



# A novel framework to evaluate the financial sustainability of marine protected areas

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## ARTICLE INFO

### Keywords:

Marine protected areas  
Marine protected area finance  
Conservation finance  
Management tools  
Marine conservation  
Parques Nacionales Naturales de Colombia  
Bonaire  
Belize  
Sustainable finance

## ABSTRACT

Marine Protected Areas (MPAs) are globally underfunded. We present a five-step framework that can help practitioners prioritize actions that may improve financial sustainability, which was applied to six MPAs in Colombia, Bonaire, and Belize. Limited funds were found to directly undermine effectiveness towards conservation goals for five sites, with these impacts particularly significant for four. Annual budgets required increases from 6 % to 141 % to meet financial needs. Two sites had significant underlying weaknesses in their financial strategies that could lead to direct impacts if not addressed, with an additional three sites having more minor, but still observable, weaknesses in this manner. Staff salaries were the largest expense for all MPAs examined and also most frequently in need of additional funds. Opportunities to potentially eliminate these funding gaps were identified for all six MPAs through reallocating existing resources ( $n = 2$ ), improving in-place mechanisms ( $n = 6$ ), or implementing one or more alternative mechanisms ( $n = 6$ ). Among several findings, some MPAs had the potential to increase tourism-based income by several million dollars per year, which would well exceed local financial requirements and could have substantial financial benefits on a network-wide scale. Some MPAs, including those with lower budgets, effectively leveraged partnerships and inter-institutional coordination to expand management capacity. Among alternative mechanisms that could be implemented, opportunities to leverage private-sector investments were especially common. Other MPAs around the world could likewise improve financial sustainability through analysis, evaluation, and execution of the full suite of options described herein.

## 1. Introduction

### 1.1. MPA Financial Sustainability

Marine protected areas (MPAs) are an important tool for conserving the ocean that can benefit nature and human well-being. Some MPAs enhance the preservation, restoration, and building of resilience of marine ecosystems against climate change (Aburto-Oropeza et al., 2011; Hoagland et al., 2019; Jacquemont et al., 2022; O'Leary et al., 2018; Roberts et al., 2017). They can also deliver important benefits including biodiversity enhancement, food provision, tourism, and climate change mitigation and adaptation (Brander et al., 2020; Jacquemont et al.,

2022; Medoff et al., 2022; Sala et al., 2013; Waldron et al., 2020). The Convention on Biological Diversity's 15th Conference of the Parties has adopted Target 3 to conserve 30 % of land and sea (Convention on Biological Diversity, 2022). Yet only 8.16 % of the ocean is currently protected ([www.protectedplanet.net](http://www.protectedplanet.net), February 22nd, 2023), and research consistently indicates that most of the ~18,000 MPAs in the world are not successful in reaching their conservation goals (Edgar et al., 2014; Gill et al., 2017).

One of the most frequent causes of ineffective MPAs, or "paper parks," is a lack of sufficient financial resources to support management and enforcement staffing (Edgar et al., 2014; Gill et al., 2017; Grorud-Colvert et al., 2021; Schultz et al., 2022; Thur, 2010). Logistical

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<https://doi.org/10.1016/j.biocon.2023.110083>

Received 11 December 2022; Received in revised form 11 April 2023; Accepted 14 April 2023

Available online 5 May 2023

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challenges of operating in marine environments makes them especially expensive over the long-term (Bohorquez et al., 2019). Limited financial expertise among MPA practitioners further inhibits the capacity for researching, identifying, and implementing financial solutions to alleviate shortfalls (Bertzky et al., 2012; MPA News staff, 2021).

Financial sustainability for MPAs requires financing that is sufficient, secure and consistent to support operations over the long-term (Bohorquez et al., 2019; Emerton et al., 2006). Some MPAs that once had sufficient funds have lost them due to shifting political and donor priorities, geopolitical events, and inadequate long-term financial planning (Thur, 2010). The success of marine conservation efforts, and their contribution to a healthy ocean, greatly depends on improving the financial sustainability of MPAs.

## 1.2. Knowledge gaps and research goals

Case-study based research that draws from practical knowledge of ground-level activities can inform MPA practitioners globally. Building on Bohorquez et al., 2022, we developed an analytical framework to identify strengths and weaknesses in MPA financial strategies and outline pathways for improvement. The framework was applied to six MPAs in Latin America and the Caribbean. Our approach and pilot tests can help practitioners evaluate these issues for the MPAs they manage. Our work also provides advice that may be broadly useful for MPA finance (see methods and supplementary material for full explanation of the framework).

## 2. Methods

We developed a structured framework to assess the financial sustainability of MPAs and identify pathways for improvement. The framework was developed concurrently with a series of case studies, MPAs in Latin America and the Caribbean, that then served as pilot tests

(Fig. 1).

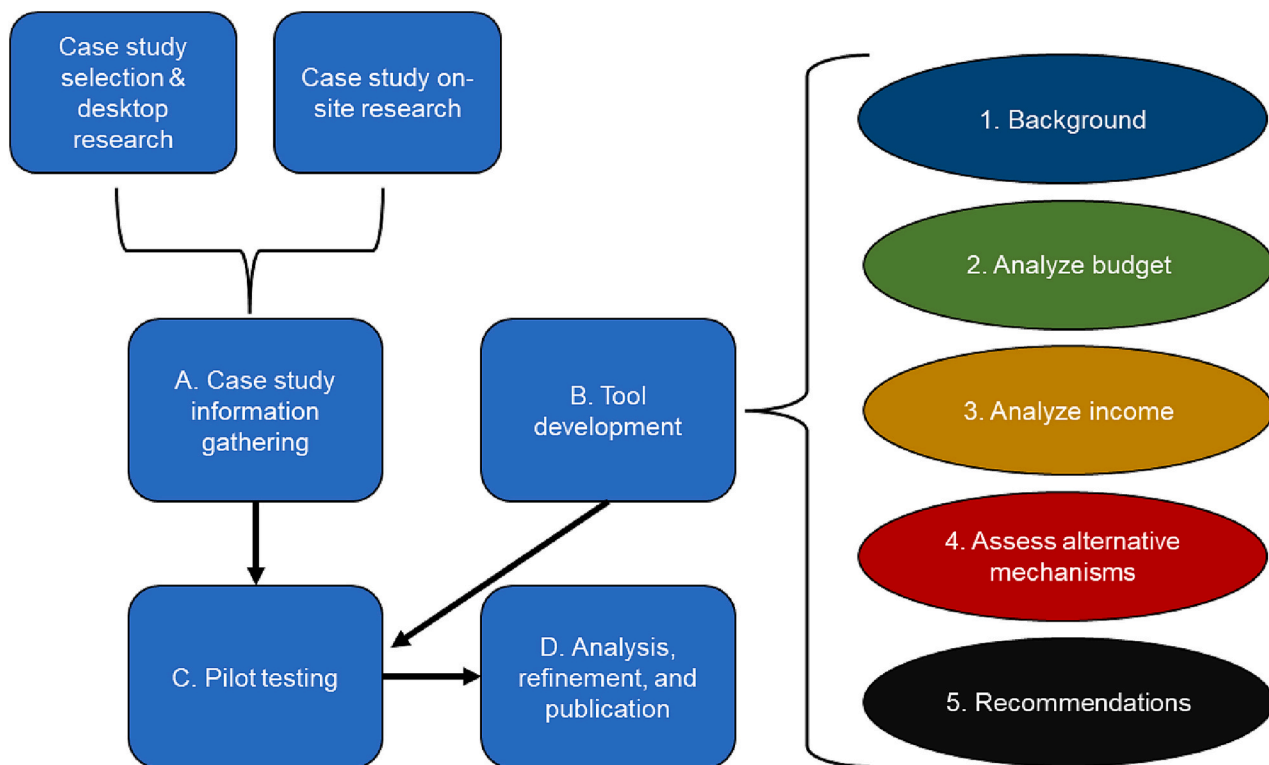
### 2.1. Information gathering

Six MPAs were selected as case studies to pilot the approach in Latin America and the Caribbean (Fig. 2) based on logistical feasibility and diversity across important characteristics for MPAs including governance (fully public, private, or co-managed), age, size, no-take status, and isolation (Edgar et al., 2014):

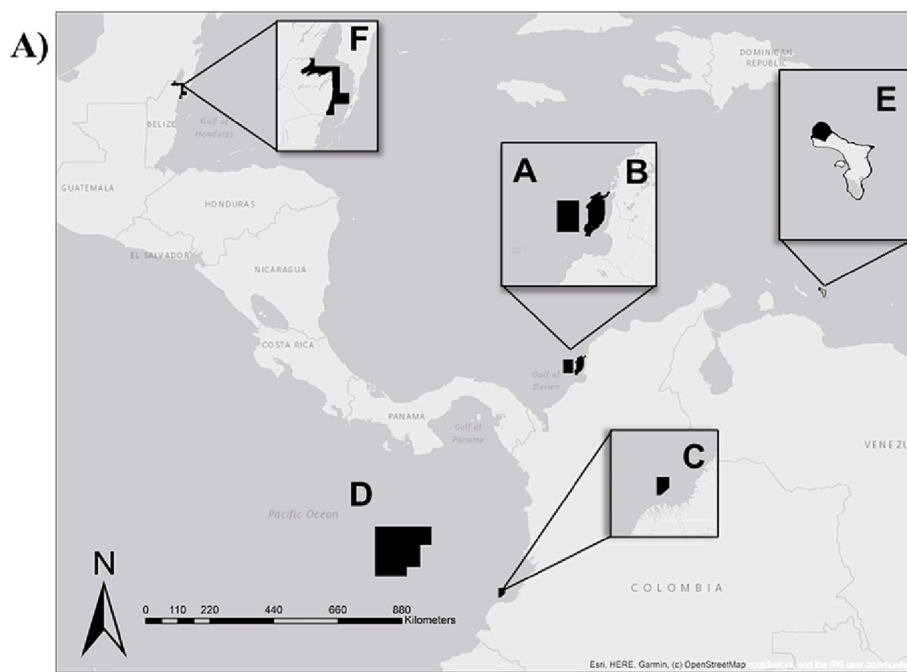
- Parque Nacional Natural Corales de Profundidad, Colombia – ‘PNN CPR’;
- Parque Nacional Natural Corales del Rosario y San Bernardo, Colombia – ‘PNN CRSB’;
- Parque Nacional Natural Gorgona, Colombia – ‘PNN Gorgona’;
- Santuario Flora y Fauna Malpelo, Colombia – ‘SFF Malpelo’;
- The Bonaire National Marine Park & Washington Slagbaai National Park, Bonaire, Netherlands Caribbean (analyzed as one PA) – ‘Bonaire’;
- Corozal Bay Wildlife Sanctuary, Belize – ‘Corozal Bay’.

We collected quantitative and qualitative information for each MPA. To be practical for MPA managers and practitioners, the case studies were assessed, and the framework designed, with only knowledge and resources that an MPA practitioner might have access to including internal documents, publicly available reports, staff input and local stakeholder knowledge. We reviewed 1) financial history (income, expenses, balance sheets), 2) the site’s management plan, and 3) semi-structured interviews with local stakeholders accompanied by a short survey to gain sufficient knowledge of each case site to complete the assessment.

Financial history, including annual line-by-line income and expenses, was collected for most case studies for 2015–2018, except for



**Fig. 1.** Steps for Research and Development: This flow chart demonstrates the steps for research, development, and application of the framework in alphabetical order from A through D. Case study research was performed prior to framework development to help inform the analytical procedure based upon available information. Numbers 1 through 5 indicate the five steps of the framework itself.



**Fig. 2.** Case Study Characteristics: A) Map showing locations for case study MPAs; (A) PNN CPR, (B) PNN CRSB, (C) PNN Gorgona, (D) SFF Malpelo, (E) Bonaire, and (F) Corozal Bay. B) Descriptive characteristics of each MPA with results from background survey (see methods and supplemental section 1). \*Malpelo is officially administered by the government, but has public-private-partnerships that support management objectives sufficiently that it was analyzed as a co-managed MPA for this exercise. \*\*Corozal Bay is officially no-take, but practically mixed use due to indigenous fishing in the area, and the park's management was working to legally transfer it to mixed use to aid enforcement.

**B)**

Name of MPA	Cor. de Prof.	Cor. del Rosario	PNN Gorgona	SFF Malpelo	Bonaire	Corozal Bay
<b>Country</b>	Colombia	Colombia	Colombia	Colombia	The Netherlands Caribbean	Belize
<b>Ocean Region</b>	Caribbean	Caribbean	Eastern Tropical Pacific	Eastern Tropical Pacific	Caribbean	Caribbean
<b>Year established</b>	2013	1977	1984	1995	1979	1998
<b>Annual visitors (2018)</b>	No Data	1,162,287	4,704	377	71,116	No Data
<b>Management type</b>	Government	Government	Government	Co-managed*	Private	Co-managed
<b>No-take status</b>	Mixed use	Mixed use	No-take	No-take	Mixed use	Mixed use**
<b>Survey Respondents</b>	7	5	7	7	13	7
<b>Interview Participants</b>	2	3	4	8	13	6
<b>Survey Results (Rating 0 - 4)</b>						
Effectiveness towards conservation goals	3.14 (Good)	2.80 (Good)	3.50 (Good-Excellent)	3.00 (Good)	2.58 (Fair-Good)	3.36 (Good-Excellent)
Financial sustainability	1.86 (Fair)	2.00 (Fair)	2.29 (Fair)	2.43 (Fair-Good)	2.86 (Good)	2.21 (Fair)
Budget for personnel relative to needs	1.00 (Below)	1.40 (Below-Equal to)	1.43 (Below-Equal to)	1.36 (Below-Equal to)	1.64 (Below-Equal to)	1.43 (Below-Equal to)
Budget for equipment and fuel relative to needs	1.57 (Below-Equal to)	1.40 (Below-Equal to)	1.71 (Equal to)	1.00 (Below)	1.85 (Equal to)	1.64 (Below-Equal to)
Quality of stakeholder relations	3.14 (Good)	2.40 (Fair-Good)	3.14 (Good)	3.43 (Good-Excellent)	2.17 (Fair)	3.29 (Good)
Inter-institutional communication and coordination	3.07 (Good)	2.60 (Fair-Good)	2.86 (Good)	3.00 (Good)	2.45 (Fair-Good)	3.57 (Good-Excellent)

PNN Gorgona for which expenses were limited to 2017–2018. Additional years were available for some MPAs and were used to identify and evaluate historical events that impacted financing. The most recent management plan for each site was also collected and reviewed.

Semi-structured interviews were conducted with stakeholders for each MPA, which included a series of multiple choice questions about the status and financial sustainability of the MPA (Fig. 2b, supplemental material section 1). These included the manager for every MPA as well as other site-, regional-, and national-level staff. Other stakeholders were interviewed as available including tourism operators, scientists & policy

experts familiar with the MPA, and representatives of fishing organizations. Most interviews for MPAs in Colombia were conducted on-site at management offices (November and December 2019). All interviews for Bonaire were also conducted on-site (February and March 2020).

The COVID-19 pandemic restricted in-person communication beginning March 2020. Some additional interviews were conducted remotely for Colombian case studies via web-conferencing (May 2020) and all interviews for Corozal Bay were performed remotely (April 2021). Follow up communication was conducted as necessary for all

case studies via web-conferencing, email, and messaging platforms (e.g. WhatsApp) up to June 2021.

A structured survey with eight questions was developed following field work in Colombia and applied in Bonaire and Corozal Bay in February through April 2020 (Fig. 2b and supplementary section 1). When possible, the survey was completed verbally concurrently with the semi-structured interview and helped guide the interview process. The survey was completed for as many participants from Colombia that had previously been interviewed as possible. Some participants completed the survey but did not participate in the formal interview. Participants were informed of the intended research purpose to evaluate financial sustainability of their respective MPA verbally or in writing prior to participating.

Some participants also voluntarily provided additional materials and documentation including financial analyses, capacity and performance assessments, and other relevant information. Desktop research was also performed for each area with an emphasis on impacts or activities important to financing and relevant stakeholders.

## 2.2. Analyzing financial sustainability

### 2.2.1. Analytical approach

We developed a five-step approach for assessing financial sustainability of currently operating MPAs and how MPAs can improve financial sustainability (Fig. 1):

- i. Background – How does finance directly or indirectly impact MPA effectiveness?
- ii. Analyze budget – How are current funds used, how much more are needed (the funding gap), and how can existing funds be used more impactfully or efficiently?
- iii. Evaluate current mechanisms – How reliable are in-place financial mechanisms and can they be strengthened or expanded upon?
- iv. Assess alternative mechanisms – What are the most feasible alternative financial mechanisms that could be implemented?
- v. Recommendations – What actions should be prioritized for improving financial sustainability?

This approach was designed to identify and prioritize actions to improve financial sustainability by (i) making most effective use of currently available resources, (ii) strengthening and maximizing in-place financial mechanisms, and (iii) identifying priority alternative financial mechanisms to pursue. A series of “Report Cards” were developed to present the results and primary takeaways for each of the five steps (see auxiliary excel file for the report card template and completed cards for case studies in supplementary section 2.3.). Methods varied slightly across each case study due to differences in information available.

We defined three different types of financial structures for MPAs based on how income generated by the MPAs was allocated (see case study summaries in supplemental material 2.3 for site-level specifics):

Closed-Loop: Income collected by the PA is kept by the managing agency for exclusive use at that PA;

Open-Loop: Income from the PA is collected by a higher government agency and reallocated for multiple purposes that may include other PAs, environmental programs, and spending not related to the environment;

Unidirectional: The MPA does not produce any income and there is no ‘financial return’ for funds invested in the MPA.

All three of these structures were represented within the six case studies. As a series of site-level analyses, it was assumed that all examples followed a closed-loop structure where any additional savings and income would be applied towards the funding gap at each site. Though in reality, those with open-loop and unidirectional structures would likely have limited influence and decision-making power regarding how

these are used.

### 2.2.2. Step 1: background

The goal of Step 1 was to describe how finance may be directly or indirectly relevant to the MPA’s effectiveness towards conservation goals. Direct impacts included whether a lack of financial resources was currently limiting effectiveness, such as enforcement activities being substantially limited by available personnel, equipment, or fuel. Indirect impacts included underlying weaknesses in the financial strategy that could eventually contribute to direct impacts if not remedied. Direct impacts were informed from stakeholder survey results and by findings from the budget analysis in Step 2 on the degree of the funding gap and specific needs requiring more funds. Indirect impacts were informed by the survey results and findings from Steps 2 and 3. Direct and indirect impacts were ranked on a three-part scale (Significant, Somewhat and Not Significant).

### 2.2.3. Step 2: analyze budget

Next, we evaluated how current funds are used, identified priority areas for additional resources, and investigated the potential for using existing financial resources more impactfully. Because accounting practices differed across MPAs, we organized annual operating expenses into a standardized set of 11 types of expenses (Results 3.1.).

We compiled a projected annual budget that represented typical long term annual operating costs for each site (Table 1) which was a composite of 2018 expenses (consistent recurring expenses) and historical averages (expenses with year-to-year fluctuations). We focused on expenses consistent with EBITDA (earnings before interest, taxes, depreciation, and amortization). Some MPAs in our study included depreciation and taxes among annual operational expenses, and these expenses were removed from the analysis. We also excluded programmatic funding that was not part of the core operational budget, unless programmatic funding could not be distinguished from other funds or if the MPA depended on programmatic funding for daily operations (e.g., Corozal Bay). Budgets were provided in local currency and were converted to USD according to 2018 annual average exchange rates provided by the World Bank.

We then derived the amount of additional funds required for the MPA to meet basic needs, or “minimum funding gap,” to inform recommendations for improving financial sustainability. The gap was estimated by evaluating pressing shortfalls in capacity (e.g. personnel, equipment, fuel, etc.) based on stakeholder interviews and surveys as well as internal capacity and performance evaluations. Historical figures for personnel, equipment, and other expenses were extrapolated on a site-by-site basis to estimate additional needs.

There was a high degree of uncertainty around each estimate so we used a range of potential values for each additional expense. These ranges followed a pre-defined scale: \$0 - \$10,000, \$10,000 - \$25,000, \$25,000 - \$50,000, and so on up to a maximum of \$1 million and up. The estimated funding gap was then a range based on the sum of the minimum and maximum values for each bracket.

The ‘severity’ of the funding gaps was categorized as Minor (0–25 %), Moderate (25–50 %), Major (50–100 %) or Severe (100 %+). As *minimum* funding gaps, these were intended to reflect basic needs to achieve the MPAs’ conservation goals based on present shortfalls and were not intended to reflect ideal or optimal funding scenarios. They also reflected long term operational costs and not large capital expenditures.

We did not apply previously published models that project MPA operational costs based on factors like area, purchasing power parity, distance from shore, and number of visitors (Balmford et al., 2004; Gravestock et al., 2008). These models were designed to estimate costs for MPA networks rather than to develop site level projections and did not directly inform our estimations for the funding gap. The exception was SFF Malpelo where we used them to project the increase in funding requirements for recent expansion of the area (supplementary material



**Table 1**

(A) Expenses and income includes the budget (composite and adjusted for purchasing power parity), number of paid employees, percent of budget to personnel, and income for each case study. Other Core Costs include undefined costs relevant to daily operations, such as contractual agreements, production of user fee tags, etc. Percentages with \* are based on 2 year running averages and \*\* based on 4-year running averages. (B) Step 1: How is finance relevant? PPP conversion factor for Curacao was used for Bonaire, adjusting for currency exchange rates with the Netherlands Antillean guilder.

(A) Expenses and income	Cor. de Prof.	Cor. del Rosario	PNN Gorgona	SFF Malpelo	Bonaire	Corozal Bay
Composite annual budget (USD 2018)	\$106,192	\$665,488	\$146,943	\$500,635	\$1,704,803	\$179,908
Budget adjusted for purchasing power parity (2018)	\$237,392	\$1,487,706	\$328,493	\$1,119,174	\$2,227,816	\$267,237
Paid employees	6	50	21	19	27	10
% to Personnel	58.6	45.1	58.3	50.7	68.4	36.9
% to Fuel	17.5	6.5	18.7*	5.2*	1.9	0.0
% to Equipment	15.1	3.1**	3.8	11.1**	4.5**	5.0**
% to Facilities	5.2	9.9**	10.7	4.1**	3.1**	1.8
% to Other Core Costs	0.0	20.5**	1.0	9.9	6.6**	30.6
% to Scientific Monitoring	0.0	0.0	0.0	9.7	2.3	2.4
% to Outreach & Education	0.4	0.3	1.4	0	6.3	15.9
% to Office Supplies	1.0	0.9	1.3	0.6	1.7	0.5
% to Travel	2.1	13.7	4.3	2.4	0.0	2.9
% to Events	0.0	0.1	1.0	0.9**	1.0	3.6**
% to Miscellaneous	0.1	0.0	0.0	5.3	4.1	0.3
Total income (USD 2018)	\$0	\$1,255,384	\$20,464	\$79,971	\$1,758,451	\$6198
(B) Step 1: Is finance relevant to effectiveness?						
Direct relevance	Significant	Significant	Somewhat	Significant	Not Significant	Significant
Indirect relevance	Somewhat	Significant	Somewhat	Somewhat	Significant	Not Significant

section 2.3.5., Table S28).

Potential opportunities to improve how current funds are used were then considered based on three types of observations. First, we tracked historical expenses and identified any major expense items that were unclear or otherwise potentially unnecessary.

Second, prior research has highlighted staff capacity as an extremely important indicator for MPA success (Gill et al., 2017) and we calculated the proportion of the budget that was allocated to staff. Expert consultation indicated that personnel costs should represent 60–70 % of the annual budget, but potentially as low as 50 % for MPAs in more remote areas (personal communication, Ramón de León, Nicolas Pascal, and Daan Vreugdenhil). MPAs that were outside of these ranges for personnel indicated potential inefficiencies in how currently available funds were used.

Third, we assessed the quality of stakeholder relations and inter-institutional communication and coordination. When possible, improving stakeholder relations could reduce frequency of violations that would reduce enforcement needs, or even encourage some stakeholders to support management and surveillance activities. Inter-institutional relations, including across co-management agencies and other law enforcement groups (e.g., navies) also provide opportunities to extend management and enforcement capacity and make most impactful use of the current budget.

#### 2.2.4. Step 3: Analyze financial mechanisms already supporting the MPA

We reviewed the financial mechanisms applied at each case study, including mechanisms that supported the budget and others that generated income from the park. We conducted in-depth evaluations of the three most prominent financial mechanisms for each site (with the exception of four for Malpelo), including strengths and weaknesses, reliability, and potential to increase funds generated by them.

We reviewed revenue from these mechanisms and events that triggered significant increases or decreases over time to identify factors that have impacted their success. This included both independent analysis of historical events and information as well as explanations from interview and survey respondents. Respondents were also asked about financial sustainability and challenges to financial sustainability for their specific MPA. These mechanisms were also evaluated against indicators of feasibility from a previously developed tool for evaluating financial mechanisms for MPAs (Bohorquez et al., 2022). Retroactive application of the tool for in-place mechanisms helped identify strengths and weaknesses among the financial mechanisms already serving the MPAs

based on which indicators of feasibility were present or not.

The potential to leverage additional funds from each existing mechanism was inferred by known inefficiencies (e.g., lack of compliance with fees), weaknesses that could be addressed, and internal documents that indicated potential for additional funding that had not been acted upon.

#### 2.2.5. Step 4: assessing alternative mechanisms

We identified potential future financial mechanisms with a previously developed tool from (Bohorquez et al., 2022). Mechanisms were organized and prioritized as follows:

- (i) Mechanisms were removed if they scored <50 %.
- (ii) They were categorized based on the proportion of the funding gap they could potentially offset as follows, ordered from highest to lowest: Majority (>50 % of the funding gap), Partial (10–50 % of the funding gap), and Supplemental (<10 % of the funding gap).
  - a. A fourth category, “scale up” was included for instances where a mechanism was potentially feasible, but would deliver funds above the needs of the MPA whereas the MPA could seek to “implement it” by lobbying for it on a network level.
- (iii) Within each category, they were ordered from highest to lowest based on the final score.

The amount of funds each mechanism could deliver were based on historical ranges (Bohorquez et al., 2022), and for some cases site level context (e.g., the area of mangroves protected by the MPA could indicate potential income from Blue Carbon). For mechanisms that delivered funds in single payouts, we assumed the funds would be placed into an endowment fund with a 4 % annual withdrawal rate such that a mechanism that delivered a single payout of \$100,000 would be equivalent to another that delivered \$4000 per year in perpetuity.

The report cards for each MPA in the supplementary material (Section 2.2.) include specifics for all mechanisms that scored above 50 %, and recommendations prioritized the top eight based on our criteria of framework score and funding potential.

#### 2.2.6. Step 5: recommendations

We prioritized recommendations for each MPA based on the potential to achieve financial sustainability (eliminating the funding gap) from outcomes defined in Steps 2, 3, and 4 respectively. The potential to achieve financial sustainability for each step was scored on a scale of

'Likely', 'Possibly', or 'Not likely'. The grading system for these outputs is described in detail in the supplemental material section 2.2. The recommendations for the case studies are discussed in full detail in the supplementary material section 2.3.

### 3. Results

#### 3.1. Case study descriptions

Our selected case studies successfully encompassed a diversity of environmental, management, and financial characteristics (Fig. 2). By age, these ranged from newly established sites (PNN CPR) to MPAs over 40 years old (Bonaire, PNN CRSB). Ecologically, they included coastal estuarine systems (Corozal Bay) and offshore pelagic zones (SFF Malpelo). Some had millions of visitors per year (PNN CRSB), while others had little, if any, tourism traffic (PNN CPR). Governance wise, the case studies ranged from fully government managed MPAs, privately managed MPAs, and co-managed MPAs managed by public and private groups.

The multiple-choice component of the survey also yielded insightful results on the context of each site (Fig. 2B). Based on opinions from participating stakeholders, effectiveness towards conservation goals ranged from "Fair-Good" to "Good-Excellent". Financial sustainability was more consistent, with four sites reporting only "Fair" ratings. SFF Malpelo and Bonaire were exceptions that reported slightly better financial sustainability at "Fair-Good" and "Good" respectively. All sites reported that personnel budgets were not equal to needs, with only PNN Gorgona and Bonaire reporting a budget for equipment and maintenance that met their needs.

Because of limited sample size and consistency in stakeholder types who participated across case studies, we generally limited our interpretation of these results and also refrained from more technical analyses including directly comparing and contrasting with the other results of the study in a statistical manner. Nonetheless, one intriguing outcome is that stakeholder relations were reportedly "Good" or better for all sites, except for PNN CRSB ("Fair-Good") and Bonaire ("Fair"), which were also closest to larger population centers and had the most visitor traffic. Interinstitutional coordination was also rated the lowest for these sites. Bonaire rated the highest for financial sustainability yet the lowest

for quality of stakeholder relations, interinstitutional coordination, and overall effectiveness towards conservation goals.

#### 3.2. Income and expenses

Annual budgets for case studies ranged from \$106,192 for PNN CPR (\$237,392 adjusted for purchasing power parity - PPP) to \$1,704,803 for Bonaire (\$2,227,816 adjusted for PPP) (Table 1). Four of six MPAs spent at least 50 % of their budget on staff, but PNN CRSB and Corozal Bay spent only 45.1 % and 36.9 % respectively. Reasons for these and other notable results are explained in the discussion. Budgetary shortfalls are explained in more detail in the Step 2 results and supplemental material section 2.

Two MPAs in the study, PNN CRSB and Bonaire, generated sufficient income to fully cover their annual operating expenses, primarily through daily and annual tourism entry-fees respectively. Particularly PNN CRSB that raised \$1.89 in income for every \$1.00 spent on operations. Though in the case of all MPAs in Colombia, including PNN CRSB, the MPA did not have control over the income which is collected by the Colombian Ministry of the Environment (Supplementary 2.3.1.).

#### 3.3. Results for financial sustainability assessment

Tables 1–5 reflect selected results from the financial sustainability analysis, with full site-specific results available in the supplementary Report Cards. The full results and recommendations for each case study, including additional qualitative discussion, are available in Section 2.3. of the supplementary material.

##### 3.3.1. Step 1 results: background and Impacts on MPA effectiveness

Insufficient financial resources were found to directly limit the effectiveness of all MPAs to varying degrees except for Bonaire which, with the increase in the fee effective July 2019, would be able to close its minor funding gap (Table 1). Finance was found to be indirectly relevant for PNN CRSB, Bonaire, and Corozal Bay as weaknesses in their current financial strategies were observed that could have more direct impacts on the MPA in the future if not addressed, such as overreliance on risky forms of funding or weakening stakeholder relations. PNN CPR and SFF Malpelo also had underlying or historical weaknesses, if less substantial,

**Table 2**

Results for Step 2 of the framework on (a) funding gap and (b) opportunities to improve impact or efficiency of existing resources.

II. Use of current funds	PNN CPR	PNN CRSB	PNN Gorgona	SFF Malpelo	Bonaire	Corozal Bay
<b>a) Funding gap</b>						
Minimum funding gap	Major to Severe (65.9 % - 141.3 %)	Moderate to major (27.0 % - 63.9 %)	Moderate (23.8 % - 51.0 %)	Moderate to major (40.5 % - 71.7 %)	Minor (10.9 % - 24.9 %)	Minor (5.6 % - 19.5 %)
Minimum funding gap (thousands \$/year)	70–150	180–425	35–75	203–359	185–425	10–35
Top funding priorities	Personnel, scientific monitoring	Facilities, equipment, personnel	Scientific monitoring, personnel	Personnel, equipment, fuel	Personnel, outreach & education, facilities	Personnel, equipment and fuel
<b>b) Opportunities to improve the effectiveness of current funds</b>						
Potential budget inefficiencies	No	Yes	No	No	Yes	Yes
Comments	Funding allocation is efficient.	Some expenses should be reviewed and re-evaluated if necessary; Other (20.5 %) & travel (13.7 %). Low personnel budget (45.1 %)	Funding allocation is efficient.	Funding allocation is low for personnel (50.7 %), but within expected range for a large remote MPA	High rate of turnover in senior staff may undermine capacity of personnel budget; could expand volunteer opportunities	Low for personnel, but could be explained by contracted labor and difficulty of paying salaries with programmatic funding.
Other actionable opportunities for improving effectiveness	Hire full-time manager to improve fiscal management and other full-time staff to limit labor gaps and turnover.	Improve stakeholder relations and inter-institutional coordination. Improve accounting and fiscal management.	None. Continue to invest in and maintain relations with tourism operators and the navy.	None. Continue to invest in and maintain relations with tourism operators and inter-institutional relations and coordination.	Important to improve stakeholder relations and communicate the importance of the MPA to locals.	None. Continue to maintain stakeholder relations and inter-institutional relations with other MPAs and the coast guard.

**Table 3**

Results for Step 3 of the framework, weaknesses and opportunities to improve or expand upon financial mechanisms already supporting the MPA, in order of highest to lowest amount of funds each brings to the MPA. Results from retroactively applying financial mechanism evaluation tool from Bohorquez et al., 2022 (Bohorquez et al., 2022).

III. Current financial mechanisms (top 3)	PNN CPR	PNN CRSB	PNN Gorgona	SFF Malpelo	Bonaire	Corozal Bay
Mechanism 1	Annual government budget	Annual government budget	Annual government budget	Philanthropic grants - BCC	Tourism entry and activity fees	Grants from NGO's, philanthropy, and international aid
Historic reliability	Moderate	High	High	Moderate	High	Moderate
Income generating	No	No	No	No	Yes	No
Evaluation score	48 %	62 %	64 %	82 %	60 %	63 %
Actionable options for improvement	Communication with higher management, broader research on economic benefits	None.	Communicate economic benefits for local region.	None.	Visitors center; mainstream online fee system; improve stakeholder relations; other	International designation or recognition (e.g. IUCN Green List, important bird area, other)
Potential for expansion	Yes, at least 12–28 %	Unknown	Yes, at least \$26 k	Unknown	Yes. At least \$1 - \$1.5 million, more if cruise ship passenger exemption eliminated.	Possible. Quantity unknown.
Mechanism 2	Multi and bi-lateral grants	Tourism entry fees	Tourism entry fees	Fondo patrimonial (trust fund)	Donations from various local and remote stakeholders	Grants from PACT (govt. conservation trust)
Historic reliability	Not year-to-year	Moderate	Moderate	High	Not reliable	Moderate
Income generating	No	Yes	Yes	No	No	No
Evaluation score	48 %	45 %	68 % - 74 %	N/A	50 % - 63 %	58 %
Actionable options for improvement	Better demonstrate economic benefits to local communities	Infrastructure; willingness to pay study; fee diversification; review collection agreement with local tourism office	Willingness to pay study; fee diversification across different activities	Monitor performance; re-evaluate distributions based on fluctuating currency exchange rates	Approach new donors (e.g. cruise companies); Improve physical presence with visitors center	Communicate economic benefits for local communities further
Potential for expansion	Unknown	Yes, by factor of 2 – 6x	Likely, quantity unknown	Yes, up to 80 %	Likely, quantity unknown	Unknown
Mechanism 3	N/A	Multi and bi-lateral grants	Tourism concession	Annual government budget	Grants from NGOs and Philanthropy	Tourism development services
Historic reliability		Not year-to-year	Moderate	Moderate	Not year-to-year	Moderate
Income generating		No	Yes	No	No	Yes
Evaluation score		62 %	68 % - 74 %	64 %	57 % - 68 %	54 %
Actionable options for improvement		Inclusion of communities in tourism economy; quality of financial reporting	Maximize tourist visitation and spending at the concession.	Produce management plan for the new expanded area (in progress.)	Investigate grants for socio-economic monitoring including carrying capacity study	None.
Potential for expansion		Unknown, received large grant in 2019	Unknown	Likely, quantity unknown	Unknown	Likely, quantity unknown

that should also be monitored or improved upon.

### 3.3.2. Step 2 results: budget analysis, funding gaps, and opportunities for greater impact

PNN CPR had the most severe funding gap and needed to increase its annual budget by 65.9–141.3 % to meet basic needs (Table 2). PNN CRSB, PNN Gorgona, and SFF Malpelo all needed to increase their annual budgets by ~25 % or more. Bonaire and Corozal Bay had minor funding gaps of <25 % of their annual budget. Personnel was a priority for additional funds for all sites except for PNN CRSB, where additional personnel were still needed but not as high a priority as other expenses (e.g., onsite infrastructure). PNN CRSB, Bonaire, and Corozal Bay may have potential budget inefficiencies based on funding allocation, and opportunities to increase the impact of existing resources and extend management capacity were identified for these MPAs.

### 3.3.3. Step 3 results: evaluation of in-place financial mechanisms

Government budgets comprised the majority of funds for PNN CPR, PNN CRSB, and PNN Gorgona. For SFF Malpelo and Corozal Bay, the primary source of funds came from philanthropic grants or donations, NGO grants, and international aid, with government budgets still being a principal source of support for SFF Malpelo. Only Bonaire was able to self-sustain on mechanisms, principally tourism entry fees, that did not encompass these more traditional ones.

We identified opportunities to improve the sustainability of at least one financial mechanism for each MPA (Table 3). Several of these in-place mechanisms had potential to raise additional funds, though the amount of additional funding was difficult to estimate. Others had clear, defined gaps in potential income, especially tourism entry and activity fees. Four MPAs generated income from tourism through entry and activity fees and/or concessions; PNN CRSB, PNN Gorgona, Bonaire, and

**Table 4**

Results for Step 4 of the analysis, priority alternative mechanisms to review for potential implementation based on the Bohorquez et al., 2022 financial mechanism evaluation tool (Bohorquez et al., 2022). Results depict the top three financial mechanisms to prioritize for each MPA from applying the evaluation tool from Bohorquez et al., 2022.

IV. Potential alternative financial mechanisms (top 3)	PNN CPR	PNN CRSB	PNN Gorgona	SFF Malpelo	Bonaire	Corozal Bay
Mechanism 1	Biodiversity offsets from oil & gas, shipping & transport, or telecomm industries	Loans from international aid groups, NGOs, or impact investors	On-site and local donations from tourists.	Loans from international aid groups, NGOs, or impact investors	Annual budget from the national Dutch government	Loans from international aid, NGOs, or impact investors
Financial mech. evaluation score	54 %	56 %	68 % - 70 %	56 % - 65 %	73 %	63 % - 66 %
Contribution to finance gap	Supplemental to majority	Supplemental to majority	Supplemental to partial	Supplemental to majority	Supplemental to majority	Supplemental to majority
Mechanism 2	Use rights for shipping & transit (passage fees) or telecom companies (right of way fees)	Blue carbon purchased by the government, international aid, NGOs, tourism, or vacation home owners	Fines and penalties from fishing and tourism	Environmental taxes from legal commercial fishing outside the area	Loans from an impact investor or NGO	Annual budget from Belize government
Financial mech. evaluation score	53 %	50 %	50 % - 68 %	50 %	65 %	58 %
Contribution to finance gap	Supplemental to majority	Supplemental to majority	Supplemental to partial.	Partial to majority	Supplemental to majority	Partial to majority
Mechanism 3	Volunteering & cost sharing with research institutes, tourism, oil & gas, shipping & transit, or telecomm industries	Volunteering and cost sharing from NGOs, tourism, and vacation homeowners	Loans from international aid groups, NGOs, or impact investors	Debt for nature swap (commercial swap) from international aid, NGOs, philanthropy, or impact investors.	Biodiversity offsets from coastal development and the cruise industry	Environmental taxes from coastal developers or tourism
Financial mech. evaluation score	52 % - 67 %	52 % - 69 %	56 %	56 % - 70 %	52 % - 63 %	54 % - 57 %
Contribution to finance gap	In kind. Supplemental to partial	In kind. Supplemental to partial	Supplemental to partial	Scale up.	Partial to majority	Supplemental to majority

**Table 5**

Potential to offset minimum funding gap by improving use of current resources, addressing weaknesses in current mechanisms, and implementing identified alternative mechanisms in consecutive order. See methods for details on ranking system.

V. Potential to alleviate financial shortfalls by addressing:	PNN CPR	PNN CRSB	PNN Gorgona	SFF Malpelo	Bonaire	Corozal Bay
1. Use of current financial resources	Not likely	Possibly	Not likely	Not likely	Possibly	Not likely
2. Weaknesses in current mechanisms	Possibly	Likely	Possibly	Possibly	Likely	Possibly
3. Potential for alternative mechanisms	Likely	Likely	Possibly	Likely	Likely	Likely

Malpelo. All had apparent room for improvement and systemic inefficiencies in tourism-based mechanisms are elaborated on in the discussion. Corozal Bay also raised income from a tourism development program that places local operators with visiting groups for a small placement and marketing fee, among other services.

### 3.3.4. Results for Step 4: evaluating and prioritizing alternative financial mechanisms for implementation

Results in Table 4 were prioritized by those that had the highest score from the evaluation tool and which could raise the most funds to offset the funding gap (see Methods for detail). Mechanisms that required an MPA to “scale up” efforts and pursue a network-based approach (if interested) were generally ruled out naturally through indicators for

institutional capacity in the Bohorquez et al., 2022 tool. Though there was one exception, debt-for-nature for SFF Malpelo, where this MPA had already leveraged funds from this mechanism before and had relatively high capacity as a large MPA with strong support from the government and NGOs. Additional site-specific research of priority mechanisms is required to fully evaluate their potential.

### 3.3.5. Results for Step 5: recommendations

We identified the potential for different actions to alleviate the funding gap for each MPA (Table 5). PNN CRSB and Bonaire had the potential to eliminate their funding gap by re-evaluating how current resources are used. They could also likely resolve financial shortfalls by expanding upon in-place mechanisms, with Bonaire already having



raised their user fee to take effect in 2019. Other MPAs could also expand on in-place mechanisms for the other four case studies, but the potential amounts of additional funds were less certain and therefore ability to meet needs was considered possible rather than likely.

Five MPAs could likely offset financial shortfalls by implementing at least one alternative mechanism. The one exception, PNN Gorgona, could still offset its funding gap by leveraging multiple mechanisms simultaneously (e.g., donations, debt finance from impact investors) or in combination with expansions to in-place mechanisms (e.g., diversification of tourism entry fees).

## 4. Discussion

### 4.1. Financial solutions for case studies

The financial sustainability assessment framework identified potential options to fully offset the funding gap for all six of the MPAs. This could be achieved through one of or a combination of reallocation of existing resources, modification of in-place financial mechanisms, and implementing one or more alternative mechanisms. The results imply that global MPAs may have a diversity of options available to them to improve their finances. When all potential options are evaluated and considered, some may be able to fully eliminate funding gaps and achieve financial sustainability.

Implementation may be limited by financial expertise among most MPA practitioners (Bertzky et al., 2012; Bohorquez et al., 2022; MPA News staff, 2021). Tools like the financial sustainability assessment framework used in this research, among others (Conservation Finance Alliance, 2001; Femmami et al., 2021; Meyers et al., 2020), can help build capacity. Further outreach efforts and peer-to-peer learning to demonstrate its applicability would be beneficial.

### 4.2. Broader takeaways for MPA finance

#### 4.2.1. Standardized and transparent financial reporting and accounting

Financial sustainability for some of these MPAs was sometimes challenged by unclear or inconsistent accounting methods. For example, budgets for national parks in Colombia were aggregated into only three line-items until 2015. According to one stakeholder, accounting was improved at the request of Colombia's National Planning Department to better track investments and fiscal management. This was an example of how clear and consistent financial reporting is important for government support and oversight. These features are also important for international public and private funds, such as Corozal Bay where organized and transparent financials were credited with attracting donor funds over the long-term.

Consistency of reporting methods across MPAs was critical for attracting and efficiently allocating funds, especially when emergency funds were needed on short notice. A participant from MAR Fund, which supports over a dozen MPAs in four countries along the Mesoamerican Reef including Corozal Bay, discussed how different budgeting practices across MPAs in their network (e.g., inconsistent distinction of programmatic versus core funds) sometimes challenged fundraising and allocation especially for relief funds during the COVID-19 pandemic.

Prior literature has also called for standardized financial reporting for MPAs, akin to other fields like global health, to help advance research and monitor budgeting and performance (Bohorquez et al., 2019; Cook et al., 2017). Other initiatives like the Paris Declaration on Aid Effectiveness also highlighted the need for standardized reporting for environmental causes (Bath et al., 2020). The standardized cost reporting method used for Step 2 of research could be applied for additional MPAs to begin building a global database of MPA budgets and expenditures (Tables 1 & S2). A similar standardized reporting tool could be applied to other marine sectors, which would be highly valuable as global ocean investments are often aggregated in national accounts and therefore difficult to define (Sumaila et al., 2021).

Strengthening financial acumen among MPA practitioners (MPA News staff, 2021) will also be crucial to improving financial reporting.

#### 4.2.2. Efficiency gaps in tourism-based funding

Tourism based income is a popular alternative to government and philanthropic funds (Peters and Hawkins, 2009; Reid-Grant and Bhat, 2009; Thur, 2010). Yet several studies have suggested that tourism prices could be increased for many user fee programs (Baird et al., 2017; Emerton et al., 2006; Reid-Grant and Bhat, 2009; Tongson and Dygico, 2004; Valderrama et al., 2018).

This research also identified room for improvement in every MPA with tourism income. The clearest opportunities were in the MPAs that had the highest visitation and income; PNN CRSB and Bonaire. The most immediate challenges were low fee compliance, exemptions for some groups of tourists, and other government actors levying independent fees upon visitors in addition to the MPA's entry fee (Supplemental 2.3.3 and 2.3.6.).

Recouping this income likely requires substantial investment in infrastructure, technology, and staff for both PNN CRSB and Bonaire. Gaining legislative support will also be necessary as some options to alleviate inefficiencies were restricted by local governance (see supplementary material). Stakeholder support, especially from tourism operators, is also of high importance for fee enforcement and raising fees without proper stakeholder consultations has caused friction at times in places like Bonaire. Debt financing (public and private) and other mechanisms to leverage the private sector could also support the required investments to reduce inefficiencies when revenue is sufficiently robust to service the debt. In addition to staff and infrastructure, such investments can also include technological advances, such as a digital fee collection system implemented in Bonaire that has the potential to improve fee compliance and stakeholder relations.

Tourism funding could also be improved by differentiating fees based on demographics and activities, while evaluating fees against methods like willingness-to-pay studies that estimate how much visitors may be willing to pay for access and can be used to inform prices (Peters and Hawkins, 2009; Thur, 2010). Willingness to pay studies were only identified for two locations in this study, of which only Bonaire was known to have incorporated the results into decision making (Maldonado, 2008; NOAA, 2012; Thur, 2010). In addition to identifying potential to raise fees, willingness to pay studies may also reveal that changes in the fee could influence rates of compliance and affect tourism traffic and broader economic consequences.

#### 4.2.3. Co-management and interinstitutional coordination can aid financial sustainability

SFF Malpelo and Corozal Bay were either officially co-managed or had public private partnerships where public and private organizations contributed to management objectives. SFF Malpelo received funds and logistical support from the Fundación Malpelo (via the Fondo Patrimonial de Malpelo) and Biodiversity Conservation Colombia (BCC), and Corozal Bay was managed day-to-day by the Sartaneja Alliance (SACD). Prior literature has described numerous benefits from these systems including facilitating the implementation of innovative financial mechanisms and promoting accountability across managing organizations (Clifton, 2003; Living Oceans, 2014; Sumaila et al., 2021; Ulate et al., 2018). This was observed for SFF Malpelo with the development of the Fondo Patrimonial which, among several benefits, contained provisions for continued participation of the government.

As private organizations, Fundación Malpelo, BCC, and SACD also had greater flexibility than government managers to independently raise external funds. In this context, co-management and public-private-partnerships provided opportunities for MPAs to achieve a greater degree of financial independence while retaining government funds and/or participation, and in the case of Malpelo to mitigate financial risks by developing a diverse portfolio of funding sources (Bovarnick, 2008; Cumming et al., 2021; Meyers et al., 2020; Phua et al., 2021).

But financial sustainability for all MPAs, most especially co-managed ones, also requires collaboration and interinstitutional coordination among stakeholder groups. For example, rangers often lacked the equipment, training, and legal authority to directly interdict with violators including boarding illegal fishing vessels and confiscating catch or equipment. All six of these MPAs called upon navies, coast guards, or police to support enforcement to varying degrees, from occasional calls for support to regularly accompanying MPA staff on patrols. Corozal Bay also coordinated with neighboring MPAs domestically in Belize and across international borders in Mexico for activities including joint patrols and reports of violations in the area. Other stakeholders like tourism operators, scientific groups, fishing cooperatives, or other organizations also provided in-kind support for activities including surveillance, transport, and management of tourism fees.

When effective, interinstitutional coordination can substantially extend the management and enforcement capacity of MPAs with limited budgets, including offsetting expenses and mitigating funding gaps. For example, PNN Gorgona had access to daily in-kind support from tourism operators and the navy. But in cases where interinstitutional coordination is lacking, inefficient use of financial resources can arise. For example, one participant reported that funds may have been used less efficiently in prior years for SFF Malpelo because relevant management groups were operating independently rather than in a coordinated fashion, which could lead to gaps and redundancies in management and enforcement activities. But these relationships can be delicate and MPAs must continually invest in them. MPAs in this research, including SFF Malpelo and PNN Gorgona, fostered some of these relationships through appointed personnel or organizations that acted as liaisons between the Colombian national parks program and the navy.

Some MPAs also fostered positive relations and coordination through formal agreements. PNN Gorgona had an agreement with the navy for a planned radar within the park that the navy would use to help aid the MPA's surveillance and enforcement efforts when able. Tourism operators in SFF Malpelo and PNN Gorgona were also contractually obliged to help with transport of personnel, supplies, and surveillance.

#### 4.2.4. Staff capacity and personnel budgets

Previous global studies have found that staffing is one of the most important indicators for MPA effectiveness (Gill et al., 2017). Terrestrial PAs have only a fraction of personnel needed to reach international goals, and there are likely similar patterns for MPAs (Appleton et al., 2022). All six MPAs we studied need to increase personnel budgets, which was the top priority for additional funding for four of them. Personnel also account for the majority of MPA funds, with salaries the largest expenditure of every MPA we studied and >50 % for four of them. Several experts we consulted who had performed or advised MPA financial planning suggested that MPAs allocate 60–70 % of their budget on personnel and as low as 50 % for MPAs needing high fuel and equipment budgets like offshore MPAs (methods, personal communications).

Evaluating personnel budgets revealed several opportunities to improve financial sustainability. Corozal Bay, which relies on outside donors and programmatic grants, only allocated 36.9 % of its annual budget to personnel reportedly due to donor-based restrictions on programmatic funds. Programmatic funding can also restrict the remit of employees, whereas salaries from unrestricted funds may allow staff to better meet personnel needs and adapt to changing contexts. Elsewhere, personnel budgets and capacity were impacted in Bonaire from high turnover, largely due to internal disagreements, that led to key senior positions frequently being unfilled for long periods of time. Additional resources were then needed for recruiting, on-boarding, and eventual training of new employees. In Colombia, most employees were hired on 11-month contracts, which has some advantages including more flexibility for hiring, but was also reported to sometimes lead to employment gaps due to contract turnover and hiring freezes.

Ensuring adequate staff capacity amidst broader financial

sustainability may call for multiple areas of action including communicating the importance of staff capacity to funders and taking measures to mitigate employee turnover.

#### 4.2.5. Mechanisms with current and future potential for MPAs

Globally, MPAs are typically supported by government budgets, philanthropic or NGO grants, and international aid (Berger et al., 2019; Deutz et al., 2020; Meyers et al., 2020; UNEP, 2022) and the MPAs in this study reflect similar patterns. While reliance on grants and donations can be especially risky, SFF Malpelo and Corozal Bay were able to find success despite these making up the majority of their finances. As previously described, both of these MPAs have found success under such circumstances in part from interinstitutional coordination. Corozal Bay has also maintained effective donor relations with the help of high-quality financial reporting, and the Fondo Patrimonial Malpelo – a trust fund – has helped allocate large donations overtime for SFF Malpelo in a sustainable manner while helping to maintain government support.

When looking at alternative mechanisms to support these case studies, debt financing from the private and public sectors was identified as a potentially feasible option for every MPA except for PNN CPR (Table 4). In contrast, all of the other MPAs already produced some form of income, primarily through tourism-based mechanisms, that can be used to underwrite and pay-back a loan. As being managed or supported by private organizations in some capacity, SFF Malpelo, Bonaire, and Corozal Bay were particularly well positioned to utilize this mechanism. Sound financial accounting and assets to serve as collateral, such as real estate and vessels, also position these MPAs for investment. Additional income generating mechanisms were potentially feasible for many sites as well, such as biodiversity offsets, fees for shipping and transport, and blue carbon, which can provide income on their own as well as be utilized to leverage additional investment.

Experts have highlighted the potential of private sector investments as a relatively underutilized source of support for conservation, including MPAs. Some organizations, such as Blue finance and the Global Fund for Coral Reefs, have joined a growing community that has begun to develop models and execute investments for MPAs and other marine conservation interventions (Meyers et al., 2021; Pascal et al., 2021; Victurine et al., 2022). Concerns remain about the scalability of such approaches, which can have several barriers to entry such as scale of investment (many opportunities are too small), risk/return profile, or lack of inclusion of some sectors in formal economies (e.g., small-scale fishing). The results from this study indicate that many MPAs may have important economic and management characteristics to support capitalizing on such opportunities, and that private finance has significant potential to augment government support. Blended finance mechanisms, embraced by programs like Blue finance and the Global Fund for Coral Reefs, are potential avenues to accelerate inclusion of private finance for MPAs (Meyers et al., 2021; Pascal et al., 2018; Victurine et al., 2022).

#### 4.3. Limitations and future research

This framework provides guidance on strengths and weaknesses of MPA financial strategies, while helping prioritize potentially feasible options for improvement. Feedback on the framework from the participating MPAs is a future research goal, and will be useful for reviewing the framework's accuracy and utility. Applying the framework to other geographical regions and sub-national or multinational MPAs, including MPAs in areas beyond national jurisdictions, would also be beneficial.

The case-study results reflect the status of the MPAs at the time of data collection in 2019 and early 2020. Political commitments and funding deals were made in Colombia and Belize in 2021 and 2022 to expand PA networks with hundreds of millions USD in additional funds (Colombia garantizó recursos para sus áreas protegidas durante los

próximos 10 años, 2022; PNN Colombia, 2022; The Nature Conservancy, 2021). The COVID-19 pandemic has also had widespread repercussions for MPA finance and management (Cumming et al., 2021; MPA News staff, 2020; Phua et al., 2021). While an already emerging area of study, significant additional research will be required on the impacts of COVID-19 on MPAs.

## 5. Conclusions: a diversity of options supports an optimistic outlook for MPA finance

We developed a replicable framework for assessing financial sustainability of MPAs around the world. Applying it to six case studies allowed us to identify strengths and weaknesses in financial strategies while charting a path forward to help managers and practitioners improve the financial sustainability.

Furthermore, this case study approach has demonstrated how context, challenges, and solutions for financial sustainability can vary dramatically across neighboring MPAs managed by the same organization, while identifying commonalities for distinct MPAs in different countries. The findings provide insights into global MPA finance and factors critical to long-term success. Some of the opportunities to improve MPA finance on a systemic level included; standardized and transparent financial reporting, eliminating inefficiencies in tourism-based revenue, diversified management structures like co-managed MPAs, interinstitutional coordination, and communicating the importance of staff capacity to funders. Widespread opportunities to scale private finance for MPAs may also be available.

Most importantly, through outlining potential pathways to financial sustainability for all six case studies, the work demonstrates that MPAs often have multiple opportunities spanning environmental, governance, managerial, and socio-economic contexts to improve their finances. It is likely that many more MPAs around the world are likely in similar positions to improve their financial wellbeing. However, leveraging the available solutions is contingent on improving financial expertise and capacity among MPA practitioners globally (Bertzky et al., 2012; Bohorquez et al., 2022; MPA News staff, 2021). Piloted using information and knowledge that many MPA managers likely already have access to, this framework can help improve that capacity. Further application and peer-to-peer learning would broaden its impacts for MPA finance and ocean conservation at large.

## CRedit authorship contribution statement

JJB; conceptualization, data curation, formal analysis, investigation, methodology, project administration, validation, visualization, writing original draft and review & editing. AD; Project administration, supervision, writing – review & editing. URS; supervision, writing – review & editing. JJ; supervision, writing – review & editing. JAN; supervision, writing – review and editing. EKP; funding acquisition, project administration, resources, supervision, writing – review & editing.

## Declaration of competing interest

All authors agree with the contents of the manuscript and its submission to the journal. The authors certify that there are no competing interests with the publication of this manuscript, financial nor otherwise. The content of the manuscript has previously appeared online in a dissertation by author JJB in 2021. The material has not been published nor is under consideration elsewhere.

## Data availability

Data will be made available on request.

## Acknowledgements

This work was made possible by the generous support of Pamela M. Thyne and John Frederick Thyne, the Ocean Sanctuary Alliance (OSA), and the Institute for Ocean Conservation Science (IOCS), and with logistical support from the Conservation Finance Alliance. The authors would like to thank the dozens of individuals across several institutions that participated in this research, especially Parques Nacionales Naturales de Colombia, Fundación Malpelo, Biodiversity Conservation Colombia, Fondo Acción, Conservation International-Colombia, INVEMAR, BIOFIN Colombia, STINAPA, Piskabon, Reef Support, the Mesoamerican Reef Fund (MAR Fund), the Sarteneja Alliance for Conservation Development, and Bruce Bowker of the Carib Inn (Bonaire) in memoriam. The authors also thank the editor and reviewers for constructive feedback.

## Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.biocon.2023.110083>.

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