Identification and Profiling of Sites for Inclusion in Surf Protected Area Networks (SPAN)

Information for Surf Protected Area (SPA) Candidates Site/
(Surf Ecosystems) Profile

INDONESIA

Background Summary on the Site:

I. PHYSICAL/BIOLOGICAL

1. Location and Accessibility of SPA Candidates Site

Indonesia lies between the Indian and Pacific Oceans (Latitude: From 05° 33' 28" N, 095° 19' 20" E in the west, to 02° 31' 36" S, 140° 42' 51" E in the east. Longitude: 120° 00' E.). The largest archipelagic state in the world, Indonesia is comprised of over 17,500 islands generally depicted in Figure 1.

Indonesia's islands are grouped into the following autonomous regional administrative divisions of the Indonesian government:

1) **Kepulauan Sunda Besar (Greater Sunda Islands)**: Sumatra, Java, Sulawesi and the southern part of Kalimantan (Borneo);
2) **Nusa Tenggara (Lesser Sunda Islands)**: islands of Bali and a chain of islands that runs eastward through the island of Timor;
3) **Maluku (Moluccas) Islands**; and
4) **Papua**: the western part of the island of New Guinea.

Only 81 of 210 Indonesian surf spots identified by surfers on a collaborative data site had complete enough data for the analysis. These sites were investigated and mapped using GIS (Figure 2 shows their locations). The individual surf spots are listed by island/island group in Appendix Table 3. These surf spot locations are accessible by a combination of air, sea, and ground transportation. Indonesia has 118 airports and 64 seaports (14 large, the remaining small). Public bemo (buses), taxis, car/driver rental packages, and rental cars are available for ground transportation; sometimes a 4x4 vehicle is required as indicated in Appendix Table 3.

Figure 1 - Indonesia Maps

Figure 1a - Location and Administrative Divisions Map of Indonesia

Figure 1b - Sunda Island Groups

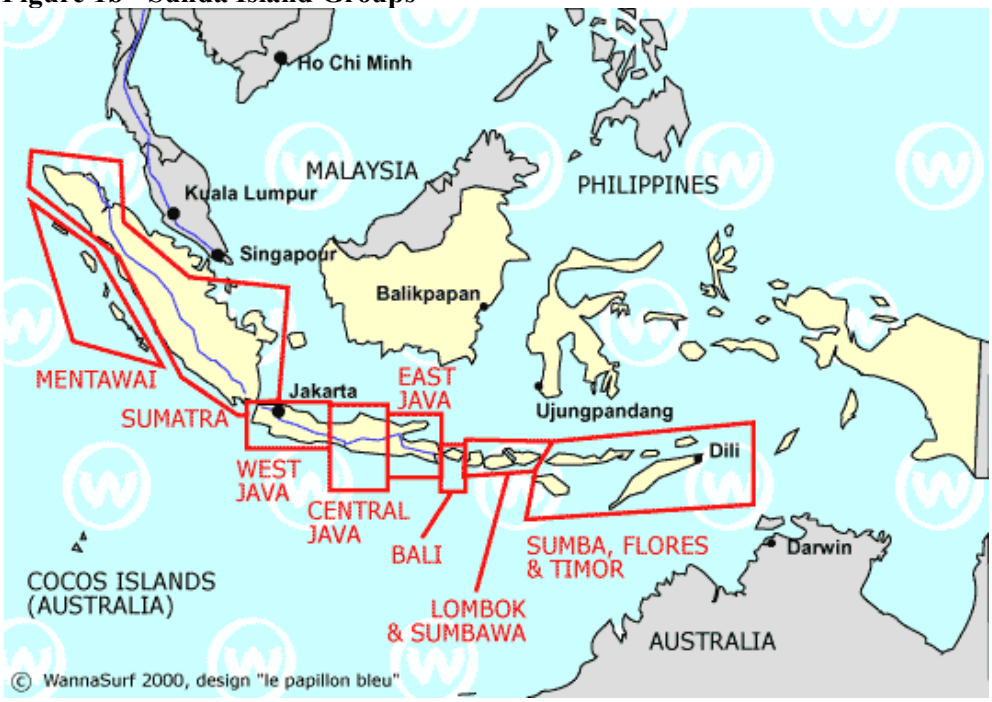


Figure 1c - Maluku Island Groups

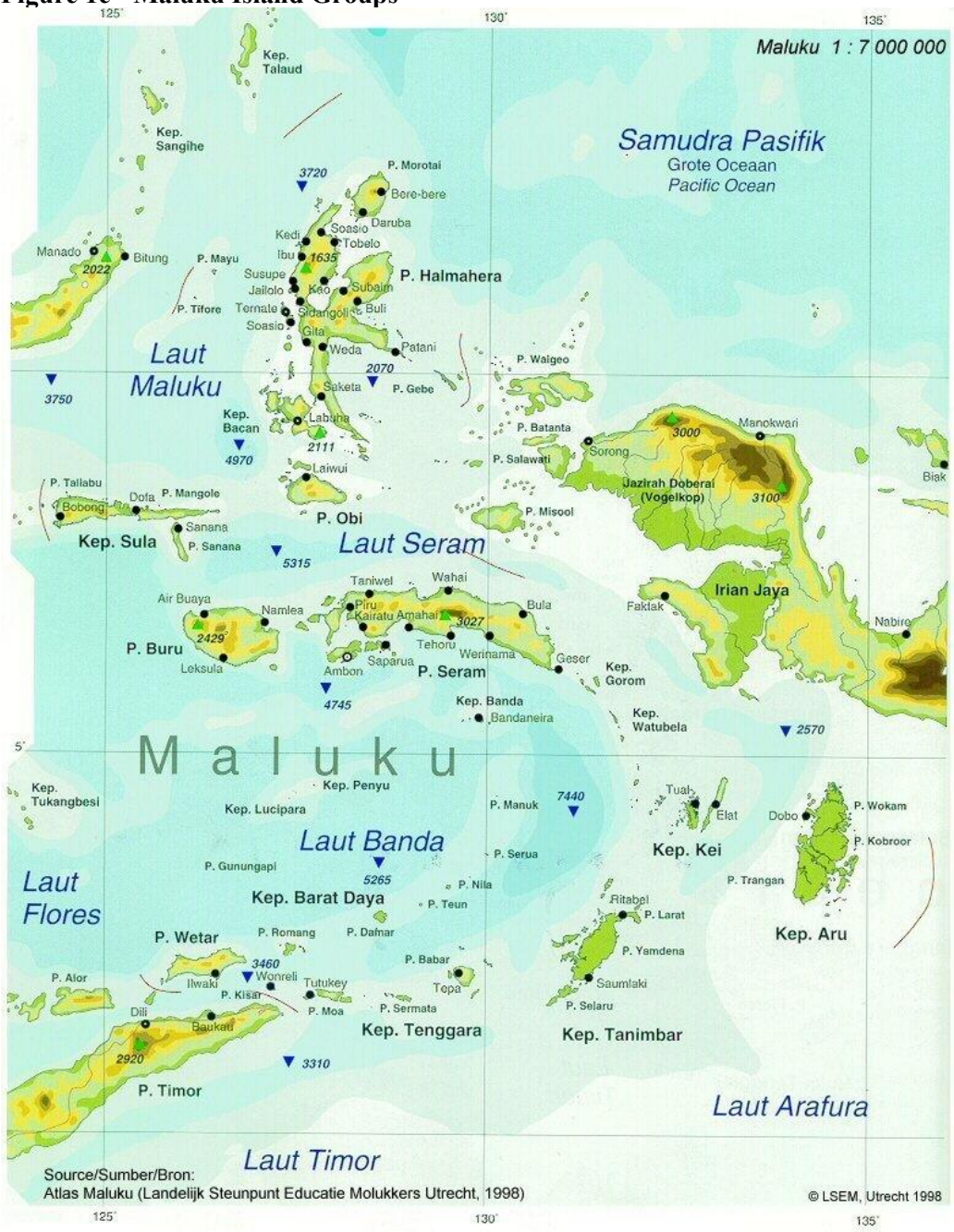


Figure 2 - Indonesian Surf Spots Maps
All three maps depict wave quality index scores on a 5 star rating scale (data from WannaSurf).

Figure 2a - Indonesian Surf Spots

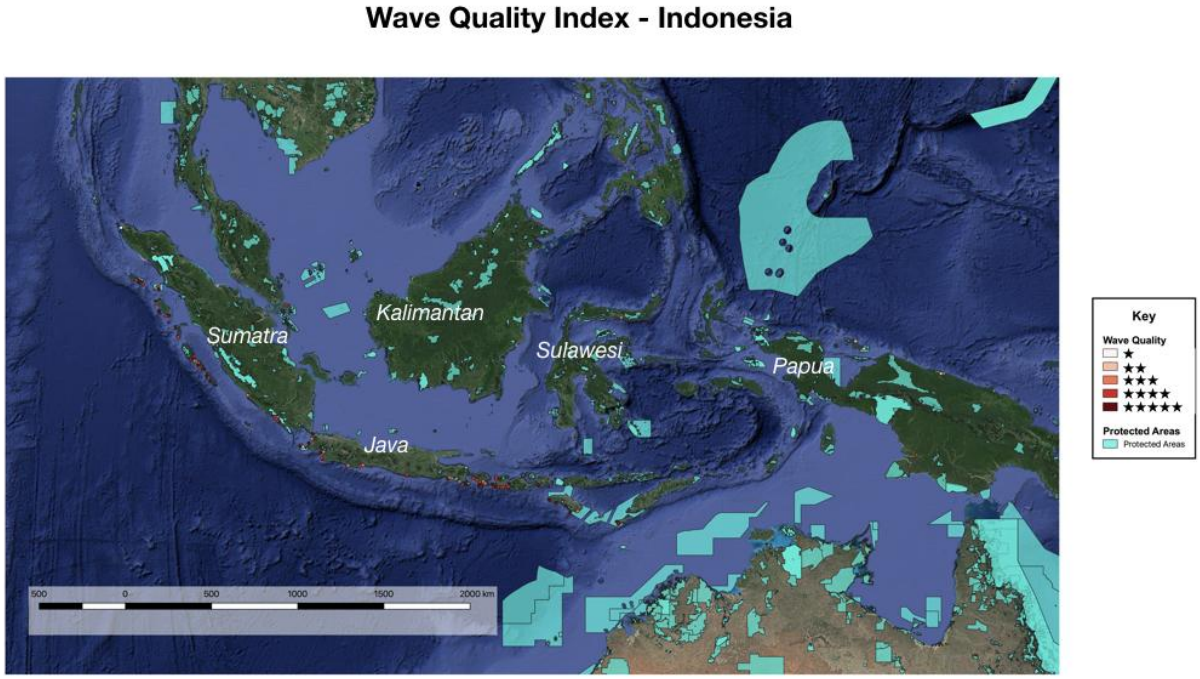


Figure 2b - Central Indonesia Surf Spots: East Java, Bali, Lombok, Lesser Sumbawa, Sumba, and West Timor

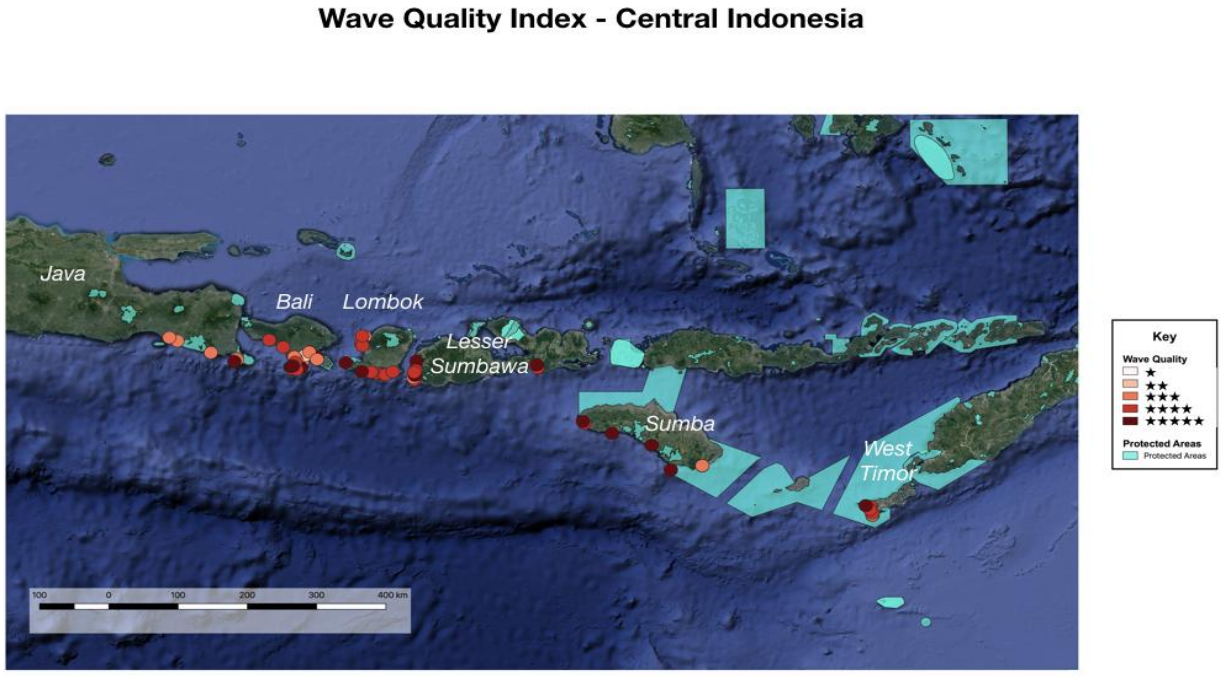
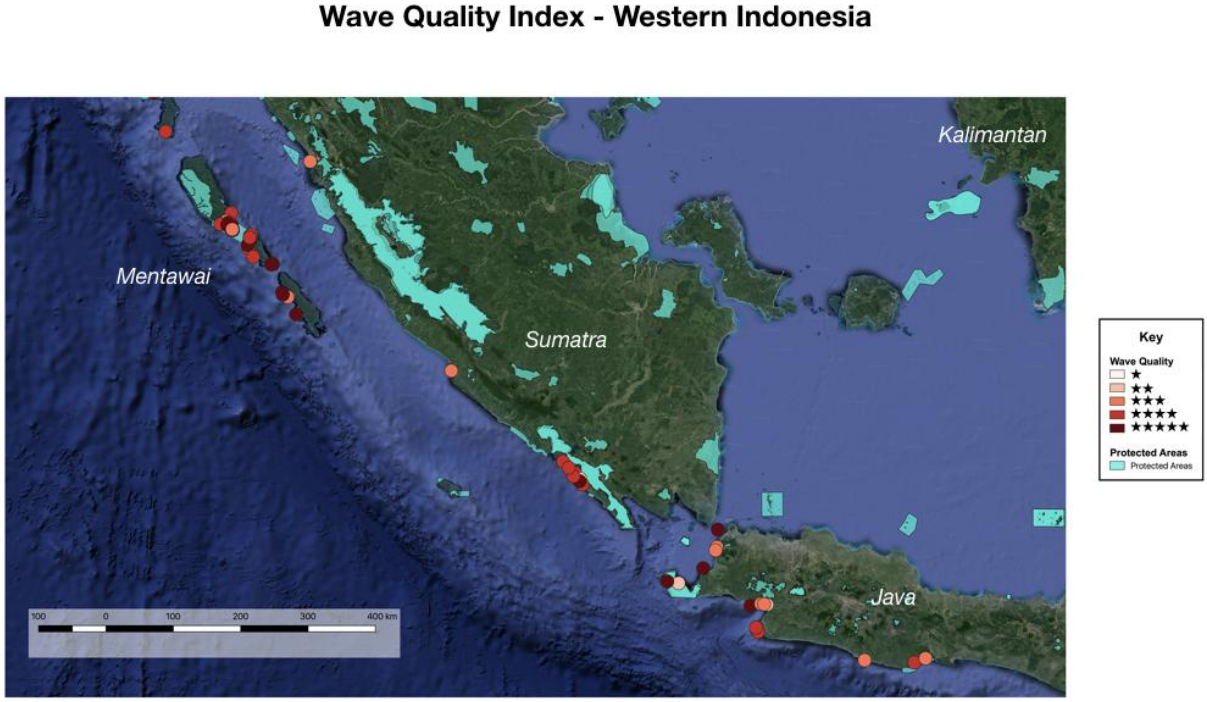


Figure 2c - West Indonesia Surf Spots: Mentawai, Sumatra, and West Java



2. Number and size of potential SPA site(s) and any associated sites

Surf Protected Area Networks (SPANs) combine legal protection of marine ecosystems and sustainable community development in areas where high quality surfing waves and priority marine ecosystems overlap. SPANs will consist of individual Surf Protected Area sites that will be protected and managed under the legal system of the country where there are developed. In Indonesia, these sites may range in size and focus from small protected areas that focus on protecting surfing waves and the immediately surrounding coastal area to large land and sea protected areas that work to manage larger ecosystems in areas where there is also high-quality surf and vulnerability to an array of threats. The character and elements of each SPAN site and SPAN vary considerably depending on the local and national context. To the degree possible, SPANs will achieve significant ecosystem scale conservation and human well-being benefits that result from management of as large an area as possible in each individual SPAN.

5 High Potential SPA site(s) were identified based on a surf spot or group of surf spot's Wave Quality and Biodiversity index scores. They are listed below by government administrative divisions and shown in Figure 3:

Kepulauan Sunda Besar (Greater Sunda Islands):

1) East Java: One large SPAN containing 4 surf sports within 5km of each other. The four surf breaks include Grajagan-G-Land, Tiger Tracks Lefts, Tiger Tracks, and 20-20s. G-Land is an internationally renowned surf break located on Eastern Java in Grajagan Bay offshore of Alas Purwo National Park. These world class breaks have very consistent and "totally epic" waves and was the origin of Indonesian surfing and the birthplace of surf camps. WannaSurf users gave G-Land the maximum surf spot wave score of 5-stars. Given its close proximity to the Alas Purwo National Park and thriving coral reef ecosystems this is a potential SPAN with immediate conservation opportunity.

Nusa Tenggara (Lesser Sunda Islands): 4 large SPAN, 2 medium-to-large SPA, or up to 11 smaller scale SPAs:

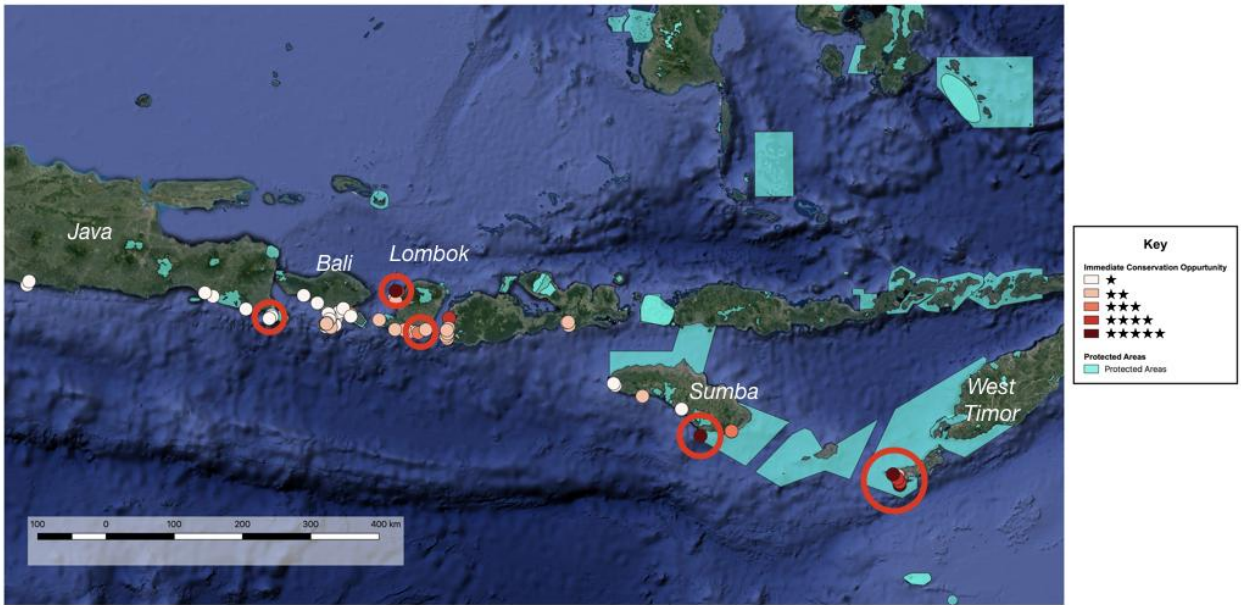
1) Rote, Savu, and Do'o Islands off West Timor: One large SPAN with 7 Breaks within 20km of each other. The most well-known surf break is T-Land off Rote Island, a much more forgivable left than G-land. The break has recently been covered by both MSW and Surfline, and is gaining popularity.[1] Nearby is Savu Right off Savu Island which has arguably the best barrels in Eastern Indonesia, although the conditions are inconsistent. Also within this region is Do'o Island, Sucky Mama's, and Boa all of which are well known surf spots in the region occasionally having phenomenal waves. Although not a world class break per se, the "Land of Lefts" sites have regular frequency and received a surf spot wave score above 3 stars. Furthermore, these sites are located within the Perairan Laut Sawu National Marine Park which protects are large expanse of coral reef habitats and is home to threatened and endangered sea turtles and marine mammals.[1] Together these attributes make it a strong candidate for SPAN sites.
2) Salura Island off Sumba: 1 medium to large SPA around the small Island. The surf break is Mengkudu or Mengkudu Left which has world class waves that are very consistent, and received a surf spot wave score of 4.25 stars. This site is also located within the Perairan Laut Sawu National Marine Park making it a potential SPAN area with immediate conservation opportunity.
3) Lombok Island: 2 strong candidate large SPA sites. Gili Air (3 stars) and Gili

Trawangan (3.5 stars) which are located in the Northwest of the Island. These breaks are regional classic waves, but can be inconsistent. However these breaks are surrounded by healthy coral reef habitats that are frequented by snorkelers and divers and are near large sea turtle nesting sites. These surf spots are currently part of the Gili Islands Marine Recreation Park. On the Southeast side of the Island are Inside and Outside Ekas (3.5 stars) which have consistent solid swells. This surf break is located with the Wisata Alam National Recreation Area.

Citations:

1. Surfline. Rounding Out in Rote. Accessed March 13, 2019
2. Tempo.Com. Coral Reefs in Sawu Sea Cover 63,339 Hectares. Accessed March 13, 2019

Figure 3 - Map of Top SPA Candidate Sites in Indonesia



3. Surf Potential (Quality, Consistency)

Indonesia is world famous region for surfing. One of the key factors that draw hundreds of thousands of surf tourists to Indonesia is the combination of beauty, power, and remoteness of breaks. The incredible diversity of coral and volcanic topography along with 54,720 km of coastline makes for some of the most legendary waves in the world. However, the shear magnitude also means that many breaks go undocumented, liming our ability to map surf spots. Furthermore, during our study we did not have access to all available surf spot information. For example we had no way to accessing all of World Surf League's Magic SeaWeed or Surfline's database. Thus we recognize the limitations of our preliminary approach in identifying the ideal SPAN sites within Indonesia.

To acquire Indonesian surf data we relied on WannaSurf, an online surfing community which allows users to upload and post descriptions of surf spots. Any model is only as good as its data and we acknowledge our reliance on community surf data. The WannaSurf community identified 210 surf spots in Indonesia. As Table 2 (in Appendix) shows, there is a great diversity of breaks across the entire country. Reef breaks (predominantly coral) are very common; WannaSurf identifies them as appropriate only for experienced surfers with the most dangerous ones (4) rated as "pro and kamikaze" spots. Indonesia also has many point, beach, rivermouth and sand bar breaks appropriate for beginners and all surfer levels. There are an equal share of left- and right- breaking surf spots; some spots have both left- and right-breaking waves. Wave frequency is regular to very consistent (especially for sites facing the Indian Ocean and receiving Antarctic swells). Wave quality is very high. According to WannaSurf, Indonesian wave quality average is Regional to World Classic level with some Totally Epic waves available for experienced and pro surfers.

Figure 4 - Perfect Barrels of Indonesian Waves (Photo: Surf Camp Nias)

Maluku Islands: Morotai/North Maluku: Remote area with low population and little coastal development. Mostly local surfers on low-tech surfing equipment. Rated surf spots rated

between 1 and 4 stars on Magic Seaweed. Access by boat or land, long walk and paddle. N,E Swell. Best time to surf: November to March. From WannaSurf there was insufficient data to complete the ranking with Maluku Islands surf spots included. They have been temporarily ranked at the bottom as a result. However, we recognize that previous SPAN efforts have identified potential sites within the region. This highlights an important point of our current SPAN analyses in that they are only as good as the publicly available datasets in which we built our ranking system from. Future efforts should incorporate the ground knowledge and improved data sets from World Surfing League, Surfline, and other surf, conservation, and ecological repositories.

Papua: Rivermouth surf spots with right and left breaks. For experienced surfers. Accessible by boat. Regional classic quality waves that sometimes break. Requires good wind direction Wave score: 1.75. Best time to surf is November-March.

Lesser Sunda Islands: Bali has good access and diversity of high quality waves for different experience levels. High quality waves with regular consistency. Varying access levels. Best time to surf is June-Sept. Crowded. Wave scores range from 0-5 stars. Mostly, S, SW, SE swell direction.

Greater Sunda Islands: Sumatra: Mainland and Islands have good access and diversity of waves for different experience levels. High quality waves with regular consistency. Varying access levels. March-Nov: 6-12 ft waves, otherwise 3-6 ft at other times of year. Can get crowded, portions heavily developed. Wave scores: 0-4.25). Java also has a wide range of surf including world class breaks (G-Land) (Wave scores: 0-5). Mostly S, SW, W swell direction.

Please see surf spot analysis and supplementary data table (Appendix Tables 3-6) for a list of Indonesian surf spots, and surf spot attributes and ranking based on selected surf and conservation criteria. 210 Surf spots were comparatively ranked assuming lowest values where data was missing. Malaku data was too incomplete to rank using the same ranking algorithm.

Additional surf quality factors that have not yet been included in this and most surf spot analyses include water quality, sustainable marine tourism management, and crowdedness. Additional data collection efforts are needed to support inclusion of these factors in a surf spot quality analysis.

Table 4 - Surf Area Rankings for Potential Economic Benefit from Surf Tourism

(Note: Top-ranking areas are highlighted in light blue.)

SURF AREA RANK

(Based on wave quality, frequency, skill level diversity, break direction diversity, and family-friendliness, indicators for broader eco-tourism market.)

SURF SPOT AREA	SURF SPOT INDEX SCORE	AREA RANK	GRADE
INDONESIA	1881		
MENTAWAI	786	11	0 star
SULAWESI	225	12	0 star
SUMBA, FLORES, SAVU, TIMOR	1478	8	1 star
SUMBAWA	1625	5	1 star
LOMBOK	1592	6	1 star
BALI	2323	4	2 star
EAST JAVA	5033	1	5 star
CENTRA JAVA	1500	7	1 star
WEST JAVA	3776	2	3 star
SUMATRA MAINLAND	2646	3	2 star
SUMATRA ISLANDS	1413	9	1 star
PAPUA	175	13	0 star
FIJI	1256	10	1 star

4. Geophysical attributes (climate, geographic attributes, substrate structure, bathymetry, source of wave)

Climate: Indonesia is characterized by a tropical climate with a distinct rainy season from December to March. Typhoon season ranges from September and December.[1]
Source of Wave: Indian ground swell picked up by the Western breaks is the strongest and most consistent during the dry season.[2] The opposite is true for Eastern breaks, though in general these tend to have more infrequent surf.[3] Short period wind swells are also present.[3]
Geographic Attributes: Indonesia is wave rich with multiple world class breaks. Regions have distinct surf profiles and attributes these include Morotai, North Maluku, Papua, Lesser Sunda, Sumatra, Bali, Lombok, and Mentawai.[4] Indonesia has two mountain chains that include active volcanoes.[5] As it lies between the Pacific and Indian Oceans, it provides habitat for marine species of both regions, including the Coral Triangle, the most biodiverse marine ecosystem in the world.[5]
Substrate structure: Given the high geologic diversity, there are a variety of substrate structures across all of Indonesia including coral reef, rocky reef, and beach breaks.[4,5] Most surf breaks are outside reef breaks.
Bathymetry: Range includes all reef types (atoll (most common), barrier and fringing (least common)).[5]

Citations:

1. Weather Online. Indonesia Climate. March 13, 2019.
2. The Inertia. 24 reasons why Indonesia is the Best Surfing Country. March 13, 2019
3. Lush Palm. Surfing Indonesia/ Everything You Need to Know. March 13, 2019
4. Wanna Surf. Indonesia Surf Spots. March 13, 2019.
5. World Atlas. Geography of Indonesia. March 13, 2019.

5. Biodiversity and Ecosystems (number of species, endemism, general ecosystem type and character)

Indonesia is located within the Coral Triangle which has the highest marine biodiversity in the World with over 1150 species of coral, and 3476 species of fish[1,9]. The Coral Triangle is centered on the Eastern region of Indonesia in Papua, Maluku, and Northern Sulawesi with decreasing biodiversity going westward towards Aceh in the Indian Ocean[2]. Coastal ecosystems are dominated by coral reefs with extensive mangrove forests and seagrass ecosystems also present.

Many large international conservation NGOs, Conservation International.[3] and The Nature Conservancy,[4] have established marine protected areas within the region, with most of them centered around West Papua and Sulawesi. There is a wide diversity of protection statuses given to the protected areas, many of which allow for a variety of forms of artisanal and small scale fishing.

Figure 5 - The Coral Triangle

Indonesia is also home to many endangered and threatened marine species under the IUCN Red List and Convention on International Trade in Endangered Species (CITES) including whale sharks, manta rays, dugongs, great hammerheads, and corals. In total there are 4,469 CITES listed species from Indonesia alone.[5]

Maluku Islands: Morotai/North Maluku: USAID SEA is working in the North Maluku area to address overfishing.[6] Volcanic activity has encouraged very rapid growth and development of coral in Pulau Gunung Api Banda with over 120 species of coral.[7] Site of Wildlife Conservation Society efforts regarding sustainable and effective conservation area management.

Papua: Location of Raja Ampat Marine Park at the heart of the coral triangle Raja Ampat is well known as a diving biodiversity eco-resort (see Figure 5)[8,9].

Lesser Sunda Islands: Site of Komodo National Park, World Heritage Center; high species richness includes coral species and marine mammals; fishing is regulated in marine buffer zone. UNESCO World Heritage Marine Programme priorities for Komodo include addressing threats to marine biodiversity by professionalizing tourism services, planning and understanding the tourism market, and developing new tourism products such as an aquatic nature trail to foster awareness in areas of the park that are threatened by destructive fishing practices.

Greater Sunda Islands: Sumatra: Known for mangrove forests, peatlands, coral reefs and large mammals and forests. Site of Wildlife Conservation Society MPA efforts.[10]

Citations:

1. The World Wildlife Fund. The coral triangle. Accessed Feb 2019.
2. Carpenter, K. E., Barber, P. H., Crandall, E. D., Ablan-Lagman, M., Carmen, A., Mahardika, G. N., & Toha, A. H. A. (2011). "Comparative phylogeography of the Coral Triangle and implications for marine management." *Journal of Marine Biology, 2011*.

3. Conservation International. Bird's Head Seascape. Bird's Head Seascape. Accessed Feb 2019.
4. The Nature Conservancy. Stories in Indonesia. Stories in Indonesia. Accessed Feb 2019.
5. CITES. Checklist of CITES Species Accessed Feb 2019.
6. USAID. North Maluku. Accessed Mar 2019.
7. Indonesia Accommodations and Hotels. Pulau Gunung Api Banda, Most Rapid Coral Growth in the World. Accessed Mar 2019.
8. Indonesia Accomodation and Hotels. Pulau Gunung Api Banda, Most Rapid Coral Growth in the World. March 13, 2019.
9. Conservation Atlas. Raja Ampat Marine Park, Indonesia: The Heart of the Coral Triangle. March 13, 2019.
10. Wildlife Conservation Society. WCS Indonesia Marine Program - Coral Reefs of Northern Sumatra: Rebuilding Local Livelihoods and Protecting Outstanding Seascapes Accessed March 2019.

6. Ecosystem services - from the four ecosystem service types: (provisioning, such as the production of food and water; regulating, such as the control of climate and disease; supporting, such as nutrient cycles and oxygen production; and cultural, such as spiritual and recreational benefits)

Provisioning: Indonesia relies heavily on marine resources for economic gain and food security.[1] 40% of protein intake is from seafood caught in Indonesia [2], thus seafood is critical for food security. Aquaculture of marine species for both consumption and sale (pearls) provides livelihoods and seafood for local communities [3]. Watersheds of the islands provide surface and groundwater to communities. Tourism is highly dependent on healthy, vibrant, ecosystems.[4] Loss of marine ecosystems, particularly coral reefs, to overfishing, habitat destruction, pollution, and climate change threatens food security for the country [5].
Regulating: Coral reefs and mangroves provide protection from storm surge, wave action, and tsunamis [6]. Large mangrove forests throughout the country help retain coastal sediment and sequester carbon, reducing the impacts of climate change [7]. Deforestation of mangroves and coastal development has led to soil erosion issues [8].

Supporting: Many communities rely on ecosystems for nutrient and waste cycling and do not have sewage treatment facilities [9]. High biodiversity supports functioning intact marine ecosystems.[10] Primary productivity of these ecosystems supports fish and seafood stocks, and produces oxygen.

Recreational: Large tourism economy to recreate in marine ecosystems and enjoy marine diversity and ocean recreation. Scale of tourism and recreation extremely variable by region, with Bali being highly visited by tourists and having substantial tourism infrastructure, and regions like Western Papua remaining largely isolated and remote. Many local surf cultures have emerged across Indonesia with strong connections to the ocean and local surf spots. Surfing and spiritual (meditation, yoga) retreats have become popular draws for tourists. Surfing, sightseeing, trekking, snorkeling, diving, hiking, and learning about the history and culture and enjoying the food and culture are just some of the things that visitors to Indonesia enjoy. However, there are conflicting desires for expansion of international and local tourism between national policies and local communities.[11]

Ecosystem services from biodiversity in Indonesia has been valued at Rp 3.13 quadrillion, which is equivalent to $220.9 billion (see Table 1).

Table 1 - Economic Value of Ecosystem Services from Biodiversity in 2012[12]

No	TYPE OF BIODIVERSITY SERVICE	VALUE (RP IN BILLIONS)
1.	**Provisioning Services:**	**1.680.758,1**
a.	Food biomass	1.338.748,5
b.	Material for medicines, health products and cosmetics	4.043,9
c.	Wood biomass & non wood forest products	1.081,3
d.	Renewable energy	336.884,4
2.	**Regulating Services**	**372.473,2**
a.	Waste processing	134.105,6
b.	Pollination	183.723,6
c.	Carbon capture/sequestration services	54.644,0
3.	**Cultural/Tourism Services**	**602,7**
	TOTAL	**3.134.016,7**

Source: result of UKNEA calculation (2001).

Citations:

1. OECD (2017), *Building Food Security and Managing Risk in Southeast Asia*, OECD Publishing, Paris,https://doi.org/10.1787/9789264272392-en.
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6. Barbier, E. B., Hacker, S. D., Kennedy, C., Koch, E. W., Stier, A. C., & Silliman, B. R. (2011). The value of estuarine and coastal ecosystem services. *Ecological monographs*, *81*(2), 169-193.
7. Mazda, Y., Magi, M., Nanao, H., Kogo, M., Miyagi, T., Kanazawa, N., & Kobashi, D. (2002). Coastal erosion due to long-term human impact on mangrove forests. *Wetlands Ecology and Management*, *10*(1), 1-9.
8. Marfai, M. A. (2017). The hazards of coastal erosion in Central Java, Indonesia: An overview. *Geografia-Malaysian Journal of Society and Space*, *7*(3).
9. Australian Agency for International Development. Urban Sanitation Review: Indonesia Country Study. March 13, 2019.
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11. Paul, M. (2017). Indonesia to promote 10 destinations with its new "Beyond Bali" campaign. TD website.
12. Republic of Indonesia (2016). Indonesia Biodiversity Strategy and Action Plan, 2015-

2020. Ministry of the National Development Planning.

II. SOCIO-ECONOMIC

1. Economy (main economic sectors, e.g. subsistence or commercial fishing, forestry, mining, tourism, government, extractive industries, or other and engagement of local communities in major economic sectors)

By the end of 2016, the Gross Domestic Product (GDP) of Indonesia was worth 1015.54 billion US$ (Figure 6). Its GDP was valued 1.64 percent of the world economy and since 2015, it has had a steady 5% annual growth.[6]

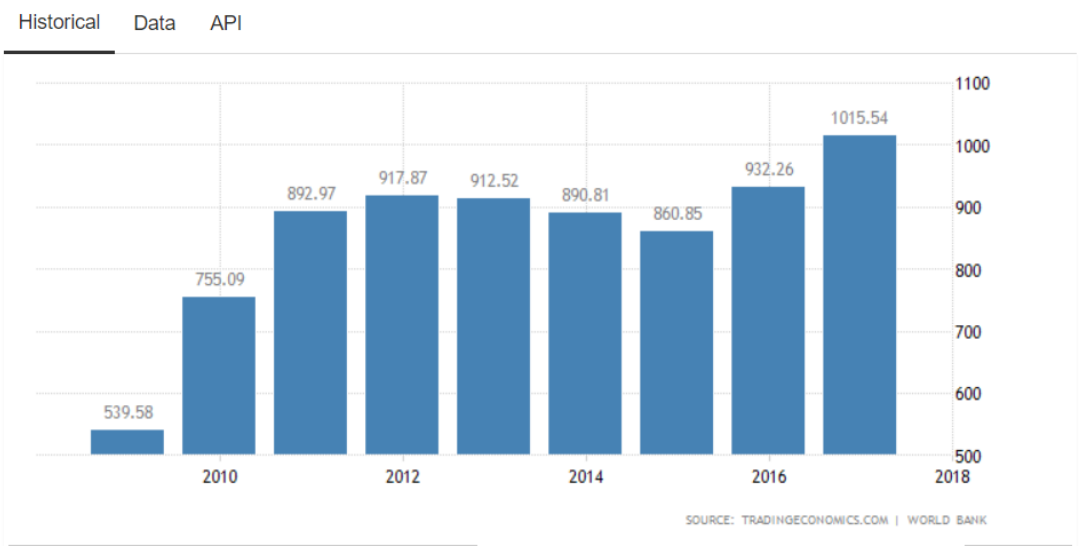


Figure 6: GDP growth in Indonesia. Source: Indonesia Investments[6]

Emerging markets will dominate the world's top 10 economies in 2050 (GDP at PPPs)

	2016	2050	
China	1	1	China
US	2	2	India
India	3	3	US
Japan	4	4	Indonesia
Germany	5	5	Brazil
Russia	6	6	Russia
Brazil	7	7	Mexico
Indonesia	8	8	Japan
UK	9	9	Germany
France	10	10	UK

E7 economies G7 economies

Report[13]

Reports from PricewaterhouseCoopers (PWC), established Indonesia's economy as 11th largest in the world in 2016. New projections predict that Indonesia will become one of the top economies in the world, reaching 4th place by 2050[13] (Table 2).

- **Agriculture:** The amount of land designated for agriculture is almost 30% of all land area in the country, and constitutes about 15% of their GDP[2].

Some of the main commodities produced are rice, tapioca, peanuts, cocoa, coffee, palm oil, poultry, beef, pork, and eggs. Importantly, Indonesia is largest producer of palm oil, providing half of the world's supply. The growing demand for palm oil from Indonesia has driven rapid deforestation of Bornean tropical rainforests.

Table 2: Emerging Markets. Source: PWC

- **Manufacturing:** Indonesia is the second largest car manufacturer in Southeast Asia and it is the third in car sales[3]. Toyota is the largest motor vehicle manufacturer on the island - controlling 50% of the country's car market. Honda and Daihatsu are also leading manufacturers on the island. Other manufacturing sectors in Indonesia include electrical and mechanical appliances parts, and rubber[7]. Table 3 is a summary of the percentage GDP for each industry.

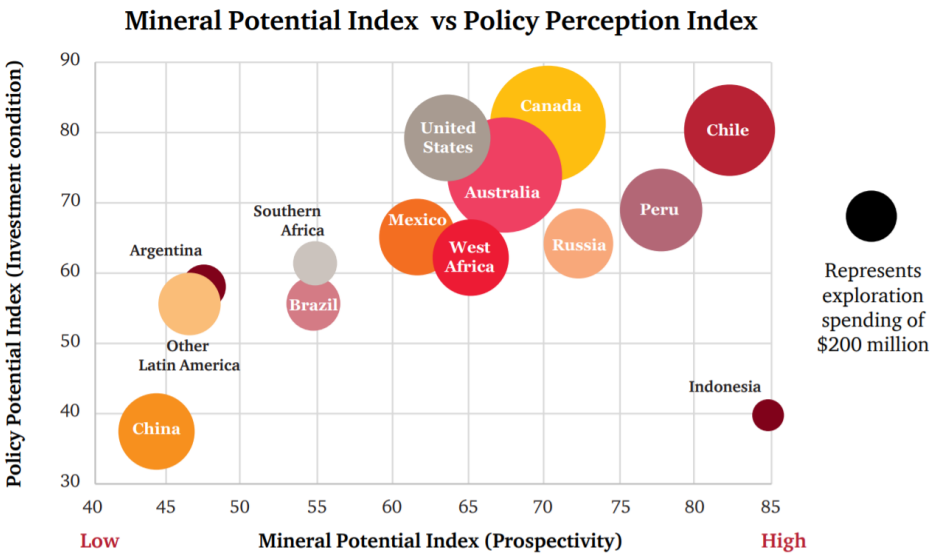
Table 3: Summary of Indonesia's major sources of GDP.

	1965	1980	1996	2010
Agriculture (percent of GDP)	51	24	16	15
Industry (percent of GDP)	13	42	43	47
Services (percent of GDP)	36	34	41	37

Source: Indonesia Investments: General Economic Outlines

- **Mining**: Indonesia is an exporter of gold, tin, nickel, and is also one of the world's largest exporters of thermal coal.[12] Also, Indonesia possesses a high potential for mineral mining, however it has a very poor policy potential for this new market as projected in the graph below.[12] Figure 7 shows the mining potential in Indonesia.

Figure 7: Mineral Potential Index. Source: PWC Report[13]



- **Fishing:** Indonesia is one of the largest producers in aquaculture worldwide. Demand for fish is both domestic and international. In 2015, the fishery sector expanded 8.37%, this was higher than the nation's overall economic growth of 4.73%. Fishery exports stood at 244.6 US$ million and imports received 12.5 US$ million.[4] The United States is the largest importer for fishing goods, accounting for 41% of Indonesia's total fishery exports. Moreover, in 2016 Indonesia became the world's top tuna producing country. However, concerns of overfishing in Indonesia are increasing. As of 2016,

only 66% of tuna fishing was conducted taking sustainability as a factor while the remaining third of tuna fisheries were fished beyond ecologically safe limits. Although overfishing is an issue that has been topic of discussion at the Bali Tuna Conference/Coastal Tuna Business Forum, there remains to be intensive efforts to ensure the sustainability of the fishing industry.[5]

- **Forestry:** Palm oil is important to Indonesia as a major export commodity for it is the largest exporter of crude palm oil in the world. This commodity raises an annual 15 billion US$ and provides millions of jobs[8]. Unfortunately, this lucrative market has taken a toll on the country's forests. Indonesia has lost more than 100,000 square miles of woodlands and peatlands between 1990 to 2015 dramatically impacting rainforest species.[15] Despite government efforts to reduce deforestation efforts via temporary moratoriums to halt the clearing of forests for palm oil production, current policies are too lax and improperly enforced.[8] Furthermore, illegal logging is a major contributor to loss of forests. In 2007 the United Nations Environment Program report estimated that 73 to 88% of timber in Indonesia is logged illegally. This further cost the government 2 billion US$ per year due to corruption, uncollected taxes, and poor resource management.[11]

Foreign Direct Investors:

- **Singapore:** The relationship between Indonesia and Singapore has always been very strong. However, this relationship became more attractive to Singapore companies when in February 2016 Indonesia released its package for foreign investors. Here, Indonesia listed the liberalization of the economy by annoucing foreign ownership limitations be relaxed to attract foreign investment and by reducing bureaucratic red tape for businesses. For Singapore this were good news specially because of the potential to invest in one of the many infrastructure projects marked for the acceleration of ports and power in Indonesia. Also, consumer culture in Indonesia is growing so this is another potential market for future investors.[9] Earlier in February 2019, it was announced that the Indonesian government will open a new office in Singapore to attract more investment from it. Currently, Singapore's investment is only 10% of its potential and Indonesia wants to tap more into it by further promoting the decrease in bureaucratic red tape and ownership for investors.[14]
- **China:** China is Indonesia's second largest investor in 2018. China has provided funding for the energy sector via the construction of power plants, and is supporting the construction of ports. China has an agenda called the Belt and Road Initiative (BRI) through which it wants to enhance regional connectivity to increase domestic and foreign trading to China.[1] For this Initiative, China is further funding Indonesia in three sectors: transportation, industry, and tourism via the construction of ports, airports, and cruise terminals.[14] This rapid increase in development may lead to dramatic changes in coastal environments.

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2. Human and Community Development (Degree of poverty, education, health, gender equity, food and livelihood security, clean water etc., other)

Indonesia has very promising economic growth, with a projected workforce of 65 million by 2035[1]. However, poverty is a significant issue in Indonesia. One of the main reasons behind this is that the national government utilizes very poor metrics for reporting poverty. Poverty is currently assessed by the amount of money people spend rather than make which is not a good representation of wages or job conditions.[4] Given that this information does not provide a clear picture on who and where the poor people in Indonesia are, the SMERU Research Institute in Jakarta have been working since 2015 on developing a Poverty Map of Indonesia. This map would partake a very deep look at the people of Indonesia down to the village level. Factors that will be included are: the national poverty line, the international poverty line, socioeconomic indicators, and village narratives.[2]

Education:
The quality of schooling and technical preparation in Indonesia is low. Issues limiting education include the construction of academic institutions, retention rates, and quality of the education offered in remote areas and gender inequality. Despite these setbacks school enrollment for students ages 13 to 15 increased from 88% in 2011, to 95% in 2015.

Clean water/sanitation:
Indonesia has 258 million inhabitants and although the economy has dramatically increased over the last 20 years, more than 27 million people still lack access to safe drinking water and 51 million still lack access to improved sanitation facilities.[5] Even the capital city of Jakarta has less than 10% sewage treatment. In areas without toilet access, people practice open defecation, greatly increasing the potential for contamination of drinking water.[5] Contaminated water has been shown to have detrimental impacts on children's long-term health, nutritional, and educational outcomes.[3] In 2014 WaterCredit was introduced by Water.org to help low-income families finance water and sanitation needs.[5] Still cultural changes are needed including education on washing hands and on menstrual cycles to improve public health [3].

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3. Cultural Attributes (Respect garnered from community, religious affiliation, community enriching)

Indonesia is a highly diverse country with a multitude of religions and over 300 native languages. As such there are strong cultural differences between regions. Indonesia is the largest Muslim-majority country, however, Bali is predominantly Hindu, and Flores Island is predominantly Christian. It is suiting that their national motto translates to "unity in diversity". In addition, many native cultures and religions still exist throughout Indonesia though there is strong pressure from globalization and national policies for modernization and cultural homogenization.

Citation:
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4. Law and Order Situation: (Armed conflict, terrorism, drugs/trafficking, violent crime, non-violent crime)

- **Armed conflict/Terrorism/Violent Crime:**
  The West Papua Liberation Army works to achieve West Papua's independence from Indonesia by continuously causing chaos for the main island by attacking and killing soldiers, resulting in the death of locals[2]. Religious and cultural terrorists have bombed and attacked nightclubs and bars in the separation efforts[1].

- **Non-Violent Crime:**
  Poverty levels in Indonesia make petty theft a common act. Environmental crimes such as poaching and violating conservation laws are rampant.[3]

- **Corruption:** This is a significant issue in Indonesia impacting business, development, and academic efforts from foreign investors. Lack of enforcement, coupled with bribery, leads to failures in biodiversity and natural resource conservation efforts. Indonesia ranks poorly (89 out of 180) on the Corruption Perceptions Index. Efforts from the government to address corruption have yet to succeed.[4]

Citations:

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III. CONSERVATION / CAPACITY

1. Level of Coastal Development / (Development of surf tourism and other sectors including tourism (and surfing's contribution to tourism), other industries)

Surf tourism is a significant draw for travelers to Indonesia.[1] Vendors offer a wide range of adventures from sustainable eco-surf experiences to luxury surfing experiences which having varying levels of associated coastal development ranging from bare bones eco-tourism and cultural experiences to 5-star resort hotels[2]. Importantly, coastal development varies dramatically by region with Bali being heavily developed and other regions such as Papua, remaining very remote.[2] The variety of surf conditions accommodate beginner to pro surfers, with multiple scales of development, along with easy access from international flights make

1

East and West Java and Bali very attractive for surf tourism. Indonesia has been marketed as a promising sustainable development opportunity, attracting a wide range of foreign investment and academic research.[2]

The nation's priority is economic development, with tourism becoming a large growth industry after the collapse of consumer goods pricing following the Great Recession.[3] Environmental health is pursued to the extent that water pollution (including trash) is threatening future tourism.[4] Thus efforts to improve wastewater treatment and trash control is a current priority. Economic evaluations of Bali have identified the water quality issue as one that would reduce tourism and use.[5-7] Researchers have developed and proposed rapid assessment methods for determining coastal water quality in recreation areas that could be used for standardizing water quality data collection for SPANs[8]. However, inadequate resources and enforcement mechanisms have been put in place to support lofty environmental goals.

Development in Indonesia has dramatically impacted biodiversity. Conversion of lowland forest and mangroves into agriculture and urban infrastructure as well as illegal activities including fires and illegal logging have led to dramatic habitat loss and pollution across Indonesia, driving the decline in health of Indonesia's marine habitats.[9] Furthermore, destructive fishing methods and illegal, unreported, and unregulated fishing continue to harm coral reefs.[9]

In addition to these industrial impacts, recreational activities such as water sports and tourism activities can also harm coral reefs.[10] Recent surveys of surfing tourists, surf operators, government officials and NGO employees in Mentawai Islands revealed that Mentawai surfing tourism industry management was not adequately protecting the marine resources it was based on[2]. Stakeholders identified that ingrained government corruption is the root cause. Researchers found that "corruption, coordination of government resources, securing the trust of stakeholders, and incorporating local community knowledge into the management framework are seen as the major barriers to effective management of the Mentawai Islands surfing tourism industry".

Therefore, Indonesia will need to adopt and implement sustainable development guidelines to allow their economy to grow in a sustainable manner that does not come at the cost of its terrestrial and marine biodiversity. A promising new integrated sustainable development monitoring method that considers the various aspects contributing to sustainable marine tourism management has recently been developed by the Wildlife Conservation Society in Fiji.[11] These sustainable development monitoring metrics could be used for monitoring efforts for SPANs with respect to sustainable surfing tourism industry management with the ultimate goal of promoting the economy, environment, and equity of local communities.

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2. Threats (Development, Water Quality, Trash/Marine Debris, Coastal Erosion / SLR vulnerability, Coral Reef Degradation, Coastal Access).

1. Marine Debris

a. Description of the problem

Marine debris is a significant and growing threat to marine ecosystems and local tourism in Indonesia.[1] The use of single-use plastics has exponentially increased over the past three decades to the point of being ubiquitous, even outside of urban centers. Currently, there is little capacity to recycle or manage solid waste, leading to improper disposal via either incineration or dumping. East Asian countries are now responsible for over 75% of marine plastic pollution. Three fourths of this plastic waste leakage is from uncollected waste, the other fourth is from formal solid waste management agencies. An estimated 0.5-1.3 million tons per year of waste that enters marine systems is generated by Indonesia[1].

b. Government response

i. Viral videos recently documented the Indonesia military being sent in to remove marine debris along a river front in Bandung, Indonesia[2,3].

ii. The President of Indonesia has committed to reducing 70% of the country's plastic waste from the year 2017. To accomplish this Indonesia has established partnerships with Norway and the World Bank. The Indonesian government has made a commitment of 1 billion US$ to clean up the ocean.[4]

iii. Current marine debris management efforts have not been effective. For instance, a regional plastic bag tax was too small to be effective and was abandoned.[5] Disagreements between federal, state, and local levels of government on who is responsible and leading marine debris efforts undermines effectiveness.

iv. However, recent efforts have been more promising including the banning of plastic straws and a 10 US$ tourist tax for beach clean up and solid waste management in Bali.[6]

c. *Impact to surfing community*
    i. Marine debris is a visible issue in Indonesia to all tourists, and surfers especially. In the past year, multiple videos of highly-polluted dive and surf spots have gone viral on social media.[7] These videos have been used in the U.S., EU, and Australia to spark discussion on the need to curb single-use plastics waste.[8]
    ii. There was a large discussion in the surfing community about the need to tackle marine debris pollution, largely centered around Bali.[6] Bali is both the epicenter of surf tourism in Indonesia, as well as home to over 4.2 million residents, a large source of the local marine pollution. However, much of this pollution is also transported from Java, which is the most populous island in Indonesia (>100 million residents)[6].
    iii. To emphasize the impact of marine debris on surfing in Indonesia we share this tweet from Kelly Slater: "*If Bali doesn't #Dosomething serious about this pollution it'll be impossible to surf here in a few years. Worst I've ever seen*". [7]
    iv. There is a strong potential for the loss of tourist revenue from surfers due to the high degree of marine pollution.

2. Overfishing

a. *Description of the problem*
    i. 64% of Southeast Asia reefs experience medium to high threat of overfishing.[9] Driving this trend has been high rates of illegal, unreported, and unregulated fished. In addition, overfishing of top predators is rampant, with sharks being particularly threatened. Importantly, there are significant disparities in regional fishing pressures.[9]
    ii. Destructive fishing practices threaten the health of coral reefs. These practices include trawling, dynamite fishing, potassium, and cyanide fishing (predominantly for live aquarium trade).[11]

b. *Government response*
    i. The Indonesia government has made a significant crackdown of Ion illegal fishing fleets in Indonesian waters, especially of foreign vessel. This has led to a massive rapid recovery of some fish stocks.[12]
    ii. However, comprehensive fisheries management is lacking and there are reports of declines in many fisheries species.[9]

c. *Impact to surfing community*
    Overfishing has indirect effects on coral reef health with the potential to affect important ecosystem services including accretion of reefs and water quality.[13] Overfishing can lead to the loss of reefs may lead to loss of surf break, especially as sea level rise continues to threaten coral reefs.

3. **Coastal development**

a. *Description of the problem*
    Indonesia is a complex and dynamic country with varying degrees of development including highly populated urban centers (i.e. Jakarta, Java and Denpasar, Bali) and remote, underdeveloped communities (i.e. Papua). In areas of high urban development, there are a variety of coastal development threats to marine ecosystems and surf spots. Coastal development has the potential to dramatically change physical oceanographic features including sediment transport and reef formation. One direct example in Bali was the development of a jetty directly into

a surf spot, rendering it permanently unsurfable.[14] Less direct impacts include heavy coastal development near beaches and coastal armoring including building jetties away from surf breaks.[15] The expansion of the Bali International Airport into the nearshore environment has changed sand accretion patterns and led to beach loss affecting local villagers with some reports of changes to the surf break.[16]

b. Government response

i. Recent initiatives from the government have been focussed on driving tourism economics and expanding the Bali style tourism and development which has drawn backlash from small communities.[17] Impressively, the government has raised 17 billion US$ specifically for tourism development with much of the funding directed towards large development projects with the potential to exacerbate coastal erosion.[17]

ii. Dramatic losses of mangroves and over pumping of groundwater on Java and Bali have led to land subsidence and coastal erosion, threatening coastal properties and marine ecosystems.[18] This has sparked government action to increase infrastructure to tackle this growing issue.[19]

c. Impact to surfing community

Coastal development can have clear impacts to the surfing community, especially with the direct loss of surf break. More frequently, smaller changes in coastal development lead to changes to wave breaks, sandbar formation, and decreased water quality. This is a critically important issue for surfing community and has already affected major surfing destinations.

4. Sewage treatment

a. Description of problem

i. Sewage treatment is one of the most significant urban coastal environmental concerns in Indonesia with 68% of urban runoff considered heavily polluted.[20] Urban areas have minimal level of centralized wastewater management systems including Jakarta and Denpasar, Bali[21]. However, there are no legal requirements to join the system and many hotels and businesses opt to conduct their own wastewater treatment. Less than 5% of all urban wastewater treatment is treated.[21]

ii. Research has argued that the most excessive pollutant in Indonesian rivers is faecal coliform from human waste.[21] This is not surprising Jakarta metropolitan areas has a population over 28 million with minimal treatment. Water-borne diseases such as cholera, dysentery, gastroenteritis, typhoid, paratyphoid, hepatitis A, and parasitic intestinal infection, are transmitted by the ingestion of water contaminated with human feces. Furthermore, nutrient pollution and biological oxygen demand lead to the rapid decline of coral reef and seagrass ecosystems.[22]

b. Government response

To date there have been minimal coordinated efforts to install centralized sewage treatment centers such as in Jakarta and Bali[20,21]. However, the lack of investment and regulatory teeth is hindering the adoption of techniques[20,21]. Some hotels have adopted their own private sewage treatment or septic systems, however these have been woefully inadequate[20,21].

c. Impact to surfing community

Poor water quality poses a public health risk to swimmers and surfers.[23] "Bali belly" is the colloquial name for surfers who come down with gastrointestinal diseases after surfing in polluted waters. Highly polluted waters can lead to loss of tourism

revenues and unsafe surfing conditions. This has already been reported and discussed on surf forums at length, potentially discouraging visitors and impacting the local economies.[24]

5. **Climate Change**
   a. *Description of problem*
      Sea level rise, increasing sea surface temperatures, increased storm frequency and severity, and ocean acidification threaten the health of Indonesia's coral reefs.[25] Climate change is an environmental threat multiplier exacerbating current environmental impacts on indonesia's marine ecosystems.[26] To date, climate change has not been the most important human impact on marine ecosystems. However, increased frequency of bleaching events have damaged many of Indonesia's reefs.[27]
   b. *Government response*
      i. Indonesia has signed onto the Paris Climate Accords COP 21 and pledged to reduce carbon emissions from deforestation by 30% by 2030[28]. However, Indonesia has yet to take a single significant step towards decarbonizing their economy.
      ii. In contrast, recent development plans from the Indonesian government have focussed on adding upwards of 100 coal fired power plants, exacerbating climate change.[28]
   c. *Impact to surfing community*
      i. Climate change threatens the ecosystem services that support world class surf breaks by threatening to drown surf breaks with reduced coral growth and sea level rise.[29] Furthermore, erosion of coastal features and urban development can lead to increased pollution and alteration to surf break maintenance.[29]
      ii. In contrast, long international flights to surf in remote islands of Indonesia have large carbon footprints, further exacerbating climate change.[30]

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3. Applicable Legal Framework (options for management) - who do you go through, who do you talk to, how would you set up a SPAN, organization of government

Indonesia adopted the Regional Autonomy Law in 1999. This law decentralized most functions

of the government to rural districts and municipalities, and increased local participation in politics and the economy.[1] The Regional Autonomy Law gave authority to two levels of regional government to make their own policies and local laws: 1) provinces (provinsi) at the first-order administrative level (ADM1), and 2) regencies (kabupaten) and municipalities (kota) at the second-order administrative level (ADM2). There are currently thirty-four (34) provinces at first-order level (ADM1), sub-divided into 514 at the second-order level (ADM2): 416 regencies (kabupaten) and 8 municipalities (kota). The latter are further divided into districts, which are further divided into administrative villages. Each province maintains a websites with contact information.

The government agency responsible for marine protection is the Ministry of Marine Affairs and Fisheries. Biodiversity issues have been integrated into the sectoral strategic plan for this agency, and the Research Center for Biology of the Indonesian Institute of Sciences and other Ministries responsible for biodiversity conservation.. Balanced use and sustainability of biodiversity and natural resources are priorities of the Strategic Plan, and are integrated into broader national strategies and programmes such as the Millenium Development Goals, the Action Plan for implementing the United Nations Framework Convention on Climate Change, and the Indonesian Strategy and Action Plan for Wetland Management (2004). Indonesia also , ratified the Kyoto Protocol in 2004.

Biodiversity is also incorporated into local governance, through the development of conservation districts and conservation areas. The size and number of existing conservation areas in Indonesia are listed in Table 4.

Biodiversity is also addressed in environmental impact assessment (EIA), strategic environmental assessment (SEA) and relevant incentives. Biodiversity conservation implementers hope environmental assessments will be integrated into regional ecosystem-based spatial planning.

Indonesian biodiversity management efforts face many systemic challenges. While legislation has been passed to protect biodiversity (see CBD profile for 786 legislation entries), there are many underlying problems that make biodiversity and ecosystem protection difficult. Experts have identified these as:overlapping and incomprehensive laws, corruption, weak enforcement, lack of capacity at a local level, lack of awareness in local people; absence of monitoring,

Table 4 - Size, Type and Number of Indonesian Conservation Areas

NO	SECTOR	AREA (HA)	TOTAL
1	Nature Reserve	3.923.001,66	216
2	Marine Reserve	152.610,00	5
3	Wildlife Reserve	5.024.138,29	71
4	Marine Wildlife Reserve	5.588,25	4
5	National Park	16.375.000,00	50
6	Marine National Park	4.043.541,30	7
7	Nature Park	257.323,85	101
8	Marine Nature Park	491.248,00	14
9	Forest Park	351.680,41	23
10	Hunting Park	220.951,44	13
11	KSA/KPA (Other conservation areas)	309.880,30	24
	Jumlah	**31.154.963,50**	**528**

Source: Partono, 2014 in LIPI, 2014.

coordination gaps, regulatory gaps, humanitarian gaps, poor or lack of governance and management in areas beyond local jurisdiction; policies that are "inconsistent with biodiversity conservation or foster activities degrading protected areas and biodiversity", inadequate funding of conservation policy implementing agencies, the "Asian economic crisis and the subsequent emergence of democratic process in Indonesia" having lead to a new uncertainty that frustrates implementation and putting more "pressure on natural resources as declining income-earning opportunities force many people to exploit land and sea resources at even higher levels" and burn land for land use conversion, limited data, local communities not deriving benefit from biodiversity conservation, illegal activities (e.g. mining, logging, dynamiting fish) going unpunished, boundary violations, perception that conservation areas are a deterrent to economic development, poor buy-in by those who are needed for collaborative management and sustainable use, sponsored migration, lack of coordination between regional development planning and planning for integrated conservation and development projects, inadequate spatial planning, not involving park managers in public investment decisions, invasion of/encroachment upon protected areas due to hostility by local officials and communities, poor commitment across government and in other key sectors, important biodiversity measures not being implemented, lack of government sector coordination, and inadequate understanding of issues resulting in poor performance.

To improve biodiversity management, relevant regulations must involve, educate, regulate, monitor and correct individuals, communities, corporations, regulators, policies, regulations, laws, processes and institutions (e.g. enforcement, performance management, anti-corruption, policy-making, policy-implementation, data collection and sharing, investment and funding decision-making, priority setting, ensuring planning for economic livelihood and humanitarian needs, ethics, environmental justice, environmental protection and enhancement, pluralism and democratization) that are doing things that are counter to biodiversity conservation and surf zone protection goals or are underperforming in their achievement of these goals. It appears from the preponderance of governance and management issues that have been identified that effective environmental management will not be possible without first improving overall governance and management and correcting systemic issues with a focus on addressing the identified challenge areas in an integrated and equitable manner.

In setting up a SPAN, CI and STW may wish to contact Wildlife Conservation Society to learn

how successful MPAs have been set up in Indonesia.

Citations:

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4. Existing or planned management designation or actions (pre-existing conservation regimes)

Indonesia is a member country in the Convention on Biological Diversity since 1992. In order to protect biodiversity, the National Development Planning Agency produced in 1993 the Biodiversity Action Plan for Indonesia (BAPI). The BAPI prioritized *in situ* conservation measures, both inside and outside protected areas, as well as *ex situ* conservation (See Table 4).

Furthermore, in 2003 a second document titled the "Indonesian Biodiversity Strategy and Action Plan (IBSAP)" was developed with a focus on achieving five goals:

1) to encourage changes in attitude and behavior of Indonesian individuals and society, as well as in existing institutions and legal instruments
2) to apply scientific and technological inputs and local wisdom
3) to implement balanced conservation and sustainable use of biodiversity
4) to strengthen institutions and law enforcement
5) to resolve conflicts over natural resources.

Although these planning efforts suggest Indonesia is taking conservation efforts seriously, there is a lack of cohesive policy-making towards effective conservation, leading to voluntary implementation of IBSAP with no coordination mechanisms established to monitor and evaluate success of implementation efforts. Thus many conservation efforts amount to paper parks, with little enforcement or regulation.

The most recent report of progress on biodiversity conservation objectives was published in 2015, as was a new Biodiversity Strategy and Action Plan for 2015-2020. Indonesia is currently implementing the current action plan with UN and USAID assistance.

Citation:

UN Environment: Conservation on Biological Diversity. Indonesia – Country Profile. Accessed March 8 2019.

5. Community Demand / Local Partners Capacity (Identify local groups and capacity for conservation including skills and knowledge of local partners and NGOs))

There are 127 Indonesian NGOs listed in the World Association of Non-Governmental Organizations (WANGO) database working on numerous causes in Indonesia. WANGO is an international organization that unites NGOs worldwide to advance peace and global well being by providing "the mechanism and support needed for NGOs to connect, partner, share, inspire, and multiply their contributions to solve humanity's basic problems." Local marine biodiversity and surf area conservation projects would also be human rights, livelihood, and poverty projects, so it is important to engage not just conservation organizations in an integrated effort. The listed organizations address a broad variety of projects.[1]

One relevant NGO is Luminoocean or Yayasan Cahaya Samudera Indonesia Foundation, an NGO that focuses on marine conservation and seeks to achieve it through education for children and young adults on remote islands.[2] In addition the Yayasan Biodiversitas Indonesia (BIONESIA) is a non-profit organization working to promote and protect Indonesian biodiversity through research and capacity building. They work hand in hand with universities and conservation organization to ensure longevity of our biodiversity.[3]

In addition, local NGOs that are dealing more with the systemic issues in North Sumatra formed a " joint team of legal experts on environmental regulations"[3] in late 2017 to provide legal defense and counsel for residents on environmental and land regulations, particularly those involved in conflicts with plantation owners. The team includes representatives from civil organizations in North Sumatra, and legal advisors on environmental regulations from the North Sumatra Advocacy and Legal Aid Association (Bakumsu); the provincial chapter of the Indonesian Legal Aid and Human Rights Association (PBHI); the Medan chapter of Indonesia's Legal Aid Foundation (LBH); Yayasan Pusaka Indonesia; and the Medan chapter of the Commission for Missing Persons and Victims of Violence (Kontras).

The Presidential Regulation No.16 2018 was passed and that makes it easier for the Indonesian government to contract social organizations to deliver services. This new regulation has the potential to improve both the reach and quality of services provided. Overall, government funds represent only a small fraction of an NGO's income, so there is still a heavy reliance on international donor funds. However, this is a good step forward towards fostering positive relationships with NGOs. This new relationship between government and NGO could potentially serve a function of deepening the understanding of social, economic, and political issues, which could help facilitate other forms of public policy.[4]

Citations:

1. World Association of Non-Governmental Organization (WANGO) WANGO Our Work. Accessed March 13, 2019
2. Luminocean. Yayasan Cahaya Samudera Indonesia. Accessed March 13, 2019
3. Bionesia. Diversity Indonesia. Accessed March 13, 2019

4. Mongabay: News and Inspiration from Nature's Frontline.Indonesian NGOs lawyer up against environmental crimes. Accessed March 13, 2019

6. Funding Potential (rapid review of potential donors working in this geography; major Indonesian donor)

There are currently quite a few philanthropic international organizations working in Indonesia that have access to an international pool of donors. These include the following conservation-focused international NGOs:

- **Global Fishing Watch:** Their goal is to monitor global commercial fishing fleet offering real-time tracking of fishing activity. Indonesia recently began sharing its monitoring data publicly which is a good step for transparency.[2]
- **Conservation International (CI):** Concerned with Indonesia's exploited oceans, deforestation, and pollution that is arising from continuous industrialization. CI works on creating and protection Marine Protected Areas.[1]
- **The Nature Conservancy (TNC):** Also concerned with protecting marine ecosystems.[3]
- **Wildlife Conservation Society (WCS) Indonesia:** Mission is to save wildlife and wild places worldwide through science, conservation action, education, and inspiring people to value nature. Deforestation and marine conservation are also main issues.[4]
- **World Wildlife Federation (WWF)**[5]: WWF-Indonesia is engaging with communities and relevant stakeholders to actively plan, create, and reap the benefits of a network of Marine Protected Areas
- **USAID SEA**[6]: The USAID Sustainable Ecosystems Advanced (USAID SEA) Project is a five-year project (2016-2021) that supports the Government of Indonesia in the improvement of the governance of fisheries and marine resources and to conserve biological diversity. The project is targeted at national, provincial, and local levels, with a focus on the Provinces of West Papua, Maluku, and North Maluku that lie within Indonesia's Fishery Management Area (FMA) 715.

Potential private donors in Indonesia can likely be identified at local fundraising events for these and local organizations, in Indonesian news, and specifically for surf conservation from among the professional surfers who frequently surf in Indonesia, such as Kelly Slater.

Citations:

1. Conservation International. Indonesia. Accessed March 1 2019.
2. Global Fishing Watch. Indonesian Vessel Data. Accessed March 1 2019.
3. The Nature Conservancy. Asia Pacific: Indonesia. Accessed March 1 2019.
4. Wildlife Conservation Society. WCS Indonesia. Accessed March 1 2019.
5. World Wildlife Fund. WWF-Indonesia. Accessed March 11 2019.
6. USAID. USAID SEA. Accessed March 11, 2019.

7. Sustainable Financing (Entry fee or conservation payment for visitors, payment for ecosystems services (PES), long-term government funding)

Conservation International created a model for sustainable financing for Indonesia's Sustainable Landscape Partnership initiative. This framework consists of four major areas, among which is "Sustainable Finance." This area proposes a "Payment for Ecosystem Services," which proposes models in which communities and the private sector pay directly for natural capital benefits and ecosystem services. This would allow for one more way of creating revenue at the same time that it limits the use of certain goods. However, this is a theoretical framework and so further work is required to implement practical and scalable models, and to identify and troubleshoot challenges and barriers to implementation.[1]

One implementation of this framework would be to charge international surfers, tour companies, or hotels near SPAN sites for use of the park, similar to National Park fees in the U.S. or Eastern Africa[2]. However, there are concerns of financial leakage and displacement of surfers and recreational tourism in response to the direct fee, potentially leading to unintended consequences and under funding of SPAN monitoring.Other potential sustainable financing options include establishing a Pristine Paradise Fee like that of Palau which charges ~100 US$ for foreign visitors when they leave the country. This revenue could be incorporated into the price of the flight and thus disentangled with direct use of the SPAN.[3] These fees can be incorporated in the hotel stay, tour guide, or airfare disentangling the conservation revenue source and use of the surf break.

Citations:

1. Conservation International. Sustainable Landscapes Partnership in Indonesia. Published March 2016. Accessed March 2019.
2. Kenya Wildlife Service. Park Fees and Accommodation. Accessed March 13, 2019
3. Pacific Note. Palau Collects $100 Pristine Paradise Fee. Accessed March 13, 2019

8. Political Climate / Feasibility (Outline decision making and climate for conservation)

In 2017 President Jokowi signed Presidential Decree No 59/2017 on UN Sustainable Development Goals (SDGs) implementation, which established the national SDG governance structure and mechanisms for planning and budgeting, financing, monitoring, and reporting.[1] Despite their good faith efforts, Indonesia still does not currently have the financial resources necessary to meet these goals, and thus depend on private donors and international aid to help them advance.[2] Therefore, inclusion and participations of outside, private partners are stressed as necessary for successful implementation of development goals.

However, current conservation efforts in Indonesia could be hindered by extensive corruption and lack of monitoring and enforcement. Conservation efforts will likely succeed with strong community support and reliance on non-governmental support for monitoring and enforcements efforts.

Citations:

1. United Nations. About the Sustainable Development Goals. Accessed March 8, 2019.

2. United Nations Development Programme. SGDs in Indonesia: 2018 and beyond. Accessed March 8, 2019.

IV. Summary Assessment of Potential of Site as a Surf Protected Area

Indonesia is a world class surf destination with some of the most famous surfing breaks in the world. At the same time, Indonesia is the epicenter of marine biodiversity, located in the heart of the Coral Triangle, with the highest marine diversity and critical coral reef habitat found anywhere on the planet. Furthermore, Indonesia has a strong surf tourism industry with a national need for further sustainable development while protecting and enhancing its vital marine resources. Together these economic drivers, coupled with the country's high biodiversity and phenomenal surf make Indonesia an ideal target for SPAN conservation efforts. Major challenges to implementation of SPAN in Indonesia have to do with governance and political ecology of the country, because many of the policies and initiatives supported by the Indonesian government are merely implemented on a voluntary basis and lack the real strength and enforcement needed to produce meaningful conservation actions. Despite these drawbacks, local and international NGOs have had a significant presence in Indonesia and have been able to successfully advocate for the protection of both marine and terrestrial ecosystems. The successful NGOs working in Indonesia, including Conservation International, are ideal partners in Save the Wave's efforts to develop a SPAN in the country. This report lays the foundation for identifying SPAN sites and providing critical background information on surf sites, marine biodiversity, governance, and economics needed to successfully implement SPAN in Indonesia.

APPENDIX

Section 1. Surf Protected Area Network Index Methodology

Overview

The goal of Surf Protected Area Network (SPAN) is to find important overlap between conservation and surf spot preservation priorities. Given the high desire and value of these sites for both biodiversity and surf conservation, these sites have strong public support for their protection, and provide the support needed for successful conservation efforts. Furthermore, combining ecological conservation priorities with the revenue generating potential of surf tourism and recreation, has the potential to provide important financial support streams needed for the effective management of these protected areas.

However, no currently available tools allow for the identification of both marine ecological and surfing data.Thus, our motivation for this project was to create a standardized tool for identifying ideal SPAN network sites. To do this we obtained metrics of surfing value and conservation score from publically available data sources. The ideal SPAN site would encompass both world class surfing breaks and critically important marine ecosystems and biodiversity hot spots while having the capacity and attractiveness to draw the political support and activity needed to ensure a successful conservation effort. Here we demonstrate how we generated 5 different indices to identify and rank candidate SPA sites for creating a SPAN in Indonesia.

We used publicly available datasets on marine biodiversity, ecosystem health, habitat distribution, protected status, and human impact along with surf data from Wanna Surf to design our Surf Protected Area Network indices. Below are a description of the following data layers incorporated into our indices as well as detailed calculations for how each of our 5 indices were calculated. All datasets were acquired from the UN Ocean Data Viewer (http://data.unep-wcmc.org/datasets/), Wanna Surf (http://wannasurf.com/), and NASA (http://sedac.ciesin.columbia.edu/data/set/wildareas-v2-human-influence-index-geographic).

Methodology of Indicator Calculations

Surf Spot Dimension

High ranking SPAN sites need to be in locations of world class surf. Thus, we obtained surfing data for each surf spot from WannaSurf to characterize the surf performance of each location. We collected Wave Quality, Direction of break, Type, Wave Frequency, Experience level, Access, and Swell Direction for each surf spot readily available. We then generated four indicators based on these metrics: Wave Score, Skill Level Diversity, Break Direction Diversity, and Family-Friendliness. Wave Score was calculated by multiplying the wave quality and frequency scores (If values were missing for a site for a given indicator, we used the smallest value recorded for the category.). The Skill Level Diversity Score was calculated as a relative weighting factor giving higher scores to surf areas that support multiple skill levels. The Break Direction Diversity score was higher in surf areas with both left and right breaks. The Family-Friendliness score gives increased weight to surf spots that are more accessible from roads, friendly for beginners, have public access, and are beach accessible (does not require a boat). We then multiplied these values together to get a Surf Accessibility Index Score that reflected the attractiveness and likely success of the

site and overall surf area for surf tourism. Then we ranked the surf spots and surf areas based on this Index. The idea behind the Surf Accessibility Index is that the ideal surf area has good wave for all surfer experience levels and so would be attractive for a broader market of surf tourists, meanwhile being a great place for surfing adventure providers who love to surf great waves because of the quality of the surf.

Adding the Biodiversity and Ecosystem Conservation Dimension

High ranking SPAN sites also should have high biodiversity and intact ecosystem function. Our goal was to identify surf spots near high quality marine habitat to meet the win-win conservation objective. We used GIS to map areas with protected area status, and to show where surf spots and biodiversity and ecosystem conservation activity overlapped. For each surf spot we calculated biodiversity scores based on seagrass cover, marine biodiversity, critical habitat, global priorities for conservation, coral diversity and human influence. We used these scores to determine which spots were the most ideal candidate SPAs for an Indonesian SPAN based on surf quality and biodiversity conservation.

To do this, a 10km buffer was generated around each surf spot to capture the characteristics of the local area. For each indicator chosen, values were either summed from within the buffer (i.e. total human influence score, sum of biodiversity metric) or the attributes of overlapping polygon data layers we extracted (i.e. protected area status, total size of estuary). Overlapping polygon layers that data extracted were Protected Area Status, Marine Georegion, and Estuary Size. Summed totals of indicators were calculated for Seagrass Cover, Marine Biodiversity 1, Critical Habitat, Marine Biodiversity 2, Global Priorities for Conservation, Coral Diversity, and Human Influence Index. Each indicator was then linearly scaled to a value between 0 and 1 for normalization. For the indicators that we used, if the values were missing for a site for a given indicator, we used the smallest value recorded for the category. Each indicator was then linearly scaled to a value between 0 and 1 for normalization.

SPAN Indices Calculation

Identifying the ideal SPAN site locations using the above data can be accomplished in a variety of metrics. Here, we generated five separate indices for comparison that reflect a variety of metrics for ranking the ideal SPAN sites. The five indices differ on the prioritization of proximity to a currently established protected area, wave quality, biodiversity, and accessibility. We note that these are five variations of many potential indicators that could have been calculated. We further note that a multiplicative index was chosen to negatively penalize sites that receive negative scores.

The five indices set higher priorities for: 1) sites with the best wave quality (Wave Quality Index), 2) sites with the most accessible surfing (Surf Accessibility Index), 3) sites with the highest biodiversity and conservation priority (Biodiversity Index), 4) SPAN sites near MPAs that have good wave quality (Immediate Conservation Opportunity), and 5) sites that have both good wave quality and high conservation priority (Wave Quality and Biodiversity Index).

The five test SPAN indices are:

1) **Wave Quality Index:**
   The Wave Quality Index was created to represent the reported Wave Quality Index on a scale between 0 and 1 to facilitate calculations. It is comprised of scaled Wave Quality scores from WannaSurf range between 0 and 1, where 1 is the highest available score given to a surf spot in Indonesia. (Does not include wave frequency data.)

2) **Surf Accessibility Index**
   The Surf Spot (Accessibility) Index was created to represent the Surf Spot Index on a scale between 0 and 1 to facilitate calculations. It includes a surf tourism/marketing perspective and a more complex look at surf spot quality than the Wave Quality Index does. Scaled Surf Accessibility index scores were calculated using the following formula and then normalized on a scale between 0 and 1:
   (Wave Score) x (Skill Level Diversity) x (Break Direction Diversity) x (Family-Friendliness)

3) **Immediate Conservation Opportunity Index**
   The Immediate Conservation Opportunity Index was calculated using the following formula with surf spots nearest to protected areas representing an immediate conservation opportunity. We chose these sites as they are likely to require the least additional effort to ensure protection of nearby surf spots as well as critical marine ecosystems. Only the wave quality dimension of the surf spot analysis was included:
   (1+Estuary Size) x (1+Marine Georegion) x (1+Protected Area Status) x (1+Scaled Seagrass Area) x (1+Scaled Marine Biodiversity 1) x (1+Scaled Critical Habitat) x (1+Scaled Marine Biodiversity 2) x (1+Scaled Global Priorities) x (1+Scaled Coral Diversity) x (1- Scaled Human Influence Index) x (1+ Scaled Wave Quality)

4) **Biodiversity Index**
   This Biodiversity Index soley represents the biodiversity in a surf spot and was calculated using the following formula:
   (1+Estuary Size) x (1+Marine Georegion) x (1+Scaled Seagrass Area) x
   (1+Scaled Marine Biodiversity 1) x (1+Scaled Critical Habitat) x (1+Scaled Marine Biodiversity 2) x (1+Scaled Global Priorities) x (1+Scaled Coral Diversity) x (1- Scaled Human Influence Index)

5) **Wave Quality and Biodiversity Index**
   The Wave Quality and Biodiversity Index combines the Wave Quality Index and the Biodiversity Index into one Index using the following formula:
   (1+Estuary Size) x (1+Marine Georegion) x (1+Scaled Seagrass Area) x (1+Scaled Marine Biodiversity 1) x (1+Scaled Critical Habitat) x (1+Scaled Marine Biodiversity 2) x (1+Scaled Global Priorities) x (1+Scaled Coral Diversity) x (1- Scaled Human Influence Index) x (1+ Scaled Wave Quality)

Generally, higher scoring sites had greater estuary coverage, more seagrass habitat, higher coral diversity, higher marine biodiversity, more critical habitat, more global priority habitats, and a lower human

influence index. Table 2 shows the five indices scores for each of the 81 surf spots analyzed out of the 210 posted on Wannasurf. Table 1 shows an abbreviated form of the table with selected potential top candidate sites for comparison. A more complete surf spot analysis on a surf quality, diversity and marketability basis only of 210+ Indonesian surf spots can be found in Tables 3-6. The final SPA analysis (Tables 1 and 2) only included the 81 surf spots for which complete data was available from WannaSurf, filtering out the sites included in the surf spot data analysis (Tables 3-6) that had incomplete data and for which the assumption of lowest value was assumed when the sites were being evaluated for tourism value.

Section 2. Surf Protected Area Network Index GIS Methodology

The following data layers were created as a result of this analysis and were used to generate maps for this report.

GIS Data Layer Descriptions
All data files are in the associated data folders.

1. Indonesia Surf Spots and Characteristics
    - *Source*:
        - Wannasurf.com
    - *Description*:
        - List of all mapped surf spots in Indonesia according to Wannasurf.com
        - Wannasurf.com is a surfing community website that allows users to map, rate, and share surfing locations around the world.
        - We had to download and compile multiple KML files for each distinct surfing region within Indonesia. We also had to manually copy and transfer surf characteristics for each site, and enter data.
        - Surf characteristics include Wave Quality, Direction of break, Type, Wave Frequency, Experience level, Family-Friendliness (Access), and Swell Direction.
    - *Purpose*:
        - This data layer was needed to identify surfing locations within Indonesia as well as provide important information about the surf break.

2. Global Critical Habitat
    - Source:
        - UNEP-WCMC (2017) Global Critical Habitat screening layer (Version 1.0). Cambridge (UK): UN Environment World Conservation Monitoring Centre. http://data.unep-wcmc.org/datasets/44
        - Brauneder KM, Montes C, Blyth S, Bennun L, Butchart SH, Hoffmann M, Burgess ND, Cuttelod A, Jones MI, Kapos V, Pilgrim J, Tolley MJ, Underwood EC, Weatherdon LV, Brooks SE, 2018. Global screening for Critical Habitat in the terrestrial realm. PloS one, 13(3), p.e0193102. doi:10.1371/journal.pone.0193102

        - Martin CS, Tolley MJ, Farmer E, Mcowen CJ, Geffert JL, Scharlemann JPW, Thomas H, van Bochove JH, Stanwell-Smith D, Hutton JM, Lascelles B, Pilgrim JD, Ekstrom JMM, Tittensor DP, 2015. A global map to aid the identification and screening of Critical Habitat for marine industries. Marine Policy 53: 45-53. doi:10.1016/j.marpol.2014.11.007 .
    - *Description*:
        - This screening layer shows the global spatial distribution of likely or potential Critical Habitat, as defined by the International Finance Corporation's Performance Standard 6 (IFC PS6) criteria.
        - The composite Critical Habitat layer draws on 20 global-scale datasets, of which 12 datasets support screening of Critical Habitat in the terrestrial realm and 15 datasets support screening in the marine realm. Datasets were disaggregated into subsets if the underlying attributes aligned with different Critical Habitat criteria.
        - The raster layer attributes each grid cell (1×1 km) as likely or potential Critical Habitat, or unclassified based on a classification scheme reflecting biodiversity data layer alignment with IFC-PS6 Critical Habitat criteria/scenarios and inherent degree of certainty (in terms of presence on the ground).
        - For further information on underlying trigger features behind a likely or potential Critical Habitat value for each cell within the composite data layer please contact business-support@unep-wcmc.org.
    - *Purpose*:
        - Indicator for SPAN sites by providing information on identifying critical marine habitats.
        - Critical habitats are predominantly in global biodiversity hotspots within developing countries.
        - Our experience with this data is that it is fairly constant across a country although variations across Indonesia were observed.

3. Global 200 Ecoregions (not used)
    - *Source*:
        - World Wildlife Fund
        - https://www.worldwildlife.org/publications/marine-ecoregions-of-the-world-a-bioregionalization-of-coastal-and-shelf-areas
    - *Description*:
        - Identifies ecoregions around the globe.
        - 200 total regions both terrestrial and marine.
        - The *Marine Ecoregions Of the World (MEOW)*data set is a biogeographic classification of the world's coasts and shelves. The ecoregions nest within the broader biogeographic tiers of Realms and Provinces. Further details about the MEOW system and PDFs of the BioScience paper the comprehensive listing of sources are available from www.worldwildlife.org/MEOW/and www.nature.org/MEOW.
    - *Purpose*:
        - A potential indicator for SPAN sites

        - However, was not used in our analysis due to the lack of marine region classification throughout all of Indonesia.

4. Global Patterns of Marine Biodiversity
    - *Source*:
        - Tittensor DP, Mora C, Jetz W, Lotze HK, Ricard D, Vanden Berghe E, Worm B (2010). Global patterns and predictors of marine biodiversity across taxa. Nature 466: 1098-1101. doi: 10.1038/nature09329; Data URL: http://data.unep-wcmc.org/datasets/17
    - *Description*:
        - The dataset shows the global patterns of marine biodiversity (species richness) across 13 major species groups ranging from zooplankton to marine mammals (11,567 species in total). These groups include marine zooplankton (foraminifera and euphausiids), plants (mangroves and seagrasses), invertebrates (stony corals, squids and other cephalopods), fishes (coastal fishes, tunas and billfishes, oceanic and non-oceanic sharks), and mammals (cetaceans and pinnipeds). Two major patterns emerged from this work: coastal species showed maximum diversity in the Western Pacific, whereas oceanic groups consistently peaked across broad mid-latitudinal bands in all oceans. The findings indicate a fundamental role of temperature in structuring cross-taxon marine biodiversity, and indicate that changes in ocean temperature, in conjunction with other human impacts, may ultimately rearrange the global distribution of life in the ocean.
    - *Purpose*:
        - Biodiversity data was used as an indicator with the objective of locating SPAN sites in areas of high marine biodiversity

5. Estuaries 2003
    - *Source*:
        - Alder J (2003). Putting the coast in the Sea Around Us. The Sea Around Us Newsletter 15: 1-2. URL: http://seaaroundus.org/newsletter/Issue15.pdf; http://data.unep-wcmc.org/datasets/23 (version 2.0)
        - Watson R, Alder J, Booth S, Christensen V, Kaschner K, Kitchingman A, Lai S, Palomares MLD, Valdez F, Pauly D (2004). Welcome to www.seaaroundus.org: launching our 'product' on the web. The Sea Around Us Newsletter 22: 1-8
    - *Description*:
        - This dataset shows the global distribution of over 1,300 estuaries, including some lagoon systems and fjords. This dataset was developed as part of the Sea Around Us project (www.seaaroundus.org).

    - *Purpose*:
        - Estuaries are important marine ecosystems for protection and thus were used as an indicator.

6. Modeled Distribution of Seagrass
    - *Source*:
        - UNEP-WCMC, Short FT (2018). Global distribution of seagrasses (version 6.0). Sixth update to the data layer used in Green and Short (2003). Cambridge (UK): UN Environment World Conservation Monitoring Centre. URL: http://data.unep-wcmc.org/datasets/7
    - *Description*:
        - This dataset shows the global distribution of seagrasses, and is composed of two subsets of point and polygon occurrence data. The data were compiled by UN Environment World Conservation Monitoring Centre in collaboration with many collaborators (e.g. Frederick Short of the University of New Hampshire), organisations (e.g. OSPAR), and projects (e.g. the European project Mediterranean Sensitive Habitats Mediseh), across the globe (full list available in accompanying metadata table within the dataset).
    - *Purpose*:
        - Potential indicator for SPAN sites.

7. World Database on Protected Areas
    - *Source*:
        - UCN, UNEP-WCMC [year]. The World Database on Protected Areas (WDPA). February 2019 release. Cambridge (UK): UNEP World Conservation Monitoring Centre. URL: www.protectedplanet.net
    - *Description*:
        - The World Database on Protected Areas (WDPA) is a joint project between the United Nations Environment Programme (UNEP) and the International Union for Conservation of Nature (IUCN), managed by UNEP World Conservation Monitoring Centre (UNEP-WCMC).
        - The Ocean Data Viewer displays the latest version of the entire WDPAdataset (i.e. terrestrial and marine components), in line with Protected Planet. This allows users to view linkages between Marine Protected Areas (MPAs) and adjacent terrestrial protected areas, in the transition zone between the ocean and the land. This is particularly important when considering coastal habitats such as mangroves. For further details on individual protected areas, please visit www.protectedplanet.net.
    - *Purpose*:
        - Potentially identify regions with and without protected areas.
        - Locate SPAN or expand existing MPA alongside other protected areas that are easily expanded in a network approach

8. Global Human Influence Index
    - *Source*:
        - Wildlife Conservation Society - WCS, and Center for International Earth Science Information Network - CIESIN - Columbia University. 2005. Last of the Wild Project, Version 2, 2005 (LWP-2): Global Human Influence Index (HII) Dataset

(Geographic). Palisades, NY: NASA Socioeconomic Data and Applications Center (SEDAC). https://doi.org/10.7927/H4BP00QC. Accessed DAY MONTH YEAR.

- *Description*:
  - To provide an updated map of anthropogenic impacts on the environment in geographic projection which can be used in wildlife conservation planning, natural resource management, and research on human-environment interactions.
  - The Global Human Influence Index Dataset of the Last of the Wild Project, Version 2, 2005 (LWP-2) is a global dataset of 1-kilometer grid cells, created from nine global data layers covering human population pressure (population density), human land use and infrastructure (built-up areas, nighttime lights, land use/land cover), and human access (coastlines, roads, railroads, navigable rivers). The dataset in Clarke 1866 Geographic Coordinate System is produced by the Wildlife Conservation Society (WCS) and the Columbia University Center for International Earth Science Information Network (CIESIN).
- *Purpose*:
  - Identify areas that have low HII to target pristine areas for SPANs

Results

The results of the analyses are attached. They include two tables for the SPA analysis results, a detailed table (Table 2), and a more abbreviated versions with selected sites including top candidate SPA sites (Table 1). The indices that combined the surf and biodiversity/ecosystem dimensions had the same results as the biodiversity index. Sites with high values in both dimensions are highlighted in yellow and circled in red.

Tables 1-2 - Indonesian Candidate SPA Analysis
(See attached pdfs from Excel File and Excel Files)

Further detail on how the surf spots were analyzed as well as recommendations to consider water quality, crowdedness, and sustainable tourism management are included in Tables 3-6. Individual surf spot ranks from a surf tourism perspective are calculated in Table 4. Table 5 shows ranks of surf areas comprised of the surf spots analyzed in Table 4 with Bali, East and West Java and Sumatra Mainland coming in as top 4 with east Java being the most ideal. Finally, Table 6 shows existing eco-surf destinations for the top ranked surf areas from Table 5. While these sites reflect ideal surf tourism sites, they may not occur within the biodiversity conservation areas that were analyzed. The SPAN analysis in Tables 1 and 2 emphasize the biodiversity and ecosystem dimension more in an integrative analysis. Candidate SPAs were identified that had high scores in both dimensions. These included those areas where the following surf spots are located or are very close by: Do'O Island, Mengkudu, and various West Java sites.

Tables 3-6- Indonesian Surf Spot Complete Data
(See attached pdfs from Excel File and Excel File)

Discussion

The results of this analysis provide a first attempt at synthesizing conservation, surfing, economic, and tourism data. Our goal was to develop a repeatable standardized framework for determining ideal candidate SPAs. This proposed method provides a starting point for CI and STW to explore the important metrics and priorities for ranking potential SPAN sites.

Our five indices provided important insights and comparisons of metrics for the selection of SPAs The wave quality index allowed for comparison of surf spots on the class of the wave, helping with the identification of world class breaks. The Surf Accessibility index provided a surf tourism dimension for the analysis as world class waves alone do not necessarily make ideal surf tourism spots. This is especially true for dangerous and remote surf breaks. Including surf tourism aspects are important as world class waves may not generate high tourism income, potentially reducing the amount of conservation fees obtained for management and monitoring of the ecosystem.

The Biodiversity index highlights area of important marine conservation importance which have both critical habitats and marine life. In addition, this dataset provides the basis for the Immediate Conservation Opportunity and Wave Quality and Biodiversity indices, and allows for the comparison of these two data sets which weigh surf metrics differently. The Immediate Conservation Opportunity index identified low-hanging SPAs by identifying the high quality surf spots which were located near or within marine protection areas. Thus the Immediate Conservation Opportunity index identifies surf areas that could be relatively easy to protect with either a small expansion of the MPA boundaries or the addition of monitoring and enforcement mechanisms. Finally, the Wave Quality and Biodiversity index identifies potential SPAs with high wave quality and biodiversity scores. Together, each index provided important information for ranking surf spots for SPAs.

While the method is promising, the results indicate that there is a strong need to apply value driven decision making in the weighting of surf dimensions. Future indices should better reflect the priorities of CI and STW. However, we caution that weighting is inherently subjective and likely no two organizations will agree on the same weighting system. Solutions to this issue can arise from compromises and averaging of weighting scores assigned by different teams.

Furthermore, indices can be improved by incorporating additional levels of data and information. We strongly encourage acquiring the SurfLine/Magic SeaWeed surf data sets which provide robust and reliable wave quality and frequency metrics, and contributing surf data to WannaSurf for the Malaku Islands surf areas. A standard procedure must also be established about whether or not to include, and how to include or represent surf spots in an analysis when critical data is missing. In addition, this method can incorporate not only remote sensing data, but also information from local communities, on the ground surveys, informational interviews, expert opinions, traditional ecological knowledge, or other forms of qualitative data which can help identify the ideal SPAs.