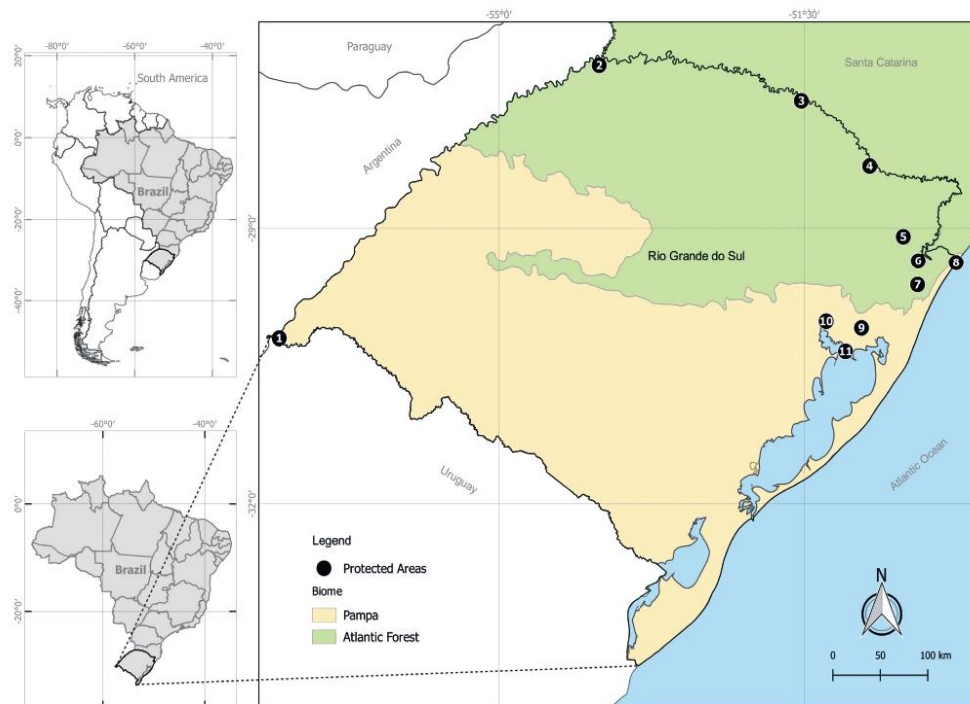


Figure 1. Distribution by Biome of the 11 Conservation Units (CUs) surveyed in Rio Grande do Sul, southern Brazil. 1. Aratinga Ecological Station; 2. Serra Geral Biological Reserve; 3. Tainhas State Park; 4. Ibitirí State Park; 5. Espigão Alto State Park; 6. Turvo State Park; 7. Itapeva State Park; 8. Banhado dos Pachecos Wildlife Refuge; 9. Itapuã State Park; 10. Delta do Jacuí State Park; 11. Espinilho State Park.

points (corresponding to the lowest standard) when the CU has less than 35%. The method was adapted to the reality of the management categories, contemplating a set of compatible indicators, but keeping EMAP's fundamentals, considering the purposes of the protected areas of the 21st century, which allow the achievement of lasting conservation results in the management of CUs.

In this context, this scale confers different quality standards (scenarios) to the indicators, being 0, the lowest value referring to the much lower standard of effectiveness, 1 still a low standard, 2 a median standard, 3 a high standard and 4 the highest value and considered a standard of excellence (Table 2).

The qualification of Management Effectiveness (EFG) occurs through comparisons of the total achieved (TA), which is the sum of the achieved scores, from the indicators' analysis and the optimal total (TA), which consists of the sum of the highest scores obtained (100%). The resulting percentages are related to the scale, which qualifies the standard considered for management quality. Moreover, each CU was briefly described to explain their strengths and weaknesses and present suggestions.

We performed ordination analyses to describe the main trends of variation between CUs in the multidimensional space of the scopes and indicators. We used the interviews of managers from the 11 CUs as our sampling units and

the 73 indicators as variables. For a more general view, a data matrix of the 11 CUs described by the eight scopes (in Likert scale) was submitted to Principal Component Analysis (PCA), based on the Pearson correlation matrix between the RAW variables (scopes). The Pearson correlation matrix, used in PCA, is equivalent to a Covariance-Covariance matrix with data centred and normalised within variables (i.e. scaled). Then, a randomisation test was used to evaluate the significance of the patterns evidenced in the first three ordination axes, considering the null hypothesis that the pattern expressed by the axis (or axes) is not different from that expected at random, for a tolerance threshold of 10% (Pillar 1999).

For a more detailed view, the same ordination procedure was performed with a Randomisation Test, but for a data matrix of the 11 CUs described by 43 indicators (in the Likert scale; the political/ institutional legal indicator had the same value for all CUs, being disregarded in this analysis). The axes considered significant in the ordinations were then interpreted. Ordination analyses and Randomisation Tests were performed in MULTIV v. 3.85b (Pillar 2006).

Table 1. Information about the nature Conservation Units (CUs) of full protection in southern Brazil, analysed between March and July 2022.

Conservation Unit	Creation Decree	Area (ha)	Biome	Municipality
Delta do Jacuí State Park	Decree No. 24.385 of January 14, 1976 / revoked by State Law No. 12.371/2005	14,242.05	Atlantic Forest Pampa	Porto Alegre, Canoas, Nova Santa Rita, Triunfo, Charqueadas and Eldorado do Sul
Espigão Alto State Park	State Decree No. 658/1949	1,331.9	Atlantic Forest	Barracão
Itapeva State Park	State Decree No. 42.009/2002.	998.06	Atlantic Forest	Torres
Itapuã State Park	State Decree No. 22.535/1973	5,566.50	Pampa	Viamão
Espinilho State Park	State Decree No. 23.798/1975	1,617.14	Pampa	Barra do Quaraí
Ibitirí State Park	State Decree No. 23.798/1975	415	Atlantic Forest	Vacaria and Bom Jesus
Tainhas State Park	State Decree No. 23.798/1975	6,654.70	Atlantic Forest	Jaquirana, São Francisco de Paula and Cambará do Sul
Turvo State Park	State Decree No. 2.312/1947	17,491.40	Atlantic Forest	Derrubadas
Banhado dos Pachecos Wildlife Refuge	State Decree No. 41.559/2002	2,560	Pampa	Viamão
Serra Geral Biological Reserve	State Decree No. 30.788/1982.	4,845.76	Atlantic Forest	Maquiné, Terra de Areia and Itati
Aratinga Ecological Station	State Decree No. 37.345/1997	5,882	Atlantic Forest	São Francisco de Paula and Itati

Table 2. Five-level scale adapted from Faria (2004) to analyse and measure the effectiveness of management for 11 Conservation Units (CUs) of full protection in southern Brazil.

Score	Percentage ratio between optimal and current situation for the indicators (%)	Quality Standard
0	0–40	very poor or very unsatisfactory standard
1	41–55	less or unsatisfactory standard
2	56–70	average standard
3	71–85	high or satisfactory standard
4	86–100	standard of excellence or very satisfactory

Results

The 11 Conservation Units analysed in this study showed, in general, an intermediate standard in the classification of management effectiveness, with 18% of the studied CUs reaching a very unsatisfactory quality standard, 36% an unsatisfactory or average standard, 9% high or satisfactory and none with excellence level (Table 3). Considering the average of the scopes (56.9%), there is a trend of moderately satisfactory to lower or unsatisfactory, in relation to the quality standards of management effectiveness (Table 4) (Fig. 2).

Amongst the studied CUs, two showed a very unsatisfactory management quality standard with less than 40%: Espinilho State Park (PEESP) with 31.6% and Ibitiriri State Park (PEIB) with 39.6%. Four other CUs resulted in a low or unsatisfactory standard: Delta do Jacuí State Park (PEDJ) 45.2%, Itapeva State Park (PEVA) 54.5%, Espigão Alto State Park (PEA) 54.9% and Tainhas State Park (PETA) 55.6%. Four CUs were considered as average regarding the quality standard: Turvo State Park (PETU) 61.1%, Aratinga Ecological Station (EEA) 65.5%, Itapuã State Park (PEIT) 65.8% and Serra Geral Biological Reserve (REBIOSG) 66.6% (Fig. 2).

Only one of the 11 UCs reached a high or satisfactory quality standard, making up a total of 85.8%, Banhado dos Pachecos Wildlife Refuge (RVSBP) and none reached the excellence standard in management quality (Fig. 2). The eight scopes showed average mostly above 50% amongst the conservation units, which explains the variation between scopes (Fig. 3).

Table 3. Classification of the management effectiveness of the studied Conservation Units (CUs).

% Optimal total	Management quality standard	% total reached	evaluated CUs
up to 40%	Very unsatisfactory	18	2
41–55%	Unsatisfactory	36	4
56–70%	Average	36	4
71–85%	High or satisfactory	9	1
86–100%	Excellence	0	0

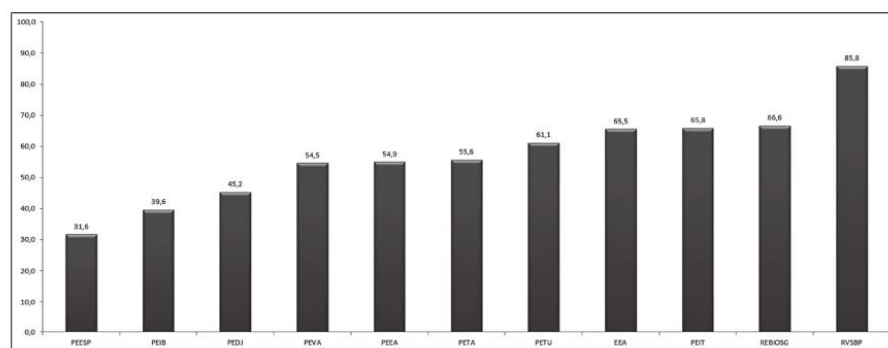


Figure 2. Average values of management effectiveness for each Conservation Unit analysed in southern Brazil, between March and July 2022. Conservation Units' acronyms: Ibitiriri State Park (PEIB); Delta do Jacuí State Park (PEDJ); Espigão Alto State Park (PEEA); Itapeva State Park (PEVA); Tainhas State Park (PETA); Turvo State Park (PETU); Itapuã State Park (PEIT); Aratinga Ecological Station (EEA); Serra Geral Biological Reserve (REBIOSG); and Banhado dos Pachecos Wildlife Refuge RVSBP.

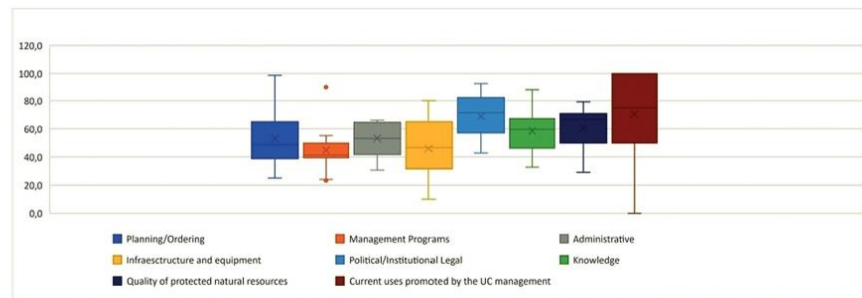


Figure 3. Boxplots expressing the general average of the eight scopes used in the analysis of Management Effectiveness for all 11 Conservation Units in southern Brazil, showing variations on average higher than 50%.

Table 4. Management effectiveness quality standard achieved (in percentages) by each conservation unit analysed in southern Brazil, between March and July 2022. Conservation Units' acronyms: Ibitirí State Park (PEIB); Delta do Jacuí State Park (PEDJ); Espigão Alto State Park (PEEA); Itapeva State Park (PEVA); Tainhas State Park (PETA); Turvo State Park (PETU); Itapuã State Park (PEIT); Aratinga Ecological Station (EEA); Serra Geral Biological Reserve (REBIOSG); and Banhado dos Pachecos Wildlife Refuge RVSBP.

Scopes	PEIT	PETA	PEDJ	PEVA	PETU	PEIB	PEEA	PEESP	REBIOSG	RVSBP	EEA
Planning/Ordering	32.5	48.8	40.0	65.0	55.0	25.0	65.0	38.8	67.5	98.8	46.3
Management Programmes	55.3	50.0	24.2	43.1	41.4	23.3	41.4	39.4	44.4	90.3	39.6
Administrative	53.1	66.1	41.7	57.3	52.6	30.7	52.1	41.7	60.4	65.1	64.6
Infrastructure and equipment	75.0	53.3	31.7	31.7	65.0	23.3	31.7	10.0	46.7	80.0	58.3
Political/Institutional Legal	82.1	57.1	50.0	71.4	85.7	42.9	75.0	57.1	71.4	92.9	71.4
Knowledge	57.7	65.4	36.5	59.6	59.6	46.2	57.7	32.7	67.3	88.5	73.1
Quality of protected natural resources	70.8	29.2	62.5	58.3	79.2	50.0	66.7	33.3	75.0	70.8	70.8
Current uses promoted by the CU	100.0	75.0	75.0	50.0	50.0	75.0	50.0	0.0	100.0	100.0	100.0
Total	65.8	55.6	45.2	54.5	61.1	39.6	54.9	31.6	66.6	85.8	65.5

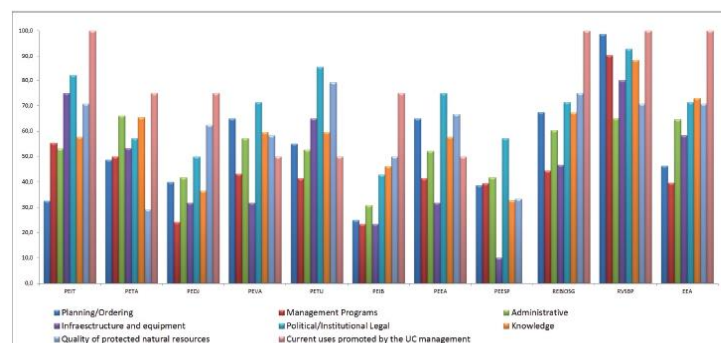


Figure 4. Results on the eight scopes analysed for each studied Conservation Unit in southern Brazil. Conservation Units' acronyms: Ibitirí State Park (PEIB); Delta do Jacuí State Park (PEDJ); Espigão Alto State Park (PEEA); Itapeva State Park (PEVA); Tainhas State Park (PETA); Turvo State Park (PETU); Itapuã State Park (PEIT); Aratinga Ecological Station (EEA); Serra Geral Biological Reserve (REBIOSG); and Banhado dos Pachecos Wildlife Refuge RVSBP.

Considering the results, we identified the weak and strong points by scope for each CU studied (Fig. 4). A detailed description of these points by CU is presented in Suppl. material 2.

In the PCA of the Scope matrix (Table 5), only the first axis was significant in the randomisation test ($p = 0.043$) and considered for interpretation. This axis explained 63.8% of the matrix's total variation, having a strongly positive association ($r \geq 0.77$) with all eight scopes considered, except for the quality of protected natural resources and for current uses promoted by the management of the CU, whose associations were also positive, but of moderate intensity ($r \sim 0.6$).

Therefore, this axis resulted from a common sign (+) between all scope variables and revealed a gradient of management quality standards between the CUs, with relatively low scores for Espinilho State Park (PEESP), Ibitirirá State Park (PEIB) and Delta do Jacuí State Park (PEDJ), medium scores for Espigão Alto State Park (PEEA), Itapeva State Park (PEVA) and Tainhas State Park (PETA), high scores for Turvo State Park (PETU), Itapuã State Park (PEIT), Aratinga Ecological Station (EEA) and Serra Geral Biological Reserve (REBIOSG) and very high scores for Banhado dos Pachecos Wildlife Refuge (RVSBP) (Fig. 5).

Furthermore, in the PCA of the matrix indicators (Table 6), only the first axis was significant in the Randomisation Test ($p = 0.051$), being retained for interpretation. This axis explained 37.5% of the total matrix variation, having a strongly positive association ($r \geq 0.67$) with 18 indicators, moderately positive ($r \geq 0.43$) with 13 indicators, weakly positive ($r \geq 0.13$) with nine indicators and weakly ($r \leq -0.13$) or moderately negative ($r = -0.49$) with the remaining three indicators. Thus, this axis represented a common sign (+) amongst the vast majority of the indicator variables and showed a gradient in the management quality standard between the CUs, with relatively low scores for Espinilho State Park (PEESP), Parque Estadual do Ibitirirá (PEIB) and Delta do Jacuí State Park (PEDJ), medium for Espigão Alto State Park (PEEA), Itapeva State Park (PEVA) and Tainhas State Park (PETA), high for Turvo State Park (PETU), Itapuã State Park (PEIT), Aratinga Ecological Station (EEA) and Serra Geral Biological Reserve (REBIOSG) and extremely high for Banhado dos Pachecos Wildlife Refuge (RVSBP).

Table 5. Principal Component Analysis with Randomisation Test for 11 Conservation Units in the State of Rio Grande do Sul, described by the correlation amongst eight general scopes of quality standard. Only the first three axes are shown.

Parameters	Axis 1	Axis 2	Axis 3
Eigenvalues	5.101	1.169	0.838
Percentage	63.8	14.6	10.5
P(roRnd $\geq$ ro)	0.043	0.49	0.36
Correlation (r) with original variables			
Planning/Ordering	0.76	-0.45	-0.21
Management Programmes	0.84	-0.38	0.08
Administrative	0.82	-0.22	0.29
Infrastructure and equipment	0.88	0.27	0.12
Political/Institutional Legal	0.87	-0.09	-0.41
Knowledge	0.94	-0.04	0.20
Quality of protected natural resources	0.59	0.55	-0.57
Current uses promoted by the CU management	0.62	0.63	0.40

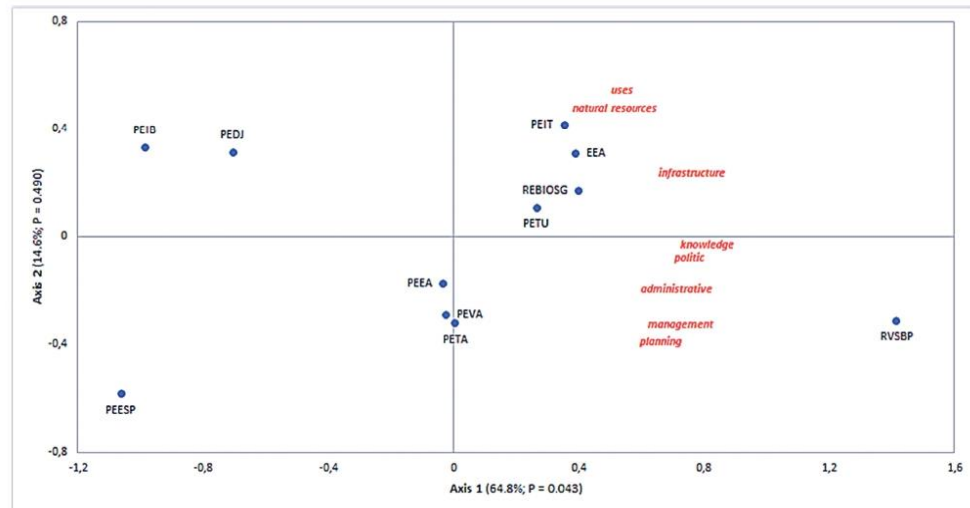


Figure 5. Principal Component Analysis with Randomisation Test for 11 State Conservation Units in Rio Grande do Sul, described by the correlation amongst eight scopes of management quality standard. Biplot of the first two axes, illustrating the dispersion of units and the association of areas with the axes. Only the variation in axis 1 (horizontal) was significant in the Randomisation Test ($P < 0.1$), being considered valid for interpretation. Conservation units' acronyms: Ibitir State Park (PEIB); Delta do Jacu State Park (PEDJ); Espo Alto State Park (PEEA); Itapeva State Park (PEVA); Tainhas State Park (PETA); Turvo State Park (PETU); Itapu State Park (PEIT); Aratinga Ecological Station (EEA); Serra Geral Biological Reserve (REBIO SG); and Banhado dos Pachecos Wildlife Refuge (RVSBP). Scopes: planning and organisation; management programmes; administrative; infrastructure and equipment; political/institutional legal; knowledge; quality of protected natural resources; current uses promoted by management.

Table 6. Principal Component Analysis with Randomisation Test for 11 State Conservation Units in Rio Grande do Sul, described by the correlations amongst 43 management quality standard indicators. Only the first three axes are shown. Original variables are sorted in descending order of correlation (r) with axis 1.

Parameters	Axis 1	Axis 2	Axis 3
Eigenvalues	16.135	5.991	5.0322
Percentage	37.5	13.9	11.7
$P(\text{roRnd} \geq \text{ro})$	0.051	0.487	0.538
Correlation (r) with original variables			
Biophysical knowledge	0.97	0.13	-0.16
Limits and demarcation of the CU	0.89	0.02	-0.26
Application and compliance with standards	0.88	-0.01	0.35
Dynamics of organisation and planning	0.86	0.28	0.03
Gaps and/or biophysical supply	0.86	-0.16	-0.09
Consulting board	0.84	0.13	-0.01
Operations management programme	0.82	0.07	0.00
Disclosure of research studies – results	0.81	0.03	0.05
Infrastructure for research	0.80	0.11	0.11
Management plan	0.78	0.39	-0.29

Parameters	Axis 1	Axis 2	Axis 3
Public management programme	0.75	-0.17	-0.35
CU manager	0.74	-0.19	-0.53
Institutional support and human resources for research	0.74	-0.12	-0.19
Relationship and institutional support	0.71	-0.54	0.04
Research feedback	0.71	-0.52	-0.19
Agreements and partners for carrying out research	0.69	0.21	-0.04
Planning level	0.69	0.14	-0.25
Infrastructure and basic facilities	0.67	-0.42	0.19
Environmental zoning	0.64	0.19	0.24
Infrastructure for the execution of peculiar management programmes	0.64	-0.43	0.55
Staff	0.62	-0.58	0.20
Compatibility of uses	0.61	-0.04	-0.23
Percentage of altered areas within the CU	0.60	0.15	0.30
Interlocution system equipment	0.59	-0.10	0.11
Environmental management programme	0.59	-0.34	-0.57
Equipment and materials	0.58	0.54	0.46
Legal information	0.58	0.06	0.40
Current uses promoted by the management of the CU	0.48	-0.11	0.53
Springs and springs	0.48	0.57	0.26
Social support to CU	0.46	0.46	-0.08
Land situation	0.43	-0.24	-0.57
CU size	0.30	-0.07	0.81
Cartographic information gaps	0.24	0.86	0.31
Rules for scientific research	0.21	-0.31	-0.07
Cartographic information	0.19	0.59	0.47
Financial	0.19	0.16	0.23
CU form	0.16	0.63	0.01
Exploration of natural resources	0.16	-0.03	-0.55
Socioeconomic information	0.15	0.77	-0.39
Application of research results to the CU management	0.13	0.47	-0.39
Buffer zone	-0.04	0.33	-0.50
CU isolation/connectivity	-0.13	-0.58	0.55
Social conflicts	-0.49	0.57	-0.05

The indicators most directly associated with this gradient were, in decreasing order of relevance: biophysical knowledge ($r = 0.97$), limits and demarcation of the CU, application and compliance with norms, dynamics of organisation and planning, gaps and/or biophysical supply, advisory board, operations management programme, dissemination of research studies – results, research infrastructure and management plan ($r = 0.78$).

There was a moderate inverse association between Social Conflicts and the axis ($r = -0.49$), which indicates a commitment relationship between the axis and the indicators in general. In other words, CUs with better (worse) indicators, in general, had a moderate tendency to record more (less) aspects of social conflicts (Fig. 6). The legal political indicator was disregarded for this analysis because it did not vary between conservation units.

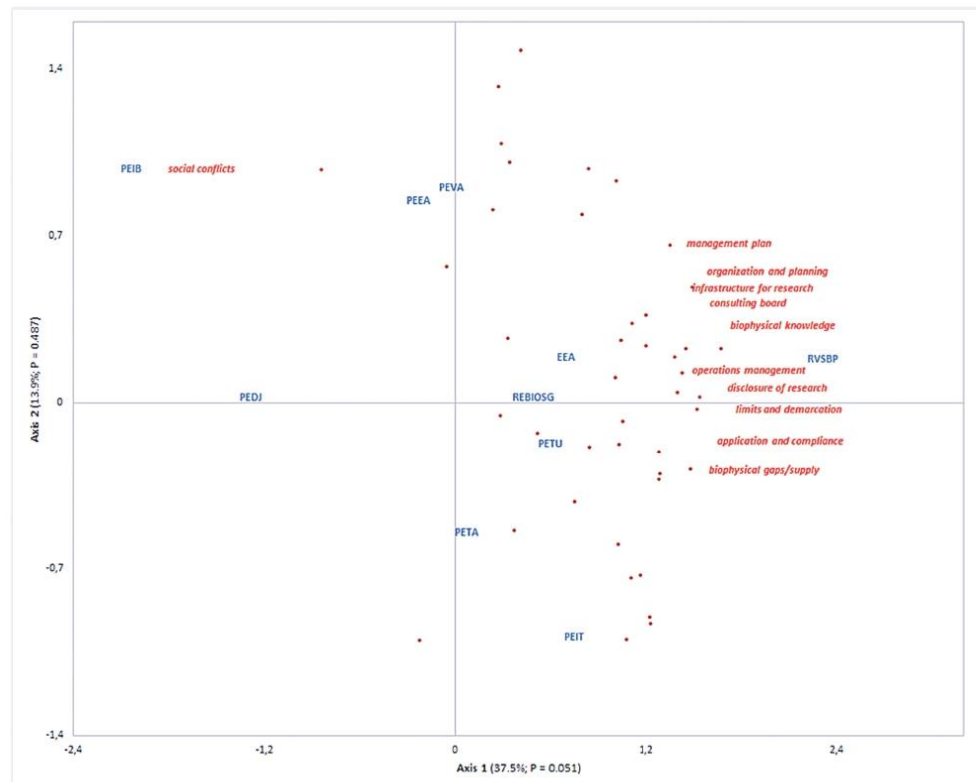


Figure 6. Principal Component Analysis with Randomisation Test for 11 State Conservation Units in Rio Grande do Sul, described by the correlations amongst 43 Management quality standard indicators. Biplot of the first two axes, illustrating the dispersion of units and the association of indicators with the axes. Only the variation in axis 1 (horizontal) was significant in the Randomisation Test ($p < 0.1$) and considered valid for interpretation. Conservation Units: Ibitirirá State Park (PEIB); Delta do Jacuí State Park (PEDJ); Espigão Alto State Park (PEEA); Itapeva State Park (PEVA); Tainhas State Park (PETA); Turvo State Park (PETU); Itapuã State Park (PEIT); Aratinga Ecological Station (EEA); Serra Geral Biological Reserve (REBIOSG); and Banhado dos Pachecos Wildlife Refuge (RVSBP).

Discussion

In this study, 11 CUs from the 23 existing in the State of Rio Grande do Sul were assessed and all have significant ecological importance for biodiversity conservation and maintenance of ecological processes, mainly because they are located in biomes of extreme relevance for Brazilian territory: Pampa and Atlantic Forest biomes. However, in general, the management effectiveness of these areas varied from average to low levels of conservation success, according to the EMAP method. Moreover, they did not fulfil the ideal objectives for which they were established. The scopes and indicators used for evaluation in this study involved the main elements for the management of a protected area, which are basic for its fulfilment and are based, above all, on the elements that make up the management plans. The application of the EMAP method

demonstrated that it is an important instrument to evaluate and monitor management effectiveness and can be applied by the managers of the CUs once they have been trained. Our results can be used by managers to improve management actions and achieve assertive goals for the efficiency of their conservation units. In this context, the adoption of evaluation mechanisms for management effectiveness is the first step amongst other actions for the successful management of protected areas.

In this study, 91% of the CUs assessed in southern Brazil by the EMAP method oscillated from average to very unsatisfactory efficacy and low management effectiveness (Table 3). Most of these units only had the basic means necessary to develop essential management programmes to achieve their goals. This scenario with similar results was also observed by Lima et al. (2005) for Minas Gerais CUs and by Faria (2006) for São Paulo State CUs. Lima et al. (2005), in the State of Minas Gerais, using the EMAP methodology, evaluated the management effectiveness of 39 state and national integral protection CUs. They concluded that 23 units (60%) from Minas Gerais showed an unsatisfactory level of management, with only one showing a satisfactory level. In 87% of the CUs, there were no management plans and no type of management planning was adopted (Lima et al. 2005). Although the results have pointed out several deficiencies in management, similar to other studies (Faria 2006; Santos 2016; Carvalho 2020; Wenceslau 2020), amongst other authors, the evaluation carried out by Lima et al. (2005), did not consider the existence of the main management instrument for protected areas, such as having a “Management Plan” as a criterion for choosing units.

Faria (2006), when evaluating the management effectiveness of 41 CUs in the State of São Paulo, also by the EMAP method, found that 88% had an average to unsatisfactory quality standard and only five (12%) had a satisfactory standard. It was observed that most of the units studied herein had the basic means necessary to develop essential management programmes to achieve their goals, but showed low management effectiveness, the same observed by Faria (2006).

A deficiency observed in terms of management procedures, such as systematic environmental monitoring, updated management plan, frequent maintenance of headquarters, implementation of consultative councils etc., prevents the effective fulfilment of the proposed objectives for the conservation of most of the protected areas analysed herein. A general suggestion for almost all CUs analysed is the establishment of flows and the administrative conduct needs to be reviewed in terms of the model used. This is corroborated by the opinion of the CU managers, according to whom the solutions must come from the managing body to establish a standardised management model (Lima et al. 2005; Silveira et al. 2012; Pegler 2018).

It is worth mentioning that the EMAP method, although extremely adaptable, is based on indicators that permeate the “management plan”, such as zoning, management programmes, research, inspection, infrastructure, economic situation, amongst other related aspects. The EMAP method is adaptable, as long as the methodological principles are maintained and allows the creation of current scenarios, having a compatible numerical valuation scale (Likert 1932) assigned to several indicators applied in our study. In this way, we measured the current situation of each CU. The adaptation of new scenarios to the reality of the CUs enabled the analysis of evaluation and future projections, establishing

between researcher and manager the possibility of analysing and building a dynamic model of reality.

The management plans evaluated in this study are mostly outdated, as is the case of the Itapuã State Park, published in 1996 and, for the other CUs, the plans were published in the 2000s, more than 20 years ago. Management activities related to the CUs' outdated management plans, for the most part, are being supplied through adaptations of secondary operation plans to meet the basic objectives, such as supervision. Moreover, although all CUs analysed in this paper have management plans, some have several deficiencies, such as the lack of financial resources and staff, precarious infrastructure or no structure and lack of land regularisation.

The lack of attention to these points prevents the effective fulfilment of the objectives, with the role of the managing body in the organisational structure of the CUs. Similar results were also found by Carvalho (2020) in eight integral protection units in the Republic of Cape Verde in Africa. They found a deficiency on the part of the management body regarding the establishment of tools for the preparation of technical management documents to provide better planning with clear and standardised guidelines through a model, in a dynamic way, following the evolution of management processes.

Another relevant aspect is the lack of standardisation in the elaboration and implementation processes, which was also observed by Santos (2016) in State Parks of Minas Gerais. Rodrigues (2014) also concluded the absence of standardisation in the management processes of those areas when analysing the management of four integral protection units in the State of Tocantins in Brazil using the Management Excellence Model (MEG method) when investigating the management maturity of the areas. Many deficiencies were observed in the management processes and only one of the four presented a high level of management quality. The author also related the low performance to the lack of standardisation of the management processes and believed that is linked to a managerial culture.

The creation of advisory councils for the units is also an issue that needs to be highlighted. We found in our study that, in some cases, the elaboration of management plans preceded the establishment of councils, which are of paramount importance for the legitimacy of management actions. These councils have the equal participation of representatives of governmental and non-governmental civil society, which is a very important aspect of CU management (Carvalho 2020). Amongst the areas analysed herein, three parks lacked advisory councils: Delta do Jacuí State Park, Espinilho State Park and Ibitirí State Park, probably resulting in loss of management efficiency.

The scopes evaluated through the application of multiple regression, which in general pointed to a higher standard of quality of management effectiveness (EFG), were the scopes: political legal, current uses promoted by the management and quality of natural resources. The political-legal scope, within this set of indicators, presented 68.8% of effectiveness, which consists of framing the CU and its legal norms. All areas studied have their legal instruments of creation. Although the managing bodies of many CUs are not the legal owners of the land, they are responsible for its use and can protect the environmental attributes in some way.

Faria (2006) evaluated CUs from the São Paulo State (SP) and found similar results to those of the present study, mainly concerning the land situation be-

cause, although the score was high in SP, the land regularisation of the areas needs to be carried out by the State government and its Department of Environment, like in southern Brazil. Moreover, the existence of a decree creating the conservation unit was also an indicator with a high overall score for both States, SP and RS, because all CUs have such a decree. However, in both cases, CUs created before Brazilian Federal Law 9.985 need to be revised because not all areas were acquired by the State government and some cases remain as private property.

Another scope that resulted in the second highest relevance was that of current uses promoted by the manager. In most units, managers promote uses compatible with the goals of the management categories, totalling 65.9% of effectiveness. The quality of protected natural resources was the third most important, with a management efficiency of 60.6%. According to Faria (2006), this scope added little to explain the model.

Our results indicated that all studied units urgently need more human and financial resources (for details for each CU, see Suppl. material 2). We also recommend the adoption of a quali-quantitative evaluation model for the units (through a mathematical model) to periodically measure their own management efficiency. However, each CU analysed has its own idiosyncrasies.

In this context, we made the following specific recommendations for each CU for improving the management effectiveness based on their weak and strong points (see, Suppl. material 2):

The Espinilho State Park needs improvements in its physical structures to meet the promotion of public use, environmental education and activities of scientific research to reach its goals. Moreover, it is recommended that there should be more employees to manage the area, mainly due to the hunting pressure and the need to monitor the buffer zone, which has a predominance of crops and cattle raising. It is also suggested the acquisition of materials and equipment.

For the Ibitirí State Park, the most important recommendations are its land regularisation, removal of liabilities from the interior of the CU and the construction of infrastructure to accommodate the manager and staff.

The Delta do Jacuí State Park needs to create its consultative council and implement management programmes, besides improving its infrastructure and acquiring equipment. Scientific research must be encouraged. This CU needs financial improvement for its administration.

Regarding the Tainhas State Park, its effective land tenure regularisation is essential, as well as the elimination of liabilities that threaten the conservation of the area. Moreover, it is necessary to increase the number of personnel. It is also recommended that attention should be given to the buffer zone, which has extensive areas of invasive exotic species, with monoculture cultivation and cattle raising.

The Espigão Alto State Park needs to carry out land regularisation and increase its staff, equipment and infrastructure (such as accommodation, machines) to improve management and research activities. It is also important to ratify and implement its revised management plan. It is recommended to monitor the buffer zone due to the extensive production areas with invasive alien species on its borders.

For the Itapeva State Park, is recommended to improve land regularisation and the staff size, especially rangers, implement infrastructure and allocate equipment for activities in the park area. The revised management plan needs

to be approved and its management programmes must be implemented. The zoning activity deserves attention, due to local conflicts with the urban expansion of the city.

Concerning the Itapuã State Park, it is recommended to update its management plan, increase the staff size and improve the maintenance of its infrastructure, mainly the administrative buildings and accommodation for researchers. Another point that deserves attention is the presence of hunting and fishing in the CU because it is accessible via water.

For the Turvo State Park it is recommended that there be an increase in the number of employees and an improvement in the accommodation for researchers. The surveillance deserves attention due to the presence of illegal hunting and illicit trafficking through the border area, which is accessible via water. Another point of concern refers to the monitoring of the buffer zone, which showed inadequate land use with extensive areas bordering the CU having invasive exotic species and the use of pesticides that drain into water sources.

For the Aratinga Ecological Station, it is recommended that there should be land tenure regularisation in the protected area and the removal of liabilities, as well as the increase in the number of staff members. It is also important to build an infrastructure in the CU to receive the staff and the administrative personnel. The existence of invasive and exotic species of flora and fauna in the CU, as well as conflicts with hunters and fishermen, are points of attention.

Regarding the Serra Geral Biological Reserve, it is recommended to increase the number of staff members (park rangers and technical/administrative personnel). It is also important to implement infrastructure, mainly in the headquarters, with equipment and technological support. There are some points of attention about monitoring the buffer zone, which has conflicts with hunting, records of pesticide use in the surrounding plantations and exotic species occurring in the CU.

For the Banhado dos Pachecos Wildlife Refuge, it is recommended to increase staff members, the acquisition of materials and equipment, improvements in existing infrastructure and basic facilities for administration, inspection, education and research (accommodation). It is also worth highlighting the existence of hunting activity in its surroundings mainly due to the presence of the Pantanal deer, amongst other species, in this CU.

Finally, several previous studies supported the result that the creation of CUs is not enough to meet the goals set for biodiversity conservation (see, for example, Cifuentes et al. (2000); Faria (2006); Carvalho (2020)), mainly due to lack of human and economic resources that affect the efficiency of the management in protected areas. Although the National System of Nature Conservation Units (SNCU) allows private and citizen donors in general, this is not a common or current practice in Brazil, which should be encouraged as an alternative to help the management in protected areas.

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Additional information

Conflict of interest

The authors have declared that no competing interests exist.

Ethical statement

No ethical statement was reported.

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Author contributions

P.B.R.W., H.H.F. and L.R.O. developed the conceptualization of the study. P.B.R.W., H.H.F., designed the experiments. P.B.R.W. carried out the interviews in the CUs. P.B.R.W. and J.M.O. performed the formal analysis. L.R.O. were responsible for acquiring funds. P.B.R.W. and L.R.O. administering the project. P.B.R.W. and L.R.O. wrote the original draft. P.B.R.W., H.H.F., L.R.O. and J.M.O. revised and edited the final version of the manuscript.

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Data availability

All of the data that support the findings of this study are available in the main text or Supplementary Information.

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Supplementary material 1

Parameters to evaluate the Effectiveness of Management of Protected Areas (EMAP) applied to eleven conservation units

Authors: Patrícia Bernardes Rodrigues Witt, Helder Henrique de Faria, Juliano de Oliveira, Larissa Rosa de Oliveira

Data type: docx

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Link: <https://doi.org/10.3897/neotropical.18.e103019.suppl1>

Supplementary material 2

Detailed description of the evaluated conservation units, with the identification of their weak and strong points

Authors: Patrícia Bernardes Rodrigues Witt, Helder Henrique de Faria, Juliano de Oliveira, Larissa Rosa de Oliveira

Data type: docx

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Link: <https://doi.org/10.3897/neotropical.18.e103019.suppl2>

SUPPLEMENTARY MATERIAL 1. Questionnaire with scopes, indicators and Likert's scores.

ASSESSMENT OF MANAGEMENT EFFECTIVENESS

IDENTIFICATION AND CHARACTERISTICS OF THE PROTECTED AREA

Conservation Unity	
Creation date	
Area Size	
Management Plan Publication Date	
Biome of location	
Has an advisory board	
Board creation date	
Manager's name and education level	
Phone:	
E-mail:	
Interviewee's name (position and education)	
Phone:	
E-mail:	

CU'S MANAGEMENT CATEGORY AND FUNDAMENTAL CONSERVATION GOALS

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MANAGEMENT CONFLICTS

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1. PLANNING AND ORDERING SCOPE

1.1. MANAGEMENT PLAN INDICATOR

1.1.1. Up-to-dateness of the Management Plan - Evaluation parameters	Score
There is a management plan that has been prepared or revised in the last 5 years and is implemented by the CU's management	4
The CU is going through a final revision process in its current Management Plan.	3
There is a plan that is more than 5 years old, and there are not enough basic studies aimed at its revision, which, although outdated, is implemented by the administration of the area.	2
There is a very outdated management plan, over 10 years old, which the CU's management uses very little.	1
There is a very outdated management plan that is over 10 years old and that the management of the area no longer uses, with no prospects for revision/updating .	0

1.1.2. Characteristics of the Management Plan Planning Team - Evaluation parameters	Score
The technical team is interdisciplinary with the participation of different legitimate social segments represented by the council, community, and institutions.	4

The team is interdisciplinary but only made up of technical staff without the participation of the community in general, but with representation on the board.	3
The team does not have representative multidisciplinary characteristics, however, there is the participation of community groups.	2
The Management Plan is prepared by a specialist/company without the participation of society and its representations.	1
There is no representative multidisciplinary team to prepare the planning review of the Management Plan.	0

1.1.3. Execution status of the Management Plan - Evaluation parameters	Score
Management plan is executed on average more than 90%	4
Management plan is executed between 75% to 90%	3
Management plan is executed between 50% to 75%	2
Management plan is executed between 35% to 50%	1
Management plan was executed less than 35%	0

1.1.4. Membership of the Advisory Board - Evaluation parameters	Score
The Advisory Board is convoked to participate in decision-making regarding the revision of the current Management Plan, with very significant active participation.	4
The Advisory Board is convoked to participate in decision-making regarding the revision of the current Management Plan, with average participation in action.	3
The Advisory Board is convoked to participate in decision-making regarding the revision of the current Management Plan, with no significant quorum	2
The Advisory Board is not convoked for the review stages of the current Management Plan.	1
The Advisory Board has not yet been constituted.	0

1.2. ENVIRONMENTAL ZONING INDICATOR

1.2.1. CU's Environmental Zoning - Evaluation parameters (*)	Score
The CU's zoning is defined in the management plan, making use of current instruments and techniques, and scientific knowledge with its regulations and standards established in the management document so that the staff and researchers have clear access to the use and management standards of each zone.	4
The zoning definitions described above clearly exist in the Management Plan, however, the functional body of the CU is not fully aware of the boundaries of the buffer zone (BZ) and specific management rules.	3
Zoning was determined in the Management Plan, regulated and implemented a few years ago, but there is a need to be revised, considering environmental changes, which refers to the need to review/update the Management Plan, as a dynamic planning.	2
The current zoning defined for the CU does not meet the demands of the proposed goals, being incompatible with the habitat reality and the degrees of conservation to be managed, as well as little recognition by the functional body, and its rules are not compatible with current uses.	1
Zoning is incompatible with the management category of the protected area.	0

1.3. BUFFER ZONE INDICATOR (*)

Buffer Zone (BZ) of the CU - Evaluation parameters	Pontuação
There is a definition of BZ for CU, with uses in accordance with the norms established in the Management Plan, which are respected and taken into account in decision-making regarding planning, use of the territory and licensing of activities.	4
There is a definition of BZ for the CU, with uses partially in accordance with the norms established in the Management Plan, with difficulties in complying with the established rules.	3
There is a definition of BZ for the CU, but the use of the territory is in disagreement with the norms established in the Management Plan.	2
There are no established definitions for BZ in the Management Plan, but the current legal regulations are used regarding the rules for uses and activities around the CU.	1
There are no definitions of this zone status (BZ) in the Management Plan, nor use of general legal rules for the management of the CU's surroundings.	0

1.4. PLANNING LEVEL INDICATOR (*)

1.4.1. Planning level - Evaluation parameters	Pontuação
The planned programs and activities have their specific plans, complying with the rules and recommendations of the Management Plan, an official technical management document, and these plans are integrated with the achievement of conservation goals.	4
The CU has a Management Plan that is in compliance and operational, however, there are no specific plans for all management programs or activities, presenting prospects for improvement in its planning.	3
The CU has a Management Plan in compliance and operational, presenting some important guiding documents for the management of some activities in the CU.	2
The CU only has the Management Plan, which is quite outdated, in need of revision, and technicians require improvement in studies and improvement in terms of the planning instrument, which is the primordial instrument for success in the management of the area protected.	1
The CU does not have other planning instruments besides the Management Plan.	0

1.5. INDICATOR OF COMPATIBILITY OF USES WITH THE MANAGEMENT CATEGORY GOALS (*)

Compatibility of uses with the goals of the CU management category - Evaluation parameters	Score
Uses are compatible, meeting the category and management plan expressing successful administrative technical management.	4
Uses are compatible considering the category and management plan, with administrative technical management.	3
Uses are compatible, however, underutilized according to the existence of facilities and load, presenting deficient technical administrative management.	2
Uses are incompatible with the goals of the management category with low incidence on ecosystems and protected species	2
Uses shown to be compatible, but underutilized according to the existence of facilities and load, without technical administrative management of the CU.	1
Uses are incompatible with the objectives of the management category with a median incidence on ecosystems and protected species.	1
Uses are incompatible with a high incidence on ecosystems and protected species, causing serious damage to the biota.	0

2. MANAGEMENT PROGRAM SCOPE

2.1. ENVIRONMENTAL MANAGEMENT PROGRAM INDICATOR (*)

2.1.1. Scientific Research Subprogram

2.1.1. Research Program - Evaluation parameters	Score
The Program is structured, encompassing all actions and activities to achieve the specific CU's goals, with all activities being developed normally.	4
The Program is structured, but not all planned activities are carried out; only priority actions are developed normally.	3
The Program is partially structured, requiring specific support to reach the level planned and essential to meet the goals.	2
Some activities inherent to the research are carried out, but the Program does not exist, or the conditions are very precarious for its development.	1
There is no Program or related activities.	0

2.1.2. Execution of the Research Program - Evaluation parameters	Score
≥90% of planned activities have been carried out	4
76-89% of planned activities have been carried out	3
51-75% of planned activities have been carried out	2
36-50% of planned activities have been carried out	1
≤35% of planned activities have been carried out	0

2.2. Environmental Monitoring Subprogram

2.2. Environmental Monitoring - Evaluation Parameters	Score
The CU has efficient mechanisms to monitor the conditions and advances of natural resources, in accordance with and meeting the goals of the protected area.	4
The CU uses mechanisms to monitor the conditions of natural resources in accordance with the goals of the protected area.	3
The CU uses some little improved tools for monitoring natural resources.	2
The CU uses some tools for monitoring natural resources, however, without periodicity, as these are informal.	1
The CU does not have a natural resource monitoring system	0

2.3. INDICATOR - MANAGEMENT PROGRAM FOR THE PUBLIC

2.3. Management program for the public - Evaluation parameters	Score
Existence of a well-structured Public Use Program, which covers activities and norms allowed in the CU, with aims to meet the conservation purposes of the management category being normally developed. ≥ 86% of planned activities are carried out.	4
Existence of a structured Public Use Program, however, not all planned activities are possible to be carried out, only the priority ones occur normally. 71-85% of planned activities are executed.	3
Existence of a partially structured Public Use Program, requiring specific structures and inputs to achieve the planned and necessary objectives. 56-70% of planned activities are executed.	2

There is no Public Use Program, but some activities are carried out although the current conditions are precarious, however, without prejudice to the objectives of the CU. 41-55% of planned activities are executed.	1
There is no Public Use Program, activities are carried out without adequate control and monitoring. ≤ 40% of planned activities are executed.	0

2.3.1. Environmental Education Subprogram

2.3.1. Environmental Education Subprogram - Evaluation parameters	Score
The program is well structured, providing all the activities and specific rules, supported by the legal rules of the management category, meeting the support capacity.	4
The program is structured, but not all projected activities can be implemented, only a few priorities are carried out normally.	3
The program is partially structured, requiring support such as infrastructure and specific equipment to meet specific goals.	2
Some intrinsic activities are carried out, however, in extremely precarious conditions.	1
There is no program or activities related to environmental education.	0

2.3.2. Sustainable Tourism Subprogram

2.3.2. Sustainable Tourism Subprogram - Evaluation Parameter	Pontuação
The program is well structured with activities compatible with the goals of the CU's category, with good rules and activities, respecting the legal norms and the support capacity of the place.	4
The program is well structured, with activities compatible with the goals of the CU's management category. However, not all planned activities are carried out.	3
The program is partially structured, with activities compatible with the goals of the CU's category, requiring physical support and specific materials to achieve the goals.	2
The program does not exist, with only a few related activities being developed, with precarious conditions for its development, that is, without specific rules and norms to meet the CU's goals.	1
The activities carried out in the CU are completely incompatible with its goals.	0

2.3.3. Public visitation subprogram

2.3.3. Public Visitation Subprogram - Evaluation Parameters	Score
The program is well structured, covering all activities proposed to achieve its specific goals, and is running normally.	4
The program is structured, but not all activities proposed in the planning are possible to be carried out.	3
The program is partially structured, requiring specific physical structures and equipment to reach the desirable and essential level for the CU's goals. Only the priority ones are being developed, due to lack of infrastructure.	2
Only a few relevant activities are developed, but the program does not exist or the conditions are very precarious for its development.	1
There is no program or related activities.	0

2.3.4. Public Relations Subprogram (Community Integration Program).

2.3.4. Public Relations Subprogram - Evaluation Parameters	Score
The CU has a structured dissemination program that meets the planning goals and objectives of the CU, occurring systematically	4
The UC has a structured dissemination program, but the planning goals are achieved systematically.	3
The CU has a moderately structured program for dissemination, barely achieving the necessary goals for the effective fulfillment of the goals. Occasional actions.	2
The CU has a program, but it does not practice systematic disclosure to meet the CU goals.	1
The CU does not have a program or any other type of planning for promoting.	0

2.4. INDICATOR - OPERATIONS MANAGEMENT PROGRAM

2.4.1. Protection Subprogram

2.4.1. Protection Subprogram - Evaluation Parameters	Score
The CU has a well-structured protection/supervision program that supports the planned activities and their goals	4
The CU has a defined protection/supervision program, but it is often not fully implemented, reaching only part of the planned goals.	3
The UC has an established protection/supervision program, but its implementation depends on administrative referrals, and its execution is unstable.	2
The CU has an established protection/supervision program, but it carries out protection and inspection actions in accordance with opportune situations only	1
The CU does not have a program or plan for inspection and protection activities.	0

2.4.2. Maintenance Subprogram

2.4.2. Maintenance Subprogram - Evaluation Parameters	Score
The program is well structured, encompasses all the actions and activities to achieve its specific goals in order to achieve the unit goals and the activities occur normally. $\geq 86\%$ of planned activities are carried out.	4
The program is structured, but not all planned activities are viable; only the main ones occur normally. 71-85% of planned activities are executed.	3
The program is partially structured, lacking specific inputs to reach the desirable and necessary level in view of its goals. 56-70% of the planned activities are carried out.	2
Some inherent activities are carried out, but the program does not exist or conditions are too precarious for its development. 41-55% of planned activities are carried out.	1
The program or related activities do not exist. $\leq 40\%$ of planned activities are carried out.	0

3. ADMINISTRATIVE SCOPE

3.1. INDICATOR - CONSERVATION UNIT MANAGER

3.1.1. Training and education level of the CU manager

3.1.1. Education level - Evaluation parameters	Pontuação
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Academic degree in the environmental area, holding a master's/doctorate in conservation and management of protected areas and similar areas.	4
Academic degree in the environmental area, with a specialization course in conservation and management of protected areas and the like.	3
Academic training in the environmental area at the undergraduate level.	2
Academic training in another area unrelated to the functions performed	1
Does not have an academic degree.	0

3.1.2. Experience working in the field

Experience working in the area - Evaluation parameters	Score
Very high, over 10 years	4
High, between 8 and 10 years	3
Average, between 3 and 5 years	2
Low, less than 3 years	1
Very low, between 1 and 2 years	0

3.1.3. Manager's Motivation

Manager's Motivation - Evaluation parameters	Score
Very high, he/she is motivated and satisfied with working conditions	4
High, he/she understands the relevance of the work, motivated, despite the lack of CU's conditions.	3
Average, he/she performs the activities normally but with a degree of dissatisfaction.	2
Low, he/she feels helpless by the management body.	1
Very low, working conditions do not meet the CU's demand, unmotivated.	0

3.1.4. Manager's dedication to the CU

Manager's dedication to the CU – Evaluation parameters	Pontuação
Exclusive dedication to the CU's management	4
Dedicates up to 4 months of the year to the CU's management, developing other activities or dedicating themselves to another CU in the remainder.	3
He/she performs other activities concurrently with the management of the CU	2
Interim management of the CU between 5 and 7 months a year.	1
There is no defined manager for the CU and/or the management takes place remotely without staying in the area.	0

3.2. CU STAFF INDICATOR

3.2.1. Number of employees

3.2.1. Number of Employees - Evaluation parameters	Score
≥ 90% of ideal	4
75% to 89% of optimal	3
55% to 75% of optimal	2
40% to 50% of optimal	1
≤ 40% of optimal 0	0

3.2.2. Team Motivation Level

3.2.2. Degree of Team Motivation - Evaluation parameters	Score
Very high motivation, employees respond enthusiastically to activities and are satisfied with working conditions.	4
High motivation, but employees feel that some achievable working conditions are missing.	3
Moderate motivation, employees perform their duties, but with a generalized feeling of dissatisfaction with working conditions.	2
Low motivation, there is little enthusiasm for work and employees feel helpless by the institution.	1
There is no motivation and enthusiasm for work, and conditions are unsatisfactory.	0

3.2.3. Presentation of the functional framework

Apresentação do quadro funcional – Parâmetros de avaliação	Score
The functional framework has adequate and complete standardization in excellent condition.	4
The staff has work uniform in good condition, but incomplete clothing.	3
The staff has some uniform, although lacks some components to complete the clothing.	2
The staff has an incomplete uniform, in a poor state.	1
There is no uniformity of standardization for identifying the CU's staff.	0

3.3. DYNAMIC INDICATOR OF ORGANIZATION AND INTERNAL PLANNING

3.3.1. Documents and files

3.3.1. Documents and files - Evaluation parameters	Score
The CU has records with complete, clear and dynamic files, with an abundance of organized information about the protected area and related issues.	4
The CU has an information system in simplified and complete files, which meets administrative needs.	3
The CU has a system of records with incomplete files that are not well sorted, making the consultation dynamic difficult.	2
The CU has an archiving system, however, disorganized and incomplete.	1
There is no record and document filing system at the CU.	0

3.3.2. Interlocution between functional team

3.3.2. Interlocution between the functional team - Evaluation parameters	Score
The CU has a flow of information between management and staff through the management processes adopted for this purpose, accessible to all those involved.	4
The CU has a satisfactory flow of information between management and staff, but lacks formal means.	3
The information between management and the team occurs casually without formalization, but there is harmony between the team and the manager, meeting the needs of the CU.	2
There is little contact between management and the team, resulting in disorders and lack of results in meeting the CU's goals and objectives.	1
There is no access between management and the team, resulting in severe damage to the achievement of the CU's goals and objectives.	0

3.3.3. Internal Procedures and Standards

3.3.3. Internal Procedures and Standards - Evaluation parameters	Pontuação
There is an integrated and current process for management procedures, adapting to the needs that conducts and monitors the activities carried out in the CU.	4
The adopted process does not integrate all the activities that take place in the CU, however, it is adaptable to the needs, exercising control over the main activities of the CU.	3
The adopted process of norms and procedures is average, lacking clarity and integrated structuring of control procedures.	2
The process adopts norms and procedures only for some activities carried out in the CU, with no procedures and norms adopted for the fulfillment of goals, objectives and control.	1
There is no evidence of conduct procedures and management standards in the CU.	0

3.4. Indicator - Financial Resources

3.4. Financial Resources - Evaluation Parameters	Score
Area receives $\geq 86\%$ or more of the optimum	4
The area receives between 71% and 85% of the optimum	3
The area receives between 56% and 70% of the optimum	2
The area receives between 41% and 54% of the optimum	1
The area receives 40% or less	0

3.4.1. Indicator- Regularity of allocation of annual Resources.

3.4.1. Regularity of allocation of annual financial resources - Evaluation parameters.	Score
The CU always receives resources regularly in the period or dates established by the central administration to meet the demands, successfully fulfilling the planned goals and objectives.	4
The CU receives resources with occasional variations, but without significant damage to meeting demands and meeting planned goals and objectives.	3
The CU receives resources with moderate regularity, which compromises meeting the demands of some planned activities.	2
The CU receives resources with very little regularity, making it difficult to plan and comply with the Management Plan.	1
The delivery of financial resources to the CU is completely irregular, substantially hindering compliance with the management plan and its objectives.	0

3.4.2. Indicator-Extraordinary Financing

3.4.2. Indicator - Extraordinary Financing	Score
There is great capacity to meet unpredictable expenses, which are of an emergency nature, quickly.	4
The management body has a specific fund that in emergency situations is activated quickly.	3
The management body has a specific fund that is activated in emergency situations, however, the process is not fast due to bureaucratic procedures.	2

Emergency situations are resolved, however, the processes and time required are appalling, compromising other CU's activities.	1
There is no capacity to resolve matters relating to financial emergencies.	0

4. INFRASTRUCTURE AND EQUIPMENT SCOPE

4.1. Indicator equipment and materials

4.1. Indicator equipment and materials - Evaluation parameters	Score
The CU has the structure of equipment and materials compatible in quantity and quality necessary for the area's activities, presenting good conditions, meeting the demands of work to fulfill the objectives.	4
The CU has a structure of equipment and materials that meet the demand in the area's activities, however, they are in non-recommended conservation conditions, needing to be replaced. There are some that are considered essential (drone, telephone).	3
The CU has only a few equipment and materials necessary for activities in the area.	2
The CU has some equipment; however, it lacks the part of those considered for consumption.	1
The CU is completely lacking in equipment and materials for the full functioning of activities in the area.	0

4.1.2. Indicator-Interlocution system equipment

4.1.2 Interlocution system equipment - Evaluation parameters	Score
≥ 90% of the communication system is compatible and in excellent condition, allowing broad communication between the work team and management.	4
89 to 75% of the communication system is compatible, allowing communication between the work team and management.	3
74 to 50% of the communication system is compatible, allowing communication between the work team and management.	2
49 to 25% of the communication system is compatible, allowing communication between the work team and management.	1
Less than 25% of the communication system is compatible with communication between the work team and management.	0

4.2. Indicator - Infrastructure and basic facilities (Administration, supervision, education and research)

4.2. Infrastructure and basic installations (Administration, supervision, education and research) - Evaluation parameters.	Score
The infrastructure and its facilities are fully in line with the management programs and the objectives and needs of the CU.	4
The infrastructure and facilities do not meet all management programs, however, it is in excellent condition and quality.	3
Infrastructure needs to be adapted and improved to adequately meet the demands of management programs.	2
The infrastructure and facilities do not meet the demand of the CU, the existing ones are in a poor state of conservation.	1
There is no infrastructure and facilities, making it difficult to carry out	0

work activities on site.	
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4.2.1. Indicador -Infraestrutura para execução de Programas de Manejo peculiares

4.2.1. Infrastructure for the execution of peculiar Management Programs	Score
≥90% of the facilities and infrastructure to meet the peculiar programs (research and environmental education) were designed and built in accordance with CU's needs.	4
89 to 75% of the facilities and infrastructure to meet the peculiar programs (research and environmental education) were designed and built in accordance with CU's needs.	3
74 to 50% of the facilities and infrastructure to meet the peculiar programs (research and environmental education) were designed and built in accordance with CU's needs.	2
49 to 25% of the facilities and infrastructure to meet the peculiar programs (research and environmental education) were designed and built in accordance with CU's needs.	1
< 25% of the facilities and infrastructure to meet the peculiar programs (research and environmental education) were designed and built in accordance with CU's needs.	0

4.3. Indicator- Limits and demarcation of the protected area

4.3. Limits and demarcation of the protected area	Score
≥90% of the CU are properly physically demarcated	4
76 to 89% of the CU are duly physically demarcated.	3
51 to 75% of the CU are duly physically demarcated.	2
36 to 50% of the CU are duly physically demarcated.	1
≤36% of the PA are duly physically demarcated.	0

4.3.1. Indicator - Knowledge on the CU's limits

Knowledge on the CU's limits - Evaluation parameters	Score
The protected area's fiscal boundaries are known by the CU's management, local community and neighboring properties, and are duly marked.	4
The fiscal limits of the protected area are known by the the CU's management, local and bordering properties, however, it is not properly marked.	3
The protected area's fiscal limits are known by the CU's management, but it is not known by the local community and neighboring properties.	2
The fiscal limits of the protected area are not known by the the CU's management, local community and neighboring properties.	1
The fiscal limits of the protected area are not known by the the CU's management, local community and bordering properties, with precarious demarcation.	0

4.4. Indicator - CU signpost

CU signpost - Evaluation parameters	Pontuação
Protected area is 100% signposted	4
Protected area is 75% signposted	3
Protected area is 50% signposted	2
Protected area is 25% signposted	1

There are no signs in the protected area	0
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5. POLITICAL/ INSTITUTIONAL LEGAL SCOPE

5.1 Indicator - Legal instrument for the CU's creation

5.1. Legal instrument for the CU's creation – Evaluation parameters	Score
The legal instrument for the CU's creation complies with the current legal norms, being updated and duly regulated/published, meeting the management category.	4
The legal instrument for the CU's creation is satisfactory, however there is a need to adapt to the precepts on the subject and to the national and regional political reality, presenting itself partially regulated.	3
The legal instrument for regulating the area is outdated, the conformities and needs of the management category, but it still does not constitute a threat to the permanence of the unit in the long term. There is a need for reassessment.	2
The instrument for regulating the area is very inadequate due to the lack of legal power, constituting a potential threat to the area's permanence in the long term.	1
The CU does not have a legal instrument for creation.	0

5.2. Indicator- Application and compliance with standards

5.2. Application and compliance with standards - Evaluation parameters	Score
The current laws and regulations related to the CU's management category are complied with by users and employees are guided and strive to comply	4
Are complied with by most users; employees carry out disclosure and enforce them with relative ease.	3
They are fulfilled with some degree of difficulty despite the disclosure and commitment of employees.	2
They are complied with great difficulty and employees limit themselves to carrying out some control and sporadic disclosures to facilitate compliance.	1
They are rarely complied with by users; there is little effort from the employees to make it happen.	0

5.3. Indicator - Land Status

5.3. Land Status - Evaluation parameters	Score
≥ than 90% of the declared area is under the domain of the institution	4
76% - 89% of the declared area is under the domain of the institution	3
51% - 75% of the declared area is under the domain of the institution	2
36% - 50% of the declared area is under the domain of the institution	1
≤ that 35% of the declared area is under the domain of the institution	0
All or most of the area is not regularized and there are no prospects for it to be so in the short term.	0

5.4. Indicator – CU's Advisory Board

5.4. CU's Advisory Board - Evaluation parameters	Score
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The council was formally created and instituted, supporting and ensuring equal social participation of community representatives and governmental and non-governmental organizations contributing to the CU's management.	4
The council was formally created and instituted with representatives of civil society and government, but it contributes in a partial way to the CU's management.	3
The council was formally created and instituted with its representations, but there is no calendar of regular calls by the CU.	2
The council was formally created and instituted with representations without parity, some sectors dominate the agendas with no significant participation.	1
There is no advisory board at the CU.	0

5.5. Indicator - Social Support to CU

5.5. Social Support to CU - Evaluation parameters	Score
The surrounding community and other civil society groups support and participate in actions aimed at the CU, through formal mechanisms of community participation and partnerships.	4
Some groups from the surrounding community and civil society support activities and actions in the CU, with no formal mechanisms, with informal participation of community leaders in favor of the CU, due to the good relationship established.	3
The support and participation of the surrounding community and other civil society groups support the CU sporadically.	2
Part of the surrounding community and other civil society groups are interested in supporting CU's actions and activities. However, there is no cooperation between the administration and the community, although the neighbors partially recognize the intrinsic value of the area; the benefits are few.	1
There is no form of cooperation, nor community recognition or support for the CU; benefits are very low or non-existent.	0

5.6. Indicator - Social Conflicts

5.6. Social Conflicts – Evaluation parameters	Score
There are no conflicting relationships between different actors and social groups within the CU.	4
There are no indications of conflicting relationships between different actors and groups associated within the CU.	3
There is a level of disharmony between some social actors within the CU	2
There are many conflicts between actors and social groups within the CU.	1
The relationships between actors and social groups and the UC are quite conflicting and difficult.	0

5.7. Indicator- Interinstitutional Relationship and Support

Interinstitutional support and relationship	
Institutional functions are well defined, with coordination for joint activities between the inter-institutional parts in order to solve problems, with information exchange, experiences and resources, with no conflicts between sectoral projects or incompatible with the protected area's goals.	4

Institutional functions are well defined, with coordination for joint activities between the inter-institutional parts in order to solve problems, but with little exchange of information, experience and resources	3
Institutional functions are well defined, with little coordination for joint activities between the inter-institutional parts in order to solve problems, however, with greater exchange of information, experience and resources	2
There are only intersectoral definitions of interinstitutional functions.	1
There are sectorial projects that conflict with the protected area's goals, and the coordination between agencies/activity sectors, as well as the exchange of information, experiences and resources are not clearly defined.	0

6. KNOWLEDGE SCOPE

6.1. Indicator - Standards for Scientific Research

6.1. Scientific research standards - Evaluation parameters	Score
The norms (registration, control and monitoring) for carrying out research at the CU follow the general criteria defined by the Department of Biodiversity (DEBIO) and the Division of Conservation Units (DUC), however there are specific norms of the unit, which guarantee the management and monitoring of research with the results returning to the protected area.	4
The norms (registration, control and monitoring) for carrying out research at the CU follow the general criteria defined by the Department of Biodiversity (DEBIO) and the Division of Conservation Units (DUC), with no specific norms for the unit, however, the results of the research are available for the CU's management.	3
The norms (registration, control and follow-up) for conducting research at the CU follow the general criteria defined by the Department of Biodiversity (DEBIO) and the Division of Conservation Units (DUC), with no periodicity or guarantee of research results for the CU's management.	2
The unit does not meet the general criteria defined by the Department of Biodiversity (DEBIO) and the Division of Conservation Units (DUC), although there is another current regulation in the CU.	1
The CU does not have a scientific research management system, and there is no registration, control and monitoring of research and requirements for delivering results.	0

6.1.1. Indicator- Infrastructure for researchers

Infrastructure for researchers - Evaluation Parameters	Score
There is an adequate structure to support consolidated research in the area, with accommodation, cafeteria, meeting room with internet service, place to store equipment and collected materials.	4
The current infrastructure for research is insufficient, but it has satisfactory quality, allowing it to meet most of the demands of researchers in the unit.	3
Research infrastructure is insufficient and of moderate quality.	2
Infrastructure for research is insufficient and of low quality.	1
There is no infrastructure to support researchers in the area.	0

6.1.2. Indicator - Institutional support and human resources to support researchers

6.1.2. Institutional support and human resources to support researchers - Evaluation parameters	Score
Adequate technical-administrative and operational team to meet the demands of the research program, with systematic training and updating.	4
Adequate technical-administrative team and insufficient operational team, with training and updating carried out in a systematic way.	3
Insufficient technical-administrative team and adequate operational, with training and updating carried out in a systematic way.	3
Adequate technical-administrative staff and insufficient operational staff, without any type of training and updating.	2
Insufficient technical-administrative staff and adequate operational staff, without any type of training and updating.	2
There are no teams exclusively responsible for the research program, but the existing human resources are able of carrying out the planned activities satisfactorily.	1
There are not enough human resources to maintain the activities foreseen in the research program.	0

6.2. Research feedback indicator

6.2.1. Research database - Evaluation Parameters	Score
The unit feeds an updated database on research, with data on researchers and projects, a collection with full results, available to researchers and research institutions, and the general public.	4
The unit feeds an updated database on research, with data on researchers and projects, a collection with satisfactory results with few publications of research available.	3
The unit feeds an updated database, however, due to the difficulty of returning research results and the unavailability of publications, the unit's collection is reduced, with few publications available of research results.	2
The unit has an outdated database, a small collection and there is no storage of research results with publications.	1
There are no management processes that conduct a database with the records and storage of projects and research results carried out at the unit.	0

6.2.2. Indicator- Disclosure of research studies / Results

6.2.2. Dissemination of research studies / results - Evaluation Parameters.	Score
The unit disseminates research through seminars, lectures, and other events to promote research at the CU. Availability of material with accessible language for information both for employees and for educational activities for the general public.	4
The unit disseminates the surveys carried out, however, sporadically. Availability of material with accessible language for information both for employees and for educational activities for the general public, but there is also no systematic frequency.	3
The Unit disseminates research, which is not frequent, and the	2

results of scientific research are not available.	
The system for disseminating knowledge at the unit is precarious and there is no production of informative materials with the results of scientific research.	1
There is no dissemination of scientific research that are conducted at the CU.	0

6.2.3. Indicator- Agreements and partners for carrying out research

Agreements and partners for carrying out research	Score
The unit has agreements and/or partnerships with research institutions, academics, NGOs, government institutions, private companies, among others who are interested in carrying out research in the protected area.	4
The unit maintains some agreements and/or partnerships at the moment, however, it is looking for new research institutions, academics, NGOs, government institutions, private companies, among others that are interested in carrying out research in the protected area.	3
The unit has few partnerships and is not motivated to seek new ones for the development of research in the protected area.	2
The unit does not have partnerships to carry out research in the protected area, but intends to.	1
The unit does not have and does not seek agreements and/or partnerships to carry out research in the protected area.	0

6.2.4. Application of research results to CU's management

6.2.4. Application of research results to CU's management – Evaluation parameters	Score
The unit's management always uses research results as a contribution to management actions and decision-making.	4
The unit's management frequently uses research results as a contribution to management actions and decision-making.	3
Research results are little used as a contribution to management actions and decision-making.	2
Research results are rarely used as a contribution to management actions and decision-making.	1
Management actions and decision-making are carried out intuitively, without any contribution from scientific research carried out in the area.	0

6.3. Indicator - Biophysical Knowledge

6.3. Biophysical Knowledge - Assessment parameters	Score
Up-to-date and available information	4
Information updated but not available.	3
Information that is not current, but available.	3
Information that is not current and not available	2
Outdated and available information.	2
Outdated and unavailable information	1
Lack of information	0

6.3.1. Indicator - Gaps and/or supply (Biophysics)

6.3.1. Gaps and/or supply (Biophysics)	Score
This type of information does not represent any knowledge gap in the unit.	4
There are knowledge gaps on this subject in the unit, but studies are already being carried out to fill them.	3
There are gaps in knowledge on this subject, which are being widely publicized in research institutions that may be interested in filling them and there has already been an expression of interest in carrying out research in the area on the subject.	2
There are gaps in knowledge on this subject, which are being disclosed in research institutions that may be interested in filling them, but there was no expression of interest in carrying out research on the subject in the area.	1
There are gaps in knowledge on this subject, but there is no study planned to fill them and no system for disclosing these gaps that could attract interested researchers.	0

6.3.2. Indicator - Cartographic information

Cartographic information - Evaluation parameters	Score
The cartographic information about the CU and its BZ and/or surroundings is updated, for use in decision-making about the management of the area and is available in a database.	4
The cartographic information about the CU and its BZ and/or surroundings is updated, for use in decision-making about the management of the area, but it is not in the UC, being available for easy access when necessary.	3
The cartographic information about the CU and its BZ and/or surroundings, exist and are available, however, they are incomplete, and some data need updating.	2
The cartographic information about the CU and its BZ and/or surroundings are in the process of implementing studies aimed at obtaining the necessary information about the PA.	2
The cartographic information about the CU and its BZ and/or surroundings is outdated for use in decision-making about the management of the area	1
Cartographic information about the CU and its BZ and/or surroundings are outdated and not available in the area.	1
Cartographic information about the CU and its BZ and/or surroundings, do not exist or are unavailable to access.	0

6.3.3. Indicator - Gaps in studies and cartographic information generated / supply and dissemination

6.3.3. Gaps in the studies and cartographic information generated / supply and dissemination - Evaluation parameters.	Score
Cartographic information is complete and up-to-date, and does not represent a knowledge gap for the CU and the BZ.	4
There are gaps in knowledge about cartographic information in the unit, however, studies are already being carried out to fill them.	3

There are knowledge gaps in cartographic information, however, there are efforts to disseminate them widely with research institutions that may be interested in carrying out studies so that they can be filled, and there are already manifestations for carrying out research at the CU.	2
There are knowledge gaps in cartographic information, however, there are efforts to disseminate them widely with research institutions that may be interested in carrying out studies so that they can be filled, but there has been no manifestation so far to carry out research on the theme at the CU.	1
There are gaps in knowledge on this subject, but there is no study planned to fill them and no system for disclosing these gaps that could attract interested researchers.	0

6.4. Indicator - Socioeconomic Information

6.4. Socio-economic information - Evaluation parameters	Score
The information is current, systematized and organized, available for consultation at the CU.	4
The information is current, systematized and organized, however, not very accessible for consultation at the CU.	3
The information is not very current, however, available in the management plan and website.	3
The information is not up-to-date, but organized and systematized, it is not easily available for consultation.	2
The information is outdated, however, available at the CU.	2
The CU management is implementing studies to obtain the necessary information.	2
There is no systematization of information, and consultation is restricted.	1
Information is not available and/or management is not aware of it.	0

6.5. Indicator - Legal information

6.5. Legal information - Evaluation parameters	Score
Comprehensive availability and disclosure in the unit, BZ and visitors, including those established in the management plan.	4
Comprehensive availability and moderate disclosure.	3
Moderate to low availability and high disclosure.	3
High availability and low disclosure.	2
Moderate availability and moderate disclosure.	2
Moderate to low availability and low disclosure.	1
There are no emphases of this level of information in the CU.	0

7. QUALITY OF PROTECTED NATURAL RESOURCES SCOPE

7.1. Indicator - Size of Conservation Unit

7.1. CU size - Evaluation parameters	Score
The CU has around 90% of its total surface optimal for maintenance and safeguarding of protected attributes.	4
The CU has between 76% and 89% of its total surface optimal for maintaining the protected attributes.	3
The CU has between 51% and 75% of its total surface optimal for maintaining the protected attributes.	2

The CU has between 36% and 50% of its total surface optimal for maintaining the protected attributes.	1
The CU has less than 35% of its total optimal surface area for maintaining the protected attributes.	0

7.2 Indicator – CU's configuration

CU's configuration – Evaluation parametetrs	Score
Circular or very regular, entire shape.	4
Circular or oval shape, regular, fragmented.	3
Denticulated shape, square, moderately regular, entire.	2
Square or rectangular shape, fragmented	2
Very irregular shape, entire.	1
Fragmented, very irregular shape	0
Linear shape, very irregular, entire or fragmented.	0

7.3. Indicator- CU's isolation/ connectivity

7.3. Indicator- CU's isolation/ connectivity – Evaluation parameters	Score
Areas with the presence of preserved ecosystems contiguous to the CU, members of other PAs as well as natural ecosystems of private areas.	4
CU's connectivity with riparian forests and fragments of scattered ecosystems in the immediate surroundings of the PA.	4
Distance of 2 to 5 km between ecosystems, with corridors and/or sparse spots.	3
Distance of 2 to 5 km between ecosystems without corridors and/or sparse patches.	2
Distance of 5 to 10 km between ecosystems without corridors and/or sparse patches.	1
Distance greater than 25 km between preserved natural ecosystems and other PAs, with difficulties in establishing connectivity.	0
Distance of 10 to 25 km between areas, without corridors and/or sparse spots.	0

7.4. Indicator- Percentage of altered areas inside the PA

7.4. Indicator - Percentage of altered areas inside the PA - Evaluation parameters	Score
Around 10% of the unit's ecosystems are altered.	4
Around 11-15% of the unit's ecosystems are altered	3
Around 16-20% of the unit's ecosystems are altered.	2
Around 21-30% of the unit's ecosystems are altered	1
More than 30% of the unit's ecosystems have been altered.	0

7.5. Indicator- Water sources and springs

7.5. Indicator - Water sources and springs – Evaluation parameters	Score
More than 86% of the CU's springs and/or water sources are protected with riparian forest coverage.	4
Around 71 to 85% of the CU's springs and/or water sources are	3

protected, with the same percentage of riparian forest coverage.	
Around 56 to 70% of the CU's springs and/or water sources are protected, with the same percentage of riparian forest coverage.	2
Around 41 to 55% of the CU's springs and/or water sources are protected, with the same percentage of riparian forest coverage.	1
≤ 40% of the UC's springs and/or water sources are protected, with the same percentage of riparian forest coverage.	0
Most springs and/or water sources are located outside the unit, are unprotected, and contaminate the waterways inside the unit.	0

7.6. Indicator - Exploration of natural resources

7.6. Indicator - Exploration of natural resources – Evaluation parameters	Score
No exploration	4
Sporadic exploration in less than 10% within the CU or BZ.	3
Systematic exploration in less than 10% or sporadic exploration between 10 and 50% within the CU or BZ.	2
Systematic exploration between 10 and 30% within the CU or BZ.	1
Systematic exploitation (of various resources) in more than 30% within the CU or BZ.	0

8. CURRENT USES PROMOTED FOR THE MANAGEMENT CATEGORY SCOPE

8. CURRENT USES PROMOTED FOR MANAGEMENT CATEGORY SCOPE	Score
The uses or activities are compatible with the PA's management goals, it is under compatible technical-administrative management, in accordance with the support capacity of the resources and is regulated by clear norms.	4
The uses or activities are compatible with the PA's management goals, acceptable technical-administrative management and do not exceed the support capacity of the resources, despite some gaps in the rules that regulate it.	3
The uses or activities are compatible with the unit's management goals, its technical-administrative management is deficient and does not exceed the support capacity of the resources, despite the clarity in the rules that regulate. There is no technical management of the area.	2
The uses or activities are compatible with the unit's management goals, there is no technical-administrative management, nor norms that regulate the activity and may be interfering with the conservation of the area.	1
The uses or activities as carried out are incompatible with the unit's management goals, exceeding the support capacity of the area's resources, with norms and rules that do not meet the management category.	0

Supplementary data 2. Detailed description of the evaluated conservation units, with the identification of their weak and strong points.

Conservation Unit	Strong points	Weak points
Itapuã State Park (PEIT)	The strong points identified in the management effectiveness in this CU were the political/institutional legal and current uses promoted by the CU administration. The first scope is because the territory legally belongs to the CU; the law creating the CU is already regulated and appropriate to the category of management and there is an advisory board. Concerning the second scope, the current uses promoted for the CU, the highest scores were related to the management activities compatible with the objectives of this category of CU.	It presented low scores mainly in the planning and ordering, management program and administrative scopes. Within planning and ordering, the weak points were an outdated management plan and the absence of a buffer zone. Regarding the management program, non-systematic environmental monitoring and absence of frequent maintenance of its buildings were indicated as frail points. In the administrative scope, the weak points were the small number of employees, very limited financial resources and limited management standards only to certain activities.
Tainhas State Park (PETA)	The strong points to management efficiency were related to the scopes of current uses promoted by the CU: knowledge and administrative. Regarding the first scope, the most important indicators were: uses or activities compatible with management goals; appropriate technical-administrative management, not exceeding the capacity to support resources. In relation to the knowledge on research developed at CU, the strong points were satisfactory support to research regarding accommodation, available dataset of local projects, existence of consortium among researchers, and frequent implementation of management actions based on research. Concerning the administrative scope, the strong points were mainly related to managers having long working experience with more than 10 years in the CU, being exclusively dedicated to the management of the CU	This CU has low scores related to planning and ordering, management program, infrastructure and equipment, and quality of protected natural resources (Fig. 4). Regarding the planning and ordering, the weak points were: the management plan is poorly implemented; the zoning does not protect all habitats; the specific zones within the CU are not clearly recognized by the employees or by the general population; 90% the territory of the conservation unit does not legally belong to the CU; and the management plan is outdated. Regarding the scope of the management program, we detected that the environmental monitoring is very informal and non-systematic; the sustainable tourism program has some activities tht are incompatible with the goals of the CU; and the general maintenance of CU is deficient. In the administrative scope, the low score was due to insufficient number of

Continuation of Tainhas State Park (PETA)	and having high academic training in conservation. Moreover, this CU has a simplified and complete file information system, that meets administrative needs. However, although this CU has sufficient financial resources, there are too many bureaucratic steps to get it.	employees. Concerning the infrastructure and equipment scopes, the weak points include less than 36% of the territory being physically delimited and 90% of its territory not belonging to the CU. In relation to protected natural resources, the weak points were: irregular shape of the CU, hindering protection and conservation actions; more than 30% of ecosystems in the CU altered by humans; contaminated creeks and springs; illegal and systematic exploitation of natural resources in more than 30% of the CU's internal area.
Delta do Jacuí State Park (PEDJ)	The strong points include the current uses promoted by the CU and quality of protected natural resources, mainly due to good state of conservation of the environment, because most of it is on islands of difficult access. It is important to mention that there are records of hunting and fishing in the region.	This was the third CU with the lowest management efficiency and has low scores in most scopes: management program, infrastructure and equipment, knowledge, planning and organization, administrative and political/institutional legal (Fig. 4). Regarding the management program, the frail points were: limited execution of the management program; the environmental monitoring is very informal and non-systematic; sustainable tourism program only has some incompatible activities with the goals of the CU; deficient community integration program, with very few actions conducted; protection/surveillance actions in the CU depend on administrative requests, being unstable and opportunistic; and minimal structural maintenance. Concerning the scope of infrastructure and equipment, the low scores were attributed to: deficiency in communication equipment; inadequate installations for administration, surveillance, education and research; deficient delimitation of the territory of the CU, because this CU is shared by different municipalities and islands;

Continuation of Delta do Jacuí State Park (PEDJ)		the territory of the conservation unit are recognized by the employees, but it is not recognized by the local community due to the difficulties in delimiting aquatic territory. Regarding the knowledge scope, the weak points were insufficient infrastructure for the researchers (accommodation and laboratories) and lack of dataset on previous research conducted in CU. In the scope of planning and ordering, the lower score was related to low level of implementation of the management plan (less than 35%) and the consultative council does not meet regularly, needing renewal of the term of office for the councilors. In the administrative scope of the CU, the weakest point was the absence of a technical manager, with only a few park rangers, and this number was still deficient. However, the park rangers include some with higher education and post-graduation in environmental sciences. Moreover, the financial resources were insufficient to respond the needs of CU. In the political/institutional legal scope, the weak point was related to the fact that most of its territory does not legally belongs to the CU, only its headquarters and 25 islands.
Itapeva State Park (PEVA)	The scopes with higher levels of management efficiency were quality of protected natural resources, knowledge, political/institutional legal, administrative and planning and ordering. The strong points in quality of protected natural resources were the shape of the CU which improves conservation, and 86% of the water springs	This CU has low scores related to infrastructure and equipment and management program (Fig. 4). Regarding infrastructure and equipment, the weak points were insufficient equipment for communication and deficient maintenance of its infrastructure and facilities, which do not meet the demands of a CU. Regarding the management

Continuation of Itapeva State Park (PEVA)	being protected with riparian forest cover. The knowledge scope for this CU has as strong points the management efficiency, satisfactory infrastructure and facilities to researchers, a consortium of researchers and the intention to amplify this network, the frequent implementation of management actions based on research and no gaps of cartographic information for the CU territory and its buffer zone. The strong points related to the political/institutional legal scope are: its decree of creation meeting the current legal norms and being updated and regulated according the protection category of this conservation unit; 76%–89% of the CU's territory belonging to it, with few legal disputes on land regularization still in progress; a consultative council that is formally supported by its participants (local community, governmental and non-governmental organizations (NGOs); and good relationship with local community leaders that embraced CU actions. In the administrative scope, the strong points were: the manager of the conservation unit has training in the environmental sciences, with experience in management of protected areas, dedicating exclusive time to the CU; and there is a simplified information system with complete files that are necessary to the administrative procedures of the UC. In the planning and ordering scope, the highlights were: the management plan in current process of revision (but still operative); the technical and interdisciplinary teams participating in the consultative council (including community and institutions) that also contribute to decision-making.	program, the points of attention were non-systematic and informal environmental monitoring; the sustainable tourism program only has some activities conducted, which need better conditions to reach the CU's goals.
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**Turvo State Park
(PETU)**

The strong points of this CU were related to three scopes: infrastructure and equipment, political/institutional legal, and quality of protected natural resources. The high scores of the infrastructure and equipment were: existence of equipment and materials that meet the CU demands (although they also need improvements); the infrastructure and facilities in good conditions to researchers; 76–89% of the CU territory clearly delimited, including its aquatic limits, which are very well known by the CU staff and the neighboring properties. Regarding the political/institutional legal scope, the high scores were: the existence of the decree of creation that meets the current legal norms (and it is updated and regulated according the protection category of this conservation unit); most visitors following the legal standards (because the staff presents and enforces them); 100% of CUs territory belonging to it; a formally created consultative council with good relationships with and socially supported by the leaders of the local community; the resolutions of problems and decisions shared by the interinstitutional consultative council. In terms of quality of protected natural resources, the high scores were related to the size of CU, 90% of its territory presenting its biodiversity in good conservation conditions, the shape of CU (which is irregular and partially delimited by water, with connectiveness between ecosystems throughout corridors, but with many plantation crops surrounding the CU), only 0,9% of its ecosystems altered and more than 86% of the water

This CU has the largest protected areas in the state, with more than 17,000 hectares. It has two scopes with low scores: management program and administrative (Fig. 4). Regarding the management program, the problem resides in undefined sustainable tourism activities (even with the great potential), informal and non-systematic environmental monitoring and punctual actions of surveillance due to lack of park rangers, even with a well-established protection program. In the administrative scope, the weak points were lack of employees (only 5, including the manager), inconstant contribution of financial resources, which hinders the compliance of the management plan, leading to emergency situations being solved with extraordinary funding, which is time consuming and compromise other UC activities.

	sources and/or springs protected by riparian forest cover.	
Ibitirirá State Park (PEIB)	PEIB's strong points are related to the current uses promoted by the manager of the CU, which are compatible with the goals of the area, the technical actions of the management and the administrative procedures being compatible with the needs of the CU, and the use not exceeding the support capacity of the resources, although the norms that regulate present some gaps.	This CU was the second unit with the lowest management efficiency, presenting seven scopes with low scores: infrastructure and equipment, management program, planning and ordering, administrative, political/institutional legal, knowledge and quality of protected natural resources (Fig. 4). In the scope of infrastructure and equipment, the weak points were: there is no local infrastructure or any kind of facilities to execute the management plan; the CU only has concrete landmarks as a demarcation without fencing or signs indicating that it is a protected area; the physical boundaries of this area are not fully known by the staff or manager of the CU as well as by the bordering properties. Regarding the scope of management program, the low scores were: $\leq 35\%$ of the planned activities have been executed; the environmental monitoring is very informal and non-systematic; and there are no planned activities for the visitors in general neither as sustainable tourism. For the planning and ordering scope, the weak points were related to the absence of consultative council, the current zoning for the CU not meeting the demands of its goals (being incompatible with the reality of the habitats and degrees of conservation to be managed), the CU lacking other planning instruments besides the management plan, the uses incompatible with the need of protection of species and ecosystems in the CU. Concerning the administrative scope the low scores were: insufficient number of employees, with just one manager who does not work in the CU's territory due to the lack of

**Continuation of Ibitiríá
State Park (PEIB)**

infrastructure; no norms and procedures adopted to reach the goals of the CU; and insufficient financial resources to maintain of the area. For the political/institutional legal scope, the weak points were insufficient staff to apply and comply with the norms, currently only 22% of its area regulated, corresponding to the Intangible Zone.

In relation to the knowledge scope, the weak points were no research facilities or human resources to support the researchers and no dataset about projects and results previously conducted in the CU. In terms of the quality of protected natural resources, the low scores were related to more than 30% of the unit's ecosystems being altered and the lack of systematic exploitation of various natural resources in more than 30% of the CU or its buffer zone. PEIB's strong points are related to the current uses promoted by the manager of the CU, which are compatible with the goals of the area, the technical actions of the management and the administrative procedures being compatible with the needs of the CU, and the use not exceeding the support capacity of the resources, although the norms that regulate present some gaps.

Espigão Alto State Park (PEEA)

The scopes that presented greater scores in this CU for effectiveness for the management of the area were: political/institutional legal, quality of protected natural resources and planning and ordering. The scope of political/institutional legal has strong points because the CU has its decree of creation meeting the current legal norms, and it is updated and regulated according the protection category of this conservation unit; $\geq 90\%$ of its territory belong to the CU; the consultative council was officially created and it is active with social support of the local community and civil society for the actions of the CU. The scope of quality of protected natural resources has strong points due to the rectangular and non-fragmented area of CU; with more than 86% of the water sources and/or springs of the CU protected with riparian forest cover.

The scope of planning and ordering has strong points related to the final revision of the management plan; there is an interdisciplinary team in this revision process of the management plan due to the participation of different parts of the society represented by the council; including local community and other institutions; the consultative council is constituted and active in decision-making regarding the revision of the current management plan; there is a defined buffer zone to the CU with uses partially in accordance with the norms established in the management plan with the proposal of a new polygonal.

This CU showed low scores of management effectiveness in three scopes: infrastructure and equipment, management program, administrative and knowledge (Fig. 4). In the infrastructure and equipment scope the weak points were: $\leq 25\%$ of the communication system was functional between the work team and management; only $< 25\%$ of the facilities and infrastructure for environmental research and education programs were projected according to the needs of CU. In the scope of management program, the weak points were: informal and non-systematic environmental monitoring; the CU has a program of public use, but only $\leq 30\%$ of planned activities were executed due to the lack of infrastructure; the sustainable tourism program only has some activities, which need better conditions to reach the goals of the CU; there is a protection and surveillance program, but with specific operations due to insufficient staff (there is only one park ranger). In the administrative scope, the low scores include the manager having no academic training in conservation or environmental sciences and insufficient financial resources received to support the CU demands. Regarding the knowledge scope, the weak points were deficient facilities and infrastructure as well human resources to support the research activities (but the existent employees were able to satisfactorily assist the researchers); there is an outdated database with no results related to research or publications.

**Espinilho State Park
(PEESP)**

In this CU, the political/institutional legal scope had high scores with strong points related to its decree of creation that meets the current legal norms; the management plan is updated and regulated according to the protection category of this conservation unit; and 76%–89% of the territory belong to the CU.

This CU was the unit that showed the lowest management effectiveness according our indicators, in six of the eight scopes analyzed: infrastructure and equipment, knowledge, quality of protected natural resources, planning and ordering, management programs and administrative. Regarding the scope of infrastructure and equipment, the weak points were: the CU is completely deficient in equipment and materials for the full operation of the activities in the area; < 25% of the communication system are incompatible for communication between working and management teams; facilities are in a very poor state; only < 25% of the facilities were able to meet the research and environmental education programs; 36 to 50% of the CU are properly demarcated, but there are no signs in the protected area. In relation to the knowledge scope, the weak points were: no infrastructure to support researchers in the area; only some human resources capable of satisfactorily assisting research activities; gaps in knowledge about the CU; no dissemination of scientific research that occurs in the CU; lack of a consortium or collaboration for research; outdated cartographic information for use in decision-making. In the scope of quality of protected natural resources, the points of attention were: only 36% to 50% of the territory of the CU are in good condition; the shape of the territory is very irregular and fragmented; more than 30% of the ecosystems of the unit are altered; most of the springs are

**Continuation of
Espinilho State Park
(PEESP)**

outside the unit and unprotected, contaminating the waterways inside the unit, near rice crops. Concerning the scope of planning and ordering, the management plan is outdated, with more than 10; the management plan was prepared by a specialist/company without the participation of society and its representatives (because at that time there was no manager in the CU); only between 35% and 50% of this management plan has been executed; the consultative council has not been constituted so far; the environmental zoning does not meet the objectives of the CU, being incompatible with the reality of the habitats and their need for conservation; the land zoning of the CU is little known by the staff; the current uses of this area are compatible with the objectives of the category of management of the CU, but underutilized, without administrative technical management present in the CU.

In terms of the scope of management program the weak points were: there is a partially structured public use program, but with $\leq 40\%$ of the planned activities; sustainable tourism has only a few activities developed in CU due to the absence of structure for the actions; the surveillance actions are punctual due to the existence of only two park rangers. In the administrative scope, the weak points were related to insufficient staff, (only two rangers, one being the manager); the CU has an incomplete database on the local research; CU adopts standards and procedures only for some activities developed, none for the fulfillment of goals, objectives and control; insufficient financial resources received intermittently to support the

		CU demands.
Serra Geral Biological Reserve (REBIOSG)	This CU was the second conservation unit that achieved the highest management efficiency. The scopes with the best results were: current uses promoted by the CU, quality of protected natural resources and political/institutional legal. The scope of current uses promoted by the CU has strong points because these uses are compatible with the management goals of the protected area; the CU has a technical-administrative management compatible with the capacity of support of the resources and is regulated by clear standards. The strong points of the scope of quality of protected were: 76% and 89% of the territory was considered optimal for the protection of its attributes; CU has contiguous preserved ecosystems and it is part of other protected areas (it makes a corridor with Ecological Station of Aratinga and Pró-Mata CUs); the CU has difficult access; only 10% of the territory has altered areas; and more than 86% of the sources of water or springs of the CU are protected, presenting riparian forest cover. In terms of the political/institutional legal scopes, the highlights were related to its decree of creation that meets the current legal norms and it is updated and regulated according the protection category of this conservation unit; current laws and regulations related to the CU management category are followed by users, and the employees are advised to reinforce this with visitors; consultative council was formally created and participates partially on the	It only has low management effectiveness in the scopes of management program and infrastructure and equipment. In the scope of management program, the weak points were: only 36-50% of the planned research activities were carried out; environmental monitoring is very informal and non-systematic (few camera traps only, without following specific methodology for monitoring); the public relation does not practice systematic disclosure of CU activities. In terms of infrastructure and equipment scopes, the high scores were: $\leq 25\%$ of the communication system was functional between the work team and management; the CU territory has no physical delimitation; with only a few locations identified by signs; its area is difficult to access; and the general signs within the UC are $\leq 25\%$ (only with access roads identified).

	decision-making of the CU; the resolutions of problems and decisions were shared with other institutions.	
Banhado dos Pachecos Wildlife Refuge (RVSBP)	It was the protected area that reached the highest degree of effectiveness among the 11 CUs, showing a high-quality standard in six of the eight scopes (Fig. 4). It presented a good organization and planning for the actions that fulfill the goals of the protected area. The strong points of this CU were the scopes of current uses promoted by the CU, planning/ordering and political/institutional legal, infrastructure and equipment and knowledge and management programs. In terms of current uses promoted by the CU, the strong points were: the CU activities are compatible with the management goals of this protected area; there is compatible technical-administrative management that acts according to the capacity of support of the resources and is regulated by clear rules. Regarding the scope of planning/ordering the strong points in the CU were: the management plan is updated (reviewed in the last 5 years and approved in 2022) in accordance with protection category of this conservation unit; the technical team of the management plan had an interdisciplinary participation of the different legitimate social segments represented by the consultative council, community and local institutions; between 75% and 90% of management plane activities were executed; the consultative council is constituted and active in decision-making regarding the revision of the current management plan; the environmental zoning and buffer	The weak points were related to only two scopes: administrative and the quality of protected natural resources (Fig. 4). Regarding administrative scope, the points of attention were: insufficient staff (CU has only one park ranger and the manager); the execution of some administrative actions is instable due to the lack of staff; the inconstant contribution of financial resources that prevents the compliance of goals of the CU; the number of staff only represents 40% of 50% of the optimum scenario. In the scope of quality of protected natural resources, the weak points were the irregular shape of the CU (but not fragmented) and only between 51% and 75% of its territory in optimal condition for maintenance of protected attributes. In the scope of quality of protected natural resources, the weak points were the irregular shape of the CU (but not fragmented) and only between 51% and 75% of its territory in optimal condition for maintenance of protected attributes.

**Continuation of Banhado
dos Pachecos Wildlife
Refuge (RVSBP)**

zone to the CU were defined in the management plan and based on current techniques and scientific knowledge, with its regulations and standards established in the management plan, the staff and researchers have clear access to the rules of use and management of each zone; the planned activities have their specific plans, meeting the standards and recommendations of the management plan; the uses of the CU are compatible, meeting the category and management plan expressing successful technical administrative management. In relation to the political/institutional legal scope, the strong points were: its decree of creation that meets the current legal norms and is updated and regulated according the protection category of this conservation unit; the laws and regulations of the CU are followed by users and employees; $\geq 90\%$ of the territory belong to the CU; the consultative council was formally created and instituted with equal social participation of community leaders, governmental and non-governmental organizations; the civil society supports and participates in actions aimed at the CU throughout the council, and the resolutions of problems and decisions were shared by the interinstitutional consultative council. Regarding the scope of infrastructure and equipment, the highlights were: the CU has equipment and materials compatible to the demands to reach its objectives of this area, but some equipment need maintenance; its communication system is functional for work and administrative teams; 89 to 75% of the facilities and infrastructure meet research and environmental education programs; $\geq 90\%$ of the CU

**Continuation of Banhado
dos Pachecos Wildlife
Refuge (RVSBP)**

territory are physically delimited and known by the management of the CU, local community and neighboring properties; and 100% of the CU territory is signaled in the protected area. In terms of the knowledge scope, the strong points include: the CU research norms (registration, control and monitoring) following the general criteria defined by the Department of Biodiversity (DEBIO) and the Division of Conservation Units (DUC); adequate support structure for research (with accommodation, cafeteria, meeting room with internet service, place to store equipment and collected materials) and planning its expansion; trained and updated technical-administrative and operational teams to meet the demands of the research program; available dataset of local research projects, including results and few publications; sporadic dissemination of studies and results; accessible material and information for employees and the general public; existence of consortium among researchers and institutions with frequent implementation of management actions based on research; updated cartographic information for the CU territory and its buffer zone (all available in a database); CU with comprehensive disclosure of legal information on the unit, buffer zone for the visitors, including on the management plan. Concerning the scope of management programs, the strong points were: the scientific research program is structured, but only priority actions are developed normally; $\geq 90\%$ of the planned activities have been executed; the environmental monitoring has efficient mechanisms and conditions to monitor the natural

Continuation of Banhado dos Pachecos Wildlife Refuge (RVSBP)	resources; the public use program only carried out the activities that occur normally, with 71-85% of planned activities executed; the environmental education program is well structured, with activities and specific norms that meet the CU support capacity; the CU public relations has a structured and systematic publicity program that meets the planning goals of the unit. Regarding the scope of quality of protected natural resources, the high scores were: 76% and 89% of the territory considered optimal for the protection of its attributes, its irregular and whole shape.	
Aratinga Ecological Station (EEA)	The scopes with the best results were: the current uses promoted by the CU, knowledge, political/institutional legal and quality of protected natural resources. The scope of current uses promoted by the CU has strong points related to most of the uses compatible with the objectives of the management category, technical-administrative management appropriate and in according to the carrying capacity of the resources and regulated by clear standards. Regarding the scope of knowledge, the strong points were: adequate structure to support the research in the UC area, with accommodation, cafeteria, meeting room with internet service and a storage area for equipment and samples; adequate technical-administrative team, but insufficient operational team, with training (park rangers that help the research); research dissemination through meetings with the staff, consultative council, the community and other stakeholders; a consortium of researchers and the	It presented lower management effectiveness in the scopes of management programs and planning/ordering. In relation to the management programs the weak points were: few research activities executed but no structure to fulfill the needs of CU, with only $\leq 35\%$ of the planned research activities carried out; no public use predicted because it is an ecological station; there is an environmental education program with the local community and schools within the UC, but it is not yet structured due to lack of land regularization of the CU; the sustainable tourism program only has some activities conducted; no headquarters in the protected area (they are the closest city). In general, the CU needs better conditions to reach its goals. In terms of the scope of planning/ordering, the weak points were that the creation and writing of management plan did not include social participants, even the consultative council, because it did not exist in that moment; there is no established buffer

Continuation of Aratinga Ecological Station (EEA)	intention to amplify this network, and frequent implementation of management actions and decision-making based on research; wide availability and dissemination of the legal information in the CU and its buffer zone to visitors, including those set out in the management plan. In terms of the political/institutional legal scope, the strong points were: the existence of the decree of creation meeting the current legal norms (and it is updated and regulated according to the protection category of this conservation unit); the standards met by most users and the employees carry out the disclosure and they reinforce it with relatively ease; the consultative council was formally created and has good relationship and social support by the leaders of the local community to the CU actions, the resolutions of problems and decisions were shared by the interinstitutional consultative council. In the scope of quality of protected natural resources, the highlight were: the CU has 76% to 89% of its territory for optimum maintenance of its protected attributes; its shape is rectangular, crenate, and regular entirely; CU has contiguous preserved ecosystems and is part of other protected areas (Mata Paludosa Biological Reserve and São Francisco de Paula National Forest); the CU is difficult to access, only 10% of the territory has altered areas, and more than 86% of the sources of water or springs of the CU are protected, presenting riparian forest cover.	zone, but the current legal regulations are used to establish the uses and activities in the surroundings of this protected area; some situations are incompatible with the objectives of the management category (there are residents living in the CU territory, presence of exotic species of fauna and flora, e.g., cattle, <i>Pinus</i> sp.).
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Corrigendum

Corrigendum: Witt PBR, Faria HH, Oliveira J, Oliveira LR (2023) Management effectiveness of Nature Conservation Units in southern Brazil. *Neotropical Biology and Conservation* 18(3): 209–230. doi:10.3897/neotropical.18.e103019

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After the publication of our recent article (Witt et al. 2023), we noticed that the distribution map of the conservation units in that study (Fig. 1 on page 214) had an error in its caption. The caption should read:

Figure 1. Distribution by Biome of the 11 Conservation Units (CUs) surveyed in Rio Grande do Sul State, Southern Brazil. 1. Espinhalho State Park; 2. Turvo State Park; 3. Espigão Alto State Park; 4. Ibitirí State Park; 5. Tainhas State Park; 6. Aratinga Ecological Station; 7. Serra Geral State Park; 8. Itapeva State Park; 9. Banhado dos Pachecos Wildlife Refuge; 10. Delta do Jacuí State Park; 11. Itapua State Park.

Additional information

Conflict of interest

The authors have declared that no competing interests exist.

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Data availability

All of the data that support the findings of this study are available in the main text.

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Witt PBR, Faria HH, Oliveira J, Oliveira LR (2023) Management effectiveness of Nature Conservation Units in southern Brazil. In: Boll P, Lehmann AP, Allgayer H, Krüger L (Eds) Diversity and Wildlife Management: The legacy of PPG Biologia Unisinos. Neotropical Biology and Conservation 18(3): 209–230. <https://doi.org/10.3897/neotropical.18.e103019.suppl2>

4 CAPÍTULO 3 – THREATS TO BIODIVERSITY IN STATE PROTECTED AREAS, RIO GRANDE DO SUL, BRAZIL

1

THREATS TO BIODIVERSITY IN STATE PROTECTED AREAS, RIO GRANDE DO SUL, BRAZIL

Abstract

Protected areas (PAs) face various types of pressures and threats that compromise biodiversity conservation and the fulfillment of the fundamental objectives of their maintenance. Currently, it is increasingly important to study the threat factors that may directly or indirectly affect the balance of protected ecosystems and associated biodiversity. Identifying and assessing these threats is essential for the conservation and maintenance of the management category for which the protected area was created. This study evaluated 11 state-level PAs of the integral protection group in Rio Grande do Sul using the Protected Area Management Effectiveness (PAME) method, analyzing 23 threats and their severity levels. The higher the percentage obtained, the lower the risk or severity of the threats, and the lower the percentage obtained, the greater the threats assessed, i.e., a warning of severity. In general, the analysis of the protected areas revealed that they had a medium threat rating. However, this result varied between each protected area evaluated, resulting in different threat gradients. The PA with the highest threats was the Jacuí Delta State Park (42.21%), and the one with the lowest threats was the Banhado dos Pachecos Wildlife Refuge (89.13%). The most serious and common threats to the protected areas were: invasive species 49.62%; absence/poor enforcement 54.55%; hunting and management plans not reviewed for 10 years or more, both with 57.20%. The state protected areas evaluated in this study need restructuring, with a need to update their management plans, improve enforcement and monitoring, expand and train staff, and have a budget compatible with the objectives, in order to improve their competencies, assess weaknesses and threats that may arise and that could compromise the conservation role of the protected area in the future. These actions are necessary for it to effectively conserve biodiversity and its ecological complexities.

Keywords: management effectiveness, PAME, pressures, protected areas, protected ecosystems, risks.

Introduction

Worldwide, the creation of specially protected territorial areas is considered one of the most effective (in situ) strategies for biodiversity conservation, which is necessary in the face of the increasing human occupation and the predatory exploitation of natural resources (Bensusan 2006). However, in many countries around the world, these actions have not been effective in protecting biodiversity, as many protected areas (PAs) continue to suffer severe threats and anthropogenic pressures (Faria 2007; Geldmann et al. 2013; Laurance et al. 2012).

Nature protected areas (PAs), according to the National System of Nature Conservation Units (hereafter SNUC), Federal Law 9,985 of 2000, are specially protected areas (PAs) that cover terrestrial areas, including the jurisdictional waters, and have relevant natural characteristics. They are created by public authorities, which ensure that their objectives regarding the conservation of nature and environmental resources are met (Brazil 2000).

The state of Rio Grande do Sul, in southern Brazil, has a wide diversity of native animal and plant species, distributed across two important Brazilian biomes: the Atlantic Forest and the Pampa. The Atlantic Forest consists of three basic formations: dense and open rainforest, mixed rainforest, and seasonal and semi-deciduous forest, as well as abundant transition zones (Galindo-Leal & Câmara 2005) with varied forest formations, such as natural fields, restinga (dry coastal biome), mangroves, and other characteristic local plant formations (Oliveira & Engel 2017).

The native fauna and flora of the Atlantic Forest and the Pampa (also known as Campos Sulinos; grasslands) are highly endangered, according to the official lists of threats to extinction (State Decrees No. 53,902/2018, which amends Decree No. 51,797, of September 8, 2014, which declares the Endangered Wildlife Species in the State of Rio Grande do Sul, and State Decree No. 54,171/2018, which amends Decree No. 52,109, of December 1, 2014, which declares the endangered native flora species in the State of Rio Grande do Sul). Habitat fragmentation, illegal hunting and trade of fauna and flora, as well as human occupations and economic exploitation, have contributed to the decline of biodiversity in Brazil and worldwide (Primack & Rodrigues 2006).

Currently, the Pampa biome has been the most impacted biome due to the lack of knowledge and its very specific ecological characteristics related to the southwestern and southern regions of Brazil (Oliveira & Engel 2017). This biome corresponds to 63% of the state's territory and 2.07% of the Brazilian territory. It is the least representative biome in the SNUC, with 0.4% of Brazilian territory protected in the form of PAs (MMA 2024). Nowadays, the State Secretariat for the Environment and Infrastructure (SEMA-RS) has 24 PAs in the Pampa and Atlantic Forest biomes, of which 11 PAs are from the Integral Protection group and comprise this study (Fig. 1).

The evaluation of the effectiveness of management in PAs has become an important tool for measuring, through indicators, the management performance of these protected spaces around the world (Witt et al. 2023; Faria et al. 2021). The discussion has been ongoing since the National Parks Congress, held in Bali in 1982, presented by the author William Deshler, "Management of Protected Areas in the Tropics," reviewed by MacKinnon in the 1980s. At the same time, the formulation of standards entitled International Standardization Organization (ISO) for the evaluation and certification of industrial products and processes (Faria 2007) started. Since this milestone, methodological assessments of management effectiveness have been improved, following guidelines based on international standards. These assessments to estimate management effectiveness were strengthened from the year 2000, when the conceptual guidelines that underpinned the procedures for evaluating and monitoring the management processes of PAs were published (Cifuentes et al. 2000; Faria 2004; Hockings et al. 2006).

The management of PAs generally presents a framework of difficulties for maintaining management effectiveness, which highlights the need for studies that promote the evaluation of management effectiveness in these areas, using specific methodologies for better planning, in terms of meeting objectives and mitigating the impacts caused by the threats, thus identifying gaps for the improvement in the management processes (Brandão & Schiavetti 2017). The analysis of the effectiveness of management of protected and conserved areas aims to verify, through indicators and parameters, the effective fulfillment of objectives (Hockings et al. 2000), with the purpose of evaluating the protection of biodiversity in those areas, mitigation of anthropogenic pressures, and maintenance of ecological processes (Geldmann et al. 2019).

Within this context, initiatives using the Protected Area Management Effectiveness (PAME) method have been the basis for evaluating protected area management, proposing and testing new criteria and indicators, in accordance with the proposal by Cifuentes (2000). New adaptations and suggestions have been created to evaluate management effectiveness and “threats” in a qualitative-quantitative manner, based on the original procedure, validating the relevance of the methodology, which has allowed adaptations to the different realities where the protected areas are located (Hockings et al. 2000; Ervin 2000; Mesquita 2002; Faria 2006; Lima et al. 2005; Pellin 2010).

Threats to the conservation of species and their ecological complexes have become increasingly serious (Dourojeanni & Padua 2001). Currently, the growth of urban centers has taken on a large dimension, often without proper land-use planning, to the detriment of environmental conservation, causing damage to protected natural environments (Pitt & Boulle 2010). According to Vallejo (2002), the creation of protected areas by government agencies requires adequate procedures to ensure their effective management and fulfillment of objectives, as they present deficiencies in land regularization, management plan development, enforcement, and management of various conflicts.

The introduction of alien plant species, especially those considered invasive, has been a threat to biological diversity, competing for space and nutrients with native species (Zenni et al. 2016). In addition, invasive alien fauna has caused severe damage to wildlife, not only through competition for territory, but also through the transmission of pathogens to wildlife, especially mammals (Jorge et al. 2010; Curi et al. 2016).

Given the above, considering that threats are possible or imminent pressures that may have an impact in the present or continue in the future (Ervin 2003), it is essential to pay attention to the assessment and measures to prevent and/or mitigate their effects on the conservation and protection of protected areas. Therefore, the objective of this study was to assess the incidence and severity of threat factors in 11 State PAs, with a view to long-term planning, considering the processes of managing risks to biodiversity and its ecological complexes involving the protected area, and based on the methodological principles of the PAME.

Methods

In this study, of the 24 terrestrial PAs created in the state of Rio Grande do Sul, southern Brazil (State Secretariat for the Environment and Infrastructure 2024), 11 were evaluated (Fig. 1). These areas have different management categories within the fully protected group (SNUC 2000): eight state parks (Itapuã, Espigão Alto, Itapeva, Delta do Jacuí, Espinilho, Ibitirí, Tainhas, and Turvo), one Biological Reserve (Serra Geral Biological Reserve), one Ecological Station (Aratinga Ecological Station), and one Wildlife Refuge (Banhado dos Pachecos Wildlife Refuge). The criteria for selecting these PAs were to belong to the fully protected group and have a management plan (official technical management document, in accordance with Federal Law 9,985/2000). Those PAs are in the state of Rio

Grande do Sul, considering two important biomes, the Atlantic Forest and the Pampa, which border other states, such as Santa Catarina, and other countries, such as Uruguay and Argentina.

Management plans are essential for assessing the conditions of PAs, as they are official management documents that guide decisions for planning and managing these areas. The criterion for selecting fully protected PAs was because they constitute the areas of "greatest protection" according to the SNUC 2000 (the most restrictive protected areas in terms of use and management). Furthermore, they are in the Atlantic Forest and Pampa biomes, which have a great diversity of species and ecosystems, of paramount importance for conservation.

Study area

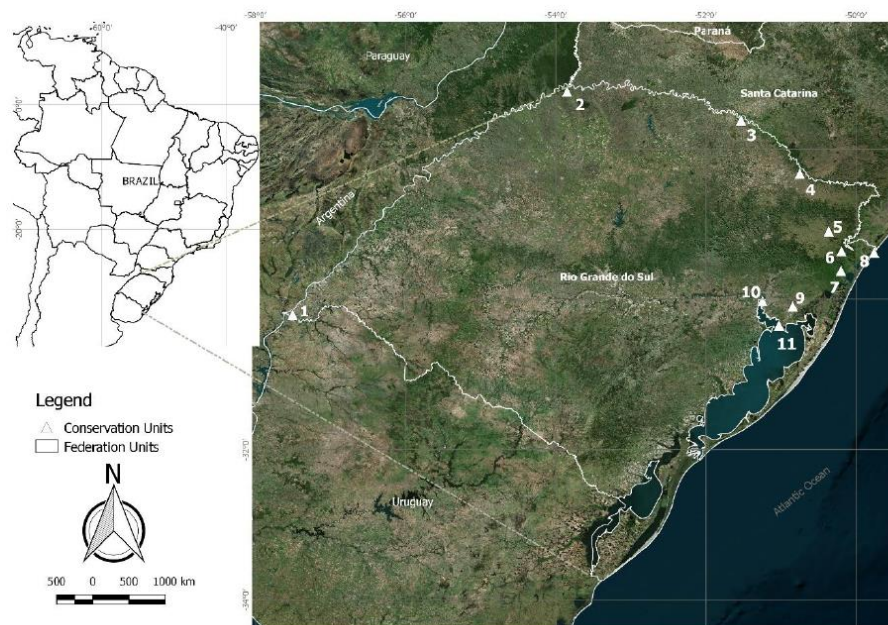


Figure 1. Location of the 11 Protected areas (PAs) evaluated in Rio Grande do Sul, Brazil. 1. Espinilho State Park; 2. Turvo State Park; 3. Espigão Alto State Park; 4. Ibitirí State Park; 5. Tainhas State Park; 6. Aratinga Ecological Station; 7. Serra Geral State Park; 8. Itapeva State Park; 9. Banhado dos Pachecos Wildlife Refuge; 10. Jacuí Delta State Park; 11. Itapuã State Park (Made using QGIS 2.18 software).

To assess the effectiveness of the PA management, interviews were conducted with the managers of PAs between 2022 and 2023, and field trips were made to survey the areas, monitoring the functioning and the current status of the processes of management and conservation of biodiversity (Witt et al. 2023). In addition, the potential threats and pressures were previously surveyed to develop the threat indicators. The parameters for assessing threats were applied to the managers through a specific questionnaire sent by email, since field observations had already been carried out previously. To assess threats, the principles and methodological structure of the Protected Area Management Effectiveness (PAME)

method were considered, with adaptations to the procedure (Evaluación del manejo de áreas protegidas), devised by Cifuentes et al. (2000). This method has been applied in Brazil by several authors, inspiring other initiatives in Hispanic America (Pavese et al. 2007; Faria 2012; Curi 2021). According to the authors of the method, the procedure is dynamic, allowing the alignment of indicators and their variables for each geographical region and its reality.

In the present case, these adjustments consisted of selecting potential threats to the PAs and adapting the metric scale for assessing these threats, which was carried out through interviews using a questionnaire, in accordance with the guidelines of the ethics committee of the University of Vale do Rio dos Sinos (Process CAAE: 53890621.9.0000. 5344), a study approved and authorized by the State Secretariat for the Environment and Infrastructure of the State of Rio Grande do Sul, under number 22/2021, registration 929.

The variables for assessing the threats were selected from studies and methods based on PAME, adapted by Pellin (2010), who drew on the studies of Ervin (2000), which uses the concepts of “pressure” and “threats,” establishing criteria for classifying risks according to the magnitude of impacts, aligned with the Likert scale (1932) in the PAME, adapted to a 5-level scale from 0 to 4, maintaining the original principles proposed by Cifuentes et al. (2000), thus standardizing for each of the 23 threats, weighing the geographical reality where the protected areas are located, their local and regional contexts, environmental characteristics, and land uses. The rating system uses a Likert scale with five quality levels, from 0 to 4, with the highest value assigned to the “best” situation and the lowest to the opposite condition. According to Pereira (1999), the scale is adequate and considered the best to be used for the assessment of qualitative variables, as it follows quality principles, with directly opposite values (0 and 4), a central value (2), and a gradient between the extreme and median values (1 and 3). There is extensive literature on the use of this scale model.

In view of the above, in order to measure the incidence and degree of threats affecting the protected areas, six different attributes were used. For this assessment of the incidence of threats, the following attributes were considered: magnitude of impact; geographical coverage (% of protected area); permanence (years); dynamics; probability of the threat materializing; existence of actions to mitigate/avoid the effects of the threats (Ervin 2003; Pellin et al. 2014).

Selection of the Indicators of Variables of Threats

Although studies point to distinctions between threats and pressures (Ervin 2003; Faria 2004; Fontoura Medeiros & Adams 2016; Araripe et al. 2021), this study applied only the concept of threats to PAs, with pressures being considered potential threats to protected areas. Thus, threats from natural and anthropogenic phenomena were analyzed and considered, weighing internal and external conditions within the boundaries of the PAs.

The PAME method, being dynamic, allows for adjustments, considering geographical conditions among other relevant characteristics, and therefore enabled the selection of indicators related to the reality of the location. In this sense, the threat components that are part of the methodology were selected within the context of the territory and biome where the PAs were located, following the methodological premises (Cifuentes et al. 2000; Ervin 2003), and based on the study conducted by Witt et al. (2023) in the 11 PAs to assess management effectiveness.

The threat indicator variables listed in this study were defined based on studies conducted in different regions of Brazil, which evaluated management effectiveness, where threats are included as one of the components of this evaluation process (Ervin 2000; Pellin 2010; Ho & Tetto 2017). Other bases used for the selection of threat indicators were the Application Manual for the Management Analysis and Monitoring System (SAMGe), created

by ICMBio (2021), which presents an extensive list of specific and generic indicators of threats occurring in PAs, as well as the International Union for Conservation (IUCN), which offers and periodically updates a list of threat factors to protected and conserved areas, based on the unified classification of threats for the process of defining the conservation and threat status of species (Salafsky et al. 2008).

Based on a preliminary list of threat variables, considering various studies on management effectiveness analysis, including threats as one of the components of this evaluation process (Ervin 2000; Pellin 2010; Ho & Tetto; 2017), 23 threat variable factors were selected for this study: 1. hunting; 2. fishing; 3. fires; 4. erosion/silting; 5. livestock farming inside/outside; 6. extraction of natural resources; 7. illegal logging; 8. deforestation; 9. wildlife trafficking; 10. mining; 11. settlement inside/outside; 12. urban real estate expansion (BZ: buffer zone); 13. transmission lines; 14. roads/railways; 15. lack of land tenure regularization; 16. management plans not reviewed for 10 years or more; 17. infectious diseases (wildlife); 18. lack of/poor environmental enforcement; 19. environmental pollution; 20. pesticide contamination; 21. roadkill (wildlife); 22. uses/activities not in accordance with the category of the PA; 23. alien/invasive alien species of fauna and flora.

Assessment criteria and attributes of threats

To assess the situation and degree of incidence of threats in protected areas, ratings were assigned to the attributes of threats affecting the PAs (Table 1). Adaptations were made based on studies by Pellin (2010), who combined Cifuentes et al. (2000) with the proposal of Ervin (2003).

1. Magnitude of impact/Intensity: intensity and extent of impacts on the protected area, whether direct or indirect.
2. Geographical coverage: extent of the protected area, expressed as a percentage, affected by the threat(s).
3. Permanence: duration of the threat and consequences in terms of damage to the protected area.
4. Dynamics: status in relation to the evolution and permanence of the threat to the protected area.
5. Probability of the threat materializing: probability of the threat materializing in the protected area.
6. Actions to mitigate/avoid the effects of threats: existence of effective/implemented actions to minimize/mitigate/prevent threats.

Table 1. Scale for assessing the attributes of threats affecting the 11 protected areas studied.

VALUATION ATTRIBUTES OF THE THREATS					
Magnitude of impact Intensity	Geographical coverage (% of UC)	Permanence (years)	Dynamics	Probability of the threat materializing	Are there any actions to mitigate/prevent the effects of threats?
(4) Very mild	(4) < 5%	(4) Ephemeral < 5	(4) Very low	(4) Very low	(4) Institutional and employee-based
(3) Mild	(3) 5-15%	(3) Short term 5-25	(3) Low	(3) Low	(3) Local with employees
(2) Moderate	(2) 15-50%	(2) Medium term 26-50	(2) Average	(2) Average	(2) Few with partnerships
(1) Severe	(1) 50-75	(1) Long term 50-70	(1) High	(1) High	(1) Some, but disjointed and without institutional support
(0) Very severe	(0) > 75%	(0) Permanent > 70	(0) Very high	(0) Very high	(0) None

*(PELLIN, 2010, adapted WITT et al. 2023)

In relation to the qualitative-quantitative scale used to assess the severity of the threat(s) affecting the protected areas, this consists of the ratio between the two dimensions, Σ and N, resulting in a value that qualifies the level of severity, i.e., how much attention should be paid to the threat factor according to the assessment scale (Table 2), which defines the assessment, where the highest percentage obtained represents the lowest threat severity index, and the lowest percentage obtained represents the highest severity index.

Therefore, for each threat variable, a sum is obtained, whose maximum value will be 24 and the lowest zero. Proceeding in this manner, a matrix is obtained that contemplates all the threats under evaluation, resulting in the sum of the total scores obtained (TA) and the sum of the total possible value to be achieved (TO). The percentage relationship between these two dimensions results in a value that qualifies the level of severity/attention/importance of the threat according to the following scale (Table 2). The higher the percentage obtained, the lower the severity index of the threat. It also allows for the overall qualification of each PA in relation to the threats assessed.

Table 2. Qualitative-quantitative scale for assessing the severity of threats to the protected areas (PAs).

Valuation of the assessment (%)	Threat severity gradient
≥ 85	Very low
71-84	Low
56-70	Medium
41-55	High
≤ 40	Very high

The method was adapted to the regional reality of the PAs and the environmental characteristics of the protected areas, land use, and occupation, considering possible threats while maintaining the basic principles of PAME. Under these conditions, the assessment scale assigns different levels to measure the variability of threat severity gradients affecting the protected area, with “0” being the lowest value considered a very severe threat, “1” still a severe standard, “2” a moderate standard, “3” a mild standard, and “4” the highest value and considered a very mild standard (Table 1). The resulting percentages are related to the five-level rating scale (0-4), which expresses the intensity of the threat, estimated as follows: ≥ 85 (very low); 71-84 (low); 56-70 (medium); 41-55 (high); ≤ 40 (very high) (Table 2).

The totals achieved (TA), which consist of the sum of the scores obtained from the analysis of the intensity of the threats assessed in the protected areas, were compared with the optimal total (TO), which consists of the sum of the highest scores obtained (100%). Threat factors that did not occur in the protected areas were assigned a score of “4” on the Likert scale, i.e., the highest score (100%), as there was no such threat to the protected area (Table 3).

Statistical Analysis

Predominantly descriptive analyses were performed (Ferreira 2005), calculating means, maximum and minimum values on numerical scales to assess threats, and percentages in accordance with the attributes and values of the Likert scale, regarding the incidence of each of the 23 threat variable factors on the PAs in relation to the severity gradient. The quantitative data were tabulated and analyzed using Excel 2010.

In addition, the results were submitted to Principal Component Analysis (PCA) in the MULTIV version 3.85b program (Pillar 1999; Pillar 2006). To present the variations in threats between the PAs in multidimensional space, a data matrix containing the 23 threat variable factors evaluated and their attribute gradients was used, with the Likert-type rating scale. The analyses aimed to identify the components that best explained the variation in results, considering the significant axes for interpreting the threats among the 11 PAs.

Results

The study, conducted in 11 PAs in the state of Rio Grande do Sul, analyzed 23 threat factors, the most serious of which were common to all Protected areas: “alien and/or invasive species” and “absence and/or poor environmental enforcement,” followed by the presence of hunting and management plan not reviewed for 10 years or more (Figure 3).

Among the protected areas studied, Jacuí Delta State Park (PEDJ) had the highest threat gradient (42.21%); the Tainhas State Park (PETA) and the Espigão Alto State Park (PEA) presented a medium degree of threats (59.96% and 68.48%, respectively) (Fig. 2).

Seven of the 11 protected areas analyzed showed a low incidence of threats, namely: Itapeva State Park (PEVA) 72.46%; Ibitirí State Park (PEIB) 72.64%; Espinilho State Park (PEESP) 74.08%; Itapuã State Park (PEIT) 80.98%; Turvo State Park (PETU) 81.88%; Aratinga Ecological Station (EEA) 84.24%; and Serra Geral Biological Reserve (REBIOSG) 84.96%. Only one of the 11 PAs analyzed presented a low severity gradient of threat incidence, the Banhado dos Pachecos Wildlife Refuge (RVSBP), with 89.13% (Table 3; Fig. 2).

Table 3. Percentages of total achievement (TA) in protected areas by threat factors, maximum and minimum values, means, and standard deviation.

TA (%)	Itapua State Park	Delta do Jacui State Park	Espigao Alto State Park	Espinilho State Park	Ibitiria State Park	Tainhas State Park	Turvo State Park	Banhado dos Pachecos Wildlife Refuge	Serra Geral Biological Reserve	Aratinga Ecological Station	Itapeva State Park	Mean	Minimum values	Maximum values	Standard deviation
Hunting	66.67	20.83	54.17	62.50	75.00	41.67	41.67	70.83	87.50	41.67	66.67	57.20	20.83	87.50	19.19
Fishing	70.83	12.50	91.67	75.00	75.00	54.17	45.83	83.33	100.00	100.00	70.83	70.83	12.50	100.00	25.75
Fires	87.50	54.17	70.83	37.50	62.50	41.67	79.17	58.33	100.00	79.17	62.50	66.67	37.50	100.00	19.00
Erosion/silting	100.00	25.00	95.83	83.33	66.67	100.00	100.00	66.67	95.83	100.00	79.17	82.95	25.00	100.00	23.23
Livestock farming inside/outside	66.67	33.33	100.00	100.00	50.00	37.50	100.00	100.00	66.67	62.50	70.83	71.59	33.33	100.00	25.40
Extraction of natural resources	87.50	100.00	75.00	100.00	87.50	37.50	100.00	91.67	83.33	87.50	79.17	84.47	37.50	100.00	17.69
Illegal logging	100.00	100.00	62.50	100.00	91.67	70.83	87.50	100.00	83.33	100.00	83.33	89.02	62.50	100.00	13.08
Deforestation	87.50	41.67	62.50	58.33	91.67	41.67	91.67	100.00	87.50	95.83	87.50	76.89	41.67	100.00	21.68
Animal trafficking	100.00	33.33	100.00	83.33	87.50	54.17	91.67	100.00	87.50	41.67	79.17	78.03	33.33	100.00	23.94
Mining	100.00	33.33	100.00	100.00	100.00	100.00	100.00	100.00	79.17	100.00	83.33	90.53	33.33	100.00	20.42
Settlements inside/outside	100.00	29.17	100.00	100.00	83.33	100.00	100.00	100.00	100.00	100.00	66.67	89.02	29.17	100.00	22.54
Urban/rural real estate expansion (BZ: buffer zone)	75.00	29.17	100.00	58.33	66.67	100.00	100.00	58.33	100.00	95.83	45.83	75.38	29.17	100.00	25.51
Transmission lines	100.00	66.67	58.33	62.50	91.67	87.50	100.00	100.00	100.00	100.00	100.00	87.88	58.33	100.00	16.92
Roads/railways	83.33	37.50	54.17	37.50	70.83	45.83	100.00	100.00	100.00	95.83	66.67	71.97	37.50	100.00	25.42
Lack of land tenure regularization	87.50	25.00	50.00	62.50	58.33	50.00	100.00	100.00	75.00	62.50	66.67	67.05	25.00	100.00	22.63
Management plan not reviewed for 10 years or more	45.83	29.17	20.83	58.33	45.83	50.00	75.00	100.00	75.00	54.17	75.00	57.20	20.83	100.00	22.83
Infectious diseases (wildlife)	100.00	100.00	37.50	100.00	58.33	100.00	58.33	100.00	100.00	100.00	83.33	85.23	37.50	100.00	22.93
Lack of/poor environmental enforcement	54.17	25.00	37.50	62.50	70.83	45.83	41.67	66.67	79.17	62.50	54.17	54.55	25.00	79.17	15.97
Environmental pollution	83.33	20.83	100.00	70.83	58.33	41.67	75.00	100.00	100.00	100.00	75.00	75.00	20.83	100.00	26.29
Pesticide contamination	66.67	33.33	50.00	100.00	54.17	41.67	70.83	100.00	54.17	100.00	79.17	68.18	33.33	100.00	24.10
Roadkill (wildlife)	75.00	41.67	41.67	95.83	95.83	50.00	70.83	100.00	70.83	95.83	62.50	72.73	41.67	100.00	22.16
Uses/activities not in accordance with the PA category	100.00	25.00	58.33	87.50	70.83	37.50	100.00	100.00	62.50	95.83	79.17	74.24	25.00	100.00	26.14
Alien/invasive species	25.00	54.17	54.17	12.50	58.33	50.00	54.17	54.17	66.67	66.67	50.00	49.62	12.50	66.67	16.50
Overall average of threats	80.98	42.21	68.48	74.28	72.64	59.96	81.88	89.13	84.96	84.24	72.46				

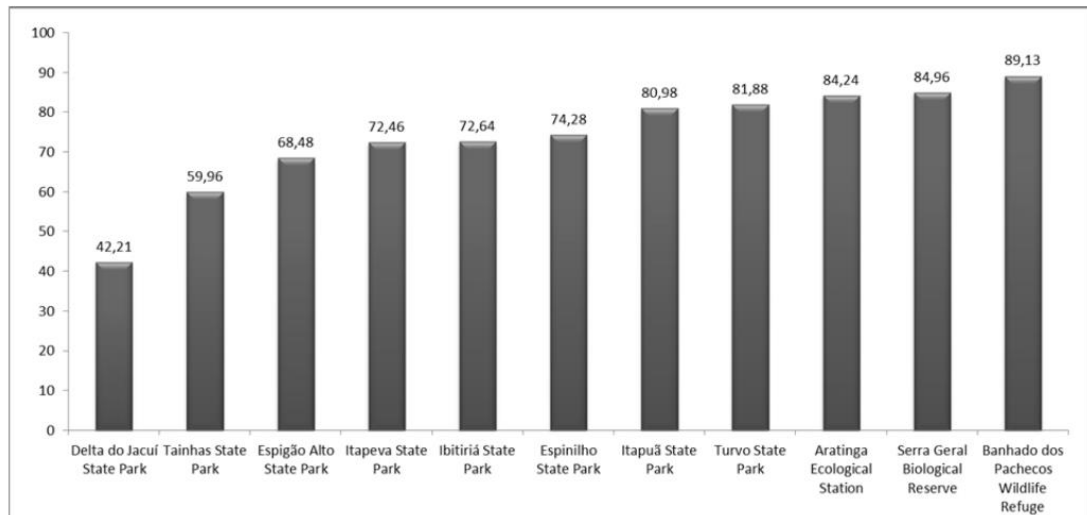


Figure 2. Mean values in percentage related to the 23 threat factors affecting each Protected area analyzed: Ibitirí State Park (PEIB); Jacuí Delta State Park (PEDJ); Espigão Alto State Park (PEEA); Itapeva State Park (PEVA); Tainhas State Park (PETA); Espinilho State Park (PEESP); Turvo State Park (PETU); Itapuã State Park (PEIT); Aratinga Ecological Station (EEA); Serra Geral Biological Reserve (REBIOSG); and Banhado dos Pachecos Wildlife Refuge (RVSBP).

Analyzing the 23 threats surveyed for each protected area, it was observed that some of these factors were considered a “serious threat” because they achieved low percentages (Fig. 3). The threat factors that reached 100% (Table 3) expressed the absence of incidence on the PAs, that is, were considered as a very “low threat.” On the other hand, it was observed that the PA that obtained the highest threat gradient was the Jacuí Delta State Park (42.21%) and the PA with the lowest was the Banhado dos Pachecos Wildlife Refuge (89.13%; Fig. 2 and Fig. 3; Table 3).

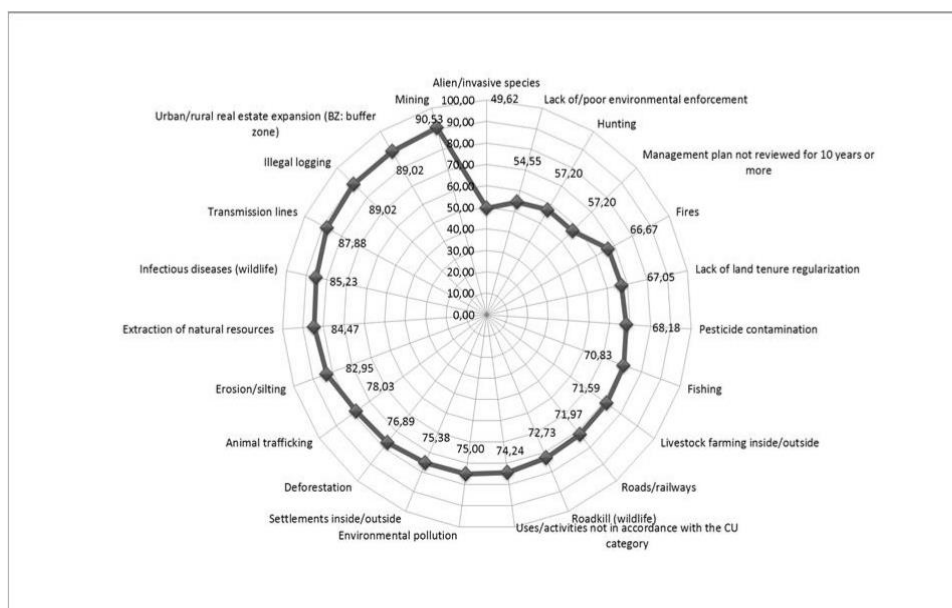


Figure 3. Percentage of the total achieved (TA) among the 23 threat factors within the optimal total (TO = 100%) for the 11 Protected areas (PAs) evaluated in Rio Grande do Sul.

Among the 23 threats, the factors with the highest and lowest incidence on protected areas were evaluated, thus considering the threat gradient to biodiversity conservation (Table 2). The factor posing the greatest risk was the incidence of “alien/Invasive Species” (49.62%), resulting in a high incidence gradient, i.e., a “high degree of threat.” In second place was the “lack of/ Poor environmental enforcement” (54.55%). Two other factors, “hunting” and “management plan without review for 10 years or more”, respectively, obtained equal percentages (57.2%), both factors having a “medium threat” level in most of the PAs studied. Within the “medium threat level”, six factors affected the protected areas: “hunting” (57.2%); “management plan without review for 10 years or more” (57.2%); “fires” (66.67%); “lack of land tenure regularization” (67.05%); “pesticide contamination” (68.18%); and “fishing” (70.83%). Ten other threat factors had a low incidence in general: “livestock inside/outside” (71.59%); “road/railway” (71.97%); “roadkill (wildlife)” (72.73%); “uses/activities not in accordance with the PA category” (74.24%); “environmental pollution” (75.00%); “urban/agricultural real estate expansion (BZ: buffer zone)” (75.38%); “deforestation” (76.39%); “animal trafficking” (78.03%); erosion/siltation (82.95%); and “extraction of natural resources” (84.47%).

Five factors analyzed were assessed as having a “very low” incidence of threats to the PAs: “infectious diseases (wildlife)” (85.23%); “transmission lines” (87.88%); “illegal logging” (89.02%); “settlements inside/outside” (89.02%) and mining (90.53%).

Given the results, it is considered that the higher the percentage value obtained for the threat factor, the lower the severity. However, it is important to note the threshold of each percentage obtained within the classification in relation to the severity gradient for each threat analyzed, requiring caution in each case. Thus, the overall incidence of threats analyzed in this study occurred in greater and lesser gradients across the PAs, considering anthropogenic influences and natural factors, as well as other peculiarities that differed between PAs.

Principal component analysis (PCA) showed that the first component explained 42.3% of the total variation and the second only 17.5% (Fig. 4 and Fig. 5). Axis 1 (Fig. 4 and Fig. 5),

which accounted for 42.3% of the total variation, revealed a positive association between threats, i.e., how PAs tend to have high percentages (i.e., low “degree” of threat) or low percentages (i.e., high “degree” of threat) for the set of variables, as demonstrated by the correlations of the threat variables with axis 1 (all positive and of moderate to high magnitude). Thus, the protected areas are distributed on a main threat gradient, from Banhado dos Pachecos (lowest threat “intensity”) to Delta do Jacuí (highest threat “intensity”). Axis 2 of the PCA (Fig. 4 and Fig. 5), with 17.5% of the total variation, revealed an antagonistic pattern between two groups of threats: urban/real estate expansion and erosion/silting, and “natural resource extraction and logging”, related to the peculiar characteristics of Tainhas and Espigão Alto, which have a higher incidence of the “natural resource extraction” and “logging” threats, and a lower incidence of “urban/real estate expansion” and “erosion/silting”, in relation to the other PAs.

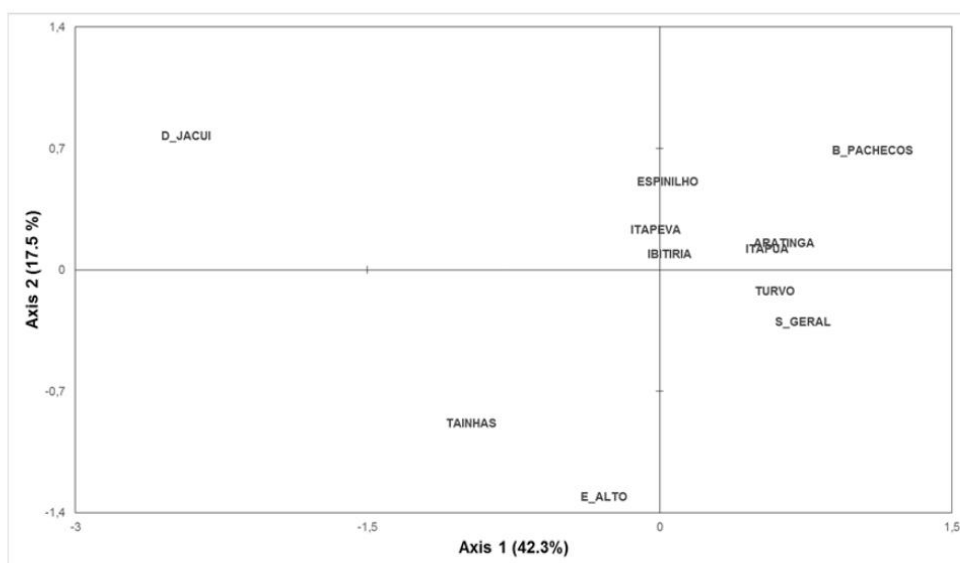


Figure 4. Principal Component Analysis (PCA) of the incidence of threats in the 11 PAs evaluated in the state of Rio Grande do Sul.

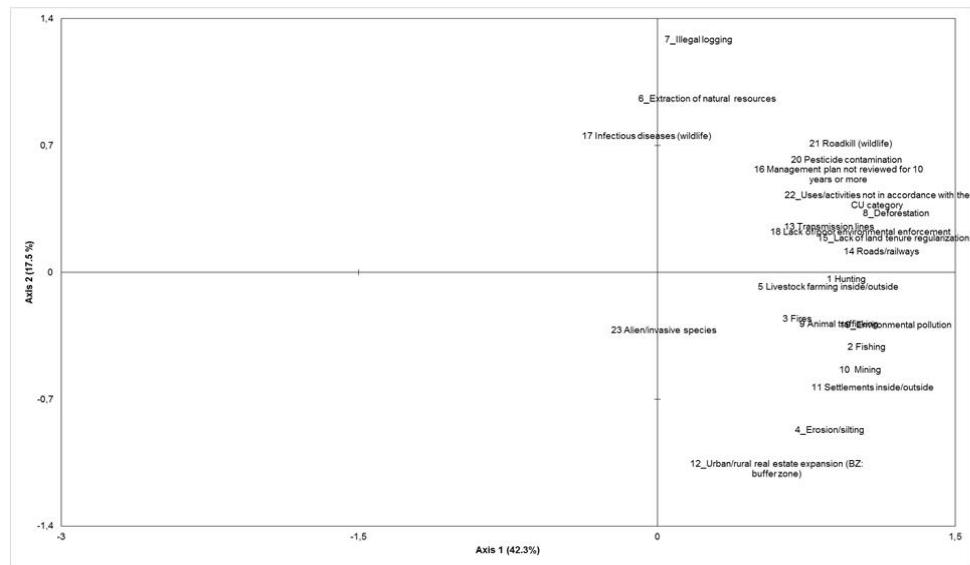


Figure 5. Principal Component Analysis (PCA) of the 23 threat factors for the 11 PAs in the state of Rio Grande do Sul.

Discussion

This study analyzed 23 factors threatening the conservation of 11 Protected areas (PAs) in Rio Grande do Sul, according to the perception of their managers. The protected areas in this study (PAs) are part of the Integral Protection Group, according to the National System of Nature Conservation Units (SNUC), Federal Law 9.985/2000. The PAs under study are in two important Brazilian biomes: Pampa and Atlantic Forest. It is well known that these PAs suffer constant threats to biodiversity, mainly due to habitat fragmentation, hunting, extraction of natural resources, and multiple irregular land uses. In particular, those located in the Pampa biome, which require greater knowledge about their biodiversity, are more fragile in the face of the growth of monoculture plantations, such as eucalyptus and pine, for example, for timber extraction (Hasenack et al. 2020). Among the studied PAs, three are in areas bordering other states and/or countries: Turvo State Park, which borders Argentina; Espigão Alto State Park, located on the border with the mountain range of the state of Santa Catarina; and Espinilho State Park, located on the border with Uruguay. In these PAs, there is a higher incidence of hunting (Witt et al. 2023), which represents 41.67%, 54.17%, and 62.50%, respectively, of the environmental crimes according to this study.

In several countries around the world, particularly in Brazil, studies conducted on threats to PAs present an extensive and varied list of factors that may vary according to the region where they are located (Terborgh et al. 2002; Ervin 2003; Salafsky et al. 2008; Nchor & Ugogo 2012; Souza & Lima 2018; Carvalho 2020; Ararape et al. 2021; Faria et al. 2021).

Some types of threats to PAs are very common in the vast majority of PAs, highlighting factors of greater risk in several studies: Dugelby & Libby (1998) found the following main threats in 28 Latin American parks: hunting, logging, agriculture, grazing, mining, contamination, fishing, and tourism; Terborgh et al. (2002), in 201 Brazilian parks, concluded that the highest incidence of threats consisted of: illegal hunting, encroachment by

agriculture, logging, grazing, highways, fire, and mining; Fontoura et al. (2016) in five “National Parks” in Rio de Janeiro (Brazil) and seven in the United States found that the greatest threat was invasive alien species; Araripe et al. (2021) in the northeastern backlands depression, in four PAs (two Ecological Stations and two National Forests), analyzed the main threats as the incidence of “alien species” and “hunting”; Faria (2006), in the state of São Paulo, in 41 PAs in the integral protection group involving 28 parks, 12 ecological stations, and one biological reserve, all state protected areas, found fishing to be the greatest threat among the areas studied. Pellin (2010), when analyzing Private Natural Heritage Reserve (RPPN) in the state of Mato Grosso do Sul, found the main threat factors to be “hunting,” “presence of invasive alien species,” “fire,” “invasion,” “fishing,” and “roads and access.” Teixeira & Venticinque (2014), in 11 PAs in geoparks in Rio Grande do Norte, found the main threats to be “illegal collection of natural resources,” “conversion of land use and occupation in the interior and surrounding area of the protected area,” “animal trafficking,” “predatory fishing and hunting,” “deforestation,” and “conflicts with tourism activities”; Salviano et al. (2023) in a municipal natural park in Minas Gerais found that the main threat was “extraction of natural resources,” mainly firewood, which points to deficiencies in enforcement in the access to the areas.

In this study, the threats that deserve to be highlighted and serve as a warning regarding the severity gradient were the presence of invasive alien species, absence and/or poor environmental enforcement, hunting, fishing, and outdated management plans. These threat factors were not only corroborated by studies conducted by other authors, but also presented a higher risk, reaching 49.62%, 54.55%, and 57.20%, representing, respectively, the presence of invasive alien species, the absence and/or lack of enforcement, hunting, and outdated management plans, common to most of the PAs in this study (Fig. 3).

It is clear that all these studies yield different results in terms of the various variables of threat factors, which occur with greater or lesser intensity and pressure on the protected areas. However, it is observed that the threats present in most of the 11 PAs evaluated were related to lack of enforcement, hunting, fishing, and extraction of natural resources. Another negative factor is land use and occupation, which, in most cases, occurs irregularly, increasing the risk of soil contamination due to the indiscriminate use of pesticides, leading to and triggering other factors that can result in serious threats.

In a globalized world, the presence of invasive alien species represents one of the most serious threats to nature conservation, both abroad and in Brazil, according to studies conducted by Dugelby & Libby (1998) and Fontoura et al. (2016). Today, they are easily found in different regions and biomes of the country, where they cause negative impacts that are difficult to remedy environmentally, especially in the PAs, both for integral protection and sustainable use, and are identified as one of the most common and observed threats, as pointed out by studies conducted by WWF (2007) in 246 federal protected areas in Brazil (belonging to integral protection and sustainable use groups), Pellin (2010) in RPPNs in the state of Mato Grosso do Sul, Silveira et al. (2012) in protected areas in the Northeast, Cunha & Araújo (2014) in Ubajara National Park (Ceará); Teixeira & Venticinque (2014) in geoparks in Rio Grande do Norte; Carvalho (2020) in eight natural parks in high altitude areas of the Republic of Cape Verde, Africa; Araripe et al. (2021) in four protected areas in the northeastern backlands depression (two Ecological Stations and two National Forests).

In this study, the PAs presented different types of biological invasions, both of fauna and flora. In Rio Grande do Sul, there are some cases of invasive species in the PAs analyzed: *Axis axis* (chital), *Sus scrofa* (wild boar), *Eragrostis plana* (annoni grass); *Pinus elliotii* (pine); *Urochloa decumbens* (brachiaria grass); *Asparagus cetaceus* (asparagus fern); *Hovenia dulcis* (Japanese raisin tree) and *Aquarana catesbeiana* (bullfrog). In the Espinilho State Park, there are records of the large deer species chital (*Axis axis*). This species has also been

observed in the municipalities surrounding the Turvo State Park, and it is very common in Argentina, which borders the protected area. In the Jacuí Delta State Park, however, the species has been recorded only once. Another invasive species worth mentioning is the wild boar (*S. scrofa*), which has also been recorded in the following PAs: Aratinga Ecological Station, Tainhas State Park, Ibitirí State Park, and Espigão Alto State Park. Other invasive species are listed in the respective management plans of the PAs and, according to the interviews with protected area managers, include: annoni grass (*E. plana*), pine (*P. elliotii*), brachiaria grass (*U. decumbens*), asparagus fern (*A. setaceus*), Japanese raisin tree (*H. dulcis*) and bullfrog (*A. catesbeiana*). Another common problem pointed out by managers is the invasion of domestic animals into the protected areas, mainly dogs (*Canis familiaris*) and cats (*Felis catus*). When these domesticated species invade natural environments, they become feral and end up preying on local fauna, in addition to increasing the risk of transmitting infectious diseases to wild carnivores, compromising the health stability of these populations and, in some cases, even causing local extinctions (Jorge et al. 2010; Curi et al. 2016; Zenni et al. 2016).

Hunting is another very common threat to PAs across the country (Constantino 2018), maintained for cultural reasons, especially in the border areas (Leal & Costa 2020). Large wild mammal populations, specially, are in decline due to hunting (Chiarello et al. 2008).

In this sense, PAs are, in many cases, true “islands” or “refuges” for local wildlife. However, several authors have warned of this constant threat in different Brazilian biomes (Terborgh et al. 2002; WWF 2007; Pellin 2010; Araripe et al. 2021; Teixeira & Venticinque 2014). It is important to note that, in some protected areas, there is no proper signage indicating their boundaries, facilitating access for invasion and environmental crimes. The presence of signage marking the boundaries of protected areas, with signs and some type of fencing, is essential and should be associated with the work performed by park rangers in their routines, which should be properly organized and planned within the protected area. Protected areas located in border areas with other countries require specific care, as they have higher rates of crimes against wildlife, and inspections should be carried out more frequently to prevent these criminal actions. In this sense, it is essential to provide constant training for park rangers, in addition to offering and maintaining working conditions with equipment and structures appropriate for the functions they perform.

Fishing is another threat to protected areas located near water resources, as it is an extremely common activity in regions with large bodies of water, which attract large numbers of people seeking leisure or sporting activities. However, the overexploitation of fishery resources has led to the loss and drastic decline of fish species (Nobre 2012). For the PAs analyzed in this study, located near these water resources or on their boundaries (Jacuí Delta State Park, Itapuã State Park, and Turvo State Park), fishing was considered an incidental threat associated with illegal fishing. Studies conducted by Faria (2006) in the state of São Paulo warn that fishing has a high incidence related to threat factors. In this study, fishing was considered an incidental threat to those PAs that have water resources within their territory, highlighting the Jacuí Delta State Park, Itapuã State Park, and Turvo State Park, where there is a high incidence of illegal fishing, as such practice is considered an environmental crime in fully protected PAs, according to Federal Law 9.605/98.

Enforcement actions are, above all, fundamental to restrain various types of environmental crimes in PAs. However, the lack of planning, specialized human resources (park rangers), and training are pointed out as the main problems recorded in the PAs, as indicated in the works of Araripe et al. (2021), Salviano et al. (2023), and Witt et al. (2023). In the present study, the lack and/or insufficient enforcement action in the PAs was one of the greatest concerns of managers, with a great need to expand the number of park rangers, as they play an essential role that is fundamental to the safeguarding of PAs. It is necessary to

train and equip the existing staff, in addition to increasing the number of employees, as provided for in the Management Plans, associated with the real needs of each PA (Witt et al. 2023).

Effective protection through patrol planning makes these protected areas less vulnerable to threats such as hunting, fishing, invasions, and extraction of natural resources.

According to current legislation (Federal Law 9.985/2000 - SNUC), the main management tool for protected areas is the “management plan,” a document that must include all guidelines for planning, management actions, and control of the protected area. This document must be constantly updated, as it should be a dynamic document for the management processes of protected areas. However, the national and state realities are very different, since, as a general rule, these plans are not updated in accordance with the guidelines imposed by the SNUC law. According to Witt et al. (2023), it is essential to monitor the management processes about the dynamics of protected areas, proceeding with effective monitoring and, consequently, updating the management plan, respecting what is provided for and determined by the SNUC, in compliance with the objectives of the management categories and conservation purposes. The technical management document is fundamental for effective management, as a technical basis for dynamic and effective planning, through continuous monitoring of future stages (Witt et al. 2023).

The threat factors, the focus of this research, were analyzed specifically in terms of incidence and different degrees in relation to the magnitude of the impacts on each of the 11 PAs, unlike the studies by Faria (2004), who treated threat factors as a scope, where he analyzed them together in his study to assess management effectiveness for the other indicators.

In the study by Cunha and Araújo (2014), when evaluating 52 factors of pressures and threats in Ubajara National Park (Ceará State), the authors found that the vast majority of factors ($n=26$) obtained “low” levels of significance, resulting in 75% of the total optimum, which is similar to this study, where the overall average incidence of threats totaling the 11 PAs obtained 73.75% of the total expected optimum. The analyzed factors occurred in all PAs, in different degrees of severity. However, the overall sum of the assessments carried out in the 11 PAs resulted in low threats to the group of analyzed PAs, like the studies carried out in Ceará.

Conclusion

Protected areas (PAs), especially protected areas (PAs), face a variety of problems, including lack of land tenure regularization, development and updating of management plans, creation of advisory/deliberative councils, and lack or even absence of human and financial resources for implementation and management (Dourojeanni & Pádua 2001; Mercadante 2007; Witt et al. 2023). In addition, when poorly managed, without adequate legal and technical support, protected areas are subject to severe implications for their maintenance and fulfillment of objectives (Faria et al. 2021; Witt et al. 2023). In this sense, we can conclude that, in general, in Brazilian PAs and, in this case, highlighting the 11 studied in Rio Grande do Sul, the effective management of protected areas is related to a series of obstacles and it is not enough to formally establish these specially protected territorial spaces; there is a need for effective management to meet the objectives of the management categories.

Therefore, it can be concluded that threats are significantly impacting protected areas, even those considered more “protected”, as in the case of the Integral Protection group, the subject of this study. In addition to the numerous problems identified in the management of these PAs, we can also consider impacts such as climate change, globalized degradation, or those resulting from anthropogenic degradation (Wiens et al. 2011).

Finally, it is recommended that the identified threats affecting the PAs in this study receive greater attention from management, with the need for attention to the measures to be taken, with the establishment of management policies, in a careful manner, regarding the occurrence and severity of the threats affecting the studied PAs. In addition, it is important that the management staff establish evaluation criteria to “measure” the effectiveness of management in the PAs in the future, again based on this study, extending it to other PAs, thus considering technical, political, and economic regional issues, which are considered essential to the fulfillment of the objectives of the PAs (Hockings et al. 2006), as it is an important tool for their management and maintenance.

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Supplementary Material 1- Questionnaire Evaluation parameters of the threat factors to conservation area managers

ASSESSMENT OF THE THREATS TO THE PROTECTED AREA

Dear Manager,

The purpose of this survey is to analyze the threats concerning the assessment of management effectiveness, which affect the Protected Area (PA).

Threats: covers natural and anthropogenic factors that may affect the balance of the protected area and the fulfillment of its objectives, which may be internal or external in origin. These are possible or imminent pressures that may occur in the present and/or continue to occur in the future.

1. PA's identification

Protected area	
Location's Biome	
Creation date	
Area size	
Has a management plan (MP)	
Date of publication of the MP	
Means of dissemination of the MP	
Has an Advisory Council	
Date of creation of the Council	
Frequency of annual meetings	
Name of Manager	
Manager's education	
How long in the PA	
Position	
Phone number	
e-mail	

2. Mark with (X) the activity, action, and infrastructure that affect the Protected area as threats and (0) when not identified.

Table 1. Identification of the threats affecting the Protected area

Ameaças	(x)/(0)	Dentro da UC	Fora da UC
1. Hunting			
2. Fishing			
3. Fires			
4. Erosion/silting			
5. Livestock farming inside/outside			
6. Extraction of natural resources			
7. Illegal logging			
8. Deforestation			
9. Animal trafficking			
10. Mining			
11. Settlement inside/outside			
12. Real estate/urban expansion (BZ: buffer zone)			
13. Transmission lines			
14. Road/railway			
15. Absence of land tenure regularization			
16. Management plan without further review (10 years or more)			
17. Infectious diseases (wildlife)			
18. Absence/insufficient environmental inspection			
19. Environmental pollution			
20. Pesticide contamination			
21. Roadkill (wildlife)			
22. Uses/activities not in accordance with the category of the protected area			

2.1 If there are other threats to the protected area or its buffer zone besides those listed above, list them below.

Table 3. Based on the information in Table 1, which lists the threats affecting the protected area and buffer zone, the table below assesses the severity of the threat(s) and defines the attributes used to classify the threats affecting the protected area you manage. Fill in the table below.

Threat	Impact Magnitude	Geographic coverage (% of the PA)	Permanence (years)	Dynamics	Probability of the threat materializing	Are there any actions to mitigate/prevent the effects of threats?	Comments
Threat 1 Hunting	☐ Very mild ☐ Mild ☐ Moderate ☐ Severe ☐ Very severe	☐ < 5% ☐ 5-15% ☐ 15-50% ☐ 50-75 ☐ > 75%	☐ < 5 ☐ 5-25 ☐ 26-50 ☐ 50-70 ☐ P > 70	☐ Very low ☐ Low ☐ Average ☐ High ☐ Very high	☐ Very low ☐ Low ☐ Average ☐ High ☐ Very high	☐ Institutional and employee-based ☐ Local with employees ☐ Few with partnerships ☐ Some, but disjointed and without institutional support ☐ None	
Threat 2 Fishing	☐ Very mild ☐ Mild ☐ Moderate ☐ Severe ☐ Very severe	☐ < 5% ☐ 5-15% ☐ 15-50% ☐ 50-75 ☐ > 75%	☐ < 5 ☐ 5-25 ☐ 26-50 ☐ 50-70 ☐ P > 70	☐ Very low ☐ Low ☐ Average ☐ High ☐ Very high	☐ Very low ☐ Low ☐ Average ☐ High ☐ Very high	☐ Institutional and employee-based ☐ Local with employees ☐ Few with partnerships ☐ Some, but disjointed and without institutional support ☐ None	

Threat 3 Fires	☐ Very mild ☐ Mild ☐ Moderate ☐ Severe ☐ Very severe	☐ < 5% ☐ 5-15% ☐ 15-50% ☐ 50-75 ☐ > 75%	☐ < 5 ☐ 5-25 ☐ 26-50 ☐ 50-70 ☐ P > 70	☐ Very low ☐ Low ☐ Average ☐ High ☐ Very high	☐ Very low ☐ Low ☐ Average ☐ High ☐ Very high	☐ Institutional and employee-based ☐ Local with employees ☐ Few with partnerships ☐ Some, but disjointed and without institutional support ☐ None	
Threat 4 Erosion/silting	☐ Very mild ☐ Mild ☐ Moderate ☐ Severe ☐ Very severe	☐ < 5% ☐ 5-15% ☐ 15-50% ☐ 50-75 ☐ > 75%	☐ < 5 ☐ 5-25 ☐ 26-50 ☐ 50-70 ☐ P > 70	☐ Very low ☐ Low ☐ Average ☐ High ☐ Very high	☐ Very low ☐ Low ☐ Average ☐ High ☐ Very high	☐ Institutional and employee-based ☐ Local with employees ☐ Few with partnerships ☐ Some, but disjointed and without institutional support ☐ None	
Threat 5 Livestock farming inside/outside	☐ Very mild ☐ Mild ☐ Moderate ☐ Severe ☐ Very severe	☐ < 5% ☐ 5-15% ☐ 15-50% ☐ 50-75 ☐ > 75%	☐ < 5 ☐ 5-25 ☐ 26-50 ☐ 50-70 ☐ P > 70	☐ Very low ☐ Low ☐ Average ☐ High ☐ Very high	☐ Very low ☐ Low ☐ Average ☐ High ☐ Very high	☐ Institutional and employee-based ☐ Local with employees ☐ Few with partnerships ☐ Some, but disjointed and without institutional support ☐ None	

Threat 6 Extraction of natural resources	☐ Very mild ☐ Mild ☐ Moderate ☐ Severe ☐ Very severe	☐ < 5% ☐ 5-15% ☐ 15-50% ☐ 50-75 ☐ > 75%	☐ < 5 ☐ 5-25 ☐ 26-50 ☐ 50-70 ☐ P > 70	☐ Very low ☐ Low ☐ Average ☐ High ☐ Very high	☐ Very low ☐ Low ☐ Average ☐ High ☐ Very high	☐ Institutional and employee-based ☐ Local with employees ☐ Few with partnerships ☐ Some, but disjointed and without institutional support ☐ None	
Threat 7 Illegal logging	☐ Very mild ☐ Mild ☐ Moderate ☐ Severe ☐ Very severe	☐ < 5% ☐ 5-15% ☐ 15-50% ☐ 50-75 ☐ > 75%	☐ < 5 ☐ 5-25 ☐ 26-50 ☐ 50-70 ☒ P > 70	☐ Very low ☐ Low ☐ Average ☐ High ☐ Very high	☐ Very low ☐ Low ☐ Average ☐ High ☐ Very high	☐ Institutional and employee-based ☐ Local with employees ☐ Few with partnerships ☐ Some, but disjointed and without institutional support ☐ None	
Threat 8 Deforestation	☐ Very mild ☐ Mild ☐ Moderate ☐ Severe ☐ Very severe	☐ < 5% ☐ 5-15% ☐ 15-50% ☐ 50-75 ☐ > 75%	☐ < 5 ☐ 5-25 ☐ 26-50 ☐ 50-70 ☐ P > 70	☐ Very low ☐ Low ☐ Average ☐ High ☐ Very high	☐ Very low ☐ Low ☐ Average ☐ High ☐ Very high	☐ Institutional and employee-based ☐ Local with employees ☐ Few with partnerships ☐ Some, but disjointed and without institutional support ☐ None	

Threat 9 Animal trafficking	☐ Very mild ☐ Mild ☐ Moderate ☐ Severe ☐ Very severe	☐ < 5% ☐ 5-15% ☐ 15-50% ☐ 50-75 ☐ > 75%	☐ < 5 ☐ 5-25 ☐ 26-50 ☐ 50-70 ☐ P > 70	☐ Very low ☐ Low ☐ Average ☐ High ☐ Very high	☐ Very low ☐ Low ☐ Average ☐ High ☐ Very high	☐ Institutional and employee-based ☐ Local with employees ☐ Few with partnerships ☐ Some, but disjointed and without institutional support ☐ None	
Threat 10 Mining	☐ Very mild ☐ Mild ☐ Moderate ☐ Severe ☐ Very severe	☐ < 5% ☐ 5-15% ☐ 15-50% ☐ 50-75 ☐ > 75%	☐ < 5 ☐ 5-25 ☐ 26-50 ☐ 50-70 ☐ P > 70	☐ Very low ☐ Low ☐ Average ☐ High ☐ Very high	☐ Very low ☐ Low ☐ Average ☐ High ☐ Very high	☐ Institutional and employee-based ☐ Local with employees ☐ Few with partnerships ☐ Some, but disjointed and without institutional support ☐ None	
Threat 11 Settlements inside/outside	☐ Very mild ☐ Mild ☐ Moderate ☐ Severe ☐ Very severe	☐ < 5% ☐ 5-15% ☐ 15-50% ☐ 50-75 ☐ > 75%	☐ < 5 ☐ 5-25 ☐ 26-50 ☐ 50-70 ☐ P > 70	☐ Very low ☐ Low ☐ Average ☐ High ☐ Very high	☐ Very low ☐ Low ☐ Average ☐ High ☐ Very high	☐ Institutional and employee-based ☐ Local with employees ☐ Few with partnerships ☐ Some, but disjointed and without institutional support ☐ None	

Threat 12 Urban/rural real state expansion (BZ: buffer zone)	☐ Very mild ☐ Mild ☐ Moderate ☐ Severe ☐ Very severe	☐ < 5% ☐ 5-15% ☐ 15-50% ☐ 50-75 ☐ > 75%	☐ < 5 ☐ 5-25 ☐ 26-50 ☐ 50-70 ☐ P > 70	☐ Very low ☐ Low ☐ Average ☐ High ☐ Very high	☐ Very low ☐ Low ☐ Average ☐ High ☐ Very high	☐ Institutional and employee-based ☐ Local with employees ☐ Few with partnerships ☐ Some, but disjointed and without institutional support ☐ None	
Threat 13 Transmission lines	☐ Very mild ☐ Mild ☐ Moderate ☐ Severe ☐ Very severe	☐ < 5% ☐ 5-15% ☐ 15-50% ☐ 50-75 ☐ > 75%	☐ < 5 ☒ 5-25 ☐ 26-50 ☐ 50-70 ☐ P > 70	☐ Very low ☐ Low ☐ Average ☐ High ☐ Very high	☐ Very low ☐ Low ☐ Average ☐ High ☐ Very high	☐ Institutional and employee-based ☐ Local with employees ☐ Few with partnerships ☐ Some, but disjointed and without institutional support ☐ None	
Threat 14 Roads/railways	☐ Very mild ☐ Mild ☐ Moderate ☐ Severe ☐ Very severe	☐ < 5% ☐ 5-15% ☐ 15-50% ☐ 50-75 ☐ > 75%	☐ < 5 ☐ 5-25 ☐ 26-50 ☐ 50-70 ☒ P > 70	☐ Very low ☐ Low ☐ Average ☐ High ☐ Very high	☐ Very low ☐ Low ☐ Average ☐ High ☐ Very high	☐ Institutional and employee-based ☐ Local with employees ☐ Few with partnerships ☐ Some, but disjointed and without institutional support ☐ None	

Threat 15 Lack of land tenure regularization	☐ Very mild ☐ Mild ☐ Moderate ☐ Severe ☐ Very severe	☐ < 5% ☐ 5-15% ☐ 15-50% ☐ 50-75 ☐ > 75%	☐ < 5 ☐ 5-25 ☐ 26-50 ☐ 50-70 ☐ P > 70	☐ Very low ☐ Low ☐ Average ☐ High ☐ Very high	☐ Very low ☐ Low ☐ Average ☐ High ☐ Very high	☐ Institutional and employee-based ☐ Local with employees ☐ Few with partnerships ☐ Some, but disjointed and without institutional support ☐ None	
Threat 16 Management plan not reviewed for 10 years or more	☐ Very mild ☐ Mild ☐ Moderate ☐ Severe ☐ Very severe	☐ < 5% ☐ 5-15% ☐ 15-50% ☐ 50-75 ☐ > 75%	☐ < 5 ☐ 5-25 ☐ 26-50 ☐ 50-70 ☐ P > 70	☐ Very low ☐ Low ☐ Average ☐ High ☐ Very high	☐ Very low ☐ Low ☐ Average ☐ High ☐ Very high	☐ Institutional and employee-based ☐ Local with employees ☐ Few with partnerships ☐ Some, but disjointed and without institutional support ☐ None	
Threat 17 Infectious diseases (wildlife)	☐ Very mild ☐ Mild ☐ Moderate ☐ Severe ☐ Very severe	☐ < 5% ☐ 5-15% ☐ 15-50% ☐ 50-75 ☐ > 75%	☐ < 5 ☐ 5-25 ☐ 26-50 ☐ 50-70 ☐ P > 70	☐ Very low ☐ Low ☐ Average ☐ High ☐ Very high	☐ Very low ☐ Low ☐ Average ☐ High ☐ Very high	☐ Institutional and employee-based ☐ Local with employees ☐ Few with partnerships ☐ Some, but disjointed and without institutional support ☐ None	

Threat 18 Lack of/poor environmental enforcement	☐ Very mild ☐ Mild ☐ Moderate ☐ Severe ☐ Very severe	☐ < 5% ☐ 5-15% ☐ 15-50% ☐ 50-75 ☐ > 75%	☐ < 5 ☐ 5-25 ☐ 26-50 ☐ 50-70 ☐ P > 70	☐ Very low ☐ Low ☐ Average ☐ High ☐ Very high	☐ Very low ☐ Low ☐ Average ☐ High ☐ Very high	☐ Institutional and employee-based ☐ Local with employees ☐ Few with partnerships ☐ Some, but disjointed and without institutional support ☐ None	
Threat 19 Environmental pollution	☐ Very mild ☐ Mild ☐ Moderate ☐ Severe ☐ Very severe	☐ < 5% ☐ 5-15% ☐ 15-50% ☐ 50-75 ☐ > 75%	☐ < 5 ☐ 5-25 ☐ 26-50 ☐ 50-70 ☐ P > 70	☐ Very low ☐ Low ☐ Average ☐ High ☐ Very high	☐ Very low ☐ Low ☐ Average ☐ High ☐ Very high	☐ Institutional and employee-based ☐ Local with employees ☐ Few with partnerships ☐ Some, but disjointed and without institutional support ☐ None	
Threat 20 Pesticide contamination	☐ Very mild ☐ Mild ☐ Moderate ☐ Severe ☐ Very severe	☐ < 5% ☐ 5-15% ☐ 15-50% ☐ 50-75 ☐ > 75%	☐ < 5 ☐ 5-25 ☐ 26-50 ☐ 50-70 ☐ P > 70	☐ Very low ☐ Low ☐ Average ☐ High ☐ Very high	☐ Very low ☐ Low ☐ Average ☐ High ☐ Very high	☐ Institutional and employee-based ☐ Local with employees ☐ Few with partnerships ☐ Some, but disjointed and without institutional support ☐ None	

Threat 21 Roadkill (wildlife)	☐ Very mild ☐ Mild ☐ Moderate ☐ Severe ☐ Very severe	☐ < 5% ☐ 5-15% ☐ 15-50% ☐ 50-75 ☐ > 75%	☐ < 5 ☐ 5-25 ☐ 26-50 ☐ 50-70 ☐ P > 70	☐ Very low ☐ Low ☐ Average ☐ High ☐ Very high	☐ Very low ☐ Low ☐ Average ☐ High ☐ Very high	☐ Institutional and employee-based ☐ Local with employees ☐ Few with partnerships ☐ Some, but disjointed and without institutional support ☐ None	
Threat 22 Uses/activities not in accordance with the PA category	☐ Very mild ☐ Mild ☐ Moderate ☐ Severe ☐ Very severe	☐ < 5% ☐ 5-15% ☐ 15-50% ☐ 50-75 ☐ > 75%	☐ < 5 ☐ 5-25 ☐ 26-50 ☐ 50-70 ☐ P > 70	☐ Very low ☐ Low ☐ Average ☐ High ☐ Very high	☐ Very low ☐ Low ☐ Average ☐ High ☐ Very high	☐ Institutional and employee-based ☐ Local with employees ☐ Few with partnerships ☐ Some, but disjointed and without institutional support ☐ None	

4. Based on your experience managing the PA, describe the specific threats listed for the protected area you manage, especially those that, in your opinion, directly affect the PA or pose severe future risks to the ecosystems and associated biota, especially regarding the objectives for which the protected area was created.

Supplementary Material 2 - Questionnaire Evaluation parameters of the threat factors to “Alien/invasive species” to conservation area managers

ASSESSMENT OF THE THREATS TO THE PROTECTED AREA

Dear Manager,

The purpose of this survey is to analyze the threats concerning the assessment of management effectiveness, which affect the Protected Area (PA).

2. Identification:

Protected area:	
Name of the employee and position:	

3. Considering the assessment of the threat identified above, the classification for the assessment is as follows: magnitude, geographical coverage, permanence and dynamics, as well as the probability of occurrence.
- ✓ Magnitude: refers to the magnitude and intensity of the damage that the pressure causes to the PA.
 - ✓ Geographical coverage: determines the percentage of the protected area where the threat occurs.
 - ✓ Permanence: defines the length of time that the effects and consequences of the threat affect the PA.
 - ✓ Dynamics: refers to the threat situation in terms of its status and evolution.
 - ✓ Probability of materialization: the possibility of the threat becoming consolidated in such a way as to cause negative effects on the PA.
 - ✓ Mitigation actions: existence of concrete actions to mitigate and/or restrain the damage caused by the threat(s) to the protected area.

5 CAPÍTULO 4 – CONSIDERAÇÕES FINAIS

Esta tese apresentou as dificuldades e fragilidades reportadas pelos gestores e avaliadas por meio de documentos oficiais e incursões a campo, de 11 Unidades de Conservação Estaduais no Rio Grande do Sul (RS). Neste estudo para avaliação da eficácia de gestão, foram selecionadas unidades de Conservação do grupo de proteção integral, relevando-se que estas áreas possuem os objetivos do maior grau de conservação, de acordo com a classificação do Sistema Nacional de Unidades de Conservação do Brasil (SNUC), Lei Federal 9.985/2000. Outro critério utilizado foi à existência de Plano de Manejo, documento técnico oficial de gestão, o qual possibilitou as análises juntamente com os parâmetros de avaliação para aplicação do EMAP. Entretanto, estes documentos na maioria das áreas protegidas, encontravam-se defasados, sem atualização, conforme previsto pelo (SNUC).

No RS até o momento foram criadas 24 unidades de conservação instituídas por ato do poder público estadual. Contudo, grande maioria não possui plano de manejo, e os documentos existentes carecem de atualização, pois ultrapassam dez anos sem reavaliação. Posto isto, considera-se de suma relevância a revisão e atualização dos planos de manejo existentes e elaboração deste documento para UCs já criadas há décadas. As atualizações dos planos de manejos estão previstas pela Lei Federal 9.985/2000 (SNUC), recomendadas a cada cinco anos ou em qualquer tempo, quando necessário aos processos de gestão e benefícios aos objetivos das áreas protegidas. Nove das 24 UCs estaduais, não possuem seus planos de manejo, quatro Parques, dois refúgios de vida silvestre e três Reservas Biológicas, em que pese à criação da maioria a décadas.

Diante desta constatação foi necessária a limitação das análises deste estudo para avaliação de eficácia de gestão. As unidades de conservação estaduais do grupo de Proteção Integral são em número de 21. Para este estudo, foi possível analisar apenas 11 UCs, considerando o critério adotado. Os planos de manejo são documento prementes e basilares para a gestão destes espaços protegidos, neste sentido, a ausência deste documento de planejamento e gestão, decorre em prejuízos aos objetivos das APs, assim como para avaliação da efetividade nas ações para conservação da biodiversidade. São fundamentais como instrumento de gestão de áreas protegidas, considerados indispensáveis, pois “medem” como as unidades de conservação estão atingindo ou não, seus preceitos legais quanto à conservação da biodiversidade e processos de gestão em geral.

As avaliações de eficácia de gestão para as 11 UCs apresentaram de modo geral um padrão intermediário na classificação da efetividade da gestão, 18%, das UCs, o que demonstra que estão atingindo padrão de qualidade muito insatisfatório, 36% atingiram padrão insatisfatório ou médio, apenas 9% atingiram o padrão alto ou satisfatório e nenhuma apresentaram nível de excelência.

O presente estudo revelou nas 11 UCs analisadas uma tendência de moderadamente satisfatório a inferior ou insatisfatório, em relação aos padrões de qualidade da efetividade da gestão analisados. Apenas uma das 11 UCs atingiu padrão de qualidade alto ou satisfatório, perfazendo um total de 85,8%, sendo esta UC o Refúgio de Vida Silvestre Banhado dos Pachecos (RVSBP) e, nenhuma atingiu o padrão de excelência em qualidade de gestão e manejo.

As Unidades de Conservação estão inseridas em diferentes realidades do território estadual, o que também é levado em consideração, ponderando as ameaças e fragilidades as quais estão circundadas. Embora em um contexto geral entre as 11 UCs analisadas, não tenha resultado em gravíssimas ameaças em uma média geral, por meio do método aplicado, podemos destacar alguns fatores importantes de ameaças que individualmente a algumas UCs estão sendo afetadas de modo severo como: a plantação de monocultura e o escoamento de agrotóxicos das lavouras, que fazem limites com algumas das áreas estudadas, onde foram observadas em atividades de campo, destacando o Parque Estadual do Turvo, Estação ecológica de Aratinga, Parque Estadual das Tainhas. Estas questões têm tomado grande dimensão ao longo dos últimos anos, devendo ser observada e monitorada para medidas de mitigação por meio de políticas de gestão, entre outras ameaças avaliadas neste estudo, que incidem em menor gradiente de gravidade, entretanto, não menos importantes de serem monitoradas e acauteladas. Além disso, foi observada em todas as áreas, a presença de espécies exóticas e exóticas invasoras tanto de fauna como de flora, tendo esta ameaça uma forte influência das características da paisagem e usos do solo.

Alguns pontos a serem destacados que foram constatado na pesquisa nas UCs estudadas, que estão intrínsecas a eficácia de gestão destes espaços protegidos, e seus objetivos foram: a falta de estrutura física, bem como de manutenção as estruturas existentes; quadro funcional inadequado, ou inexistentes; necessidade de capacitação do quadro funcional para desempenho das funções compatíveis com o cargo; a fiscalização deficitária para proteção dos atributos protegidos; a necessidade de monitoramento ambiental; a disponibilidade de recursos financeiros para efetiva implementação e gestão atendendo as necessidades de cada UCs.

Estes resultados são bastante preocupantes em cenários futuros, uma vez que não tenham uma adequada gestão pelo poder público, havendo a necessidade de atualização dos planos de manejo que é norteador da gestão de forma dinâmica e adaptativa, sendo fundamental a presença de gestão técnica, devidamente qualificada, e equipe prevista em plano de manejo para a gestão de uma área protegida, que é complexa. Além disso, a destinação de recursos financeiros adequados e necessários para suprir as demandas e necessidades destas áreas. Outra questão que merece destaque trata-se da importância da regularização fundiária, que é crucial para os processos de gestão, o que ainda está bastante deficitário em algumas UCs estaduais criadas há décadas. A fiscalização ambiental, monitoramento das áreas por meio dos guardas-parques e /ou fiscais são prementes para salvaguarda dos bens ambientais, o que atualmente é muito precário possibilitando, sobretudo, a prática de crimes ambientais tais como: caça, pesca e coletas recursos florestais.

A falta de monitoramento e medidas para erradicação de espécies exóticas invasoras vem agravando-se e causando prejuízos à conservação nas UCs. A necessidade de planejamento, priorizando os espaços protegidos que estão ameaçados por invasões biológicas, tanto de flora como de fauna, é urgente uma vez que há existência de um programa específico no órgão gestor intitulado “Invasoras RS”. Esse programa tem grupo técnico designado formalmente, em ato legal, por meio da Portaria conjunta N° 32 de 04 de dezembro de 2020, entre a Fundação Estadual de Proteção Ambiental Henrique Luiz Roessler e Secretaria Estadual do Meio Ambiente e Infraestrutura do RS.

Diante do exposto, observa-se a necessidade de aliar componentes que abordem cada um dos elementos apresentados acima, para os processos de avaliação da efetividade das UCs, de forma a complementação de indicadores ao longo dos anos, conforme a necessidade, com ênfase nas etapas do ciclo de avaliação de gestão (contexto, planejamento, insumos e processos). Neste sentido, é importante mencionar que a Convenção sobre a Diversidade Biológica (CDB), realizada no ano de 2004, tendo o Brasil como um dos países signatários, deliberou quanto a necessidade de avaliações sistemáticas de efetividade de gestão das áreas protegidas. Este sistema ainda não implantado nas UCs estaduais, que também tem por responsabilidade avaliar as UCs municipais no estado por competência, de acordo com o Sistema Estadual de Unidades de Conservação (SEUC), vigente no RS, sendo indicado o mesmo procedimento aos municípios para melhoria nos processos de gestão e conservação das APs. Importante salientar o cumprimento dos acordos internacionais, sobre a Convenção da Diversidade Biológica (CDB, 2025), destacando alguns alvos tais como o Alvo 3, dentre

seus objetivos, pondendo as metas serem aplicadas através da Estratégia e Planos de Ação Nacionais de Biodiversidade (EPANB).

Diante da importância deste processo de avaliação de eficácia de gestão, o monitoramento torna-se fundamental, pois subsidia a gestão, por meio de dados periódicos e sistematizados, através da aplicação de parâmetros, indicadores e observações em campo, que devem ser estabelecidos de forma temporal e espacial, com objetivos específicos e dados que possam ser analisados e mensurados, promovendo a comparação, desta forma, utilizando-se de metodologias específica e padronizada, para a avaliação de eficácia de gestão.

A realização deste estudo foi motivada pela experiência técnica em gestão de UCs da autora do estudo, que definiu avaliar a situação que se encontravam as áreas protegidas geridas pelo Estado do RS, a fim de levantar as principais fragilidades e necessidades, embora que somente em parte destas UCs. Assim, com o propósito de contribuir ao órgão gestor, propondo que estas unidades de conservação, possam ser avaliadas de forma periódica, e que cumpram efetivamente com os propósitos de criação para manutenção e conservação de ecossistemas importantes, espécies associadas e seus processos ecológicos. Desta forma, que para além de seus objetivos básicos, as áreas protegidas, em especial as unidades de conservação, proporcionam benefícios imensuráveis a população humana, qualidade de vida, culturais, recreativas, educativas, e econômicos por meio dos serviços ecossistêmicos que prestam. As áreas protegidas precisam ser entendidas e valorizadas como um bem difuso e direito das futuras gerações, pois são espaços de manutenção da Biodiversidade, essencial aos processos vitais.

Por fim é fundamental o equilíbrio das atividades humanas e respeito à manutenção das áreas protegidas, que são bancos genéticos futuros para as próximas gerações. Espera-se que os resultados obtidos no presente estudo possam fornecer evidências reais e direcionar esforços de conservação para a gestão mais eficaz das Unidades de Conservação, alertando para as principais fragilidades e necessidades dessas APs, servindo de ponto de partida para aplicação as demais UCs estaduais e municipais, sobretudo, no estado do Rio Grande do Sul (RS).