

OA and Marine Spatial Management (including MPAs)

Provides operational guidance on using Ocean Accounts to support marine spatial management decisions.

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Last updated September 2026 **Responsible officer** Dr Jordan Gacutan

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OUTCOME

This Circular sets out how Ocean Accounts support marine spatial management decisions: Marine Protected Area designation and target tracking, effectiveness monitoring, and assessment of the economic impact of spatial restrictions.

Readers will learn how to apply ecosystem accounting outputs to three decision contexts:

- MPA designation: identifying priority areas for protection using extent and condition baselines, and tracking coverage against GBF Target 3 and SDG 14.5.1
- Effectiveness monitoring: tracking conservation outcomes through time-series condition accounts, and comparing protected against unprotected areas using a counterfactual design
- Economic impact assessment: quantifying how spatial restrictions affect ecosystem service flows and the sectors that depend on them

For each, Section 3.2 states the account types required, the key indicators derived, and the operational procedure. Section 3.6 works a full before-after-control-impact assessment through to an ecosystem enhancement entry in the monetary asset account.

Indicator method is not set here. Condition variables are normalised and aggregated following [TG-2.1 Aggregate Biophysical Indicators of Environmental State](#) Sections 3.4 and 3.6, which is normative for this Circular, and asset valuation follows [TG-3.1 Asset Accounts](#) Section 3.5.3. For the broader spatial planning context within which MPAs sit, see [TG-1.2 OA and Marine Spatial Planning](#).

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ABOUT THIS CIRCULAR

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DRAFT

¶1 ⓘ Framework Position

¶2 TG-1.3 applies the foundational Ocean Accounts concepts established in TG-0.1 to the specific governance context of marine spatial management and Marine Protected Areas. It bridges the Section 1 policy-decision guidance with the indicator derivation work in Section 2, demonstrating how extent and condition accounts compiled under SEEA EA methodology can directly inform MPA designation, effectiveness monitoring, and conservation finance decisions.

1. Outcome

¶1 This Circular sets out how Ocean Accounts support marine spatial management decisions: Marine Protected Area designation and target tracking, effectiveness monitoring, and assessment of the economic impact of spatial restrictions.

¶2 Readers will learn how to apply ecosystem accounting outputs to three decision contexts:

- ¶3 **MPA designation:** identifying priority areas for protection using extent and condition baselines, and tracking coverage against GBF Target 3 and SDG 14.5.1
- ¶4 **Effectiveness monitoring:** tracking conservation outcomes through time-series condition accounts, and comparing protected against unprotected areas using a counterfactual design
- ¶5 **Economic impact assessment:** quantifying how spatial restrictions affect ecosystem service flows and the sectors that depend on them

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2. Requirements

- ¶1 **TG-0.1 General Introduction to Ocean Accounts** – provides foundational understanding of Ocean Accounts components, including the distinction between ecosystem assets, environmental assets, and ecosystem services.

¶2 Readers approaching Section 1 for the first time should begin with **TG-1.0 Ocean Accounting and the Blue/Ocean Economy**, the framing circular for the section, which sets out the ocean economy terminology used throughout, what an ocean account can and cannot certify about a blue economy claim, and the map from a policy question to the circular that answers it. It is recommended reading, not a prerequisite.

3. Guidance Material

3.1 Marine spatial management and MPAs

¶1 Marine spatial management encompasses the governance mechanisms through which human activities in marine areas are planned, regulated, and monitored. This includes **Marine Spatial Planning (MSP)**, which organises the spatial allocation of ocean activities, and the designation and management of **Marine Protected Areas (MPAs)**, which restrict or regulate activities in specific geographic areas to achieve conservation objectives¹. For UNCLOS maritime zone definitions

(territorial sea, EEZ, continental shelf, ABNJ), see **TG-0.6 Glossary** (Exclusive Economic Zone entry). UNCLOS requires States to take measures to “protect and preserve the marine environment” (Part XII, Article 192) whilst recognising sovereign rights over resources within Exclusive Economic Zones (EEZs)². Achieving conservation targets set by international agreements – including the Kunming-Montreal Global Biodiversity Framework target to protect 30% of marine areas by 2030 – requires reliable information systems to guide MPA designation, monitor outcomes, and support adaptive management³.

¶2 The relevance of ocean accounts for marine conservation is recognised in CBD Decision 15/24 (2022), which encourages regional efforts towards ocean accounting and economic valuation of ecosystem services for marine and coastal biodiversity, and in related COP16 decisions on marine biodiversity⁴.

***Accounting boundary note:** This Circular applies only to national marine waters (territorial sea and EEZ). Some MPAs straddle EEZ boundaries or are established under high-seas treaty frameworks – including the recently adopted BBNJ Agreement (2023) – and these scenarios introduce attribution and accounting boundary questions that are not yet standardised in SEEA EA or international guidance. Where an MPA straddles the EEZ boundary, compilers should restrict the national Ecosystem Accounting Area (EAA) to the EEZ portion and note the transboundary extent and any jointly managed area in account metadata. Guidance on fully transboundary and Areas Beyond National Jurisdiction (ABNJ) accounting is the subject of potential future GOAP Technical Guidance work. Cross-reference **TG-1.2 OA and Marine Spatial Planning** for transboundary MSP considerations.*

3.2 Decision use cases for Ocean Accounts

3.2.1 Use Case 1: MPA designation and target tracking

¶1 **Decision context:** Countries must identify priority areas for protection to meet international commitments (Kunming-Montreal GBF Target 3: 30% of marine areas by 2030; SDG 14.5: at least 10% coverage) whilst ensuring ecological representativeness and connectivity. Designation decisions require baseline information on ecosystem distribution, condition, and irreplaceability.

¶2 **Account types required:**

- ¶3 **Ecosystem extent accounts** (SEEA EA Chapter 4) – record the spatial distribution and area of each ecosystem type within the Ecosystem Accounting Area (EAA), providing the foundation for calculating protected area coverage and assessing representativeness. For marine applications, extent accounts distinguish coastal and marine ecosystem types following the IUCN Global Ecosystem Typology, including seagrass meadows (M1.1), kelp forests (M1.2), photic coral reefs (M1.3), shellfish beds (M1.4), subtidal rocky reefs (M1.6), mangroves (MFT1.2), and pelagic water column ecosystems⁵.
- ¶4 **Ecosystem condition accounts** (SEEA EA Chapter 5) – document baseline ecosystem health at the time of designation using the Ecosystem Condition Typology (ECT), enabling identification of high-integrity areas warranting protection and degraded areas requiring restoration-focused management.
- ¶5 **Governance overlay on extent accounts** (drawing on SEEA EA Section 13.5 on ocean accounts and Appendix A13.3) – record existing MPA designations aligned with the Kunming-Montreal GBF classification (IUCN categories Ia-VI and Other Effective Area-Based Conservation Measures, OECMs) and spatial overlap with ecosystem types, enabling assessment of GBF Target 3 coverage across ecosystem types. SDG 14.5.1 coverage totals can be derived

from the same account by applying the relevant national definition; see **TG-2.10 Multilateral Environmental Agreement Indicators** for indicator derivation rules.

¶6 **Key indicators derived:**

- ¶7 MPA coverage as percentage of total marine area by ecosystem type (GBF Target 3 primary; SDG 14.5.1 complementary)
- ¶8 Representation index showing which ecosystem types are under- or over-represented in protected areas
- ¶9 Baseline condition index for newly designated MPAs

¶10 **Operational procedure:** Compilers first establish the EAA corresponding to national marine waters (territorial sea and EEZ). Ecosystem extent accounts are compiled using the IUCN GET marine ecosystem classification, at the spatial resolution set out in **TG-2.12 Spatial Data Frameworks** Section 3.3, which is normative for minimum mapping units and Basic Spatial Unit resolution. The question for an MPA agency is not what resolution to specify but whether the resolution of the accounts available for the area is fine enough to resolve the designation boundaries and habitat patches the decision turns on; where it is not, TG-2.12 Section 3.3 sets out the data sources that would improve it. Each BSU is attributed to an ecosystem type and protection status (IUCN categories Ia–VI, OECM, or unprotected). The extent account aggregates BSU areas by ecosystem type and protection status, producing a cross-tabulation that reveals coverage gaps. Condition accounts are compiled for a subset of high-priority ecosystem types (typically coral reefs, seagrass, mangroves) using available monitoring data. Reference conditions are established from historical baselines, comparison with protected reference sites, or ecological modelling. The resulting extent and condition data inform spatial prioritisation, with high-condition unprotected areas and low-representation ecosystem types identified as designation priorities.

3.2.2 Use Case 2: MPA effectiveness monitoring

¶1 **Decision context:** MPA managers and conservation agencies must assess whether protection is achieving intended outcomes – maintaining or improving ecosystem condition – and whether management interventions (zoning, enforcement, restoration) require adjustment. Effectiveness assessment requires comparison of outcomes against expectations or counterfactuals⁶.

¶2 **Account types required:**

- ¶3 **Ecosystem condition accounts** (time-series) – track changes in condition variables within MPAs across accounting periods, distinguishing abiotic characteristics (physical and chemical state), biotic characteristics (compositional, structural, and functional state), and seascape characteristics (connectivity, fragmentation). The time-series enables detection of trends and attribution of changes to management interventions versus external drivers⁷.
- ¶4 **Ecosystem asset accounts** (SEEA EA Chapter 10) – record ecosystem degradation (decline in condition) and ecosystem enhancement (improvement in condition) in monetary terms, enabling integration with economic accounts⁸ and assessment of whether protection is maintaining the natural capital base.
- ¶5 **Ecosystem services accounts** (SEEA EA Chapters 6–7) – measure changes in ecosystem service flows (fish provisioning, coastal protection, carbon sequestration, recreation) associated with changes in extent and condition, linking conservation outcomes to human wellbeing.

¶6 **Key indicators derived:**

- ¶7 Ecosystem Condition Index (ECI) trends for protected versus unprotected areas
- ¶8 Area under effective protection (combining extent with condition criteria)
- ¶9 Change in ecosystem service capacity attributable to protection

¶10 **Operational procedure:** Effectiveness monitoring requires establishing a baseline condition account at or near the time of MPA designation, followed by periodic re-compilation (annually for

intensively monitored sites, every 3–5 years for standard monitoring). Condition variables are selected from the ECT based on data availability and policy relevance, with priority given to variables responsive to management interventions (e.g., coral cover, fish biomass, water quality for marine reserves). Each condition variable is normalised against its reference value to produce a condition indicator on a 0–1 scale, with indicators aggregated into an overall Ecosystem Condition Index using area-weighted averaging. Comparing ECI trends inside versus outside MPAs provides evidence of protection effectiveness. Where condition is improving, this is recorded as ecosystem enhancement in the asset account, and where declining, as degradation. Reliable effectiveness assessment rests on counterfactual comparison: compilers should establish comparable condition accounts for unprotected control sites matched to MPA characteristics.

3.2.3 Use Case 3: Economic impact assessment of spatial restrictions

¶1 **Decision context:** Policymakers must assess the economic implications of MPA restrictions on fishing, tourism, and other marine uses, balancing conservation benefits against livelihood impacts and economic opportunity costs. This requires integrated environmental-economic analysis.

¶2 **Account types required:**

- ¶3 **Ecosystem services supply and use accounts** (SEEA EA Chapters 6–7) – record flows of provisioning services (wild fish, genetic resources), regulating services (coastal protection, climate regulation), and cultural services (recreation, education) from marine ecosystems to economic beneficiaries, enabling quantification of service flows before and after spatial restrictions.
- ¶4 **Monetary ecosystem services accounts** (SEEA EA Chapter 9) – value ecosystem services in monetary units consistent with SNA conventions, enabling comparison of ecosystem service values with GDP contributions from extractive industries.
- ¶5 **Extended supply-use tables** (SEEA EA Chapter 11) – integrate ecosystem services with conventional economic production, revealing dependencies of ocean-based industries on ecosystem service inputs and distributional effects of spatial restrictions across sectors.

¶6 **Key indicators derived:**

- ¶7 Ecosystem service value per hectare by protection status
- ¶8 Economic dependency ratio (ocean industry GDP / ecosystem service value)
- ¶9 Distributional incidence of MPA restrictions across sectors and communities

¶10 **Operational procedure:** Economic impact assessment begins with ecosystem services supply accounts that quantify service flows in physical units (tonnes of fish provisioned, volume of coastal protection service, recreation visitor-days). Supply is attributed to specific ecosystem assets (MPAs, adjacent fishing grounds) using spatial models that link ecosystem characteristics to service generation. Use accounts record which economic units (fishing enterprises, tourism operators, coastal households) receive these services. Monetary valuation applies methods consistent with SEEA EA Chapter 9: exchange values for provisioned fish, avoided damage cost for coastal protection, travel cost or contingent valuation for recreation. Comparing service values before and after MPA designation reveals net economic effects. Where MPA restrictions reduce extractive service flows (reduced fishing area) but enhance long-term service capacity (stock recovery, habitat restoration), the extended supply-use framework enables integrated assessment of short-term costs versus long-term benefits.

¶11 Where primary valuation data (travel cost surveys, contingent valuation studies) are not available, compilers should apply the following tiered framework:

- ¶12 **Tier 1 – Primary valuation study available:** Apply stated methods directly (exchange values, avoided damage cost, travel cost, contingent valuation).
- ¶13 **Tier 2 – No primary study; comparable study available in region:** Apply benefit transfer from a comparable regional study. Compilers must document transfer errors and provide an ex-

explicit comparability assessment (ecosystem type, service type, socio-economic context, and study quality) following SEEA EA Chapter 9 guidance.

- ¶14 **Tier 3 – No comparable study available:** Report physical supply-use accounts only. Flag monetary values as not available and note this limitation in the statistical disclosure metadata.

¶15 For detailed guidance on ecosystem services valuation, see **TG-2.4 Environmental (including Ecosystem) Goods and Services**.

3.3 Ocean accounts for monitoring ecosystem health

¶1 The accounting approach rests on three properties: completeness (covering all relevant ecosystem types within the MPA boundary), consistency (applying the same classifications and methods across accounting periods), and coherence (ensuring data from different sources can be integrated)⁹.

3.3.1 Establishing baseline accounts

¶1 When an MPA is designated, compiling baseline accounts establishes the starting point against which future changes can be measured. Baseline ecosystem extent accounts document the spatial distribution of ecosystem types at the time of protection, providing the foundation for monitoring changes in habitat coverage – for example, detecting expansion or contraction of seagrass meadows or coral reef area.

¶2 Condition variables are selected and normalised following the procedure in **TG-2.1 Aggregate Biophysical Indicators of Environmental State** Sections 3.2–3.4, which is normative for this Circular. Every condition indicator in this Circular, including those in the worked example in Section 3.6, is derived using the TG-2.1 Section 3.4.1 transformation $\text{Indicator} = (V - L) / (U - L)$, with the inverse-polarity and logarithmic-scale variants set out there. Both an upper reference (**U**) and a lower reference (**L**) are required for every linearly transformed variable; an upper reference alone is not sufficient. For marine ecosystems, relevant condition variables may include those summarised in Table 1.3.1 below. In the Ocean Accounts Framework (TG-0.1 General Introduction to Ocean Accounts), the economic pressures that drive changes in the chemical state variables – such as nutrient loading and pollution discharge – correspond to Edge E1 (pollution/residuals from economy to environment).

¶3 **Table 1.3.1: Marine ecosystem condition variables relevant to MPA baselines**

Class	Variables
Abiotic physical state	Water temperature, salinity, turbidity, current patterns, bathymetric characteristics.
Abiotic chemical state	Dissolved oxygen, pH (ocean acidification), nutrient concentrations, pollutant levels.
Biotic compositional state	Species richness, community composition, abundance of indicator species, presence of threatened species.
Biotic structural state	Coral cover percentage, seagrass canopy height and density, kelp forest biomass, mangrove stem density.
Biotic functional state	Primary productivity, fish recruitment rates, trophic structure, decomposition rates.
Seascape characteristics	Habitat patch size distribution, connectivity between reef systems, fragmentation of coastal wetlands.

¶4 SEEA EA recommends measuring condition relative to a reference condition that reflects, where possible, the natural or undegraded state of the ecosystem (SEEA EA para 5.69)¹⁰. For marine ecosystems, establishing appropriate reference conditions may require drawing on historical data, scientific literature, expert knowledge, or comparison with similar unimpacted areas.

¶5 Table 1 illustrates a simplified ecosystem condition account structure for an MPA.

¶6 **Table 1: Illustrative ecosystem condition account for a marine protected area**

Condition Variable	Indicator	U (upper reference)	L (lower reference)	Baseline (Year 1)	Year 5	Condition Index (Year 5)
Abiotic: Physical						
Water clarity	Secchi depth (m)	25	5	18	21	0.80
Abiotic: Chemical						
Ocean pH	pH units	8.2	n/a ¹¹	8.05	8.03	0.70
Biotic: Compositional						
Fish species richness	Species count	120	30	85	102	0.80
Biotic: Structural						
Coral cover	% cover	40	5	22	28	0.66
Seagrass density	Shoots/m ²	800	100	450	580	0.69
Seascape						
Habitat connectivity	Index (0-1)	0.9	0.2	0.6	0.65	0.64

¶7 Lower reference values in this illustration are indicative. Compilers must establish both anchors from national or regional evidence and document them, following TG-2.1 Section 3.4.2.

3.3.2 Condition indices and aggregation

¶1 Individual condition variables can be aggregated into composite condition indices to provide summary assessments of ecosystem health. An ECI value of 1 indicates reference condition, whilst values below 1 indicate degradation¹².

¶2 Aggregation methods, the default among them, and their implications for interpretation are set out in **TG-2.1** Section 3.6. The worked example in Section 3.6 of this Circular uses the arithmetic mean across condition variables, and the area-weighted mean across habitat sub-accounts, in both cases following TG-2.1.

¶3 Figure 1.3.1 sets out the four sequential steps by which heterogeneous condition variables are measured, normalised against baseline condition, compiled and aggregated to a composite ECI, and then tracked across accounting periods.

1 Measure condition variables

natural units · per ecosystem accounting area

Each selected variable is observed in its own physical unit for the ecosystem asset (one MPA reef-and-seagrass asset shown).

CONDITION VARIABLE	MEASURED (CURRENT)	BASELINE CONDITION
Water clarity (Secchi depth)	21 m	25 m
Ocean pH	8.03	8.2
Fish species richness	102 species	120
Coral cover	28 %	40 %
Seagrass density	580 shoots/m ²	800
Habitat connectivity	0.65 index	0.90

● Abiotic ● Biotic ● Seascape (Ecosystem Condition Typology classes)

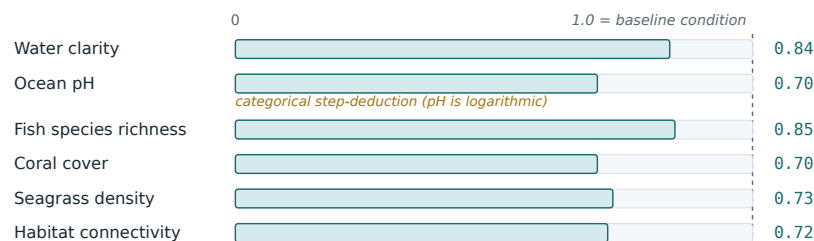
rescale to 0-1

2 Normalise against baseline condition

dimensionless 0-1 indicator

indicator = observed ÷ baseline condition, capped at 1.0 (1.0 = at baseline; lower = degraded).

Variables now share a common scale, which is what makes them comparable for aggregation in step 3.

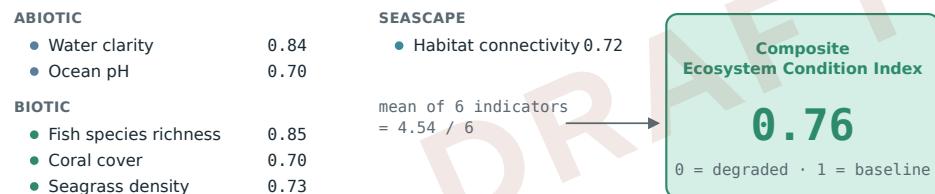


compile & aggregate

3 Compile condition account & aggregate

arithmetic mean → composite ECI

The 0-1 indicators are entered in the condition account, grouped by ECT class, then aggregated (default: arithmetic mean).



track over time

4 Track composite ECI over accounting periods

effectiveness monitoring

Re-compiling the account each period yields a trajectory, assessed against a management target and a critical threshold.

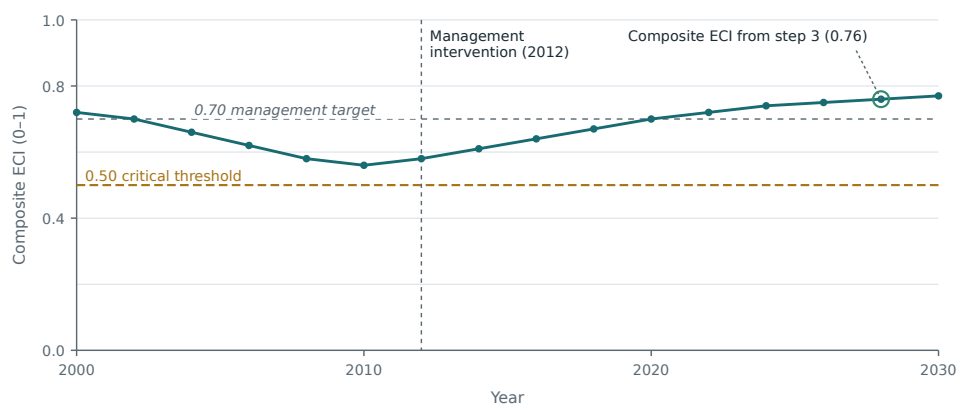


Figure 1.3.1 Four panels show how measured condition variables become a composite MPA Ecosystem Condition Index tracked against management thresholds. Values are illustrative. Scale is 0–1 against each variable’s own baseline, not min–max across variables.

Source: SEEA EA 2024 ch. 5 (ecosystem condition accounts, variables, indicators and reference levels); IUCN-WCPA protected-area management-effectiveness framework. See TG-1.3 (MPA condition assessment) and TG-2.1 (aggregate biophysical indicators).

Adapted from: SEEA EA 2024 §5.69 and Table 5.1 (condition indicators, reference levels, categorical abiotic variables).

¶4 For MPA management, condition indices can be constructed at different scales: individual ecosystem assets (e.g., a specific reef), ecosystem types within the MPA (e.g., all coral reef area), or the entire protected area. Tracking changes in these indices over time provides a quantitative basis for assessing whether management interventions are achieving conservation objectives.

3.4 Measuring MPA effectiveness

3.4.1 Accounting for ecosystem degradation and enhancement

¶1 SEEA EA provides explicit accounting treatments for changes in ecosystem condition.

Ecosystem enhancement is defined as “the increase in the value of an ecosystem asset over an accounting period that is associated with an improvement in the condition of the asset during that accounting period” (SEEA EA para 10.15), whilst **ecosystem degradation** is defined as “the decrease in the value of an ecosystem asset over an accounting period that is associated with a decline in the condition of the ecosystem asset during that accounting period” (SEEA EA para 10.21)¹³. These accounting entries enable tracking of whether ecosystems within MPAs are improving (net enhancement), stable (no net change), or declining despite protection (net degradation).

¶2 The accounting framework distinguishes between changes due to human activity (recorded as degradation or enhancement) and changes due to natural processes (recorded as other changes in volume). This distinction is analytically important for MPA assessment – for example, distinguishing coral decline due to reduced local pressures (management success) from decline due to thermal stress associated with climate change (external driver). Attribution of observed condition changes to drivers should draw on expert assessment, scientific literature, or statistical attribution studies.

¶3 Where the source or causality of a condition change cannot be reliably attributed to either anthropogenic or natural drivers, compilers should **not** attempt to disaggregate the change between “degradation” and “other volume changes.” Instead, record the total condition change without attribution and document the limitation in account metadata. Recording the change without attribution mirrors the treatment in extent accounts, where planned and unplanned additions and reductions are recorded separately only when reliably known (SEEA EA para 10.21; see also SEEA EA guidance on extent-account planned/unplanned changes). Cross-reference **TG-2.8 Climate Change Indicators** for attribution approaches when climate drivers are a principal confound.

¶4 Where decline is observed in both protected and unprotected areas and scientific evidence links the decline to climate-driven thermal stress, the change may be attributed to natural processes (other volume changes) rather than management failure. Where decline is observed only in poorly enforced MPAs but not in well-enforced sites experiencing similar environmental conditions, the differential may be attributed to management effectiveness and recorded as anthropogenic degradation.

3.4.2 Ecosystem services as effectiveness indicators

¶1 Changes in ecosystem services flow provide another dimension for assessing MPA effectiveness. Table 3.4.2 below summarises four ecosystem service effectiveness indicators that accounts can track to assess whether protection is maintaining or enhancing the capacity of marine ecosystems to deliver services.

¶2 **Table 3.4.2: Ecosystem service effectiveness indicators for MPA assessment**

Ecosystem Service	Effectiveness Indicator
Fish provisioning	Monitoring fish biomass and catch per unit effort in areas adjacent to no-take zones to assess spillover effects
Coastal protection	Measuring changes in wave attenuation capacity of reef systems or mangrove forests within the MPA
Carbon sequestration	Quantifying carbon storage in seagrass meadows, mangroves, and other blue carbon ecosystems
Recreation and tourism	Recording visitor numbers, satisfaction levels, and economic contributions from MPA-based tourism

¶3 For detailed guidance on compiling ecosystem services accounts for marine ecosystems, see **TG-2.4 Environmental (including Ecosystem) Goods and Services**. The combined presentation of ecosystem and economic accounts is addressed in **TG-3.8 Combined Presentations**.

3.4.3 Counterfactual analysis

¶1 Credible effectiveness assessment often requires counterfactual analysis – comparing outcomes within the MPA against what would have occurred without protection. The counterfactual approach requires selecting control sites that are comparable to the MPA in terms of baseline ecosystem characteristics, environmental conditions, and human pressure levels, but differ in protection status. Condition accounts are compiled for both MPA and control sites using identical variable selection, reference conditions, and aggregation methods. The difference in condition trends between MPA and control sites provides an estimate of the protection effect.

¶2 Three principal counterfactual designs are applicable:

- ¶3 **Before-After-Control-Impact (BACI)**: Strengthens the effectiveness estimate by controlling for regional trends that affect both sites where baseline data from before designation exist.
- ¶4 **Matching-based approaches**: Applicable where baseline data from before designation are unavailable but a pool of candidate control sites with comparable characteristics exists.
- ¶5 **Regression discontinuity designs**: Applicable where a continuous spatial or temporal running variable at the MPA boundary can be defined.

¶6 Each design should be applied according to standard counterfactual-design practice for the specific study context. Minimum data requirements depend on the research question, expected effect size, and spatial and temporal grain of available monitoring data; no universal thresholds are prescribed here. Where none of the designs is feasible due to data limitations, compilers should report descriptive condition trends with an explicit caveat that causal attribution is not supported by the available data.

3.5 Linking accounts to conservation targets

3.5.1 SDG 14 and marine conservation

¶1 The 2030 Agenda for Sustainable Development includes SDG 14 “Life Below Water” with targets directly relevant to marine spatial management. SDG Target 14.5 calls for countries to “conserve at least 10 per cent of coastal and marine areas, consistent with national and international law and based on the best available scientific information,” with indicator 14.5.1 measuring “coverage of protected areas in relation to marine areas”¹⁴. SDG Target 14.2 addresses sustainable management and protection of marine and coastal ecosystems, monitored through indicator 14.2.1 on “proportion of national exclusive economic zones managed using ecosystem-based approaches.”

¶2 Ecosystem extent accounts can directly inform reporting on protected area coverage, whilst condition and services accounts support assessment of whether protection is achieving intended ecosystem management outcomes. The alignment between ocean accounts and SDG 14 indicators is detailed in **TG-2.10 Multilateral Environmental Agreement Indicators**.

3.5.2 Kunming–Montreal Global Biodiversity Framework

¶1 The Kunming–Montreal Global Biodiversity Framework, adopted at CBD COP15 in December 2022, establishes the ambition to protect 30% of marine areas by 2030 (Target 3) and to ensure that areas under protection are “effectively conserved and managed” through “ecologically representative, well-connected and equitably governed systems of protected areas”¹⁵. The Framework explicitly calls for integration of biodiversity values into national accounting processes (Target 14), and related CBD decisions have recognised the role of ocean accounts in supporting marine conservation⁴.

¶2 The GBF Target 3 coverage classification is the primary framing for the governance overlay on extent accounts in this Circular (see Section 3.2.1). The GBF classification distinguishes IUCN categories Ia–VI¹⁶ and Other Effective Area-Based Conservation Measures (OECMs) as defined under the KM-GBF. SDG 14.5.1 coverage totals can be derived from the same account as a complementary indicator¹⁷. Compilers should not maintain duplicate or competing coverage tables.

3.5.3 Corporate reporting and private-sector engagement

¶1 The Taskforce on Nature-related Financial Disclosures (TNFD) has developed recommendations for businesses to assess and report on nature-related dependencies, impacts, risks, and opportunities. Ocean Accounts compiled for MPAs provide data on ecosystem condition and services that can contribute to such assessments. Guidance on mapping ocean account outputs to specific corporate disclosure frameworks – including the TNFD LEAP approach (Locate, Evaluate, Assess, Prepare) – falls within the scope of private-sector-focused Technical Guidance circulars rather than this NSO-facing circular. For organisations seeking to use national ocean account statistics in corporate reporting, the mapping is set out in **TG-1.11 OA and the Private Sector** Section 3.3, with the LEAP approach in Section 3.2.

3.5.4 Adaptive management and decision cycles

¶1 Accounts support adaptive management by providing a systematic basis for tracking outcomes and adjusting strategies. The cyclical nature of accounting – with regular updates to extent, condition, and services data – aligns with adaptive management frameworks that emphasize learning from management interventions and adjusting approaches based on observed results.

¶2 For MPA managers, accounts can inform decisions such as:

- ¶3 Zoning adjustments based on observed changes in ecosystem condition
- ¶4 Resource allocation priorities based on identification of degraded areas requiring restoration
- ¶5 Stakeholder engagement supported by clear communication of ecosystem trends
- ¶6 Investment decisions supported by assessment of ecosystem services benefits

3.6 Worked Example: MPA Effectiveness Assessment

¶1 This section presents a synthetic worked example demonstrating how ecosystem condition accounts can be applied to assess MPA effectiveness using a before–after–control–impact (BACI) design. All data are hypothetical but structured to illustrate operational procedures.

3.6.1 Scenario

¶1 A coastal nation designated a 15,000-hectare marine protected area in 2018 to protect coral reef ecosystems. The MPA includes 3,500 ha of coral reef habitat, 4,000 ha of seagrass meadows, and 7,500 ha of pelagic water column. Management objectives include maintaining coral cover above 30%, improving fish biomass to within 20% of unfished levels, and ensuring water quality meets reference conditions for pH and nutrient levels. A control site of comparable size and baseline characteristics but without protection restrictions was identified 50 km away.

¶2 The worked example in Sections 3.6.2–3.6.7 focuses on the **coral reef** sub-account (3,500 ha). Section 3.6.8 extends the example to the **seagrass meadow** sub-account (4,000 ha) and demonstrates area-weighted ECI aggregation across benthic habitat types.

3.6.2 Baseline condition account (2018)

¶1 At the time of designation, baseline condition accounts were compiled for both the MPA and control site using field surveys, remote sensing, and water quality monitoring. The following condition variables were measured:

¶2 **Table 2: Baseline condition variables for MPA and control site (2018)**

ECT Class	Variable	Unit	Polarity	U (upper reference)	L (lower reference)	MPA Baseline	Control Baseline
Physical state	Water clarity	Secchi depth (m)	Normal	20	4	14	13
Chemical state	pH	units	Logarithmic	8.2	n/a	8.05	8.04
Chemical state	DIN	mg/L	Inverse	0.1	1.0	0.4	0.5
Compositional	Fish biomass	kg/ha	Normal	600	60	180	170
Structural	Coral cover	%	Normal	40	5	22	20
Structural	Seagrass density	shoots/m ²	Normal	750	75	400	380

¶3 Notes: DIN = dissolved inorganic nitrogen. Upper reference values are based on regional historical data and comparison with remote pristine sites; lower reference values on regional records of fully degraded sites of the same habitat type. Both anchors are required by the TG-2.1 Section 3.4.1 transformation and must be documented (TG-2.1 Section 3.4.2). pH uses the categorical step deduction in TG-2.1 Section 3.4.1 and takes no lower anchor. Fish biomass reference represents a single-species maximum sustainable yield benchmark (B_{MSY} estimated at approximately 40% of unfished biomass) used here for the provisioning service assessment context (Use Case 3); for ecosystem-level condition accounting (Use Cases 1 and 2), an unfished or near-pristine biomass reference is more appropriate. See SEEA EA Chapter 5 (reference conditions) and FAO Technical Guidelines for Responsible Fisheries No. 4.¹⁸

3.6.3 Normalising condition indicators

¶1 Each condition variable is normalised to a 0–1 scale using the transformation in **TG-2.1** Section 3.4.1, applying the polarity recorded for it in Table 2:

- ¶2 **Normal polarity** (water clarity, fish biomass, coral cover, seagrass density): $\text{Indicator} = (V - L) / (U - L)$
- ¶3 **Inverse polarity** (DIN): $\text{Indicator} = (L - V) / (L - U)$
- ¶4 **Logarithmic scale** (pH): the categorical step deduction, $\text{Indicator} = 1.00 - (0.10 \times n)$, where n is the number of complete 0.05-unit steps in the deviation D

¶5 Indicators are capped at 1.00 and clamped at 0; any observation beyond an anchor is noted in account metadata. Composite indices below use the arithmetic mean across the six variables, following TG-2.1 Section 3.6.

¶6 *Worked check (MPA water clarity, 2018):* $(14 - 4) / (20 - 4) = 10 / 16 = 0.63$. *Worked check (MPA DIN, 2018):* $(1.0 - 0.4) / (1.0 - 0.1) = 0.6 / 0.9 = 0.67$. *Worked check*

(MPA pH, 2018): $D = 8.2 - 8.05 = 0.15$, which falls in the $0.15 \leq D < 0.20$ band, so $n = 3$ and the indicator is $1.00 - 0.30 = 0.70$.

¶7 **Table 3: Baseline condition indicators (2018)**

Variable	MPA Indicator	Control Indicator
Water clarity	0.63	0.56
pH	0.70	0.70
DIN	0.67	0.56
Fish biomass	0.22	0.20
Coral cover	0.49	0.43
Seagrass density	0.48	0.45
Mean ECI	0.53	0.48

3.6.4 Monitoring results (2024)

¶1 After six years of protection and enforcement, condition monitoring was repeated at both sites using identical protocols.

¶2 **Table 4: Monitoring results and condition indicators (2024)**

Variable	MPA 2024	MPA Indicator	Control 2024	Control Indicator	Change (MPA)	Change (Control)
Water clarity (m)	17	0.81	12	0.50	+0.18	-0.06
pH	8.00	0.60 ¹⁹	7.98	0.60 ¹⁹	-0.10	-0.10
DIN (mg/L)	0.25	0.83	0.55	0.50	+0.16	-0.06
Fish biomass	340	0.52	160	0.19	+0.30	-0.01
Coral cover (%)	30	0.71	18	0.37	+0.22	-0.06
Seagrass (shoots/m ²)	520	0.66	350	0.41	+0.18	-0.04
Mean ECI		0.69		0.43	+0.16	-0.05

3.6.5 Effectiveness interpretation

¶1 The MPA site recorded improvement in condition (ECI increased from 0.53 to 0.69), whilst the control site recorded decline (0.48 to 0.43). The treatment effect – the difference in change between MPA and control – is +0.21 points on the ECI scale (MPA change +0.16; control change -0.05; treatment effect = $0.16 - (-0.05) = 0.21$), indicating that protection contributed approximately 21 percentage points of condition improvement beyond background environmental trends.

3.6.6 Ecosystem asset accounting

¶1 The condition improvement in the MPA is recorded as **ecosystem enhancement** in the monetary ecosystem asset account. The two method choices this requires – perpetuity or finite horizon, and the functional form linking condition to service capacity – are set out in **TG-3.1 Asset Accounts** Section 3.5.3 and must be documented in account metadata.

¶2 This illustration applies a perpetuity, on the basis that the designation has no terminal date, and a linear condition-to-service scaling as a screening-level approximation only. Both are choices a compiler must justify rather than defaults.

1. ¶3

Baseline asset value (2018): the coral reef ecosystem within the MPA (3,500 ha) generated ecosystem services valued at USD 500/ha/year at baseline condition (ECI = 0.53). At a 4%

discount rate in perpetuity, the baseline asset value = $(\text{USD } 500/\text{ha} \times 3,500 \text{ ha}) / 0.04 = \text{USD } 43.75 \text{ million}$.

2. ¶4

Current asset value (2024): after condition improvement to $\text{ECI} = 0.69$, linear scaling gives a service flow of $\text{USD } 500/\text{ha} \times (0.69 / 0.53) = \text{USD } 650.94/\text{ha}/\text{year}$. Current asset value = $(\text{USD } 650.94/\text{ha} \times 3,500 \text{ ha}) / 0.04 = \text{USD } 56.96 \text{ million}$.

3. ¶5

Ecosystem enhancement: the increase in asset value attributable to improved condition = $\text{USD } 56.96\text{M} - \text{USD } 43.75\text{M} = \text{USD } 13.21 \text{ million}$ over the six-year period, or approximately $\text{USD } 2.20 \text{ million per year on average}$.

¶6 Because the scaling is linear, the enhancement figure moves in direct proportion to the ECI ratio, and any error in the condition indicators propagates undamped into the asset value. See **TG-2.4 Environmental (including Ecosystem) Goods and Services** for service flow estimation methods.

3.6.7 Limitations and caveats

¶1 This worked example simplifies several aspects of real-world MPA assessment:

- ¶2 **Attribution:** The analysis assumes the difference between MPA and control outcomes is attributable to protection, but other factors (differential enforcement, community engagement, coincident management interventions) could contribute.
- ¶3 **Baseline comparability:** Perfect matching of control sites is rarely achievable; residual differences in baseline characteristics may confound treatment effects.
- ¶4 **Spatial heterogeneity:** Within-MPA variation in condition may be substantial; the example presents aggregate figures but operational assessments should examine spatial patterns.
- ¶5 **Temporal lags:** Ecosystem responses to protection occur at different timescales; six years may be insufficient for slow-responding variables (e.g., structural complexity, apex predator recovery).
- ¶6 **Condition-to-service scaling:** Linear scaling is used here as a screening-level approximation only. Operational asset valuations should apply empirically calibrated functional forms, following TG-3.1 Section 3.5.3.
- ¶7 **Reference anchors:** Both the upper and lower reference values in Table 2 are illustrative. Because the transformation is bounded by the two anchors, the choice of lower reference moves every indicator and therefore the treatment effect; anchors must be evidenced and documented (TG-2.1 Section 3.4.2).

3.6.8 Extending to seagrass and other benthic sub-accounts

¶1 The same BACI procedure applied to the coral reef sub-account in Sections 3.6.2–3.6.7 can be extended to seagrass meadows and other benthic habitats present within the MPA. Appropriate condition variables for a seagrass sub-account include percent cover, shoot density (shoots/m²), and epiphyte load (as an indicator of eutrophication pressure). Other benthic sub-types (e.g., soft-sediment benthos, shellfish beds) should use variables appropriate to their IUCN GET functional group. So that managers and reporting agencies can distinguish habitat-specific trends from over-all MPA condition, sub-type ECIs should be **reported separately alongside the aggregate MPA ECI** – not only as components of the aggregate.

¶2 The MPA-wide aggregate is the area-weighted mean of the sub-type ECIs, following **TG-2.1** Section 3.6.1.

¶3 **Table 5: Illustrative area-weighted ECI aggregation across benthic sub-accounts (2024)**

Sub-account	Area (ha)	ECI (2024)	Area × ECI
Coral reef	3,500	0.69	2,415

Sub-account	Area (ha)	ECI (2024)	Area × ECI
Seagrass meadow	4,000	0.65*	2,600
Total / Aggregate	7,500	0.67	5,015

¶4 *Illustrative seagrass ECI based on percent cover, shoot density, and epiphyte load indicators, normalised against upper and lower references using the same TG-2.1 Section 3.4.1 transformation as the coral reef sub-account.*

¶5 Pelagic sub-accounts (7,500 ha in this scenario) are excluded from this aggregation for want of condition data, and the excluded area is stated with the index as TG-2.1 Section 3.6.1 requires. Practitioners with pelagic condition data (e.g., chlorophyll-a, dissolved oxygen, plankton biomass) may extend the area-weighted ECI to include a pelagic component using those variables and the same normalisation procedure.

4. Acknowledgements

¶1 **Authors:** [To be confirmed]

¶2 **Reviewers:** [To be confirmed]

5. References

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- ¶9 United Nations. (2021). *System of Environmental-Economic Accounting – Ecosystem Accounting*. Chapter 2: Principles of ecosystem accounting.
- ¶10 United Nations. (2021). *System of Environmental-Economic Accounting – Ecosystem Accounting*. Para 5.69: Reference conditions.
- ¶11 pH is measured on a logarithmic scale and does not use the linear two-anchor transformation. The categorical step deduction in TG-2.1 Section 3.4.1 applies instead: reference 8.2, observed 8.03, deviation 0.17 units, which falls in the $0.15 \leq D < 0.20$ band, so $n = 3$ and the indicator $= 1.00 - 0.30 = 0.70$.
- ¶12 United Nations. (2021). *System of Environmental-Economic Accounting – Ecosystem Accounting*. Section 5.4: Ecosystem condition indices.
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- ¶17 United Nations. (2021). *System of Environmental-Economic Accounting – Ecosystem Accounting*. Chapter 12: Links to broader assessment frameworks.
- ¶18 FAO. (1997). *FAO Technical Guidelines for Responsible Fisheries No. 4: Fisheries Management*. Rome: FAO. See also FAO Fisheries Technical Paper 347 (Garcia, 1994) for biological reference points including B_{MSY} .
- ¶19 Both pH indicators use the categorical step deduction in TG-2.1 Section 3.4.1. MPA pH 8.00: $D = 0.20$, which falls in the $0.20 \leq D < 0.25$ band, so $n = 4$ and the indicator $= 1.00 - 0.40 = 0.60$. Control pH 7.98: $D = 0.22$, also

in the $0.20 \leq D < 0.25$ band, so $n = 4$ and the indicator = 0.60. Control mean ECI = $(0.50 + 0.60 + 0.50 + 0.19 + 0.37 + 0.41) / 6 = 2.57 / 6 = 0.428$, rounded to 0.43. Rounding convention: individual indicators are reported to two decimal places, and the mean ECI is rounded to two decimal places after summing the six rounded indicators.

DRAFT