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Carrying Capacity Assessment for Tourism in Coron and El Nido: A Step toward Sustainable Management of Marine Ecosystems

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KEY POINTS

- Coron and El Nido's ocean ecosystems are an invaluable resource for blue ocean ecotourism in the Philippines.
- Rapid and unmanaged ocean tourism growth threatens the sustainability of these ecosystems.
- A key management tool for sustainable ocean ecotourism site management is the concept of environmental carrying capacity.
- Determining environmental carrying capacities requires a combination of a science-based assessment at specific sites, an understanding of the current impact on the biophysical environment, and agreement among stakeholders on capacity limits and when to apply them.
- Retrofitting capacity limits based on environmental carrying capacities is complicated by existing investment in ocean tourism infrastructure.
- Environmental carrying capacity determinations based on scientific principles provide a solid framework for the use of blue ocean resources.
- Phased introduction of environmental capacity limits based on an experimental approach with a sound monitoring and evaluation system is likely to work with all stakeholders.

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INTRODUCTION

In 2018, it was estimated that globally, 350 million people traveled to a destination containing coral reefs. Coral reef tourism has an estimated annual value of $36 billion, covering over 70 countries (Fosse et al. 2019). While profitable, the environmental impact of coral reef tourism has been problematic (Tonazzini et al. 2019). The coronavirus disease (COVID-19) has paused ocean ecotourism, but it is likely that this activity will resume its fast growth trajectory after the pandemic.

A key element in ensuring that marine ecosystem tourism services are used sustainably is to put in place the necessary management systems and safeguards to prevent irreversible damage to coral reef ecosystems (Armono et al. 2017). Among a range of policy tools for the sustainable management of ocean resources is an understanding of the sustainable carrying capacity of the coral ecosystems to provide services to tourists and other users over time.

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ADB

The problems associated with rapid tourism growth are well-illustrated at the Coron and El Nido municipalities in northern Palawan in the Philippines. Uncontrolled growth in the absence of necessary urban services infrastructure and ocean and tourism enterprise management has the potential to negatively impact their ocean ecosystems and the services they provide.

In this context, the Asian Development Bank (ADB) provided technical assistance (TA) to the Government of the Philippines to formulate more sustainable visions for the development of their destinations and to design the necessary urban services infrastructure and management systems, for a more sustainable outcome for their ocean resources.[1]

This brief provides a better understanding of the approaches and experiences developed under the TA in conducting carrying capacity assessments at key coral reef ecotourism sites in Coron and El Nido. It first provides an overview of the two ocean ecotourism destinations. The approach to defining initial environmental carrying capacities (ECCs) for selected sites in Coron and El Nido—as well as the results—are presented. The main challenges in the actual application of the ECC are then discussed.

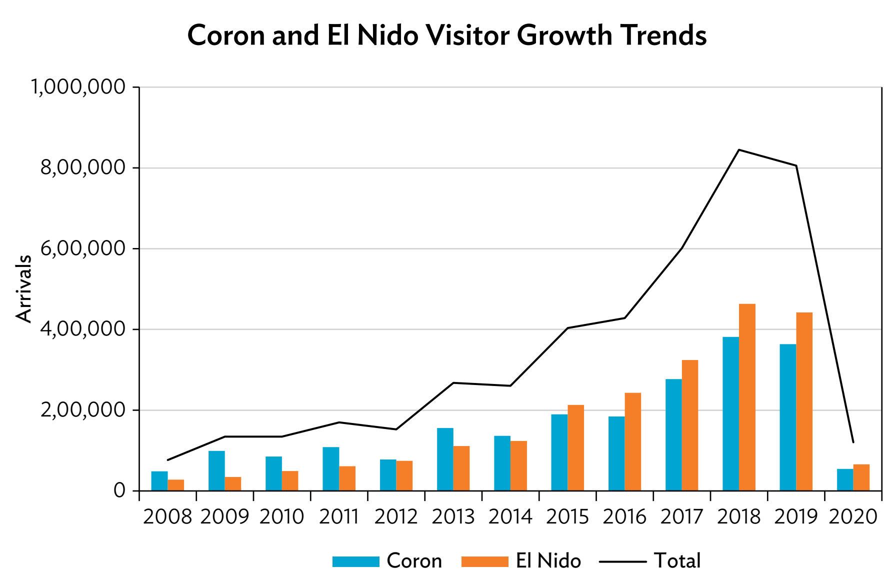
OVERVIEW OF ECOTOURISM

Coron and El Nido municipalities are located in the northern part of the island Province of Palawan in the Philippines, which is situated within the Coral Triangle. Both are major destinations for marine-based ecotourism in the country.

As with northern Palawan, the landscape of Coron and El Nido is dominated by dramatic karst geomorphology set within a still relatively pristine coastal and island marine environment.

Extensive areas of coral reef, seagrasses, and mangrove stands are in relatively good condition. The marine environment of the two destinations supports one of the richest fisheries areas in the Philippines. Aside from their rich coastal and islands ecosystems, extensive areas of El Nido have been designated as part of the El Nido–Taytay Managed Resource Protected Area (ENTMRPA). Barangay Bintuan in Coron is where 12 World War II shipwrecks are clustered. Coron and El Nido towns function as the main access hub for tourists to northern Palawan, arriving by air and sea to Coron, as well as by road to El Nido from the provincial capital of Puerto Princesa.

From modest beginnings in 2008, when the two areas hosted 76,815 tourist arrivals, tourism increased rapidly by 25% per year to around 903,166 by 2019. By 2019, tourists stayed an average of 4–5 days, spent around $424.5 million in the local economies, and supported 1,904 mostly small-scale enterprises employing 8,588 people—about 38% of the total workforce. The rapid increase in tourism was driven by the strong interest in blue ocean ecotourism complemented by improved air, sea, and road accessibility, and enhanced destination marketing and investment in accommodations and related facilities and services.



Source: Asian Development Bank. 2020. *Southeast Asia Urban Services Facility for the Preparation of Philippines Sustainable Tourism Development Project*. Manila.

[1] This brief draws from the reports prepared by the regional TA on: Southeast Asia Urban Services Facility for the Preparation of Philippines Sustainable Tourism Development Project (STDP) in 2020.

The primary activity of visitors to the two areas is island hopping and related activities such as snorkeling, diving, swimming, and sight-seeing. A significant fraction (estimated at 724,000 or around 85 % of total arrivals) engage in snorkeling and diving to explore coral reefs, and in the case of Coron, to view its shipwrecks.[2] In the evenings, the main activities are dining out, visiting bars, shopping for souvenirs, and promenading the main streets of the two towns. January to May are the peak tourism months in both areas. December and June to August are the "shoulder" months. The off-season months occur in September, October, and November where the monthly pattern flattens due to weather and transport capacity constraints.

The Sustainable Environmental Management Project for Northern Palawan (SEMP-NP), undertaken by the Japan International Cooperation Agency on behalf of the Palawan Council for Sustainable Development (PCSD), provides the primary framework for policy regarding tourism development and operations in northern Palawan. This identified the main marine tourism clusters (MTCs) and marine tourism sites (MTSs) in the Coron (Map 1) and El Nido (Map 2) destinations. In Coron, the main clusters are the Coron Island MTC 1 with 16 MTSs, the Bintuan–Concepcion MTC 2 with 11 MTSs, the Maricaban Bay MTC 3 with 17 MTSs, and the East Coast MTC 4 with 5 MTSs. In El Nido, these are Bacuit Bay MTC 1 with 42 MTSs, Poblacion–Villa Libertad MTC 2 with 26 MTSs, Nacpan–Daracotan MTC 2 with 46 MTSs, and Imorgue–Shark Fin Bay MTC 4 with 8 MTSs.

Table 1 provides the estimated volume of site visits in the main marine tourism clusters (MTCs) of each destination. The total volume of site visits in Coron in 2018 is significantly lower (1.55 million) compared to those in El Nido with 4.06 million visits. This reflects the larger volume of tourists and boat excursions, larger number of sites, and larger number of sites visited per tour in El Nido.

In Coron, the Coron MTC with almost 80% of site visits, dominates the number of site visits in the destination, followed by the Bintuan MTC with around 18%, and the other two with estimated very small shares at no more than 1% each. In El Nido, the Bacuit Bay MTC dominated total visits, accounting for over 85% of visits, followed by the Poblacion–Villa Libertad MTC with just over 12%, and the other two MTCS accounting for very small shares of total site visits. The volume of visits to specific sites in the top two clusters in each destination is provided in Table 2. This shows that visitor volumes at key sites in the top two MTCs of both destinations are substantial, and especially so in the Bacuit Bay MTC in El Nido where peak day visits to specific sites can reach 1,631 per day.

A survey of 24 selected coral reef tourism sites (12 in Coron and 12 in El Nido) identified the following significant negative impacts caused by tourism:

(i) damage from boat groundings and boat anchors in both coral reefs and seagrass beds,
(ii) damage from snorkelers and divers trampling on corals,
(iii) siltation from land conversion and deterioration of water quality due to untreated effluents,
(iv) pollution from improper site toilet and waste management facilities in beach areas, and
(v) use-conflict between fishermen and gleaners of reefs adjacent to resorts and marine protected areas (MPAs).

Although the COVID-19 pandemic reduced visitor volumes in 2020 by over 85%, giving the ocean ecosystems rest from ecotourism pressure, it is likely that with effective control over the pandemic, the 2019 volume will be recovered in a few years. Based on the TA report, the potential growth of the tourism market to both destinations is high given implementation of further planned improvements in air, sea, and road transportation and assuming no negative impediments to growth—the reference scenario.

If the development of tourism continues in an uncontrolled and unsustainable way, growth could be expected to diminish as their reputation as attractive destinations decline—in which case it was expected that tourist volumes to both destinations would not increase significantly over 2018 levels in coming years. If the stakeholder's vision for the sustainable development of tourism in Coron and El Nido were implemented, this would result in a more managed tourism growth scenario that places a premium on protecting blue ocean resources, quality services, length of stay, and higher spending per day over just tourism volumes.[3] The carrying capacity assessment provides a key tool and indicator for determining what the overall growth rate should be given the management systems available.

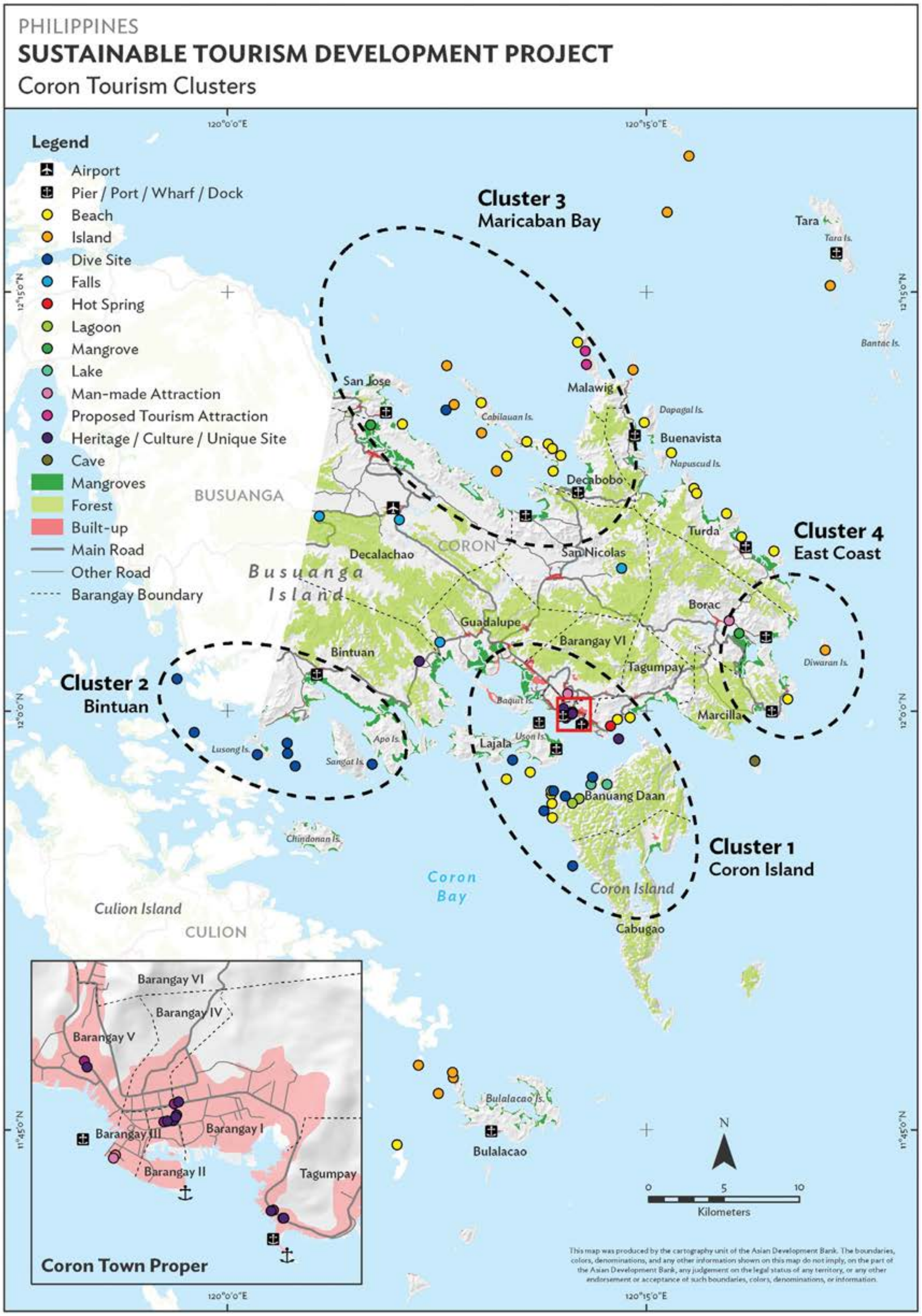
ENVIRONMENTAL CARRYING CAPACITY

A key instrument in reducing the degree of disturbance by people in highly sensitive marine environments is the concept of environmental carrying capacity (ECC). The most useful definition of tourism carrying capacity is the definition of the United Nations World Tourism Organization (UNWTO): "The maximum number of persons which could visit a location within a given period, such that local environmental, physical, economic, and socio-cultural characteristics are not compromised, and without reducing tourist satisfaction" (Coccossis 2001; Butler 2010; Saarinen 2006; and Wong 2003). This definition indicates that various capacities—physical, economic, perceptual, social, ecological, and political—are involved in determining the maximum number of tourists.

2 Estimate based on interviews with dive tour operators in Coron and El Nido undertaken in October and November 2019 and data from El Nido Municipality on boat diving tour departures in 2018 and 2019.

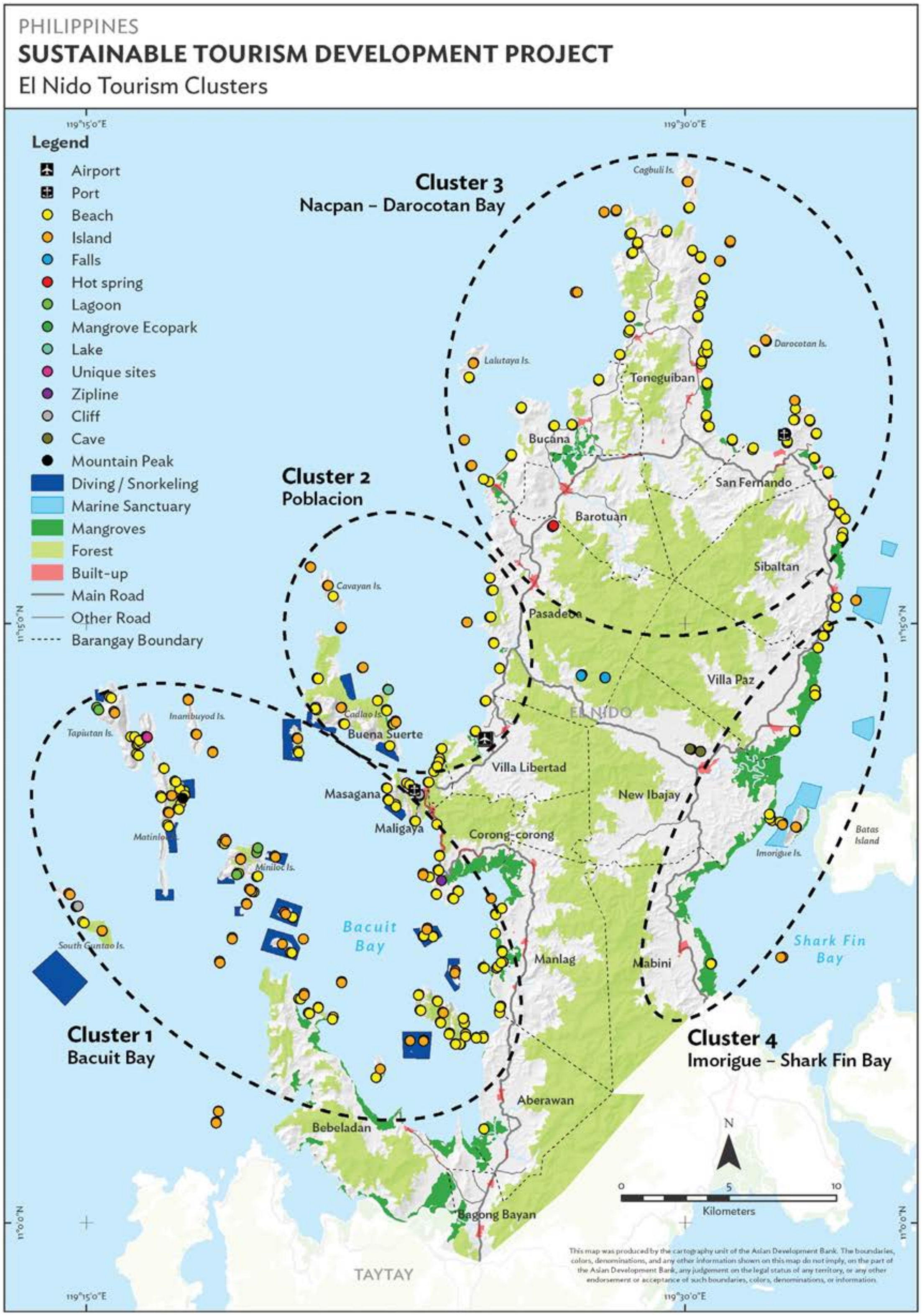
3 Both Coron and El Nido municipalities see themselves as prime tourist destinations in the Philippines that adhere to the principles of sustainable development; are ecologically-balanced; supported by a secure economy, a responsive infrastructure, and an empowered citizenry under a transparent and efficient governance.

Map 1: Tourism Cluster Map of Coron



Source: Asian Development Bank.

Map 2: Tourism Cluster Map of El Nido



Source: Asian Development Bank.

Table 1: Estimated Site Visits in Coron and El Nido

Destination	Est. Site Visits 2018	%
Coron		
MTC1: Coron Island	1,239,063	79.76%
MRC2: Bintuan-Concepcion	283,356	18.24%
MTC3: Maricaban Bay	15,535	1.00%
MTC4: East Coast	15,535	1.00%
Sub-total	**1,553,489**	**100.00%**
El Nido		
MTC1: Bacuit Bay	3,511,447	86.36%
MTC2: Poblacion-Villa Libertad	454,476	11.18%
MTC3: Nacpan-Daracotan	50,000	1.23%
MTC4: Imorgue-Shgark Fin Bay	50,000	1.23%
Sub-total	**4,065,923**	**100.00%**

MTC = marine tourism cluster.

Source: El Nido estimates based on tour boat ticket sales to Bacuit Bay and Pobalacion-Villa Libertad and tour operators estimates for MTC 3 and 4; Coron estimates based on survey of visitors applied to boat excursionists in 2018 reported in ADB TA-9554 - REG: Southeast Asia Urban Services Facility: PHP: Sustainable Tourism Development Project.

The data for these factors will come from a range of sources, the most important being ecosystem data. The UNWTO definition recognizes that the maximum number of visitors per unit of time at a destination or site may vary depending upon the technology and management systems employed, and the extent to which stakeholders concerned are willing to trade off the use of ecosystem services versus their conservation. What is critical is the ability to measure the impact of these decisions and to take the remedial actions to prevent further decline in and enhance ecosystem service values.

In the Philippines, several development partners including large international environmental nongovernment organizations have been supporting the government in setting up their regulatory framework for coastal and marine protected areas. The first law on all protected areas, whether terrestrial, coastal, or marine, was enacted in 1992, and governed by the Philippines' Department of Environment and Natural Resources (DENR) with the support of international donors, but the concept of carrying capacities as a tool in the management of ecotourism in protected areas was introduced as part of its National Ecotourism Strategy and Action Plan 2013–2022.

Regulation on protected areas is a continuous process that needs to progressively elevate its ambitions in line with the international agenda on carrying capacity and biodiversity. In this context,

Table 2: Estimated Peak Day Visitor Volumes at Selected Sites

	2018		
Cluster and Sites	**Visitors**	**Average**	**Peak Day**
Coron			
Coron MTC 1			
Kayangan Lake	121,404	333	603
Twin Lagoon	98,913	271	491
Siete Pecados	38,000	104	189
Bintuan MTC 2			
Coral Gardens	84,584	232	420
Lusong Wreck	84,584	232	420
Sangat wreck and beach	44,500	122	221
El Nido			
Bacuit Bay MTC 1			
Secret Lagoon	371,844	1,019	1,631
Big Lagoon	371,844	1,019	1,631
PE. Pangulasian Island	66,106	181	290
Poblacion-Villa Libertad MTC 2			
Ubogon Cove – Cadlao	90,895	249	399
Nat Nat Beach	90,895	249	399
Villa Libertad (Ipil Beach)	90,895	249	399

MTC = marine tourism cluster.

Source: Based on visitor survey bot tour operators in Coron and on El Nido Tourist Office records of boat trips and passengers to specific sites in 2018.

the DENR, through its Ecosystems Research and Development Bureau (ERDB), has supervised the preparation of carrying capacity studies at the Puerto Princesa Subterranean National Park, the Big and Small Lagoons in Bacuit Bay in the ENTMRPA, and, more recently, at Boracay island after its temporary closure in 2018, and for the whole of El Nido.

To support protected area managers in undertaking carrying capacity assessments, in 2015, ERDB produced a manual on computing the carrying capacity of ecotourism sites in protected areas.[4] This approach relies mainly on the standard requirements of the visitors to conduct activities in the form of time, space, material, and other needs such as distance separation of tour boats in a subterranean river or number of snorkelers per square meter (m^2). These standards are based on models from earlier studies and cases.

4 Following the methodology of Boullon 1985 et al.

The approach uses "expert observation" as a proxy for assessing the structure and condition of the ecosystem at a site and factoring this into the final carrying capacity determination.[5] While this is a good and cost-effective start, it must be recognized that (i) site conditions and the threats they face differ significantly from one another, (ii) universal activity standards adjusted by expert observation of the conditions of the ecosystem may be a poor proxy for capacity of a particular ecosystem, and (iii) a science-based approach will be essential in defending and agreeing on capacity limits with stakeholders. It is this extra dimension that has been addressed in assessing the ECC of the blue ocean ecosystems of Coron and El Nido.

SITE SELECTION

To effectively control and manage the impact of tourism on the blue ocean ecosystems of Coron and El Nido, it was necessary to first identify the MTCs most affected by tourism and, within these, the critical sites that were most at risk; and secondly, to assess the level of tourism activity—in this case, snorkeling, swimming, and diving—that the most affected sites can support without degrading the coral reef ecosystems on which the tourism activity and other users depend. Given limited resources, it was necessary to prioritize the MTCs in each area to identify the top two MTCs considered to be under most pressure and, within each, to identify the top six critical sites—from the 12 sites in each destination and 24 sites across both destinations—where tourism pressure needed to be managed most.

From a visitor volume point of view, the top two MTCs are readily evident (Tables 1 and 2). A multi-criteria selection methodology based on 10 criteria-based indicators was used to verify the two priority MTCs in each destination of Coron and El Nido and, within these, the six top priority sites to be selected for detailed assessment.

The multi-criteria selection methodology covered the following:

(i) natural, environmental, and physical factors such as accessibility, coastal biodiversity, vulnerability to natural hazards and climate;

(ii) socioeconomic and cultural factors such as water recreation and aesthetics, technology and quality access equipment, and access to basic infrastructure (mooring buoys, waste management, and others); and

(iii) policy and regulatory factors such as zoning, property ownership, potential for MPA, and compatibility with existing uses such as fisheries and mariculture.

Table 3: Priority Marine Tourism Clusters

Coron	El Nido
Coron MTC 1	**Bacuit Bay MTC 1**
1. Siete Pecados	1. Secret Lagoon
2. Uson Island	2. Big Lagoon
3. CYC Beach	3. Matinloc Island
4. Kayangan Lake	4. Miniloc Island
5. Twin Peaks Coral Garden	5. Lagen Island
6. Twin Lagoon	6. E. Pangulasian Island
Bintuan MTC 2	**Pobalcion-Villa Libertad MTC 2**
1. Bintuan	1. Ubogon Cove – Cadlao
2. Lusong Island	2. Nat Nat Beach
3. Apo Island	3. Poblacion
4. Bintuan Sangat Marine Park	4. Corong Corong Beach
5. Sangat Island Reserve	5. Villa Libertad
6. Lusong Coral Garden	6. Mangrove Ecopark

MTC = marine tourism cluster.

Source: ADB Southeast Asia Urban Services Technical Assistance Facility for Philippines Sustainable Tourism Development Project Vol. V: Ecosystem-Based Tourism Site Management.

Specific indicators were developed for each, and a weighting system devised to score results and rank MTCs and, within them, marine tourism sites. The results of the first-round evaluation involving the rating and ranking of the four MTCs in each of Coron and El Nido confirmed the top two priority clusters based on volume of tourist visits shown in Tables 1 and 2. The results of the second-round assessment of the marine tourism sites in each of the two priority MTCs are shown in Table 3.

A detailed biophysical assessment of the conditions of the reef and associated seagrasses and mangrove forests at the 24 marine tourism sites was subsequently undertaken as part of ADB's project preparation following the approach used in ADB's Coral Triangle Initiative Project at Taytay Bay in El Nido.[6] The key elements of the survey methodology are presented in the Box (at the end of the brief).

[5] For example, in the case of the carrying capacities calculated for the Puerto Princesa Subterranean National Park, the state of the cavernicole ecosystem in the subterranean river could have been assessed in detail to provide a more precise understanding of its real carrying capacity from an ecological perspective.

[6] ADB. 2020. *Southeast Asia Urban Services Facility for the Preparation of Philippines Sustainable Tourism Development Project*. Manila; ADB. 2015. *Regional: Coastal and Marine Resources Management in the Coral Triangle – Southeast Asia*. Manila; Marine Environment and Resources Foundation, Inc. 2020. *Biophysical Assessment of Coral Marine Tourism Sites in Coron and El Nido*.

The survey mapped, assessed, and documented the current condition of the reef ecosystem at each site over key ecosystem indicators to (i) identify existing negative impacts on the coral ecosystems, their likely causes, and appropriate management interventions; (ii) provide input into the carrying capacity measurement tool; and (iii) provide a baseline for monitoring future changes in site conditions in response to proactive management of reef users.

The key indicators to assess carrying capacity for snorkeling, swimming, and diving activities were: (i) water transparency, (ii) coral cover as a percent of the total area mapped, (iii) number of coral fish species, (iv) current velocity in centimeter per second (cm/sec), (v) reef width, and (vi) reef depth using a snorkeling and diving suitability weighting and categorization system for managing ecotourism based on a case study at Sebesi Island in Lampung Province, Indonesia.[7]

BIOPHYSICAL REEF ASSESSMENT

Overall, the survey found that the coral reef ecosystems in Coron and El Nido are still in good condition relative to other areas in the Philippines. In addition to damage from tourism activities (boat groundings, anchoring, trampling, siltation, pollution, and use-conflicts among resorts and fishers and gleaners), other negative impacts observed were:

(i) illegal fishing including poison and blast fishing and cutting and removal of mangroves;
(ii) coral bleaching from seawater temperature increases and damage from increased storm events; and
(iii) crown-of-thorns-starfish and Drupella snail infestations in the reefs.

While coral tourism is itself problematic, climate change, biological predation, and lack of regulation affect the outcome for the coral reefs of the two areas. Managing these impacts is thus critical to the retention and strengthening of the ecosystem services provided by the sites and, by extension, to each of the priority marine tourism clusters.

DETERMINATION OF ENVIRONMENTAL CARRYING CAPACITY

The methodologies used to determine the ECC for the 24 marine tourism sites incorporates the concepts of basic, potential, and real carrying capacities (Calanog 2015). The basic carrying capacity (BCC) is a function of an area's physical size in square meters and the area requirements of a visitor to enjoy the activity experience during a visit, i.e., the total area of the site divided by the standard area required by the visitor (150 m^2 for snorkeling [Calanog 2015] and 1,000 m^2 for two divers [Armono 2017]).

The potential carrying capacity (PCC) is the adjusted BCC accounting for the number of sets of tourists visiting the area over any 1 day—known as the rotation rate—which is the average time per visit divided into the number of hours the site is operational. The product of the BCC and rotation rate yield the PCC for snorkeling, swimming, or diving. The real environmental carrying capacity (RCC) or ECC brings in the limiting factors of the ecosystem, mostly using data collected from the biophysical assessment.

These factors include the following: (i) number of rainy days per annum; (ii) a tourism suitability index score for snorkeling and diving (Yulianda 2007 and Lelloltery 2018) that reflects water transparency, coral cover percent, number of lifeforms, type of lifeforms based on reef fish species, water current velocity in cm/sec, reef depth and width for snorkelers and reef depth only for divers; and (iii) damage caused by snorkelers and divers through touching using a measure based on contact per minute per snorkeler or diver following (Philipps 2018 and Roche 2016).

The survey of site conditions undertaken by the Marine Environment and Resources Foundation provided the site physical and biometric parameters, with other parameters such as comfortable area of activity for snorkeling and diving, and the calculation of the tourism sustainability index based on earlier studies and benchmarks cited. The initial results of the PCC and RCC determinations for snorkeling and diving in the 24 marine tourism sites in the two destinations are presented in Table 4.

The results show that once environmental factors are incorporated into the carrying capacity analysis, site capacity falls off significantly on average by over 70%, reflecting the weight of ecosystems in the carrying capacity determination. The results highlight the sensitivity of key sites such as:

(i) Kayangan Lake, Twin Lagoon, Twin Peaks Coral Garden, and CYC Beach in the Coron MTC; and the Sangat MPA, the Sangat Island Reserve (for diving only), the Lusong Gunboat, and Lusong Coral Garden in the Bintuan MTC.
(ii) In El Nido, Lagen Island, South Miniloc, Secret Lagoon in the Bacuit MTC; and the Villa–Libertad MTC Nat Nat Beach and Ubogon Cove.

A comparison between the results of the carrying capacity analysis and the actual volume of site visits for snorkeling at some of the selected sites identified in Table 2 is shown in Table 5.

[7] Developed by F. Yulianda. 2007. *Marine Ecotourism as an Alternative to Conservation Based Resources Utilization*. Department of Water Resources Management, Faculty of Fisheries and Marine Sciences, Bogor Agricultural University, Bogo.

Table 4: Initial Environmental Carrying Capacity Determinations

Coron				El Nido			
Cluster/Site	Activity	PCC/Day (Potential)	RCC/Day (Real)	Cluster/Site	Activity	PCC/Day (Potential)	RCC/Day (Real)
Cluster 1: Coron				**Cluster 1: Poblacion Villa-Libertad**			
Siete Pecados	Snorkeling	2,978	833	Nat Nat Beach	Snorkeling	1,244	294
	Diving	1,042	279		Diving	64	13
Kayangan Lake	Snorkeling	267	70	Ubogon Cove	Snorkeling	1,289	304
	Diving	0	0		Diving	64	15
Twin Peaks Coral	Snorkeling	844	236	Mangrove EcoPark	Snorkeling	2,933	692
	Diving	280	82		Diving	192	45
Twin Lagoon	Snorkeling	444	97	Corong-Corong Beach	Snorkeling	8,000	2,308
	Diving	144	34		Diving	1,280	343
Uson Island	Snorkeling	3,778	1,090	Masagana	Snorkeling	4,000	5,769
	Diving	560	150		Diving	800	214
CYC Beach	Snorkeling	1,444	467	Villa Libertad	Snorkeling	18,667	5,384
	Diving	280	91		Diving	2,880	772
Cluster Total	**Snorkeling**	**9,755**	**2,793**	**Cluster Total**	**Snorkeling**	**36,133**	**14,751**
	Diving	**2,306**	**636**		**Diving**	**5,280**	**1,403**
Cluster 2: Bintuan				**Cluster 2: Bacuit Bay**			
Bintuan	Snorkeling	533	154	Pangulasian Island	Snorkeling	13,556	3,199
	Diving	80	21		Diving	2,320	622
Apo Island	Snorkeling	889	256	Lagen Island	Snorkeling	1,244	348
	Diving	192	51		Diving	560	183
Bintuan-Sangat MPA	Snorkeling	289	81	South Miniloc	Snorkeling	400	105
	Diving	56	15		Diving	64	19
Sangat Island Reserve[a]	Snorkeling	0	0	Big Lagoon	Snorkeling	3,200	727
	Diving	74	13		Diving	224	47
Lusong Gun Boat	Snorkeling	89	28	Secret Lagoon	Snorkeling	667	186
	Diving	32	10		Diving	192	40
Lusong Coral Gardens	Snorkeling	44	12	Matinloc Island	Snorkeling	2,089	548
	Diving	27	7		Diving	496	150
Cluster Total	**Snorkeling**	**1,844**	**531**	**Cluster Total**	**Snorkeling**	**21,156**	**5,113**
	Diving	**461**	**117**		**Diving**	**3,856**	**1,061**

MPA = marine protected area, PCC = potential carrying capacity, RCC = real carrying capacity.

[a] Sangat Island Reserve is not suitable for snorkeling because the seabed is too deep.

Source: ADB. 2020. *Southeast Asia Urban Services Facility for the Preparation of Philippines Sustainable Tourism Development Project*. Manila. Vol. V.: Ecosystem-Based Tourism Site Management.

Table 5: Comparison of Existing Daily Visitor Volumes with Carrying Capacities at Selected Sites for Snorkeling

Cluster and Sites	2018 Visitors	Average	Peak Day	PCC	RCC
Coron					
Coron MTC 1					
Kayangan Lake	121,404	333	603	267	70
Twin Lagoon	98,913	271	491	444	97
Siete Pecados	38,000	104	189	2,978	833
Bintuan MTC 2					
Coral Gardens	84,584	232	420	44	12
Lusong Wreck	84,584	232	420	89	28
Sangat wreck and beach	44,500	122	221	289	81
El Nido					
Bacuit Bay MTC 1					
Secret Lagoon	371,844	1,019	1,631	667	186
Big Lagoon	371,844	1,019	1,631	3,200	40
PE. Pangulasian Island	66,106	181	290	13,556	3,199
Poblacion–Villa Libertad MTC 2					
Ubogon Cove–Cadlao	90,895	249	399	1,289	304
Nat Nat Beach	90,895	249	399	1,244	294
Villa Libertad (Ipil Beach etc.)	90,895	249	399	18,667	5,384

MTC = marine tourism cluster, PCC = potential carrying capacity, RCC = real carrying capacity.

Source: ADB. 2020. *Southeast Asia Urban Services Facility for the Preparation of Philippines Sustainable Tourism Development Project*. Manila.

The results indicate the following:

(i) In many cases, peak day visitor volumes at the selected sites in Coron and El Nido are already greater than the calculated RCCs for these sites, the exceptions being Siete Pecados in Coron and East Pangulasian and the Villa Libertad marine area in El Nido that appear to have substantial additional capacity.

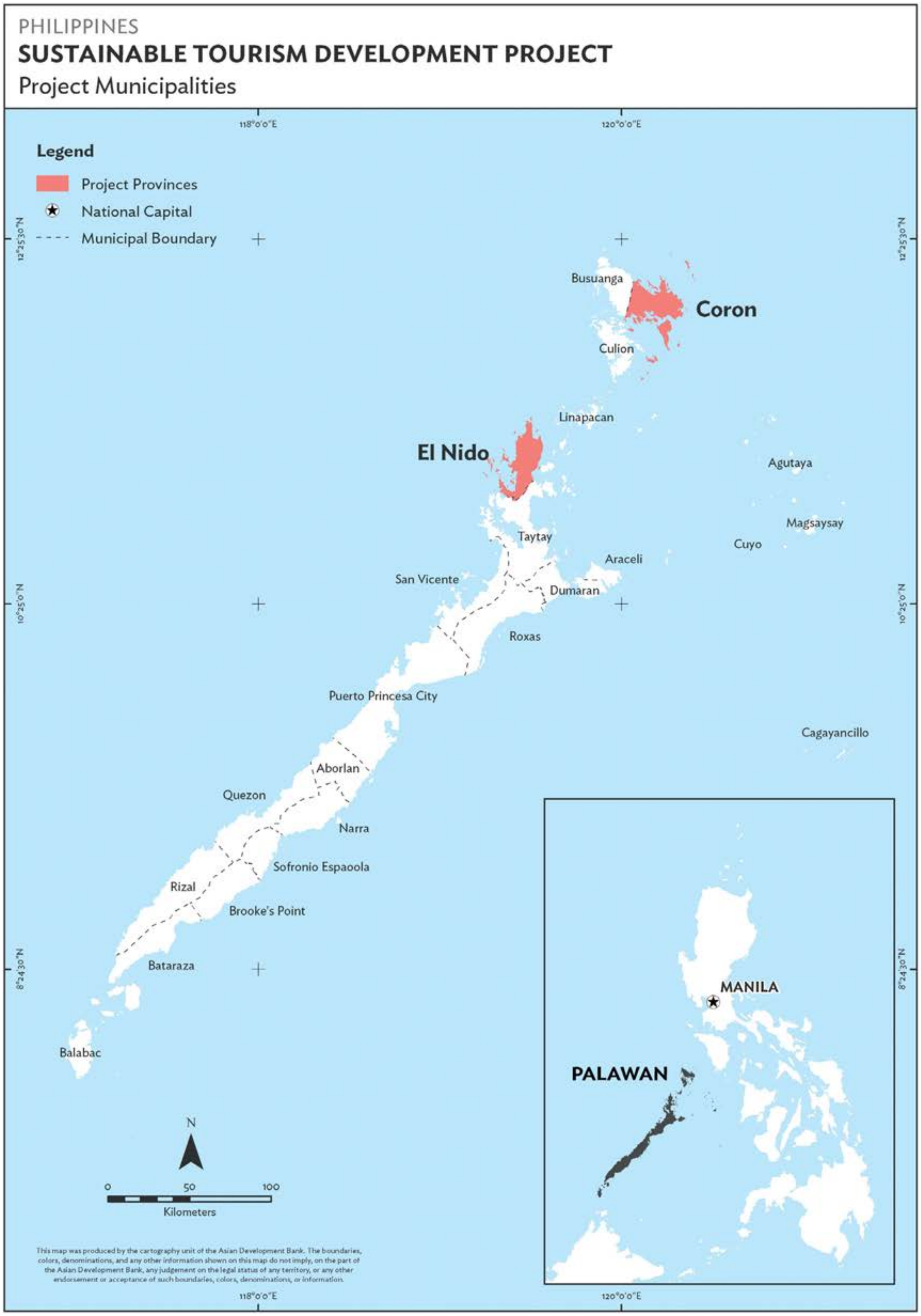
(ii) There are areas with surplus capacity that could be used as alternatives to visiting existing high-use marine tourism sites. For example, the East Pangulasian area in the Bacuit Bay MTC, and the Villa Libertad MTS in the Poblacion–Villa Libertad MTC for the most part have substantial capacity for blue ocean ecotourism and should be mobilized to reduce pressure on existing high-use sites in the Bacuit Bay Tourism Cluster. Similarly, in Coron, the Uson Island MTS in Coron MTC can take additional visits.

(iii) Tourism is already having a negative impact at the site level that needs to be managed through a reduction in pressures; and provision of infrastructure such as boat mooring holding areas away from the reef, use of flat bottom electric shuttle vessels to access the coral reef, and provision of interpreted snorkeling and diving trails to limit the area contacted.

(iv) In both destinations, there is a need to regulate the level of visits to sites, including diversifying the tourism offering away from marine tourism toward other forms of outdoor terrestrial tourism.

The results provide an indication of the ranges with the potential PCC as the upper limit and the RCC as the lower limit that stakeholders can use to make decisions about the treatment of each site and the management strategies for reducing visitor pressure at these. The measurement of RCCs does not have to lead to a single number of visitors, but can provide the framework for setting upper and lower limits (Coccossis et al. 2001).

Map 3: Location Map of the Project



Source: Asian Development Bank.

Methodology to Assess Priority Coral Reef Tourism Sites

One transect of 50 meters (m) x 10 m (500 square meters [m^2]), comprising a grid within each quadrat of 5 m x 10 m or 50 m^2, was identified at each site, based on the recreation area. Divers made one set of photos per 3-m interval and, where necessary, at 1-m or 2-m intervals, depending on site conditions. Transect selection is based on main visitor use area. At each transect:

(i) The coral reef structure and health were assessed based on the following:

(a) The photo-transect (Vergara and Licuanan 2007) following the method undertaken in Taytay, Palawan (CTI-SEA 2015).

(b) Representative transect stations were chosen, global positioning system coordinates and digital photographs taken (at 3-m intervals, at 75 centimeters [cm] camera-to-substrate distance, camera at full wide angle). The images from the 1 m^2 quadrats refined using Adobe Photoshop, with 10 points superimposed in each image. In each of these points, life forms (English et al. 1997) and hard coral genus intercepted were recorded and scored. Benthic life form category identification and percent cover were taken, and percent cover computed using the following equation: Percent cover (%) = Total number (no.) of points per life form / Total no. of points per transect X 100%.

(c) Reef health was assessed using the quartile index (Gomez and Alcala 1979; Gomez et al. 1981) wherein the proportion of living corals (soft + hard) is compared relative to other benthic components (e.g., dead coral, soft coral, algae, rubble, and others). Coral reefs will then be classified as poor (0%–24.9% live hard coral cover), fair (25%–49.9% cover), good (50%–74.9% cover), and excellent (75%–100% cover).

(ii) Reef fish community structure was assessed based on the following:

(a) The Fish Visual Census (FVC) technique (English et al. 1997). This technique determines the species diversity, abundance, and biomass.

(b) To complement the benthic data, the FVC was conducted on the same transect lines surveyed for reef benthic community.

(c) Observers waited for about 5–10 minutes after the line had been lain, before the actual census was performed to allow for the disturbed fish community to return to its normalcy.

(d) Starting at one end of the line, all fishes within a 50 m x 10 m or 500 m^2 imaginary quadrat area were identified up to species level (where possible) and their numbers and estimated sizes recorded. This was done at every 5-meter mark along the line until the transect line was complete.

(e) The sizes of all fishes encountered within the transect belt were estimated to the nearest centimeter using the total length.

(f) Fish density and biomass were then computed using ReefSum (Uychiaoco 2000). Fish biomass is based on the relationship: $W = aL^b$, where W is the weight in grams; a and b are the growth coefficient values taken from published length: weight data; and L is the length of the fish in cm (English et al. 1997).

(g) All fishes were grouped into target, coral indicator, and major species. Target species are the commercially important fishes, coral indicator species are coral-associated, and major species are those that belong to non-commercially important species.

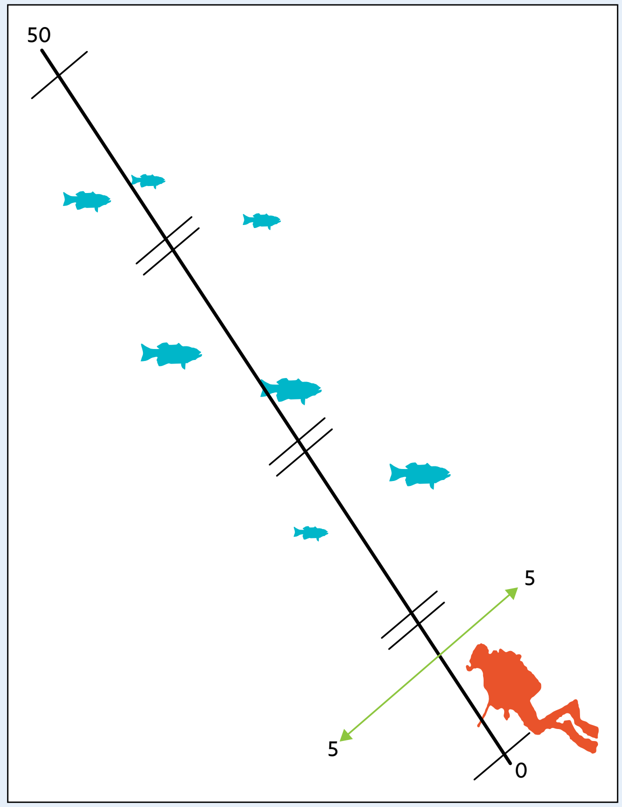


Diagram of the 500-square meter quadrat area for reef fish assessment.

(iii) Seagrass and mangrove community structure where present were assessed, based on the following:

(a) A slightly modified version of the photo-transect-quadrat method used in coral reefs was used based on the standard quadrat size of 0.25 m^2 (50 cm x 50 cm) for seagrass, and a 5 m x 5 m (25 m^2) quadrat was used for mangrove areas.

(b) To maintain ecological coherence, 100-meter transects landward were laid contiguous with the coralfish transects at each site.

(c) The entire extent of the two ecosystems was assessed using drone technology assisted by land and underwater cameras.

(d) The assessment and analysis of the cover (percent), distribution, density, aboveground biomass, status (degree of disturbance), and others were made from the resulting images taken at 3-meter intervals (for seagrass) and continuous (for mangroves).

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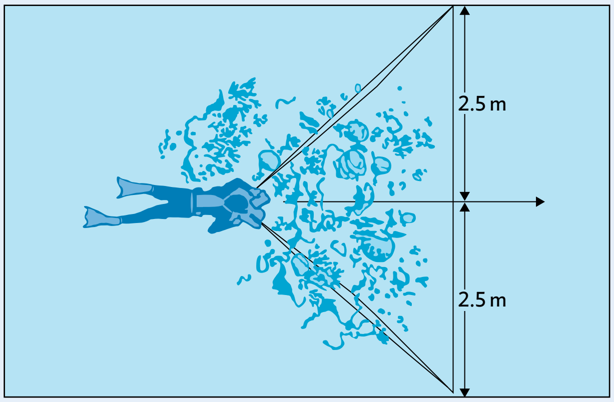
Continued

(e) A modified grading and ranking scale similar to that used for coral reefs was used to determine the health of the ecosystems.
(f) This resulting information was then used in tandem with the other environmental data and information to initially describe the potential of the sites as sink or source of carbon.



Diver positioning for the 25-square meter quadrat area for mangrove assessment.

(iv) Logistics and timing of work:
(a) There were four divers and two drone technicians. One of the technicians was a research associate of the carrying capacity specialist.
(b) Gear for five scuba divers (including the carrying capacity specialist), full equipment rentals on-site, modest room and board, two trips (one for each destination: Coron and El Nido), and 12 days per trip (inclusive of 10 full dive days, surveys; 0.5 day consultation).
(c) There was no provision for depth decompression, only standard safety provision as working at shallow depth.
(d) One week for trip preparation, 2 weeks for data collation.
(e) One week for analysis (with divers).
(f) The team averaged 1–1.5 sites per day (coral–seagrass–mangrove stations in relatively favorable weather and sea conditions) for a total of 24 sites: 12 in Coron and 12 in El Nido.

Source: ADB. 2020. *Southeast Asia Urban Services Facility for the Preparation of Philippines Sustainable Tourism Development Project*. Manila.

CHALLENGES AND LESSONS LEARNED

The key challenges facing the use of carrying capacity tools include the following:
(i) the difficulty of establishing science-based limits in a complex and dynamic environment, especially when factoring in human use and human perception;
(ii) existing tourism metrics are not currently collected on the use of tourism clusters and sites, making it difficult to determine the actual level of site use and, hence, determination of the ECC;
(iii) the initial high cost of data collection, especially data on the state of the ecosystem—the cost of the survey per site was around ₱91,000 or $1,820 at 2019 prices;
(iv) getting all stakeholders on board with an agreed-on set of capacity limits well below what they are currently used to—the undertaking is challenging and must be done in a phased way to allow for adaptation of business and management models if it is to be successful;
(v) pressure from affected stakeholders in implementation can modify the limits and compromise the effort to protect the reefs; and
(vi) fragmented approach to marine area management with various national, provincial, and local government agencies with uncoordinated visions, objectives, and programs.

It was found that to develop the carrying capacities for Coron and El Nido, much of the critical data such as detailed site visit volumes, length of stay, number of passengers per tour boat, and number of sites visited on a typical itinerary in the case of Coron were not available and had to be extrapolated from survey data. It is also clear from the stakeholders' reactions to the initial carrying capacity calculations that it will be difficult to obtain support and unanimity for implementation unless everyone is able to see the benefit of such an approach.

Tourist operators have structured their businesses around the existing volume of tour boat activity, the reduction of which is perceived to result in significant income loss. However, adapting existing business models to lower visitor volumes need not result in reduced income. Scarce tourism resources are usually more expensive to access, and what is needed is a program to help tour operators move to higher-yielding business models that depend on fewer tourists to sustain.

Lessons learned include the importance of:
(i) engaging ecosystem services stakeholders in the design phase of the marine ecotourism ecosystem area surveys and in resulting carrying capacity assessment;
(ii) including stakeholder variables in the carrying capacity assessment to allow phasing-in of the management system; and
(iii) adopting an experimental approach toward the application of carrying capacities at specific sites based on data and monitoring and evaluation system feedback.

RECOMMENDATIONS

While the present level of knowledge allows only an initial understanding of the carrying capacity assessment for tourism in the context of coastal and islands areas, ECC must be considered as one tool in implementing an adaptive management, i.e., implementing management while learning which management actions are most effective at achieving the objective. Such approaches for tourism development need to be set within a broader resilience-based management framework with well-defined monitoring and evaluation procedures. Nonetheless, ECC is a valuable aid in shaping development policies and implementing sustainable resource management.

In this respect, the carrying capacity assessment can provide a general framework to guide the local community, planners, and decision-makers regarding tourist development in the targeted areas. While this tool can be useful in setting up a capacity limit for sustaining tourism, consultations with relevant stakeholders remain a key issue at all stages before making decisions about managing tourism to guarantee the participation of all major actors and the communities at large.

Overall, measuring a site or sites based on RCC and/or ECC does not have to lead to a threshold, such as the maximum number of visitors permitted at a site in a given period. Even when this is achieved, this limit does not necessarily yield to objective, unchangeable, everlasting criteria. An upper and a lower limit of tourism carrying capacity may be of more use than a fixed value. However, the combination of site RCCs and/or ECCs provides a framework for establishing limits to sustainable growth in tourism for the destination—the tourism carrying capacity.

Carrying capacity is not only a scientific concept or formula of obtaining a number, beyond which development should cease. The eventual limits must be considered as guidance. They should be carefully assessed and monitored, complemented with other standards. Carrying capacity is not fixed. It develops with time and the growth of tourism and can be affected by management techniques and controls.
(Saveriades 2000)

This brief is the outcome of extensive site investigations and analysis undertaken between October 2019 and March 2020 under the ADB Southeast Asia Urban Services Facility for the Preparation of Philippines Sustainable Tourism Development Project, with the strong support of the Department of Tourism, other national agencies, the local governments of Coron and El Nido, local communities, and tourism operators.

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