IUCN Conservation Outlook Assessment 2017 **(archived)**
Finalised on 12 November 2017

Please note: this is an archived Conservation Outlook Assessment for Rock Islands Southern Lagoon. To access the most up-to-date Conservation Outlook Assessment for this site, please visit https://www.worldheritageoutlook.iucn.org.

Rock Islands Southern Lagoon

SITE INFORMATION

Country:
Palau
Inscribed in: 2012
Criteria:
(iii) (v) (vii) (ix) (x)

Site description:
Rock Islands Southern Lagoon covers 100,200 ha and includes 445 uninhabited limestone islands of volcanic origin. Many of them display unique mushroom-like shapes in turquoise lagoons surrounded by coral reefs. The aesthetic beauty of the site is heightened by a complex reef system featuring over 385 coral species and different types of habitat. They sustain a large diversity of plants, birds and marine life including dugong and at least thirteen shark species. The site harbours the highest concentration of marine lakes anywhere, isolated bodies of seawater separated from the ocean by land barriers. They are among the islands' distinctive features and sustain high endemism of populations which continue to yield new species discoveries. The remains of stonework villages, as well as burial sites and rock art, bear testimony to the organization of small island communities over some three millennia. The abandonment of the villages in the17th and 18thcenturies illustrates the consequences of climate change, population growth and subsistence behaviour on a society living in a marginal marine environment. © UNESCO

SUMMARY

2017 Conservation Outlook

Good with some concerns

Overall, the conservation outlook for the Rock Islands Southern Lagoon is optimistic. Koror State has put in place a number of excellent management practices to protect the values of the Rock Islands Southern Lagoon. Potential issues include visitor impacts from large numbers of visitors to Jellyfish Lake and popular scuba dive and snorkeling spots as well as impacts associated with climate change and fishing pressure. * For mixed sites Conservation Outlook Assessments only evaluate the natural values of these sites (criteria vii, viii, ix and x) and the overall assessment reflects the potential of a site to preserve its natural values over time.

Current state and trend of VALUES

Low Concern
Trend: Stable

Overall, the current state of values is good. Coral reefs are threatened by climate change but management practices to reduce other stressors such as overfishing, visitor impacts and poor land use that causes nutrient pollution and sedimentation on the reefs, will be key.

Overall THREATS

Low Threat

Increasing tourist numbers is the most serious current threat and impacts from dive tourism are evident in some frequently visited dive sites. Potential threats include impacts from tsunamis and potential contamination from wastewater effluent. Overall, threats to the site are low to high.

Overall PROTECTION and MANAGEMENT

Mostly Effective

Overall, the protection and management of the Rock Island Southern Lagoon is mostly effective. The legislative framework regulating use and management of the environment and its resources is comprehensive and clear and is implemented effectively. There is, however, some room for improvement in education, enforcement, and involvement of local residents.

FULL ASSESSMENT

Description of values

Values

World Heritage values

▶ **Mollusks**
Criterion:(x)

7 species of giant clams and an endemic species of nautilus are found in the Rock Islands (SoOUV, 2012).

▶ **Sharks and turtles**
Criterion:(x)

13 species of sharks and manta rays and 2 species of marine turtle listed on IUCN’s Red List are found in the Rock Islands (SoUV, 2012).

▶ **Terrestrial biodiversity**
Criterion:(x)

All of Palau’s endemic birds, mammals, herpetofauna and nearly half of Palau’s endangered plants are found in Rock Islands Southern Lagoon (SoOUV, 2012).

▶ **Fish**
Criterion:(x)

746 species of fish occur in the Rock Islands Southern Lagoon, including endemic and threatened species (SoOUV, 2012).

▶ Corals

Criterion:(x)

385 species of coral are known to occur in the Rock Islands Southern Lagoon (SoOUV, 2012).

▶ Marine lakes and associated species

Criterion:(ix)

The Rock Islands Southern Lagoon contains 52 marine lakes, more than at any other site in the world. Furthermore, the marine lakes of the property are at different stages of geological and ecological development, ranging from lakes with high connectivity to the sea to highly isolated lakes with notably different species composition, including unique and endemic species. These features represent an outstanding example of how marine ecosystems and communities develop, and make the lakes valuable as “natural laboratories” for scientific study of evolution and speciation (SoOUV, 2012). Five new subspecies of the Mastigias papua jellyfish have been described from the marine lakes, and new species discoveries continue to be made both in the marine lakes as well as in the complex reef habitats of the property (SoOUV, 2012).

▶ Exceptional area with high variety of habitats

Criterion:(vii)

The Rock Islands Southern Lagoon contains an exceptional variety of habitats within a relatively limited area. Barrier and fringing reefs, channels, tunnels, caves, arches, and coves, as well as the highest number and density of marine lakes in the world, are home to diverse and abundant marine life (SoOUV, 2012).

▶ Exceptional beauty of Rock islands

Criterion:(vii)

The maze of dome-shaped and green Rock Islands seemingly floating in the turquoise lagoon surrounded by coral reef is of exceptional aesthetic beauty (SoOUV, 2012).

► Exceptionally high biological and marine habitat diversity

Criterion:(x)

The Rock Islands Southern Lagoon has exceptionally high biological and marine habitat diversity. The marine lakes are unique in terms of number, the density at which they occur, and their varying physical conditions. With low fishing pressure, limited pollution and human impact, as well as an exceptional variety of reef habitat, the resilience of reefs of the property makes it a critical area for protection, including as an area important for climate change adaptation of reef biota, and potentially as a source of larvae for reefs in the region (SoOUV, 2012). The corals in the Rock Islands are more thermally tolerant than patch and outer reefs. Rock Island corals also appear to be adapted to naturally acidified waters and may be uniquely resistant to ocean acidification (Shamberger et al., 2014, Barkley et al., 2015, Barkley et al., 2017). However, ocean acidification is affecting bioerosion rates as well as the calcium carbonate budget of the Rock Island reefs, and thus remains a viable threat (see below).

Assessment information

Threats

Current Threats

High Threat

Increasing tourist numbers is the most serious current threat and impacts from dive tourism are evident in some frequently visited dive sites.

► Ocean acidification

High Threat
Inside site, throughout(>50%)
Outside site

The Rock Islands are naturally more acidic than the patch and outer reefs of

Palau due to the long residence time of seawater in the bays, and the effects of calcification and respiration on seawater pH. The Rock Islands corals are adapted to low pH (Shamberger et al., 2014; Barkley et al., 2015; Barkley et al., 2017) but bioerosion rates in the Rock Islands are high due to the low pH (DeCarlo et al., 2015) and rates of Net Ecosystem Calcification are the lowest ever measured (Shamberger et al., 2017). As pH declines further due to anthropogenic CO2, the Rock Islands reefs will eventually shift to a state of net dissolution. It is not yet known when this will happen. Reducing local stresssors, including land based sources of nutrient pollution, will slow the effects of ocean acidification (DeCarlo et al., 2015; Prouty et al., 2017).

► Fishing / Harvesting Aquatic Resources

Low Threat
Inside site
Outside site

Fishing occurs in the Rock Islands Southern Lagoon outside of no-take zones, and has been known to occur inside of no-take zones illegally. (Matthews 2004).

► Tourism/ visitors/ recreation

Very High Threat
Inside site, extent of threat not known
Outside site

Impacts from dive tourism are evident in some frequently visited dive sites in the Rock Islands Southern Lagoon; numbers of tourists are continually increasing each year. (Poonian et al 2010) Number of tourists visiting Palau increased from 58,000 in 2000 to 79,000 in 2008, and to 109,000 in 2011 and 141,000 in 2014 (World Bank, 2012, 2015). Most of these tourists visit the Rock Islands. Tourism also brings increase in wastewater and increased demand for hotel and road-building that can cause erosion, sedimentation and nutrient pollution to the reefs.

► Temperature extremes

Low Threat
Inside site, throughout(>50%)
Outside site

Ocean warming has already affected Palau. Temperatures in the Western

Pacific Warm Pool are rising and thus, the impact of ocean warming on Palau's reefs is likely to increase over the next two decades. The Rock Islands; reefs may be more resilient to this warming which is thus ranked as a "low threat" at this time. In 1998 and 2010, coral bleaching occurred across the archipelago. In 1998, bleaching induced mortality was as high as 90% on some sites patch and outer reefs. In the Rock Islands, water temperatures were higher but bleaching and mortality levels were low (Bruno et al., 2001; Golbuu et al., 2007l; van Woesik 2012; Barkley and Cohen 2016). Rock Islands corals also show excellent recovery (Golbuu et al., 2007), resulting in rating of "low threat at this time.

Potential Threats

Low Threat

Potential threats include impacts from tsunamis and typhoons and potential contamination from wastewater effluent.

► Earthquakes/ Tsunamis

Low Threat
Inside site
Outside site

Typhoons are rare in Palau; however, Typhoon Bopha hit Palau in December 2012 with serious impact.

Protection and management

Assessing Protection and Management

► Relationships with local people

Mostly Effective

Overall, the Rock Islands Southern Lagoon is a source of pride for Palauans and the management of the area is supported by local residents. However, there is room for improvement to involve local stakeholders. One project aiming to improve this is the Koror State-Rare campaign

(www.rareplanet.org).

▶ Legal framework

Mostly Effective

The legislative framework regulating use and management of the environment and its resources is comprehensive and clear (SoOUV, 2012). Rules and regulations for the Rock Islands Southern Lagoon are clearly delineated in the management plan and enforced by the Koror State Rangers. Enforcement is mostly effective, with some room for improvement.

▶ Enforcement

Data Deficient

Data deficient.

▶ Integration into regional and national planning systems

Mostly Effective

Palau’s Protected Areas Network works to integrate state and national planning.

▶ Management system

Mostly Effective

The area falls in its entirety in Koror State, and the management jurisdiction of Koror State Rangers is well known and respected. Management authorities are operating on relatively reliable revenue from tourism. The strength of traditional value systems including resource governance systems is an asset, and can enable management and zoning that accommodate both cultural/traditional and biodiversity conservation needs. Management objectives and priorities are defined in the Rock Islands Southern Lagoon Management Plan (SoOUV, 2012).

▶ Management effectiveness

Mostly Effective

The Nature Conservancy conducted a management effectiveness evaluation of the Rock Islands Southern Lagoon in 2012; results showed that the

management is mostly effective (Personal communication, 2013).

▶ Implementation of Committee decisions and recommendations

Data Deficient

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▶ Boundaries

Mostly Effective

Boundaries are clearly delineated, with some room for improvement in boundary markers.

▶ Sustainable finance

Highly Effective

The Rock Islands Southern Lagoon is relatively well financed through user fees from tourists visiting the area (SoOUV, 2012).

▶ Staff training and development

Some Concern

Koror State Rangers receive training in law enforcement and educational enforcement. The Guam government is a partner on this. However, more training is needed.

▶ Sustainable use

Mostly Effective

Fishing is the main extractive industry in the Rock Islands and it is relatively well managed. However, subsistence and recreational fishing taking place within the property and in designated zones require constant monitoring (SoOUV, 2012).

▶ Education and interpretation programs

Some Concern

A number of partners provide education programs in the Rock Islands; however, a more systemized approach to provide educational opportunities

to Palau's students would improve effectiveness.

▶ Tourism and visitation management

Some Concern

Tourism and interpretation are carried out by private industry, with many dive shops taking tourists to the Rock Islands. Some of these dive shops have commitments to sustainability and excellent interpretation, while other dive shops have room for improvement on both (Poonian, 2010).

▶ Monitoring

Mostly Effective

The Palau International Coral Reef Center and other partners such as the Coral Reef Research Foundation and The Nature Conservancy regularly monitor coral reefs and fish populations (Golbuu, 2005).

▶ Research

Mostly Effective

The Palau International Coral Reef Center leads research efforts in the Rock Islands Southern Lagoon, including impacts of climate change on coral reefs (Golbuu, 2005). The site is also important for research on coral reef resistance to ocean acidification (Shamberger et al., 2014)

Overall assessment of protection and management

Mostly Effective

Overall, the protection and management of the Rock Island Southern Lagoon is mostly effective. The legislative framework regulating use and management of the environment and its resources is comprehensive and clear and is implemented effectively. There is, however, some room for improvement in education, enforcement, and involvement of local residents.

▶ Assessment of the effectiveness of protection and management in addressing threats outside the site

Some Concern

The main threat outside the site comes from climate change and

acidification, which is a threat that can’t be managed locally. However these threats can be slowed by management of local stressors. Most important are land-based sources of pollution.

▶ Best practice examples

Sustainable financing of enforcement efforts through relatively high user fees.

State and trend of values

Assessing the current state and trend of values

World Heritage values

▶ Mollusks

Data Deficient
Trend:Data Deficient

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▶ Sharks and turtles

Low Concern
Trend:Stable

Palau has abundant shark populations and recent measures to ban shark fishing (including the government declaring the EEZ as a shark sanctuary in partnership with Pew) will need strong enforcement to ensure that these species persist.

▶ Terrestrial biodiversity

Data Deficient
Trend:Data Deficient

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▶ Fish

Low Concern
Trend:Data Deficient

Reducing fishing impacts, particularly to endangered and threatened species will be important to prevent irreversible losses.

▶ Corals

High Concern
Trend:Data Deficient

Overall, the current state of values is good. Coral reefs are threatened by climate change but management practices to reduce other stressors such as overfishing, visitor impacts and poor land use that causes nutrient pollution and sedimentation on the reefs, will be key (Poonian, et. al 2010, Gouezo et al., 2016; TNC, n.d.).

▶ Marine lakes and associated species

Low Concern
Trend:Stable

Most marine lakes are not visited, which means they receive protection. The jellyfish in the main jellyfish lake are under stress due to visitor impacts.

▶ Exceptional area with high variety of habitats

Good
Trend:Stable

The site remains a unique area with exceptionally high variety of habitats.

▶ Exceptional beauty of Rock islands

Good
Trend:Stable

The aesthetic values of the site have been well preserved.

▶ Exceptionally high biological and marine habitat diversity

High Concern
Trend:Data Deficient

Coral reefs be are threatened by climate change but management practices to reduce other stressors such as overfishing, visitor impacts and poor land use that causes nutrient pollution and sedimentation on the reefs, will be

key. (Poonian, et. al 2010, Gouezo et al., 2016; TNC, n.d.).

Summary of the Values

► **Assessment of the current state and trend of World Heritage values**

Low Concern

Trend: Stable

Overall, the current state of values is good. Coral reefs are threatened by climate change but management practices to reduce other stressors such as overfishing, visitor impacts and poor land use that causes nutrient pollution and sedimentation on the reefs, will be key.

Additional information

Benefits

Understanding Benefits

► **Health and recreation, Outdoor recreation and tourism**

Tourism is about 50% of Palau’s GDP (one of the highest rates in the world), most tourists visiting the Rock Islands (IMF, 2012).

► **Health and recreation, Outdoor recreation and tourism**

The Rock Islands Lagoon provides recreational opportunities for Palauans and visitors, including boating, BBQing, fishing, snorkeling, and beach visits.

► **Knowledge, Importance for research**

The Rock Islands Lagoon provides a natural laboratory for scientific research on coral reef health and climate change impacts to coral reefs and has spawned numerous scientific publications (e.g. Golbuu, 2007; Van Woesik et

al., 2012; Shamberger et al., 2014; DeCarlo et al., 2015).

Summary of benefits

Benefits provided by the Rock Islands Lagoon include tourism, recreation, and scientific research. The primary benefit is tourism and its associated impact on Palau's GDP.

Projects

Compilation of active conservation projects

№	Organization/ individuals	Project duration	Brief description of Active Projects
1	Unknown		Archaeological assessments of the Rock Islands
2	Ileb Olkerriil, Koror State Rangers		Rare Pride campaign for Ngederrak MPA in Rock Islands Southern Lagoon
3	Palau Ministry of the Natural Resources, Environment, and Tourism		Assessment of carrying capacity for tourists at dive sites

Compilation of potential site needs

№	Site need title	Brief description of potential site needs	Support needed for following years
1	.	Catch per unit effort for fishing in Rock Islands (Golbuu 2005)	
2	.	Long term monitoring of diver impacts to coral reefs (Poonian, et. al., 2010)	
3	.	Better understanding of fisheries to help guide fisheries regulations (Confidential consultation, August 2013)	
4	.	Better understanding of coastal erosion (Confidential consultation, August 2013)	

REFERENCES

№	References
1	Barkley Hannah C., Anne L. Cohen, Daniel C. McCorkle, Yimnang Golbuu (2017), Mechanisms and thresholds for pH tolerance in Palau corals, Journal of Experimental Marine Biology and Ecology, 489, doi: 10.1016/j.jembe.2017.01.003.
2	Barkley Hannah C., Anne L. Cohen, Daniel C. McCorkle, Yimnang Golbuu (2017), Mechanisms and thresholds for pH tolerance in Palau corals, Journal of Experimental Marine Biology and Ecology, 489, doi: 10.1016/j.jembe.2017.01.003.
3	Barkley, H.C., Cohen, A.L., Golbuu, Y., Starczak, V.R., Shamberger, K.E.F., and DeCarlo, T.M. (2015) Changes in coral reef communities across a natural gradient in ocean acidification, Science Advances, 2015;1:e1500328
4	Confidential consultation form. August 2013.
5	Conservation International Pacific Islands Program. 2011. Biodiversity Conservation Lessons Learned Technical Series 9: Documenting an Existing Invasion to Prevent Future Introductions of Non-Indigenous Species in the Island-like Marine Lakes, Koror, Palau. Conservation International, Apia, Samoa.
6	DeCarlo, T.M., A. L. Cohen, H. C. Barkley, Q. Cobban, C. Young, K. E. Shamberger, R. E. Brainard, Y. Golbuu. (2015) Coral macrobioerosion is accelerated by ocean acidification and nutrients. Geology, 2015; 43 (1): 7 DOI: 10.1130/G36147.1
7	Golbuu, Y; A. Bauman, J. Kuartei, and S. Victor. 2005. The State of Coral Reef Ecosystems of Palau.
8	IUCN. Rock Islands Evaluation. 2012.
9	International Monetary Fund. 2012. Republic of Palau Staff Report for the 2012 Article IV Consultation.
10	Marine Gouezo, Shirley Koshiba, Evelyn I. Otto, Dawnette Olsudong, Geory Mereb, Randa Jonathan PICRC Technical Report No 16-06, March 2016
11	Matthews, E. 2004. Subsistence Fishing Activities in the Rock Islands. Palau Conservation Society. PCS Report No. 2004-1.

№	References
12	Poonian, C., P.Z.R. Davis, and C.K. McNaughten. 2010. Impacts of Recreational Divers on Palauan Coral Reefs and Options for Management. Pacific Science (2010). vol 64, no. 4: 557-565.
13	Prouty, N., Anne Cohen, Kimberly Yates, Curt Storlazzi, Peter Swarzenski, and Darla White (2017) Land based pollution exacerbates acidification and bioerosion on coral reefs. JGR Oceans, In Press
14	Shamberger K., Lentz, S., Cohen A., (2017) Low and Variable Ecosystem Calcification in a Coral Reef Lagoon under Natural Acidification. Limnology and Oceanography, doi:10.1002/lno.10662
15	Shamberger, K. E. F., A. L. Cohen, Y. Golbuu, D. C. McCorkle, S. J. Lentz, and H. C. Barkley. 2014, Diverse coral communities in naturally acidified waters of a Western Pacific Reef, Geophys. Res. Lett., 41, doi:10.1002/2013GL058489.
16	The Nature Conservancy. Date unknown. Reef Resilience Toolkit Case Study on Palau’s coral reefs. http://www.reefresilience.org/Toolkit_Coral/C8_Palau.html
17	World Tourism Organization, Yearbook of Tourism Statistics, Compendium of Tourism Statistics and data files. http://data.worldbank.org/indicator/ST.INT.ARVL?page=2. Accessed September 16, 2013.