A Regionalisation of Papua New Guinea's Marine Environment

A technical report prepared for Papua New Guinea's Department of Environment and Conservation with support from the Australian Government.

April 2014

By Alison Green[1], Mat Kertesz[2], Nate Peterson[1], Simone Retif[2], Tim Skewes[3], Piers Dunstan[3], Jennifer McGowan[4], Vivitskaia Tulloch[4], and Benjamin Kahn[5].

1 The Nature Conservancy, 2 Australian Government Department of the Environment, 3 Commonwealth Scientific and Industrial Research Organisation, 4 University of Queensland and 5APEX Environmental.

For more information contact: Alison Green (**agreen@tnc.org**) and Mat Kertesz (**Mat.Kertesz@environment.gov.au**)

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Preamble

The Australian-funded Pacific Public Sector Linkages Program (PSLP) supports strengthening of development-focused public sector linkages and transfer of capacity building skills to public sector counterparts in Pacific countries. The Marine Gap Analysis is an activity under the PSLP project "Sustaining Oceans Wealth". Objectives of the activity include:

- Supporting the development and interpretation of marine aspects of PNG's Protected Areas Policy.
- Undertaking a gap analysis to identify conservation priorities throughout Papua New Guinea's marine area to inform protected area planning, environmental impact assessment and other biodiversity conservation interventions.
- Developing skills and capacity for conservation planning, policy and management within the PNG Department of Environment and Conservation (DEC)
- Fostering links between DEC, the Australian Government and partner organisations

This report contributes to the development of a marine gap analysis for Papua New Guinea's marine area. This regionalisation was developed at a workshop held at CSIRO in Brisbane on 5 and 6 March 2014, attended by Alison Green and Nate Peterson (The Nature Conservancy Australia), Mat Kertesz and Simone Retif (Australian Government Department of the Environment), Tim Skewes and Piers Dunstan (CSIRO), Jennifer McGowan and Vivitskaia Tulloch (University of Queensland). Benjamin Kahn (APEX Environmental) also participated by teleconference. The draft report of this workshop was provided for comment to PNG Department of Environment and Conservation (DEC) and results presented to stakeholders including PNG Government agencies and environmental Non-Government Organisations at a project workshop for the marine gap analysis in Port Moresby in April 2014, following which it was circulated for comment.

The authors wish to thank all stakeholders for their time and input. The report does not aim to represent the views of any of the parties and the authors assume responsibility for any errors or omissions.

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Executive summary

Papua New Guinea's Department of Environment and Conservation is currently undertaking a national marine gap analysis to contribute towards their commitment under the Convention on Biological Diversity to establish a *"comprehensive, effectively managed and ecologically-representative national system of protected areas."* The gap analysis will identify conservation priorities throughout Papua New Guinea's marine area to inform protected area planning, environmental impact assessment and other biodiversity conservation interventions.

This regionalisation of Papua New Guinea's marine environment was developed to assist with this process. This analysis builds on previous marine regionalisations that were completed to delineate ecologically distinct areas for conservation in the Coral Triangle (Green and Mous 2008, Veron et al. 2009, 2011) and around the world (Spaulding et al. 2007).

Our regionalisation identifies five ecoregions and 21 shelf bioregions (nested within ecoregions) in Papua New Guinea's marine waters. These ecoregions and bioregions will be used to apply CARR principles to the national marine gap analysis for deep and shallow water habitats respectively.

While this regionalisation was based on best available information, it was a desktop exercise that relied on expert opinion regarding the biophysical characteristics of the area. Thus it will require field validation and refinement over time.

Background

Papua New Guinea National Marine Gap Analysis

The Papua New Guinea (PNG) draft Protected Areas Policy was developed to guide the implementation of PNG's commitment under the Convention on Biological Diversity (CBD) to establish a *"comprehensive, effectively managed and ecologically-representative national system of protected areas"*. PNG's Department of Environment and Conservation (DEC), with assistance from the Australian Government, The Nature Conservancy, CSIRO and the University of Queensland, is currently undertaking a national marine gap analysis aimed at identifying and addressing ecological gaps in their marine protected area (MPA) system, and identifying areas of conservation interest for protected area planning, environmental impact assessment and other management and conservation activities.

The CBD Program of Work on Protected Areas (PoWPA), adopted by the 7th CBD Conference of Parties in 2004, identified a range of actions to address impediments to implementing protected areas. Included in this, Action 1.1.5 aims to *complete protected area gap analyses at national and regional levels based on the requirements for representative systems of protected areas that adequately conserve terrestrial, marine and inland water biodiversity and ecosystems.*

Based on the CBD requirements and activities, the [draft] *PNG Protected Area Policy* articulates the principles of comprehensiveness, adequacy, representativeness and resilience (CARR) as the basis for the development of a national protected area system.

The purpose of this regionalisation is to classify the large and diverse marine environment of PNG into regions that can be used to apply the CARR principles to the gap analysis, particularly regarding: including representative examples of focal biodiversity across biological scales (species and ecosystems) to capture the full array of biodiversity in the protected area system; and including sufficient examples of species and ecosystems within a protected area network to capture genetic variation and protect against unexpected losses.

Marine regionalisations for the Coral Triangle and the world

The marine area of PNG has previously been divided into ecoregions and/or seascapes as part of processes to delineate the Coral Triangle (Green & Mous 2008) and the world (Spalding et al 2007) for conservation planning.

In 2008, Green and Mous delineated all or part of three ecoregions[1] (Bismarck Sea, Solomon Sea and Solomon Archipelago) and 15 functional seascapes[2] within Papua New Guinea waters, as part of a process to delineate the Coral Triangle for conservation (Figure 1). This delineation was based on expert opinion from 30 international and local scientists, managers and conservationists[3] regarding biophysical characteristics[4] of the region. While this delineation considered all marine areas, it focused primarily on nearshore, shallow water habitats (particularly coral reefs). Furthermore since this delineation was only for the area within the scientific boundary of the Coral Triangle (hereafter known as the Coral Triangle: see Figure 1), it did not include areas in southern PNG, the Gulf of Papua and the northern Torres Strait.

In 2007, Spalding et al. (2007) delineated all or part of seven marine ecoregions in PNG when they delineated the ecoregions of the world based primarily on nearshore/intertidal biota to a depth of 200 meters (Figure 2). These ecoregions differed from those in Green and Mous (2008) in two ways:

- Spalding et al. (2007) adopted an earlier version of the three ecoregions delineated by Green and Mous (2007) in PNG (the Bismarck Sea, Solomon Sea and Solomons Archipelago), so the southwest boundary of the Solomon Sea Ecoregion is different (see Figures 1 and 2).
- Spalding et al's (2007) was a global analysis, so they included four ecoregions that intersect with PNG waters outside of the Coral Triangle (in southeast PNG, the Gulf of Papua, the Arafura Sea and Torres Strait: Figure 2).

Veron et al (2009, 2011) subsequently delineated ecoregions within the Coral Triangle based on spatial data analysis of hard coral species (Figure 3). Since these ecoregions were based on hard corals only, they differ to the two previous delineations in three ways:

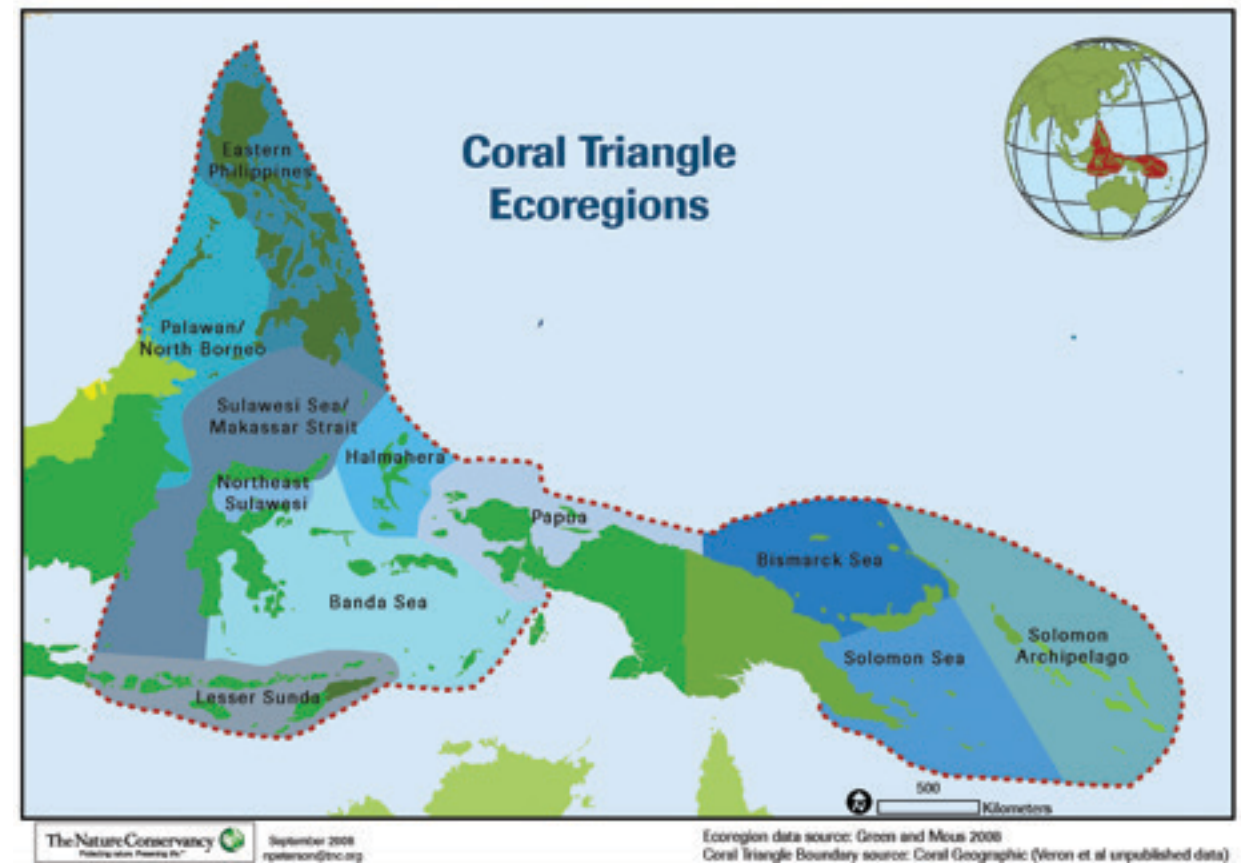
- Veron et al.'s Bismarck Sea Ecoregion boundary extends further south, east and west than it does in Green and Mous (2008) and Spalding et al. (2007), since it includes areas south of the island of New Britain, east of the island of New Ireland and further west along the northern coast of the mainland of New Guinea.
- Veron et al's. Milne Bay Ecoregion is similar to that of the Solomon Sea Ecoregion delineated in Green and Mous (2008), but its northern boundary is further south and its eastern boundary is further west.
- Veron et al.'s Solomon Islands and Bougainville Ecoregion is similar to the Solomons Archipelago Ecoregion in Green and Mous (2008) and Spalding et al. (2007), although its western boundary is further west and its northern boundary is further south.

1 Large areas containing geographically distinct assemblages of species, natural communities and environmental conditions.

2 Areas within a wider ecoregion within which there is some geographic or ecological distinctiveness, but over a smaller area that may be more suitable for the application of management measures such as MPA networks.

3 Including world experts on corals, reefs fishes and other invertebrates (see Allen 2007;Veron et al 2009, 2011).

4 Species diversity, habitat type and diversity, oceanography, geomorphology, bathymetry, sea level fluctuations and river discharge.



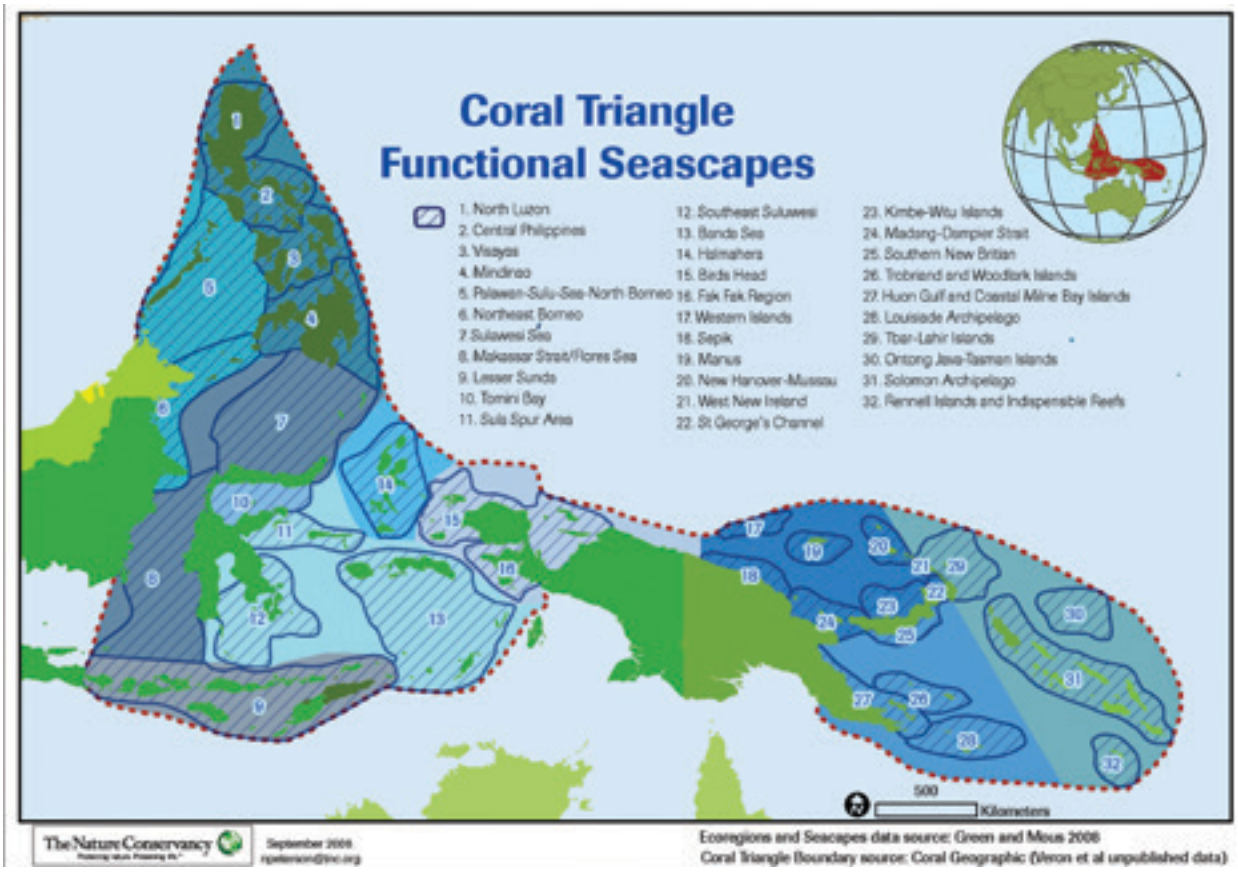


Figure 1. Ecoregions and functional seascapes within the Coral Triangle scientific boundary (red dotted line: Veron et al 2009, 2011) as defined by Green and Mous (2008) based on a range of biophysical characteristics for all marine areas (particularly nearshore, shallow water habitats such as coral reefs).

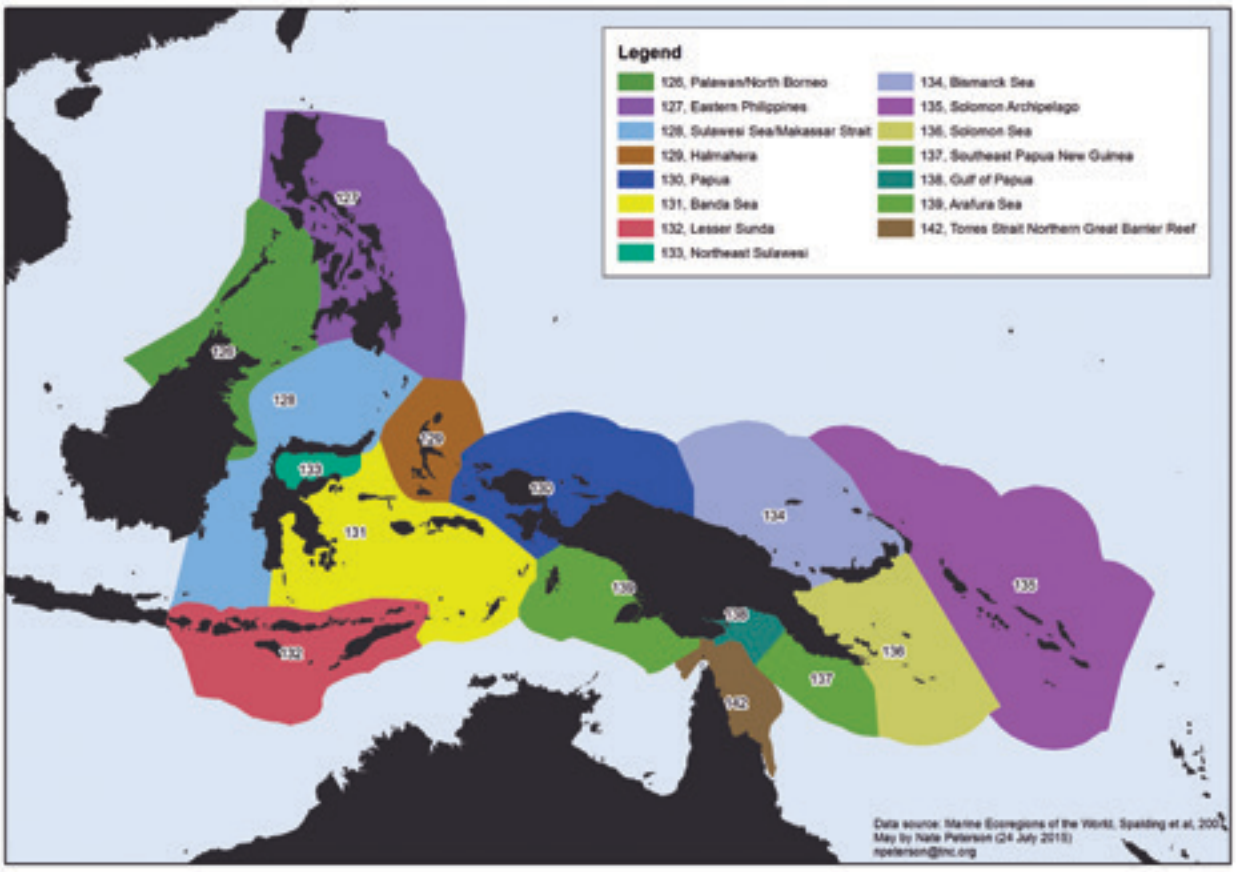


Figure 2. A subset of the 232 marine ecoregions of the world delineated by Spalding et al (2007), where the numbers refer to the name of the ecoregion. These ecoregions were delineated based primarily on nearshore/intertidal biota to 200m.

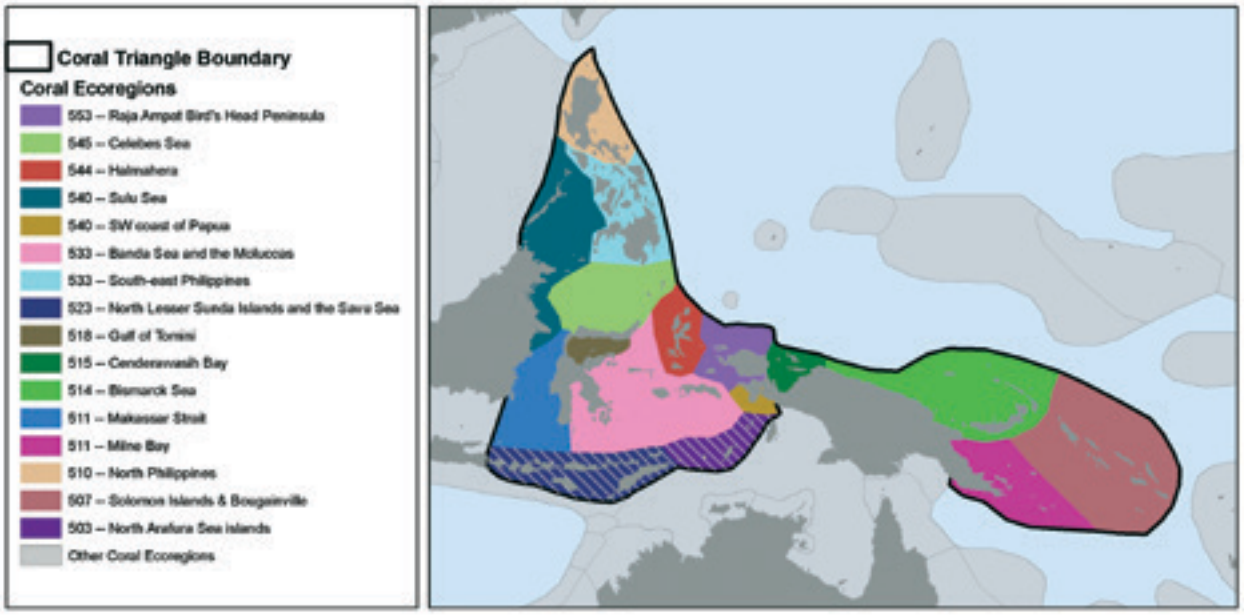


Figure 3. Coral Triangle ecoregions based on zooxanthellate (hard) corals by Veron et al (2009, 2011). Where: the numbers in the legend refer to the number of hard corals per ecoregion; and the hatched areas are considered data deficient.

This study

While there are many similarities in the previous regionalisations for PNG (Spalding et al. 2007, Green and Mous 2008, Veron et al. 2009, 2011), there are some key differences (see above) that need to be resolved to develop a regionalisation for the PNG National Marine Gap Analysis.

Furthermore, since the PNG National Marine Gap Analysis includes both nearshore and offshore waters, encompassing both shallow and deepwater environments, the previous regionalisations need to be refined and expanded to include consideration of all marine habitats. New biophysical information and regional analyses have also become available in recent years, which necessitates reviewing and refining previous delineations for PNG (e.g. Harris et al. 2014, McKinnon et al. 2014, Skewes et al. 2003, 2011).

To address this, we held a workshop in February 2014 where we used expert opinion and biophysical information to:

- Review the previous delineations;
- Review new or additional information to be considered (particularly regarding oceanographic and physical features, deep water habitats and species: e.g. Harris et al. 2014); and
- Develop a refined marine regionalisation for both shallow and deepwater habitats that can be used for the PNG National Marine Gap Analysis.

The following is a description of the marine regionalisation developed for PNG's waters, which will be used in the PNG National Marine Gap Analysis.

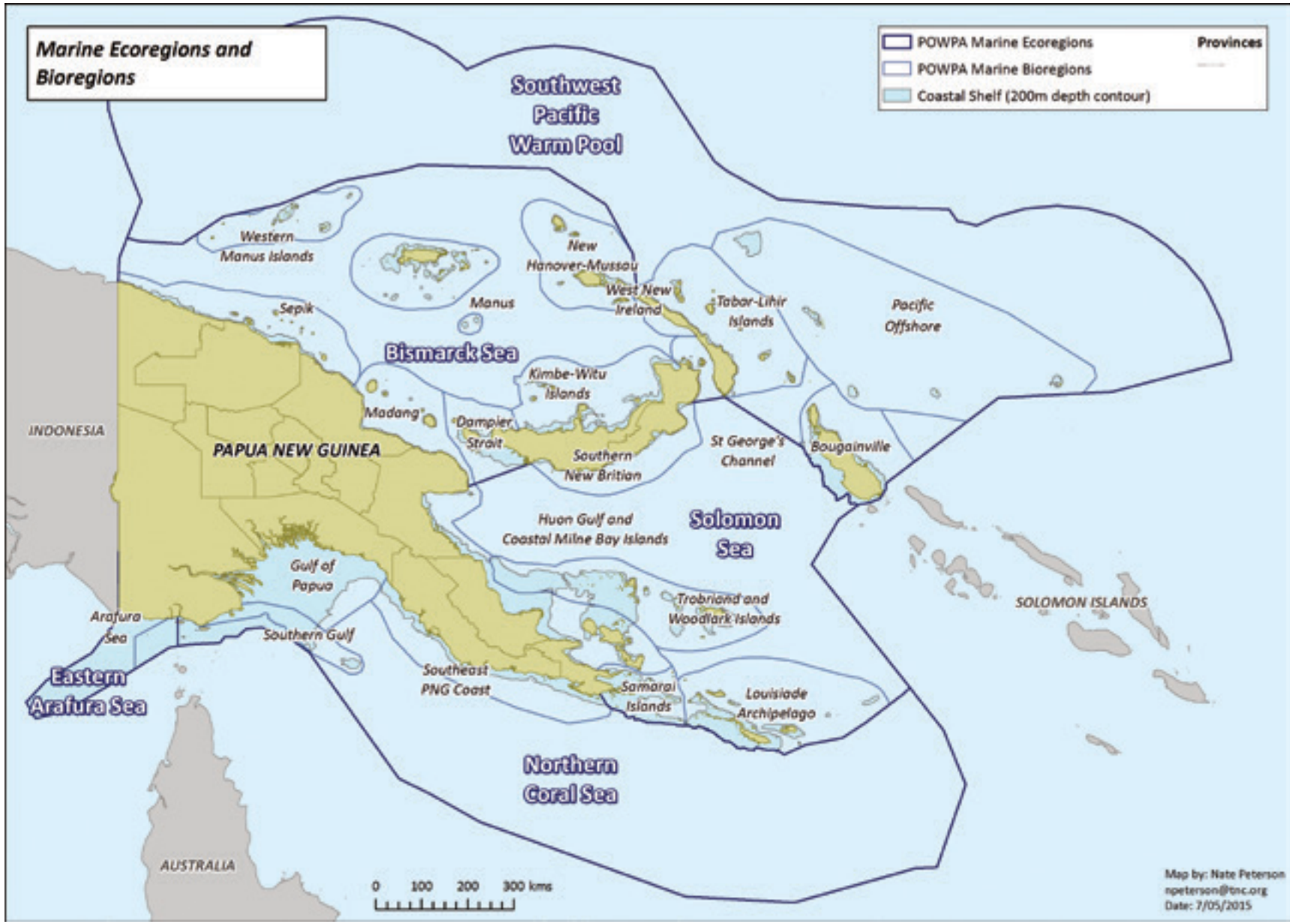


Figure 4: A regionalisation of PNG's marine waters that includes five ecoregions and 21 shallow water bioregions. Where: the outer boundaries of the external ecoregions are concurrent with the outer boundary of PNG's Economic Exclusive Zone (EEZ).

A marine regionalisation for Papua New Guinea

Planning area

Although primarily an ecological analysis, this regionalisation focuses on all of the marine areas that PNG has sole jurisdiction over (Figure 4). Thus where ecologically distinct areas extend into areas that PNG does not have (sole) jurisdiction over [such as waters of adjacent nations and jointly managed areas (i.e. the Torres Strait Protected Zone Joint Authority area)], these areas are excluded from the analysis and boundaries are drawn as far as the outer limit of PNG's Exclusive Economic Zone (EEZ).

Delineation between shallow and deepwater areas

To account for the differences in ecology and management of shallow and deepwater marine areas, a distinction is drawn between shallow and deepwater areas based on the 200 meter (m) isobath derived from the General Bathymetric Chart of the Oceans (GEBCO). We used this isobath, since it is widely used as a proxy for the continental shelf edge that often corresponds to a dramatic ecotone (transition) between shallow and deep water habitats (see Spalding et al. 2007).

Ecoregions

For this analysis, we adopted the definition for marine ecoregions from Spalding et al. (2007) as *Areas of relatively homogeneous species composition, clearly distinct from adjacent systems. The species composition is likely to be determined by the predominance of a small number of ecosystems and/or a distinct suite of oceanographic or topographic features. The dominant biogeographic forcing agents defining the ecoregions vary from location to location but may include isolation, upwelling, nutrient inputs, freshwater influx, temperature regimes, exposure, sediments, currents, and bathymetric or coastal complexity. In ecological terms, these are strongly cohesive units, large enough to encompass ecological or life history processes for most sedentary species.*

To delineate PNG's marine ecoregions, we started with those identified during previous planning processes that focused on a range of biophysical characteristics (Spalding et al. 2007, Green and Mous 2008: Figures 1–2), and refined them to take more oceanographic processes (currents, gyres, etc) and physical features (e.g. islands and deepsea seafloor features such as trenches and ridges), and the interactions among them, into account.

Thus we determined that PNG's national marine waters comprise all or part of five large scale ecoregions (Figure 4) that includes: two ecoregions (the Bismarck Sea and Solomon Sea) that are entirely located within PNG's sole jurisdiction; and three ecoregions that extend into other jurisdictions (portions of the Pacific Warm Pool, the Coral Sea, and the Arafura Sea).

We then modified the ecoregion boundaries to: ensure that the entire Planning Area (see above) was included within these five ecoregions; and exclude areas within ecoregions that lay outside the Planning Area (see above). Where PNG ecoregions only comprise a component of broader ecoregions that extend beyond the planning area, we gave them names that reflect this i.e. the Southwest Pacific Warm Pool, the Northern Coral Sea and the Eastern Arafura Sea.

Our revised ecoregions are presented in Figure 4, and each of the five ecoregions is described in Table 1.

Shallow water bioregions

We delineated 21 bioregions for PNG's shallow marine areas (200m deep or less) by refining and expanding on the functional seascapes previously described by Green & Mous (2008). Green & Mous (2008) defined these functional seascapes as "areas within a wider ecoregion within which there is some geographic or ecological distinctiveness, but over a smaller area that may be more suitable for the application of management measures such as MPA networks". The boundaries of these functional seascapes were delineated based on expert opinion regarding geographic integrity, connectivity, environmental factors, and shared ecological characteristics of shallow water habitats (primarily coral reefs, mangrove forests and seagrass beds) and species.

Since then the term "seascapes" has been used in different ways in the Coral Triangle (e.g. Atkinson et al. 2011 and the Coral Triangle Initiative on Coral Reefs, Fisheries and Food Security Regional Plan of Action[5]), and this term has led to some confusion among governments, NGOs and other stakeholders in the Coral Triangle (including in PNG). Therefore we will use the term "bioregion" to refer to these shallow water areas (previously called functional seascapes) that are nested within ecoregions.

PNG's 21 bioregions are delineated in Figure 4 and described in Table 1 (along with a description of the similarities and differences of each bioregion with the functional seascapes previously described by Green & Mous 2008).

It is important to note that where these bioregions are drawn on a map, the boundary is indicative only, since the bioregion is restricted to the parts within the indicated area that are less than 200 m in depth (i.e. deep water areas between islands, gulfs etc. are not included because the bioregions were delineated using criteria for shallow water ecosystems only).

Application of regionalisation in PNG National Marine Gap Analysis

The ecoregions and bioregions defined in Figure 4 will be used as stratification units to apply CARR principles in the PNG National Gap Analysis, where these principles will be applied to:

- Deepwater habitats based on ecoregions; and
- Shallow water habitats based on bioregions.

This is because the delineation of shallow water habitats was based primarily on characteristics of shallow water ecosystems (particularly coral reefs), so they are not applicable to deepwater habitats.

For the marine gap analysis, further stratification of deep water habitats within ecoregions will be applied using depth classes based on those used during Australia's bioregional planning process[6].

5 www.coraltriangleinitiative.org/library/cti-regional-plan-action

6 Deep water depth classes: 200–1500m, 1500–2500m, 2500–4000m, 4000–5000m, 5000–6000m, and >6000m.

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Table 1. Ecoregions within Papua New Guinea's EEZ, criteria used to define them, and relevance to previous ecoregions delineated by Green and Mous (2008) and Spalding et al. (2007).

Ecoregion	Criteria	Relevance to Previous Ecoregions
Bismarck Sea	This area, known as the Bismarck Sea, is considered to be a semi-enclosed tropical marginal sea (after McKinnon et al 2014). The area is semi-enclosed by the north coast of the main island of New Guinea and the offshore island arch of New Britain, New Ireland, Manus and associated reefs and islands. The southern boundaries across Dampier Strait and St George's Channel are placed at the southern end of these major channels, since the reef types are known to change at Cape Merkus at the southern end of the Dampier Strait (south-western end of New Britain), with a similar pattern observed for St George's Strait.	This ecoregion is very similar to the Bismarck Sea Ecoregion delineated by Green and Mous (2008) and Spalding et al. (2007), although we've modified it to take PNG's EEZ and more oceanographic, shallow and deepwater features into account by: • Using the southern side of the Manus Trough (north of Manus Island) as the northern boundary of the Bismarck Sea. Thus this boundary excludes the deep offshore area further north of Manus Island that Spalding et al (2007) included in the Bismarck Sea Ecoregion, since this area is likely to be more affected by oceanic influences from the Western Pacific Ocean (so it is now included in the Southwest Pacific Warm Pool Ecoregion—see below). • Extending the western boundary further west to align with the western extent of PNG's EEZ (at the border with Indonesia), which is consistent with the oceanography and biophysical features of the area. • Moving the north east boundary of this ecoregion slightly east to include Tench Island in the St Matthias Islands, since the biophysical characteristics of this area are likely to be more similar to those on New Hanover and Mussau Islands further west in the Bismarck Sea Ecoregion than they are to the other islands further east (in the Southwest Pacific Warm Pool Ecoregion – see below). • Moving the boundary between the islands of New Britain and New Ireland slightly south to ensure that all of the reefs within St George's Strait are included in this ecoregion.
Solomon Sea	This area, known as the Solomon Sea, is considered to be a semi-enclosed tropical marginal sea (after McKinnon et al 2014). The area is semi-enclosed by the island of New Guinea in the west, and the island of New Britain in the north. Currents and major influences from the western Pacific Ocean and northern Coral Sea are thought to be largely blocked by the islands of Bougainville and New Ireland in the east and the Louisiade Archipelago and Pocklington Trough in the south (Skewes et al. 2011). This ecoregion includes an important deepsea feature—the New Britain Trench, which is just south of the island of New Britain.	This ecoregion is similar to the Solomon Sea Ecoregion delineated by Green and Mous (2008) and Spalding et al (2007), although we modified the boundaries to take the PNG EEZ and more oceanographic and deepwater features (e.g. the New Britain Trench and the Pocklington Trough) into account by: • Moving the north-east boundary further east to extend from the southern tip of New Ireland southwest to meet the 200 m isobath on the northwest side of Bougainville. • Following the 200m isobath south along the southern side of Bougainville Island until it meets the boundary of the PNG EEZ. • Following the PNG's EEZ boundary as it zigzags southwest and then southeast from Bougainville until it meets the northern ridge of the Pocklington Trough, which is located east of Pocklington Reef (east of the Louisiade Archipelago). • Following the northern ridge of the Pocklington Trough west until it meets the 200 m isobath on the southern side of the Louisiade Archipelago, where it continues to head west until it meets the southeast tip of the PNG mainland.

Ecoregion	Criteria	Relevance to Previous Ecoregions
Northern Coral Sea	The deep water parts of this ecoregion are largely influenced by oceanic influences of the northern Coral Sea. Since this ecoregion only comprises a small component of a much larger oceanic ecosystem in the Coral Sea that extends further south and east into territorial waters of other countries, we've called this the Northern Coral Sea Ecoregion. The boundaries of this ecoregion include: • As previously described (as the southern boundary of the Solomon Seas Ecoregion), the northeast boundary of this ecoregion runs from the southeast tip of the main island of New Guinea east along the 200m isobath south of the Louisiade Archipelago and then heads further east following the northern ridge of the Pocklington Trough until it intersects with PNG's EEZ boundary. Thus this ecoregion includes an important deepsea feature – the Pocklington Trough. • The ecoregion boundary then runs south and west concurrent with the PNG's EEZ boundary and then north along the western Torres Strait ancient land bridge until it intersects with the main island of New Guinea on the southwest coast of PNG. • Although this ecoregion includes the area of the Torres Strait Protected Zone Joint Authority, this area is excluded from the analysis (see Planning Area above).	In previous regionalisations, the south-eastern extent of PNG's waters was included in a much larger Solomon Sea Ecoregion: • As far south as the PNG's EEZ boundary in Spalding et. al. 2007; and • As far south and west as the Coral Triangle scientific boundary in Green & Mous 2008). Spalding et al (2007) also described two other ecoregions in PNG's south-eastern waters (Southeast Papua New Guinea and the Gulf of Papua). In this regionalisation, we've combined all three of these areas to create one ecoregion, since the deep water parts of this ecoregion are all largely influenced by oceanic influences of the northern Coral Sea.

Ecoregion	Criteria	Relevance to Previous Ecoregions
Southwest Pacific Warm Pool	This area is characterised by very deep water, which is largely abyssal plain. The area is distinct from the semi-enclosed waters of the Bismarck and Solomon Seas, since it is most heavily influenced by the oceanic processes of the western Pacific Ocean in an area known as the Western Pacific Warm Pool. This ecoregion comprises a small portion of a much larger ecoregion that extends further out into the Pacific Ocean. Since only a component of this ecoregion is located within PNG waters, we've called it the Southwest Pacific Warm Pool Ecoregion.	This is a new ecoregion that includes the deep ocean environments that were previously considered as: • The northern extent of the Bismarck Sea Ecoregion delineated by Spalding et al (2007); and • The northern extent of the Solomon Archipelago Ecoregion delineated by Green and Mous (2008) and Spalding et al. (2007). The boundaries of this new ecoregion are: • The northern and eastern boundaries are delineated by PNG's EEZ. • The Manus Trough and the islands of New Ireland and Bougainville provide large-scale barriers isolating the semi-enclosed Bismarck and Solomon Seas, giving rise to the southern boundaries of this ecoregion (see the Bismarck and Solomon Seas Ecoregions above). • The island of Bougainville is entirely included in this ecoregion. • The east coast of New Ireland is included in this ecoregion, although the west coast is in the Bismarck Sea Ecoregion (because ecological surveys that have found that coral reef fishes on the western side of New Ireland are more similar to those in other parts of the Bismarck Sea than they are to those on the Pacific side of New Ireland). • The western boundary starts at the intersection with the Bismarck Sea Ecoregion boundary and Indonesian border. It then extends north and east following PNG's EEZ boundary, before heading south and west until it meets the 200 m isobath on the southeast corner of Bougainville where it meets the Solomon Sea Ecoregion.
Eastern Arafura Sea	This ecoregion represents a small extrusion of PNG's EEZ into the Arafura Sea (in an area locally known as the "dog leg"). Since this ecoregion only includes a small component that is within PNG's marine waters, it's called the Eastern Arafura Sea Ecoregion. This area is likely to be ecologically distinct from other marine areas in PNG, since the islands and very shallow waters of Torres Strait to the east (which include ancient land bridges) provide a barrier to the oceanic influences of the Coral Sea.	Spalding et al. (2007) previously delineated the Arafura Sea Ecoregion, which includes PNG waters. Our ecoregion includes just the component of this broader ecoregion that is within PNG's EEZ.

Table 2. Shallow water bioregions (nested within ecoregions) within Papua New Guinea's EEZ, criteria used to define them, and relevance to previous functional seascapes delineated by Green and Mous (2008).

Ecoregion	Bioregion	Criteria	Relevance to Previous Functional Seascapes
Bismarck Sea	Western Islands	Oceanic coral atolls on the northwest side of the Bismarck Sea.	This bioregion is the same as the Western Islands Functional Seascape.
	Manus	Large island and associated volcanic and coral atolls. Strong oceanic influences from the Bismarck Sea, with some influence of the Western Pacific Ocean.	This bioregion is very similar to the Manus Island Group Functional Seascape, but it has been expanded to include the coral atolls south east of Manus.
	Sepik	North coast of PNG influenced by outflows from large river systems (Sepik & Ramu Rivers).	This bioregion is very similar to the Sepik River Area Functional Seascape, but it was expanded further west to the PNG EEZ boundary with Indonesia.
	Madang	Coastal and offshore islands and reefs along the north coast of the main island of New Guinea, which are influenced by coastal and oceanic conditions in the Bismarck Sea.	These two bioregions were previously combined in the Madang-Dampier Strait Functional Seascape. Although the eastern boundary of the Dampier Strait has been moved slightly west so as not to bisect a contiguous reef system on the northwest coast of New Britain.
	Dampier Strait	A major strait between the main island of New Guinea and New Britain Island, which experiences strong currents and a mix of oceanic influences from both the Bismarck and Solomon Seas.	
	Kimbe-Witu Islands	Coastal and offshore reefs experience oceanic influences from the Bismarck Sea, but are not influenced by currents from the major straits either side of New Britain (Dampier Strait and St. George's Channel).	This bioregion is very similar to the Kimbe-Witu Islands Functional Seascape, although the western boundary has been moved slightly west so as not to bisect a contiguous coastal reef system on the northwest side of New Britain.
	St George's Channel	A major strait between the islands of New Britain and New Ireland, which is strongly influenced by currents between the Bismarck and Solomon Seas. It also experiences volcanic influences in some locations, particularly around Rabaul.	This bioregion is very similar to St George's Channel Functional Seascape, except that the south boundary has moved slightly south to ensure that all of the reefs in the channel are included (and to coincide with the ecoregional boundary between the Bismarck and Solomon Seas).
	West New Ireland	Narrow fringing reefs in the calm protected waters of the Bismarck Sea, which experience little oceanic influence and no major currents.	These two bioregions are very similar to the New Hanover—St. Matthias Group and West New Ireland Functional Seascapes, except that the boundary between the two has been moved slightly north (to include a cluster of coastal coral reefs with similar reefs in the West New Ireland bioregion).
	New Hanover-Mussau	Large islands and associated islands and coral atolls that experience oceanic influences from both the Bismarck Sea and Western Pacific Ocean.	

Ecoregion	Bioregion	Criteria	Relevance to Previous Functional Seascapes
Solomon Sea	Southern New Britain	Coastal fringing reefs in very deep water close to shore, along the southern side of New Britain Island and the northern side of the Solomon Sea and Solomon Trench. This area is influenced by coastal rivers and streams.	This bioregion is the same as the South New Britain Functional Seascape.
	Huon Gulf and Coastal Milne Bay Islands	Coastal reefs on the north-eastern side of the southeast peninsula of the main island of New Guinea, including nearshore areas and coastal islands (including the D'entrecasteaux Islands). These areas are more affected by coastal rather than oceanic influences.	These two bioregions were previously combined in the Huon Gulf & Milne Bay Coastal Areas Functional Seascape. The south-eastern portion of this seascape and the western reach of the Louisiade Archipelago Functional Seascape have now been combined to create the Samarai Islands Bioregion, based on reef classification and refined ecological system characterization in this area (Skewes et al. 2003, 2011). The remaining component is now the Huon Gulf and Coastal Milne Bay Islands Bioregion, although it extends further north to meet the boundary with the Madang Bioregion (which is also concurrent with the boundary between the Bismarck Sea and Solomon Sea Ecoregions).
	Samarai Islands	Coastal islands and reefs off the southeast tip of the main island of New Guinea, which also have oceanic influences.	
	Louisiade Archipelago	Offshore reefs off the eastern tip of the southeast peninsula of the main island of New Guinea, which experience strong oceanic influences from both the Solomon and Coral Seas.	This bioregion is very similar to the Louisiade Archipelago Functional Seascape, although the western boundary was moved further east to accommodate the new Samarai Islands Bioregion (see above). The boundary between the Samarai Islands and Louisiade Archipelago Bioregions is a very deep water channel, which is used as a major shipping route (Skewes et al. 2011).
	Trobriand & Woodlark Islands	Offshore reefs with strong oceanic influences from the Solomon Sea.	This bioregion is very similar to the Trobriand & Woodlark Islands Functional Seascape, although the western boundary has been extended further west and south (closer to the coast) to reflect the distinction between coastal and offshore reefs (Skewes et al. 2003) and refined ecological system classification in this area (Skewes et al. 2011).

Ecoregion	Bioregion	Criteria	Relevance to Previous Functional Seascapes
Southwest Pacific Warm Pool	Tabar-Lihir	Coastal and nearshore islands off eastern New Ireland and the Tabar-Lihir Island chain.	This is very similar to the Tabar-Lihir Islands Seascape, except that the outer boundary has moved southwest (closer to New Ireland) to exclude the far offshore shelf and atolls that have stronger oceanic influences (and are now part of the Pacific Offshore Bioregion).
	Pacific Offshore	Offshore reefs and atolls in the Western Pacific Ocean that are distant from major land bodies, have small areas of shallow water rising from very deep seafloor, and are subject to very strong disturbance regimes and oceanic influences from the western Pacific Ocean.	This is a new bioregion that comprises a disparate group of offshore reefs and atolls that previously were included in the Tabar-Lihir Islands, Ontong-Java-Tasman Island and Solomon Archipelago Seascapes.
	Bougainville	Large volcanic island with oceanic influences and fringing and barrier reefs.	This was previously part of the much larger Solomon Island Chain Functional Seascape, which extends further south from Bougainville through the main Solomon Island Chain of islands. Since Bougainville is the only part of this seascape that is included in PNG's EEZ, it was assigned its own bioregion. An offshore atoll northeast of Bougainville, which was previously included with Bougainville in the Solomon Archipelago Seascape, was excluded from this bioregion because it is likely to be more similar to the western Pacific atolls, so it was included in the Pacific Offshore Bioregion (above).

Ecoregion	Bioregion	Criteria	Relevance to Previous Functional Seascapes
Northern Coral Sea	Southeast PNG Coast	Coastal reefs and systems along the southeast coast of the main island of New Guinea that are primarily affected by oceanic influences from the northern Coral Sea, including the Coral Sea Gyre and Hiri Current (Ceccarelli, 2013). This area also has coastal influences, but it is distinct from the heavily river-influenced Gulf of Papua.	Since the Northern Coral Sea and Arafura Sea Ecoregions are outside the scientific boundary of the Coral Triangle, functional seascapes were not defined for these areas.
	Gulf of Papua	The Gulf of Papua is a large, shallow shelf area heavily influenced by runoff from the Fly and other major river systems. It is characterised by large, complex mangrove systems and silty water.	
	Southern Gulf	The offshore reefs in the southern Gulf of Papua comprise the northernmost parts of the Great Barrier Reef. These are thought be ecologically distinct and affected by a mix of coastal influences from the major rivers and Gulf of Papua and oceanic influences from the Coral Sea and Great Barrier Reef. This area extends from the isolated East Reef west to the southern coast of PNG, capturing a series of offshore reefs within the southern extent of PNG waters.	
Eastern Arafura Sea	Arafura Sea	Shallow waters and mangrove assemblages of the Arafura Sea. This area experiences coastal influences including runoff from rivers, and is isolated from the oceanic influences of the Coral Sea by the islands in the very shallow waters of Torres Strait, which include ancient land bridges (Heap and Sbaffi, 2008).	

Australia and the Coral Triangle Initiative (CTI) on Coral Reefs, Fisheries and Food Security

The CTI is a partnership—between Indonesia, Malaysia, Papua New Guinea, the Philippines, Solomon Islands and Timor Leste—focused on improving marine conservation and management, and through this, sustainable livelihoods, food security and economic development. Australia is a strong supporter of the CTI and is one of six formal partners. Australian Government support for the CTI is outlined in a series of documents that can be found online at **environment.gov.au/cti**

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