one earth
FUTURE
Peace Through Governance

STABLE SEAS
MARITIME SECURITY INDEX:
CODEBOOK, VERSION 1.0

JULY 2018

STABLE SEAS
MARITIME SECURITY INDEX

STABLE SEAS
MARITIME SECURITY INDEX:
CODEBOOK, VERSION 1.0

Curtis Bell, Ph.D. | cbell@oneearthfuture.org
Sarah Glaser, Ph.D. | sglaser@oneearthfuture.org

July 2018

The Stable Seas Maritime Security Index is developed by programs of
One Earth Future: OEF Research and Secure Fisheries.

one earth
FUTURE
Peace Through Governance

www.stableseas.org
www.oneearthfuture.org

TABLE OF CONTENTS

I. THE STABLE SEAS MARITIME SECURITY INDEX

The Stable Seas Maritime Security Index is a first-of-its-kind effort to measure and map nine issues that are central to achieving sustainable maritime security and good maritime governance. The project highlights regional and country-specific strengths and challenges while demonstrating how issues like maritime trafficking, piracy and armed robbery, maritime mixed migration, and coastal welfare relate to each other. Stable Seas combines interesting case studies and qualitative vignettes with novel quantitative measures that bring new data to bear on maritime security challenges. This codebook describes these measures.

The first version of the Stable Seas Maritime Security Index covers the 30 African exclusive economic zones (EEZs) that envelop sub-Saharan Africa from the mid-Atlantic to the Gulf of Aden. Countries in this region face varied maritime security challenges and suffer from insufficient maritime enforcement capacity. Overcoming these challenges will require continued international coordination and a shared understanding of how different maritime threats complement and compete with each other in African waters. By taking a holistic view and considering these inter-issue linkages, efforts to improve African maritime security will be greatly improved.

This technical documentation describes how each of nine maritime security issues is measured. These issues, which include both threats and buffers against those threats, are:

- International Cooperation
- Rule of Law
- Maritime Enforcement
- Coastal Welfare
- Blue Economy
- Fisheries
- Piracy and Armed Robbery at Sea
- Illicit Trades
- Maritime Mixed Migration

Each country is scored on each issue on a scale of 0 to 100, with 0 reflecting worse conditions and 100 reflecting better conditions. For ease of representation, each score is rounded to the nearest whole number.

These calculations represent the best available information about complex and under-reported activities occurring in expansive and remote maritime regions. Scores are derived from original research and information from external stakeholders and secondary sources. Quantitative data, surveys of subject-matter experts, and qualitative information are used to compile these scores. Some issue-area scores necessarily reflect operationalizations of concepts or best-faith estimates rather than precise numbers.

Vocabulary Note

The Stable Seas Maritime Security Index uses dozens of data points to measure each country's threats and capacities across nine maritime security issue areas. All of the issue scores comprise multiple data sources, and some rely on nested hierarchies of components and subcomponents. The following terms are used to explain these data hierarchies throughout the codebook.

Issue-Area Scores: Each country receives nine issue-area scores corresponding to the nine sections of this codebook: International Cooperation, Rule of Law, Maritime Enforcement, Coastal Welfare, Blue Economy, Fisheries, Piracy and Armed Robbery at Sea, Illicit Trades, and Maritime Mixed Migration. These top-level scores are comprised of multiple inputs.

Indicators: Indicators are distinct data inputs or variables. These are the disaggregated parts for each score, component, and subcomponent used in the Stable Seas Maritime Security Index. Examples of indicators include coastline length, infant mortality rate, and composite scores adopted from other sources, such as Transparency International's Corruption Perceptions Index.

Components: A component occurs on the second level and is itself comprised of multiple indicators. For example, the Rule of Law Score includes a Judicial Integrity

Subcomponents: Like components, subcomponents are formed from multiple distinct indicators to capture a unified concept. Subcomponents differ from components in that they are nested within components. For example, our Maritime Enforcement Score includes a Difficulty Component (second level). The Difficulty Component is further divided into two subcomponents: Geography (indicators for coast length and EEZ size) and Maritime Relations (indicators for the number of maritime neighbors and recognition of maritime boundaries in formal treaties).

II. INTERNATIONAL COOPERATION

Maritime instability in sub-Saharan Africa causes economic, security, and social issues with spillover effects that ripple across the globe. Acknowledging this interdependency, a variety of international actors, from individual states to global institutions, have facilitated multilateral programs which aim to build a more secure African maritime domain. The International Cooperation Score measures participation in and commitment to multilateral efforts that facilitate maritime security and governance.

We measure the International Cooperation Score with three equally weighted components: International Agreements, Regional Security Strategies, and Violations and Disputes.

International Agreements Component

The first component reflects the signing and ratification of seven relevant global maritime legal agreements. In some states, the signing and the ratification of a treaty are separate legal processes. Agreements are typically signed at international conventions or negotiations. These signatures express a country's willingness to participate, but they are not usually legally binding. Most countries require a separate ratification process in which the country's legislature debates and votes to formally approve participation.

Signings are positive steps that reinforce the norms described in international treaties, but international agreements have a much stronger effect when ratification makes participating countries legally bound to the treaties.

The exception to this process applies to treaties that are accepted as customary international law. Customary law, though it may or may not be formally enshrined in a treaty, is legally binding on all states. It derives from the general practice of states. The United Nationas Convention on the Law of the Sea (UNCLOS) is an example of customary international law. All states are bound by it, regardless of whether they have signed or ratified it. In the case of UNCLOS, ratification is a sign of commitment to the international process rather than being indicative of the application of the law.

Table 1 Components of the International Cooperation Score

Component	Justification	Measurement Strategy
INTERNATIONAL AGREEMENTS	The adoption of norms and legally binding arrangements in the maritime space supports greater maritime security.	Signing and ratification of seven relevant global maritime legal agreements (listed below)
REGIONAL SECURITY STRATEGIES	Participation in major regional maritime security agreements captures international cooperation among smaller groups of African states.	Participation and material commitment to three regional agreements: the Yaoundé Code of Conduct, the SADC Maritime Security Strategy, and the Djibouti Code of Conduct
VIOLATIONS AND DISPUTES	The presence of maritime disputes between neighbors hinders effective governance of the maritime space.	Presence of ongoing maritime boundary disputes or claims that are related to the interpretation of the United Nations Convention on the Law of the Sea

The International Agreements Component accounts for both signings and ratifications of global treaties. For each of the treaties described below, countries receive a score of 0 if they have neither signed nor ratified an agreement, 0.33 if they have signed but not ratified, or 1 if they both signed and ratified by January 2018. The total score is divided by the maximum possible score (7) to arrive at a value that ranges between 0 and 1.

The seven agreements are:

The United Nations Convention on the Law of the Sea (UNCLOS)

UNCLOS is the most comprehensive international convention on state sovereignty over the use of maritime space. The agreement, established during the Conference on the Law of the Sea, which concluded in 1982, enshrined established principles as global standards that are central for global maritime governance, including definitions of territorial waters and exclusive economic zones. It entered into force in 1994. Unlike the other six agreements in this section, UNCLOS enjoys universal participation among the 30 coastal states in sub-Saharan Africa.[1]

UNCLOS Part XI

Part XI, which addresses Western concerns over the International Seabed Area, establishes international laws around the production of subsurface seabed minerals in international waters. This section of the agreement takes an important step toward reducing interstate conflict over offshore resources, so we consider it separately from the more general UNCLOS agreement; 23 of 30 states have signed and ratified UNCLOS Part XI.

The United Nations Fish Stocks Agreement

The fisheries provisions in UNCLOS were not deemed fully comprehensive. In response, states convened at the 1993 Conference on Straddling Fish Stocks and Highly Migratory Fish Stocks. The outcome of the meeting, the UN Fish Stocks Agreement, established rules for the coordinated management of these resources. The agreement also empowers regional fisheries management organizations to oversee efforts to sustainably fish species that frequently cross the boundaries of international legal jurisdictions. Only 12 of 30 coastal sub-Saharan countries have signed and ratified the UN Fish Stocks Agreement. [2]

The Convention for the Suppression of Unlawful Acts against the Safety of Maritime Navigation (SUA)

The SUA Convention emerged from a 1988 meeting in Rome that defined and criminalized several threats to maritime security, including seizing a ship by force, destroying cargo or navigational equipment, injuring or killing seafarers, or conveying false information intentionally. Along the sub-Saharan coastline, 24 countries have signed and ratified the SUA Convention.[3]

The United Nations Food and Agriculture Organization Port State Measures Agreement (PSMA)

The PSMA, originally adopted in 2009, addresses illegal, unreported, and unregulated fishing by applying new legal regimes to foreign fishing vessels seeking to land or offload their catch in ports. Under the agreement, ports can inspect foreign fishing vessels, request documentation, and even deny service. Only 17 of 30 coastal sub-Saharan countries have signed and ratified the PSMA.[4]

The United Nations Convention against Transnational Organized Crime (CTOT, or the Palermo Convention)

The 2000 Palermo Convention established protocols on three aspects of transnational organized crime that are acutely present in the maritime space: trafficking in persons, smuggling of migrants, and trafficking in arms. As of 2017, 28 of 30 coastal sub-Saharan countries have ratified the treaty, the exceptions being Somalia (neither

---

1 Lists of signatories to UNCLOS, UNCLOS Part XI, and the UN Fish Stocks Agreement can be found on the United Nations website: http://www.un.org/depts/los/reference_files/chronological_lists_of_ratifications.htm.
2 The United Nations Treaty Collection reports that three states, Gabon, Côte d'Ivoire, and Guinea-Bissau, have signed but have not ratified the UN Fish Stocks Agreement: https://treaties.un.org/pages/ViewDetails.aspx?src=TREATY&mtdsg_no=XXI-7&chapter=21&lang=en.
3 The International Maritime Organization publishes a list of signatories for major maritime agreements here (see pp. 421–425): http://www.imo.org/en/About/Conventions/StatusOfConventions/Documents/Status%20-%202017.pdf.
4 The FAO updates the status of the PSMA in each country at http://www.fao.org/fileadmin/user_upload/legal/docs/037s-e.pdf.

signed nor ratified) and the Republic of the Congo (signed, not ratified). [5]

The United Nations Convention against Illicit Traffic in Narcotic Drugs and Psychotropic Substances

A 1988 meeting in Vienna established an international legal framework for combating international drug trafficking and money laundering. Though Africa's Atlantic and Indian coasts have become major transshipment points in the global narcotics trade, two states, Somalia and Equatorial Guinea, have yet to sign or ratify this agreement.[6]

Regional Security Strategies Component

African maritime security initiatives include both continent-wide efforts and regional multilateral agreements that institutionalize cooperation among smaller groups of states. The Regional Security Strategies Component reflects commitment to three regional agreements: the Yaoundé Code of Conduct (Gulf of Guinea), the South African Development Community (SADC) Maritime Security Strategy (southern Africa), and the Djibouti Code of Conduct (Western Indian Ocean). Notable continent-wide efforts include the AIMS 2050 strategy and the Lomé Charter, both African Union initiatives, but because these continent-wide agreements are planning documents that, at this point, lack binding commitments and formal ratifications, they are not included.

We measure the Regional Security Strategies Component as the mean of two indicators: membership and material commitment. In terms of membership, states receive a score of 1 if they are party to all of the regional maritime security agreements relevant to their regions. Material commitment reflects the progress made by these strategies. Material commitment is measured individually for each agreement depending on the unique context and aims of each treaty. We gauged these material commitments with open-source research on regional maritime coordination, by visiting with member states, and by engaging with regional stakeholders, U.S. Africa Command, U.S. Naval Forces Africa, and African maritime-focused non-governmental organizations.

The Yaoundé Code of Conduct calls for the creation of regional maritime operations centers (MOCs) organized around five zones with Multinational Maritime Coordination Centers (MMCC). Where these centers are in development, participating states receive a score of 0.5. One zone, Zone D, has a fully operational MMCC, so the states in this zone—Sao Tome and Principe, Gabon, Equatorial Guinea, and Cameroon—receive the full score of 1.

On the other side of the continent, the new Jeddah Amendment to the Djibouti Code of Conduct has directed attention to a broad range of maritime security issues, but it has yet to produce tangible outcomes. Until these outcomes occur, states receive credit for membership (0.5) but 0 for material commitment. Similarly, the confidential SADC maritime security strategy has participation from SADC members, but there have not been material regional efforts on the same scale made by the Yaoundé Code members in the Gulf of Guinea.

Violations and Disputes Component

The third component of the International Cooperation Score is the presence of ongoing maritime boundary violations or disputes according to UNCLOS. We define violations as territorial water claims that extend beyond the twelve-nautical-mile boundary defined by UNCLOS. We define disputes as competing claims over the exclusive economic zones (EEZs) defined by UNCLOS.

We identify excessive territorial claims by reviewing claims recorded in the latest CIA World Factbook.[7] Four countries—Benin, Liberia, Somalia, and Togo—claim territorial waters that extend beyond the twelve-nautical-mile area. In terms of disputes, many states have competing claims over their exclusive EEZs that have

---

5 See the UN list at https://treaties.un.org/pages/ViewDetails.aspx?src=TREATY&mtdsg_no=XVIII-12&chapter=18&clang=_en.
6 See the UN list at https://treaties.un.org/Pages/ViewDetails.aspx?src=TREATY&mtdsg_no=VI-19&chapter=6&clang=_en.
7 This resource, updated annually by the United States government, is available here: https://www.cia.gov/library/publications/the-world-factbook/fields/2106.html.

yet to be formally resolved under UNCLOS. According to the Flanders Marine Institute,[8] 11 of 30 countries have ongoing EEZ boundary disputes. However, the Ghana/Côte d'Ivoire dispute (Case #23) was resolved by the International Tribunal for the Law of the Sea in September 2017, so these states are not penalized despite the dispute being listed. Seychelles and Mauritius have also resolved their dispute and established a joint management area, so we do not penalize these states' scores. [9]

Countries receive a score of 0 for violations if they claim additional territorial waters or 1 if they do not claim additional territorial waters. Countries receive a score of 0 if they have EEZ disputes with their neighbors or 1 if they do not have EEZ disputes. The Violations and Disputes Component is an average of these two indicators.

Calculating the International Cooperation Score

We average the International Agreements Component, the Regional Security Strategies Component, and the Violations and Disputes Component to arrive at the International Cooperation Score. After we multiply by 100, the scores range from a high of 92 (Ghana, Guinea, and Senegal) to a low of 26 (Somalia).

International Cooperation Variables in the Data File

IC_FINAL	International Cooperation Score
IC_AGREEMENTS	International Agreements Component
IC_UNCLOS	UNCLOS 1994
IC_UNCLOSXI	UNCLOS PART XI
IC_FISHSTOCKS	UN Fish Stocks Agreement
IC_CSUA	Convention On The Suppression Of Unlawful Acts
IC_VIENNA	UN Convention Against Illicit Traffic In Narcotic Drugs And Psychotropic Substances (Vienna 1988)
IC_PORTSTATE	UN Port State Measures Agreement

IC_REG_MEMBER	State Membership In Regional Strategies
IC_REG_PROGRESS	Material Progress Toward Regional Strategy
IC_VIOLATE	Violations And Disputes Component
IC_DISPUTES	Unresolved Boundary Disputes With Neighbors
IC_TERRCLAIMS	Excessive Territorial Claims
IC_EEZ_DISPUTES	List Of Countries With Which State Has Unresolved Dispute

III. RULE OF LAW

Good maritime governance requires having bureaucratic and legal structures that are capable of designing, implementing, and enforcing policy. Threats to the rule of law, including corruption, bribery, discrimination, and underdeveloped and ineffective political institutions, impede a state's capacity to provide good maritime governance.

We measure the Rule of Law Score with five equally weighted components: Corruption, Government Efficacy, Government Efficiency, Judicial Integrity, and Inclusion.

Corruption Component

Corrupt officials fail to enforce policy and thus enable transnational crime and corruption in maritime governance. Maritime trade is especially affected because nearly all of Africa's international trade transits the maritime space.

Many organizations have already created corruption measures, so we adapt Transparency International's Corruption Perceptions Index[10] to create the Corruption Component. This measure averages 13 other corruption variables on a scale from 0 to 100, with more corrupt countries earning lower metrics. Transparency International's methodology prevents nearly every state from exceeding 80, so we divide each country's score by

---

8 This resource is available here: www.marineregions.org.
9 See the text of the treaty here: http://mdr.govmu.org/English/defence/Documents/treaties/Treaty%20Concerning%20the%20Joint%20Management%20of%20the%20Continental%20Shelf%20in%20the%20Mascarene%20Plateau%20Region.pdf.
10 These data are available here: https://www.transparency.org/news/feature/corruption_perceptions_index_2016.

Table 2 Components of the Rule of Law Score

Component	Justification	Measurement Strategy
CORRUPTION	Corrupt officials fail to enforce policy and enable transnational crime.	The Corruptions Perceptions Index produced by Transparency International
GOVERNMENT EFFICACY	Ineffective governments cannot enforce policy, and this hinders a state's ability to secure its maritime space and prevent illicit maritime activities.	The Functioning of Government score produced by Freedom House
GOVERNMENT EFFICIENCY	Governments with unnecessary administrative and bureaucratic hurdles provide more opportunities for bribery and corruption.	The Ease of Trading Across Borders score from the World Bank Doing Business report
JUDICIAL INTEGRITY	Where judges are bribed and laws go unenforced, the rule of law is too weak for policies aimed at the maritime domain to be effective.	Judicial Accountability, Judicial Attacks, and Judicial Bribery measures from the Varieties of Democracy Project
INCLUSION	Non-discrimination ensures inclusive maritime governance.	Varieties of Democracy Project data on unequal treatment under the law according to social group, subnational region, religion, socioeconomic status, and gender

800 to achieve a more reasonable high benchmark that varies from 0 to 1. No African state exceeds 80 in the most recent iteration of the report, but had any state met the benchmark, it would have received the maximum score of 1.

Data were missing for two of the 30 countries in the 2016 edition of the Corruption Perceptions Index: Seychelles and Equatorial Guinea. In both cases, we used the last available scores, as both countries were included in past recent editions of the Corruption Perceptions Index.[11]

Government Efficacy Component

An ineffective government cannot enforce policy, and this hinders a state's ability to secure its maritime space and prevent illicit maritime activities. We measure efficacy by rescaling the Functioning of Government indicator from Freedom House. This indicator, published as part of the annual *Freedom in the World* report, reflects expert responses to questions like:

> *Do non-state actors, including criminal gangs, the military, and foreign governments, interfere with or prevent elected representatives from adopting and*

> *implementing legislation and making meaningful policy decisions?*

> *Are there independent and effective auditing and investigative bodies that function without impediment or political pressure or influence?*

Freedom House's Functioning of Government indicator ranges from 0 to 12, with the most efficacious governments receiving higher scores. We divide the score by 12 to create a range of 0 to 1. The 2017 *Freedom in the World* report website provides these scores.[12]

Government Efficiency Component

Governments with unnecessary administrative and bureaucratic hurdles provide more opportunities for bribery and corruption, especially as these systems relate to trade, customs, and international migration. Because more than 90 percent of sub-Saharan Africa's international trade flows through its seaports, port administrators are uniquely positioned to demand bribes, permit illicit economic activity, and undermine good governance.

---

11 The most recent CPI scores for Seychelles and Equatorial Guinea are from 2015 and 2013, respectively.
12 See https://freedomhouse.org/report/fiw-2017-table-country-scores.

Each year, the World Bank's *Doing Business* report gauges government efficiency in several areas, one of which is Trading Across Borders. This indicator is computed from expert estimates of the amount of time and money required to move a standard shipping container into the country. The measure is especially relevant for efficiency in African maritime governance, as the region's international trade transits almost exclusively through seaports.

The score is scaled between 0 and 100 and it is available for all 30 countries. To arrive at the Government Efficiency Component, we simply divide the Trading Across Borders indicator by 100 to set it to a 0 to 1 interval. We use the 2017 World Bank *Doing Business* report[13].

Judicial Integrity Component

Judicial integrity is important to the enforcement of existing laws and to ensuring that the *de jure* regulations are *de facto* conditions. Where judges are bribed and laws go unenforced, the rule of law is too weak for policies aimed at the maritime domain to be effective.

We create the Judicial Integrity Component using three indicators—Judicial Attacks, Judicial Accountability, and Judicial Bribery—from the Varieties of Democracy Project (V-Dem), a leading dataset on the strength of governance around the world. The three questions used to create these indicators are described at length in the Varieties of Democracy Codebook, version 6. Answers reflect what occurred in 2016.[14]

The Judicial Attacks ndicator[15] captures how often the government attacks the judiciary in public. The Judicial Attacks question asks experts, "How often did the government attack the judiciary's integrity in public?" Respondents can answer on a scale ranging from "Attacks were carried out on a daily or weekly basis" (0) to "There were no attacks on the judiciary's integrity" (4).

The Judicial Accountability indicator[16] captures how often corrupt or inept judges are held accountable and removed from office. For Judicial Accountability, experts answer, "When judges are found responsible for serious misconduct, how often are they removed from their posts or otherwise disciplined?" Responses range from "Never" (0) to "Always" (4).

The Judicial Bribery indicator[17] captures how often individuals and businesses pay bribes in return for favorable or speedy decisions. The Judicial Bribery indicator asks, "How often do individuals or businesses make undocumented extra payments or bribes in order to speed up or delay the process or to obtain a favorable judicial decision?" Responses range from "Always" (0) to "Never" (4).

We weight Judicial Accountability and Judicial Bribery more heavily than verbal attacks from the government, so we divide Judicial Attacks by 2 and sum responses to the three questions to arrive at a component that ranges from 0 to 10. In doing so, Judicial Accountability and Judicial Bribery each account for 40 percent of the component, while Judicial Bribery determines the final 20 percent of the Judicial Integrity Component. We then divide by 10 to achieve a measure of Judicial Integrity with a range of 0 to 1.

Inclusion Component

We gauge political inclusion with five indicators from the Varieties of Democracy Project (V-Dem). These cover unequal treatment under the law according to social group identification,[18] subnational region,[19] religion,[20] socioeconomic status,[21] and gender.[22]

These are measures of equal treatment under the law, not of the absolute provision of liberal and transparent governance. Non-democratic states can score well if the law is equally applied across all five of these social divisions.

13   Available at doingbusiness.org
14   For more information, see the codebook at https://www.v-dem.net/files/42/Codebookv6.pdf.
15   The Judicial Attacks measure is variable name v2jupoatck_ord in V-Dem.
16   The Judicial Accountability measure is variable name v2juaccnt_ord in V-Dem.
17   The Judicial Bribery measure is variable name v2jucorrdc_ord in V-Dem.
18   Unequal treatment under the law according to social group identification is variable name v2pepwrsoc_ord in V-Dem.
19   Unequal treatment under the law according to subnational region is variable name v2clrgunev_ord in V-Dem.
20   Unequal treatment under the law according to religion is variable name v2csrlgrep_ord in V-Dem.
21   Unequal treatment under the law according to socioeconomic status is variable name v2pepwrses_ord in V-Dem.
22   Unequal treatment under the law according to gender is variable name v2pepwrgen_ord in V-Dem.

The phrasing of the survey questions varies slightly for each indicator. For the questions about gender, socioeconomic status, and social group, respondents are asked: "Is political power distributed according to…?" Responses range from "A favored group has a monopoly of political power" (0) to "Power is distributed equally" (4).

The religion question asks: "Does the government attempt to repress religious organizations?" Answers range from "Severely" (0) to "No" (4).

The region question asks: "Does government respect for civil liberties vary across different areas of the country?" Here, respondents are constrained to "Yes" (0), "Somewhat" (1), or "No" (2).

All of the scores are rescaled to be between 0 and 1 by dividing the raw score by the maximum possible response. The Inclusion Component is the average of these five rescaled indicators of inclusion.

Calculating the Rule of Law Score

We create the Rule of Law Score by taking the average of the five components: Corruption, Government Efficiency, Government Efficacy, Judicial Integrity, and Inclusion. We multiply by 100 to achieve a score that ranges from 0 to 100. The final Rule of Law Score ranges from 76 (Cabo Verde) to 22 (Democratic Republic of the Congo) with a mean of 48.

Rule of Law Variables in the Data File

RL_FINAL	Rule Of Law Score
RL_CORRUPTION_RAW	Raw CPI Indicator From Transparency International
RL_CORRUPTION_FINAL	Converted Corruption Perceptions Index Indicator
RL_EFFICACY_RAW	Raw Functioning of Govt Indicator From Freedom House
RL_EFFICACY_FINAL	Efficacy Component
RL_EFFICIENCY_RAW	World Bank Ease of Trading Across Borders
RL_EFFICIENCY_FINAL	Efficiency Component

RL_JUD_ATTACK	Judicial Attacks From Varieties of Democracy
RL_JUD_ACCT	Judicial Accountability From Varieties of Democracy
RL_JUD_CORRUPT	Judicial Corruption From Varieties of Democracy
RL_JUD_FINAL	Judicial Integrity Component
RL_INC_RELIGION	Varieties Of Democracy Inclusion of Religion
RL_INC_REGION	Varieties of Democracy Inclusion of Subnational Region
RL_INC_SES	Varieties of Democracy Inclusion of Socioeconomic Status
RL_INC_GROUP	Varieties of Democracy Inclusion of Social Group
RL_INC_GENDER	Varieties Of Democracy Inclusion of Gender
RL_INC_FINAL	Inclusion Component

IV. MARITIME ENFORCEMENT

Good maritime governance is not possible without navies and coast guards that are adequate for monitoring territorial waters and exclusive economic zones. Where states are up to this task, smugglers and traffickers cannot operate freely and fisheries laws are enforceable. However, inadequate capacity to govern the maritime space can hamper a country's efforts to regulate maritime activity and effectively render any maritime legislation irrelevant. Poor capacity in this area provides tempting opportunities for those who seek to profit from the absence of real enforcement of maritime law.

For this reason, we measure and define Maritime Enforcement as each country's capacity to effectively patrol its territorial waters and EEZ for the purposes of investigating illicit activity and enforcing maritime law. The score is not concerned with legal regimes or naval warfighting efforts, though both of these related concepts are greatly affected by Maritime Enforcement. Rather, this score focuses on the difficulty of managing a state's specific maritime space, its capacity to perform constabulary duties in that space, and the development and regional integration of its maritime domain awareness systems.

Table 3 Components of the Maritime Enforcement Score

Component		Justification	Measurement Strategy
EEZ DIFFICULTY	**GEOGRAPHY OF THE EEZ**	Some maritime spaces require more resources than others, specifically very large EEZs and those with longer coastlines.	Geographic data on EEZ size and coast length
	MARITIME BOUNDARIES	As the number of maritime boundaries increases, a state will have more difficulty governing the borders of its maritime space, especially when those borders have not been mutually agreed upon and formally recognized.	Count of maritime neighbors, defined as those with abutting EEZs, and the legal status of each boundary between two or more EEZs
COASTAL PATROL ASSETS		All else being equal, countries with larger navies and coast guards will have greater capacity to patrol their maritime spaces.	Count of coastal patrol vessels as recorded in *Military Balance* 2016
NAVAL CAPACITY ASSESSMENT		More capable navies can intercept threats before they reach coasts and monitor for illicit maritime activity.	Expert assessments of naval capacity go beyond simple ship counts and qualitatively assess relative naval strength
MARITIME SITUATIONAL AWARENESS		Maritime situational awareness is a crucial aspect of any nation's ability to provide maritime law enforcement and governance in its maritime domain.	Evaluation of maritime situational awareness against an original five-tier rating system

We measure the Maritime Enforcement Score with four components: EEZ Difficulty, Coastal Patrol Assets, Naval Capacity Assessment, and Maritime Situational Awareness.

Difficulty Component

The Difficulty Component measures the difficulty of governing one's maritime space, and is determined by the unique geographical attributes of a country's particular maritime space. The component is derived from two the following equally weighted inputs: Geography of the EEZ and Maritime Boundaries.

Geography of the EEZ

We measure the Geography of the EEZ subcomponent as an average of two indicators: EEZ size and coastline length. Though these two concepts are correlated, they can diverge based on the shape of a coastline and the arrangement of neighboring EEZs. Cameroon, for example, has a very low EEZ- to- coastline ratio because its offshore claims quickly meet those of island neighbors like Equatorial Guinea. Conversely, Cabo Verde's relative isolation in the mid-Atlantic means it has an EEZ that extends many nautical miles in all directions. Analyzing EEZ size captures the problems faced by states with expansive maritime territories, such as Seychelles. Including coastline length accounts for how more complex coastal areas and archipelagos like the Niger River Delta can ease smuggling and evasion of law enforcement authorities.

Data on EEZ size is drawn from maritimeregions.org, an online gazetteer produced by the Flanders Maritime Institute. This resource contains comprehensive geospatial and legal information about maritime spaces around the world. Rather than usinge the raw value, we make three transformations to the data before including it in the Geography of the EEZ Score.

First, we log- transform the size of each EEZ. This allows the effect of small increases in size to be much greater in countries with small EEZs while minimizing the additional effect of size in countries that already have very large EEZs. For example, an additional 1,000 square kilometers is a much greater challenge for a state that only had 1,000 square kilometers to patrol than it is for a large country that already had an expansive EEZ.

Second, we rescale the data to the interval between 0 and 1 by establishing a maximum benchmark. Setting that benchmark at the global maximum (France's EEZ) would effectively eliminate meaningful variation among other countries because France is an extreme outlier with a global EEZ that is nearly eight times larger than the largest African EEZ. Instead, we set a maximum possible value of 2.5 million square kilometers (approximately the size of the Indian EEZ), which approximates the global 90th percentile. This allows for more meaningful variation among countries with EEZs that are closer to the global mean. Any countries with larger EEZs are given the maximum value.

Finally, we rescale EEZ size to a 0 to 1 scale by calculating the ratio of a country's EEZ to the maximum EEZ size. More formally, where Z_c is the size of the EEZ in country C in tens of thousands of kilometers:[23]

$$\text{Scaled EEZ Size} = ln(Z_c+1) \, / \, ln(250+1)$$

Data on coastline length is drawn from the CIA World Factbook. We create our measure of coastline length following the same three steps as in the EEZ Size measure. Coastline lengths are log-transformed, benchmarked to a maximum of 7,000 kilometers (the approximate coast length of India, or the global 90th percentile), and converted into a ratio using the following equation, where Cc is the coastline length of country C in hundreds of kilometers:

$$\text{Scaled Coastline Length} = ln(C_c+1) \, / \, ln(70+1)$$

Maritime Boundaries

Two indicators form the Maritime Boundaries subcomponent: the number of EEZ neighbors and the proportion of those neighbors with which a state has not come to a formal mutual agreement about the placement of maritime boundaries. We argue that the difficulty of patrolling a maritime space increases with the number of direct maritime neighbors and that this patrolling is even more difficult when borders are not explicit and mutually agreed upon.

We draw both indicators from the Flanders Maritime Institute. The number of neighbors is rescaled to a 0 to 1 scale by dividing the number of neighbors by five. Countries with five or more EEZ neighbors receive the maximum value of 1. We then calculate the proportion of neighbors with which a country does not have a formal treaty recognizing the EEZ boundary. As noted in the International Cooperation–Violations and Disputes section above, we make two changes to the dispute list to reflect that, as of late 2017, Ghana/Côte d'Ivoire and Mauritius/Seychelles have resolved the disputes recorded by the Flanders Maritime Institute. The Maritime Boundaries subcomponent is the average of these two indicators.

Finally, to calculate the Difficulty Component, we average the Maritime Boundaries subcomponent and the Geography of the EEZ subcomponent. In effect, this measure is a simple average of rescaled EEZ size, coastline length, number of EEZ neighbors, and the proportion of neighbors without a formal agreement. We subtract this average from 1 to achieve a measure that ranges from 0 (most difficult EEZ to patrol) to 1 (least difficult EEZ to patrol).

Coastal Patrol Assets Component

We measure the number of coastal patrol vessels available to federal forces, which may include a navy, coast guard, port police, and/or other maritime

---

23 In every instance in which we use logged values, we add "1" to the value being logged. Doing so is necessary to avoid undefined values that approach negative infinity. When "1" is added to the logged value, the minimum is set to 0.

enforcement division.[24] We derive these vessel counts from The Military Balance 2016, an annual global report from the International Institute for Strategic Studies (IISS). Theis report did not include information for São Tomé and Príncipe or Comoros, so we supplemented these data with in-house research and inquiries to regional stakeholders. We adopt the coastal patrol vessel definition from the Military Balance report:

> *Patrol and Coast Combatants are: "surface vessels designed for coastal or inshore operations. These include corvettes…, … offshore patrol ships…, patrol craft…, and patrol boats."*

A simple vessel count does not take into account vessel age, working condition, or funding, but we address these factors in the Naval Capability Component below.

We create the Coastal Patrol Assets Component that ranges from 0 to 1 by first identifying a reasonably high benchmark of 100 coastal patrol vessels. Any country that has 100 or more coastal patrol vessels receives a score of 1.

Second, we account for the diminishing returns of each additional vessel by log-transforming each country's vessel count. Third, we measure the ratio of a country's vessel count to the benchmark where *C* is a country's coastal patrol vessel count:

$$\text{Coastal Patrol Assets} = \ln(C+1) \,/\, \ln(100+1)$$

In the final Coastal Patrol Assets Component, Nigeria's coastal patrol efforts dwarf those of any other sub-Saharan country. *Military Balance 2016* reports well over 100 qualifying vessels in Nigeria. No other government in the region has more than 30.

Naval Capability Assessment

Counts of vessels miss some important aspects of naval capability. Equipment can be outdated and navies can be underfunded or inadequately trained. To address this reality and complement our Coastal Patrol Vessels Component, we use an in-house expert assessment to measure naval capability by gauging what activities fall within and beyond the capabilities of African navies. Four coders, three of whom have military backgrounds and have engaged in African maritime security throughout their careers, independently classified naval capability according to the following rubric.

Naval Capacity Assessment

This assessment gauges a country's capacity to enforce its laws and exercise governance of its waters based on the number, type, and capability of its naval assets (including coast guard and other agency assets) and a subjective evaluation of the ways in which those assets are employed in support of maritime enforcement and governance. Assessment of a country at a certain rank implies that country has the capacity to also meet the requirements of the subordinate rankings.

> ***Tier 6: Regional Naval Power***
> *These are countries with naval, coast guard, and other agency assets capable of executing the full range of naval operations, from maritime enforcement to naval warfighting and limited offensive power projection, from the coastline to beyond the nation's EEZ.*

> ***Tier 5: Full Offshore Constabulary Capacity***
> *These are countries that have assets of sufficient capability and in sufficient numbers to conduct regular and routine patrols, and to respond to incidents, out to the limits of the EEZ. This implies a force consisting of large offshore patrol vessels (ranging from 50m to small frigate size) capable of sustained at-sea operations of a week or more, supported by an organic naval aviation or land-based maritime patrol aircraft capability.*

> ***Tier 4: Limited Offshore Constabulary Capacity***
> *These are countries that have assets capable of patrolling and responding to incidents beyond the limits of territorial waters but which, whether for*

---

24 Measures of naval warfighting capacity often measure total tonnage rather than the number of vessels based on the argument that larger ships have more fighting power. Because we are interested in a force's ability to patrol physical space rather than ability to compete with opposing fleets, we use the number of vessels. This better approximates the amount of physical space a force can monitor at a given time.

lack of numbers, range, or sustainment resources, do not do so regularly or routinely or cannot cover the entire EEZ. This implies a force consisting of a small number of capable offshore patrol vessels (OPVs) or a larger number of smaller OPVs, and possibly a limited maritime patrol aircraft capability.

Tier 3: Inshore Constabulary Capacity

These countries have primarily inshore (i.e., extending to the limit of their territorial waters) capabilities, making them capable of constabulary duties within, and perhaps slightly beyond, the 12nm limit. This implies a force comprising smaller OPVs (vessels up to 30m in length) that actually patrol the country's territorial waters routinely.

Tier 2: Coastal Constabulary Capacity

These are countries with naval assets sufficient in number and capability to allow maritime enforcement along the coast, in estuaries, and along approaches to ports. Such countries may or may not have limited inshore patrol capability but do not routinely or regularly patrol their territorial waters.

Tier 1: Token Capacity

These are navies that have some minimal capability, but this often consists of little more than a formal organizational structure and a few coastal craft. These states, the world's smallest and weakest, perform the most limited constabulary functions.

Tier 0: No Naval Capacity

These countries have no naval, coast guard, or other maritime law enforcement agency to speak of.

Following an initial independent ranking, classifications were correlated at over 0.90, showing nearly absolute agreement across the 30 navies. However, the following process was used to address the few discrepancies of two or more tiers:

First, initial scores were recorded by the project director.

Second, scores with significant disagreement (+2 tiers)

were shared with the four coders. The coders were then asked to openly exchange sources and discuss revisions.

Third, coders were allowed to independently revise any of the scores which had initially shown significant disagreement. Coders were explicitly told that differences of opinion were allowed and that each coder should make an independent decision and not worry about remaining differences with other coders.

Fourth, the project director took the mean of the four scores each country received and then standardized to a scale of 0 to 1 by dividing by 6.

Maritime Situational Awareness Component

Finally, we assessed maritime situational awareness (MSA) using the same methodology as the Naval Capacity Assessment and applied the following rubric:

MSA Effort Assessment

This category assesses the extent to which a country has made a deliberate commitment to establishing the onshore infrastructure needed to develop MSA. It takes into account the establishment of Maritime Operations Centers (MOCs), the information-gathering, processing, and sharing capabilities of those MOCs, and the country's level of integration into multinational MSA constructs, such as participation in regional MOCs or Zone information-sharing arrangements.

Tier 4: These states have a robust network of MOCs that support development of MSA and contribute to the conduction of enforcement operations. These states also actively participate in regional MSA initiatives and share information with neighbors.

Tier 3: These states have a robust network of MOCs that support development of MSA and contribute to the conduction of enforcement operations, but are not actively, or are only superficially, engaged in regional MSA initiatives and do not share information easily with neighbors.

Tier 2: These states have a network of MOCs, but

these MOCs make a more limited contribution to MSA or are not used effectively to direct enforcement operations. However, these states do actively participate in regional MSA initiatives and share information with neighbors.

Tier 1: These states may have MOCs, but these exist in name only and make no contribution to MSA or to the conduction of enforcement operations. However, these states do actively participate in regional MSA initiatives.

Tier 0: These states do not have MOCs and do not participate in regional MSA initiatives or share information with neighbors.

The only difference from the process outlined above is that we achieved a range of 0 to 1 by dividing the average score by 4 (there are fewer tiers in this rubric).

Calculating the Maritime Enforcement Score

We calculate the Maritime Enforcement Score as a function of Difficulty, Coastal Patrol Assets, Naval Capability, and Maritime Situational Awareness. We weight the Coastal Patrol Assets Component by the Difficulty Component before taking the average. Thus, the formula is:

Maritime Enforcement Score = {(1 - Difficulty + Coastal Patrol Assets) / 2 + Naval Capability + Maritime Situational Awareness} / 3

Last, we multiply the result by 100 to achieve a score ranging from 0 (weakest) to 100 (strongest).

Maritime Enforcement Variables in the Data File

ME_FINAL	Maritime Enforcement Score
ME_MOC	Maritime Situational Awareness Component
ME_COAST_RAW	Coastline Length, CIA World Factbook
ME_COAST_FINAL	Rescaled Coastline Length
ME_EEZ_RAW	EEZ Size

ME_EEZ_FINAL	Rescaled EEZ Size
ME_GEOG_FINAL	Geography (Coast/EEZ)
ME_AGREE	Number Of Maritime Neighbors With Formal Recognition Of Maritime Borders
ME_UNESTAB-LISHED	Number Of Maritime Neighbors With No Formal Recognition Of Boundaries, But No Active Dispute
ME_DISPUTE	Number Of Maritime Neighbors With Which Country Has An Active Maritime Boundary Dispute
ME_NEIGHBORS	Total Number Of Maritime Neighbors
ME_NEIGHBORS_SCALED	Neighbors Rescaled
ME_NOTREATY	Sum Of ME_UNESTABLISHED And ME_DISPUTE, As Percentage Of Neighbors
ME_BOUNDAR-IES_FINAL	Maritime Neighbors Score
ME_DIFFICUL-TY_FINAL	Difficulty Component
ME_COASTAL	Raw Number Of Coastal Patrol Vessels
ME_VESSELS	Rescaled Number Of Coastal Patrol Vessels
ME_NAV_CAP	Final Naval Capacity Evaluation

V. COASTAL WELFARE

The security of a maritime region is closely linked to the well-being of the people living in adjacent coastal areas. The economically insecure are more likely to turn toward piracy, smuggling, and trafficking. Transnational criminal networks are especially likely to establish themselves along coastlines that are weakly governed and affected by armed conflict and other forms of violence. As seen in Nigeria, Somalia, the Philippines, and elsewhere, violent non-state actors operating onshore often turn to the maritime space to profiteer from poor governance or to smuggle arms and illicit goods.

We conceptualize coastal welfare as a function of a population's physical and economic security, both on

Table 4 Components of the Coastal Welfare Score

Component	Justification	Measurement Strategy
COASTAL PHYSICAL SECURITY	The deleterious effects of physical and economic insecurity are more immediate in coastal regions. When coastal residents suffer from violence and poverty on or near the coast, close proximity to the sea can draw people toward maritime crime and the illicit maritime economy.	Armed-conflict events within 50 km of a coastline from the UCDP Georeferenced Event Dataset
COASTAL ECONOMIC SECURITY		Artisanal Fishing Opportunities goal from the Ocean Health Index (OHI), Coastal Livelihoods & Economies goal from the OHI weighted by the Human Development Index from UNDP
COUNTRYWIDE PHYSICAL SECURITY	Poor conditions farther inland can also threaten a country's maritime space as those in the interior migrate to the coasts to seek economic opportunities or maritime migration routes. Violence that emerges in one region can quickly spread to others, so coastal welfare cannot be entirely separated from socioeconomic conditions in a country's interior.	Countrywide armed-conflict events from the UCDP Georeferenced Event Dataset, homicide rate from UNODC
COUNTRYWIDE ECONOMIC SECURITY		Human Development Index from UNDP, infant mortality rate from the World Bank

the coast and in a country more generally. We calculate the Coastal Welfare Score with four equally weighted components: Coastal Physical Security, Coastal Economic Security, Countrywide Physical Security, and Countrywide Economic Security.

Countrywide Physical Security Component

We use two indicators to measure the Countrywide Physical Security Component: countrywide armed-conflict events and homicide rates.

The first indicator is derived from the Georeferenced Event Dataset (GED) produced by a joint initiative of the Uppsala Conflict Data Program (UCDP) and the Peace Research Institute of Oslo (PRIO). The dataset includes geocoded information about specific lethal instances of armed conflict, such as battles between governments and rebels or uses of violence against civilians worldwide.[25] The project codebook defines a qualifying event as:

> *"An incident where armed force was used by an organized actor against another organized actor, or against civilians, resulting in at least one direct death at a specific location and a specific date."*

We used version 17.1 of this dataset and counted all events of armed conflict occurring during the 2016 calendar year in each of the 30 countries. During this period the 30 countries of study collectively experienced 1,039 qualifying events.

We made three adjustments to the counts of armed-conflict events to arrive at a score that ranges from 0 (extremely high frequency of conflict) to 1 (no conflict). First, we log-transformed event counts to account for the decreasing importance of an additional event as the number of total events increases. Second, we established a maximum benchmark of 250 events (the 90th percentile of countries worldwide in 2016) to reduce the influence of extreme outliers like Iraq, Afghanistan, and Somalia. Finally, we took the ratio with the following formula, where C is the count of armed-conflict events:

$$\text{Transformed Armed-Conflict Event Count} = \max(0, 1 - \ln(C+1) / \ln(250+1))$$

Any country that had an event count above the 90th percentile of countries worldwide (above 250 events) received the lowest possible score of 0, while states suffering zero instances of armed conflict received a score of 1.

25 See: Ralph Sundberg and Erik Melander, "Introducing the UCDP Georeferenced Event Dataset," Journal of Peace Research 50, no.4 (2013): 523–532; Mihai Croicu and Ralph Sundberg, "UCDP GED Codebook version 17.1," Department of Peace and Conflict Research, Uppsala University, 2017.

The second indicator in the Countrywide Physical Security Component is the homicide rate taken from the United Nations Office on Drugs and Crime (UNODC). Homicide data were taken for the most recent available year for each country. In most cases, 2015 was the year used.[26]

As in the armed-conflict event measure above, we set a maximum benchmark around the global 90th percentile (20 homicides per 100,000). Any country with a homicide rate above this threshold receives the lowest score of 0. Next, to achieve a curve that depreciates with the homicide rate, we convert the rate to a logged ratio. The denominator is the log-converted maximum threshold (20 per 100,000), while the numerator is the country's homicide rate subtracted from this maximum threshold. Leaving the unit in the homicides per 100,000 produces a curve that declines far too gradually. Countries with homicide rates around double the global mean (approximately 15 per 100,000) earn roughly 0.59 on a 0 to 1 scale. To produce a sharper curve, we convert the unit to homicides per 10,000 by dividing by 10. Under this transformation, scores drop more sharply as the homicide rate climbs. After this conversion, a country with the same homicide rate would earn around 0.37. After converting to homicides per 10,000 and adding "1" to both the numerator and denominator to avoid undefined logged values, we get a denominator of $\ln(20/10 + 1) = \ln(3)$ and a numerator of $\ln(20/10 + 1 - H/10) = \ln(3-H/10)$. Homicide rates, which are measured as a count of homicides per 100,000 citizens, were transformed to a 0 to 1 scale using the following formula, where H is the homicide rate:

Transformed Homicide Rate = $\max(0,\ln(3-H/10) / \ln(3)$

Finally, we created the Countrywide Physical Security Component for each country as an average of the transformed countrywide armed-conflict event count and homicide rate. This portion of the score produces significant variation, with scores ranging from 0.99 (Madagascar) to 0.31 (the Democratic Republic of the Congo).

Coastal Physical Security Component

To isolate armed conflict occurring near the coastline, we identified events of armed conflict occurring within 50 kilometers of a country's coast using the same Georeferenced Event Dataset from UCDP. This reduced the number of events to 256. The events are spread across six countries: Somalia, Nigeria, Kenya, Angola, Mozambique, and Côte d'Ivoire.

This distinction between coastal armed conflict and countrywide armed conflict used in the Countrywide Physical Security Component above helped us capture the geographic differences in armed conflict in each affected country. Some countries, like Somalia and Angola, experienced most of their armed-conflict events near the coast. Others, like the Democratic Republic of the Congo and Cameroon, suffered conflict in interior regions but not in coastal areas.

We transformed the coastal armed-conflict event count for each country to a 0 to 1 scale using the following formula, where C is the count of coastal armed-conflict events:

$$\text{Coastal Physical Security Score} = \max(0,1-\ln(C+1) / \ln(101))$$

As in the measure of countrywide armed conflict, we set a maximum benchmark to eliminate the influence of extreme outliers. We set the benchmark to 100 events to approximate the global 90th percentile of coastal armed-conflict events. As in all of our logged transformations, we add "1" to each value before logging to avoid undefined results.

Coastal Economic Security Component

We use two indicators to measure coastal economic security. The first is the Artisanal Fishing Opportunities goal from the Ocean Health Index (OHI). The second is the Coastal Livelihoods and Economies goal from the OHI weighted by the Human Development Index (HDI) produced by the United Nations Development Program (UNDP).

---

26 The data are available here: https://data.worldbank.org/indicator/VC.IHR.PSRC.P5

The Artisanal Fishing Opportunities goal from the OHI measures "whether people who need to fish on a small, local scale have the opportunity to do so."[27] In other words, it captures whether the demand for fishing opportunities is met on the coast in a lawful and sustainable manner. Anecdotes from Somalia, Nigeria, and elsewhere demonstrate the importance of sustainable artisanal fishing as a deterrent against illicit economic activity. The score is measured on a scale from 0 (worst) to 100 (best). We divide the scores for each country by 100 to get a measure within the 0 to 1 interval.

The Coastal Livelihoods and Economies goal from the OHI assesses jobs and revenue produced from marine-related industries relative to national trends in employment and GDP. The goal thus captures the relative economic well-being of coastal areas in comparison to the rest of the country. The industries considered in the measure are: 1) commercial fishing, 2) mariculture, 3) tourism and recreation, 4) shipping and transportation, 5) whale-watching, 6) ports and harbors, 7) ship- and boatbuilding, and 8) renewable energy production (wind and wave). Like the Artisanal Fishing Opportunities goal, it is also scaled 0 to 100 and can be reset to the 0 to 1 interval through a simple division by 100.

Because Coastal Livelihoods and Economies is a measure of coastal well-being *relative to conditions elsewhere in a country*, it is not particularly useful for cross-national comparisons unless it is transformed. A very poor country like Somalia can receive an outstanding Coastal Livelihoods and Economies measure so long as the people on the coast are no more impoverished than those living in the country's interior.

Accordingly, we transform the Coastal Livelihoods and Economies goal with the Human Development Index to ensure that the final indicator takes into account differences between states rather than just within them.

The Human Development Index is perhaps the world's most influential score of social well-being. The HDI seeks to capture well-being by looking at three key measures of economic and human development: life expectancy,

education provision, and gross national income. We used the 2016 release of the Human Development Index that covers all 30 countries with data from 2015.

We transformed the Coastal Livelihoods and Economies goal from the OHI with the following formula:

$$\text{Transformed CLE} = \text{CLE} / 100 * \text{HDI}$$

Finally, we calculated the Coastal Economic Security Component for each country as an average of the Artisanal Fishing Opportunities goal and the transformed Coastal Livelihoods and Economies goal. The result ranges from a maximum of 0.72 (South Africa) to 0.38 (Guinea and Guinea-Bissau) with a mean of 0.50.

Countrywide Economic Security Component

We measure countrywide economic security using two indicators: The Human Development Index (HDI) from the UNDP and infant mortality data from the World Bank.

The first indicator, the HDI score, is described above in the Coastal Economic Security Component section.

The second indicator is the infant mortality rate (IMR), which is commonly viewed as one of the best single indicators of social welfare. To improve infant mortality rates, countries must invest in health care, transportation infrastructure, nutrition, and women's education across all socioeconomic classes and social groups. We use the most recent data from the World Bank, which defines infant mortality as the number of infants per 1,000 live births who perish before reaching their second birthday.

As with other measures in the index, we establish a maximum benchmark near the global 90th percentile to reduce the influence of extreme outliers. Any country where infant mortality exceeds 75 per 1,000 receive a score of 0. The score can reach 1 only when infant mortality is in effect eliminated throughout a country. As with the homicide conversion described above, we first convert the IMR into deaths per 100 to achieve a sharper curve with greater penalties for higher infant

---

27   See "Goal: Artisanal Fishing Opportunities," Ocean Health Index: http://www.oceanhealthindex.org/methodology/goals/artisanal-fishing-opportunities.

mortality rates. We also add "1" to the numerator and denominator to avoid undefined values. This results in the following conversion:

$$\text{Transformed Infant Mortality Rate} = \max(0, \ln(8.6 - IMR/10) / \ln(8.6)$$

Finally, we calculate the Countrywide Economic Security Component as an average of the HDI and the transformed infant mortality rate.

Calculating the Coastal Welfare Score

The final Coastal Welfare Score equally weights the four components described: Countrywide Physical Security, Coastal Physical Security, Coastal Economic Security, and Countrywide Economic Security.

When these are averaged, we achieve an overall score that ranges from 0.26 (Somalia) to 0.89 (Seychelles) with an average of 0.67. We convert to a 0 to 100 scale as in all of the other issue areas by multiplying this value by 100.

Coastal Welfare Variables in the Data File

CW_FINAL	Coastal Welfare Score
CW_PHYS_COAST_RAW	Raw Count of Conflict Events Within 50 Km Of Coast
CW_PHYS_COAST_FINAL	Coastal Physical Security Component
CW_PHYS_NAT_INCID_RAW	Raw Count of Conflict Events In Country In 2016
CW_PHYS_NAT_INCID_FINAL	Log-Transformed Countrywide Conflict Events
CW_PHYS_NAT_HOM_RAW	Homicides Per 100,000 Per UNODC
CW_PHYS_NAT_HOM_FINAL	Log-Transformed Homicide Rate
CW_PHYS_NAT_FINAL	Countrywide Physical Security Component
CW_ECON_NAT_HDI	Human Development Index From UNDP
CW_ECON_NAT_IMR_RAW	Raw Infant Mortality Rate
CW_ECON_NAT_IMR_FINAL	Log-Transformed IMR

CW_ECON_NAT_FINAL	Countrywide Economic Security Component
CW_ECON_COAST_LIVELIHOODS	Coastal Livelihoods Goal
CW_ECON_COAST_ARTFISH	Artisanal Fishing Goal
CW_ECON_COAST_FINAL	Coastal Economic Security Component

VI. BLUE ECONOMY

This score incorporates six components that are central to the Blue Economy; the components were chosen after review of literature pertaining to the Blue Economy globally and to the Blue Economy in Africa specifically, and are commonly cited as being the most important aspects of the Blue Economy and the most relevant to current and future trends in Africa.

We measure the Blue Economy Score with six equally weighted components: Fisheries, Marine and Coastal Tourism, Maritime Transportation and Shipping, Offshore Oil and Gas, Adjusted Net Savings, and Climate Change.

Fisheries Component

Fisheries are an important part of the economy throughout Africa. In some countries, fisheries products are the top-grossing export. In others, the income from artisanal and small-scale fisheries are important for livelihoods. We combine the values of wild-caught marine fish and mariculture for this score. The Fisheries issue area incorporates indicators of the health of the stock and the management of the resource, but the economic value is a critical component of the Blue Economy separate from the health of the fishery.

The value of wild-caught marine fish taken in by a given country was obtained from The Sea Around Us for 2014,[28] the most recent year available. The total landed value of fish catch (in real 2010 USD), regardless of location of that catch, was summed from the category "Fishing Entity." That is, we did not limit the value of the catch to a country's own EEZ.

---

28   See http://www.seaaroundus.org/

Table 5 Components of the Blue Economy Score

Component	Justification	Measurement Strategy
FISHERIES	Wild fisheries and increasingly aquaculture (fish farming) contribute to local economies and national (export) economies.	Value, per capita, of combined wild fish and aquaculture production from the UN Food and Agriculture Organization and The Sea Around Us
MARINE AND COASTAL TOURISM	The tourism sector generates jobs and supports coastal economies, especially in Small Island Developing States.	Ocean Health Index goal for Tourism and Recreation
MARITIME TRANSPORTATION AND SHIPPING	Ports support extensive national and regional trade networks and provide local jobs and services.	Indicators of port size, quantity of port-based trade, port infrastructure
OFFSHORE OIL AND GAS	The offshore energy sector contributes to national trade economies, produces income through resource licensing, and supports employment.	Original indicators of oil and gas reserves and potential for future accessibility
ADJUSTED NET SAVINGS (ANS)	Sustainable growth is key to a thriving Blue Economy. ANS measures standard economic growth conditioned by a country's investment in education and the environment.	World Bank Adjusted Net Savings index
CLIMATE VULNERABILITY	Climate change may threaten Blue Economy gains. Climate Vulnerability measures the risks a country faces from climate change.	Notre Dame's Global Adaptation Initiative (ND-GAIN) Country Index

The value of mariculture to a given country was obtained from the UN Food and Agriculture Organization's Global Statistical collection's Global Aquaculture Production database.[29] The definition of mariculture includes fish-farming occurring in the ocean or coastal zones and farming of marine species.[30] The query was also limited to marine waters, marine and brackish water environments, and the year 2014. Of countries included in this version of Stable Seas, the following reported the value of mariculture in 2014: The Gambia, Ghana, Kenya, Madagascar, Mauritius, Namibia, Senegal, Seychelles, South Africa, and Tanzania.

The values of domestic wild fish catch and mariculture were summed and divided by the national population estimated by the World Bank.[31] All data were downloaded on 2 or 3 April 2018. Globally, fisheries value per capita ranged from $0.14 per person (Jordan) to $32,123.22 per person (Faroe Islands) with an average of $446.33 per person. We adjusted values by benchmarking to the global 90th percentile. All countries in the 90th percentile or higher received a score of 1, and those below 90th percentile received a score divided by 0.9. After adjusting for the global range, Stable Seas countries ranged from $397.20 per person (Seychelles) to $0.50 per person (the Democratic Republic of the Congo) with a regional average of $67.93.

Marine and Coastal Tourism Component

Sustainable coastal tourism supports jobs and livelihoods in coastal communities. We use the Tourism and

---

29 See http://www.fao.org/fishery/statistics/global-aquaculture-production/en
30 Specifically, for a given country, the following species groups were included in the query: brown seaweeds; green seaweeds; seaweeds not elsewhere included; red seaweeds; crabs and sea-spiders; lobsters and spiny rock lobsters; miscellaneous marine crustaceans; shrimps and prawns; salmons, trouts, and smelts; marine fishes; sea-squirts and other tunicates; sea-urchins and other echinoderms; abalones, winkles, and conchs; clams, cockles, and arkshells; miscellaneous marine molluscs; mussels; oysters; scallops and pectens; squids and cuttlefishes; and octopuses.
31 See http://databank.worldbank.org/data/reports.aspx?source=health-nutrition-and-population-statistics:-population-estimates-and-projections. Estimates for the population of Taiwan, Republic of China, were obtained from CEIC. at https://www.ceicdata.com/en/indicator/taiwan/population

Recreation goal[32] in the Ocean Health Index. The Ocean Health Index assesses countries on biological, physical, economic, and social factors to measure how sustainably humans are using the ocean. The Tourism and Recreation goal measures the proportion of the total labor force engaged in the coastal tourism and travel sector, factoring in unemployment and sustainability, and countries where such employment was 9.5 percent or greater of the total labor force received a perfect score (100). The Ocean Health Index collects data for all countries of the world and issues annual updates. We used the 2016 score for all countries without transformation or alteration other than dividing by 100 to convert to a range of 0 to 1.

Maritime Transportation and Shipping Component

Maritime ports and the shipping and commerce they support are pillars of the Blue Economy. Large, well-functioning ports support larger volumes of shipping and greater export and import markets and link national economies to the global economy. We calculated this component by combining two indicators: port quantity and port quality.

Port Quantity

Port quantity was calculated from the Liner Shipping Connectivity Index,[33] a national-level metric developed by the UN Conference on Trade and Development that ranges from 0–100. This indicator includes the number of ships using a country's ports, the container capacity of those ships, the maximum vessel size, the number of services, and the number of companies that operate in ports. We used the index calculated for 2016 and converted it to range from 0–1 by dividing by 100.

Port Services and Quality

We developed an indicator of port services and quality that accounts for harbor size plus availability of the following services: first port of entry, tug assist, air and rail communications, medical facilities, water and fuel

supplies, and dry-dock repair. Data from the International Maritime Organization's Global Integrated Shipping Information System[34] was collected for each country for 2016. Our indicator was calculated by assigning points values as follows.

- Harbor size: values of small = 1, medium = 2, large = 3, and very large = 4 were divided by 4.
- First port of entry: yes = 1, no = 0
- Tug assist available: yes = 1, no = 0
- Communications available: air = 0.5, rail = 0.5
- Medical facility: yes = 1, no = 0
- Supplies available: provisions, water, fuel, and diesel each received 0.25
- Drydock available: values of none = 0, small = 1, medium = 2, and large = 3 were divided by 3.

For each port in a country, points were tallied and the total divided by 7 so the range was 0 to 1. Of all the ports within a country, the port with the highest score was used for the national score.

The overall Maritime Transportation and Shipping Component was calculated by equally weighting the port quantity and quality indicators.

Offshore Oil and Gas Component

Offshore oil and natural gas development contributes substantially to the economies of some African nations, like Nigeria, but the distribution is highly skewed: of the 30 nations included in this report, 17 gain no income from and have no proven reserves of offshore oil or gas. However, the oil and gas scene is changing rapidly as new discoveries and new extraction technologies are creating opportunities for emerging oil and gas players.

We created the Oil and Gas Component from six indicators, four of which are drawn directly from the U.S. Energy Information Agency (EIA), a resource providing annual data on hydrocarbon production, consumption, and discovery. The four indicators downloaded are the most recent data available for national-level oil production, proved oil reserves, natural gas production,

32 See http://www.oceanhealthindex.org/methodology/goals/tourism-and-recreation
33 See http://unctadstat.unctad.org/wds/TableViewer/tableView.aspx?ReportId=92
34 See https://gisis.imo.org/Public/Default.aspx

and proved natural gas reserves. The two remaining indicators are original weights for offshore oil and offshore gas industries. We combine these indicators into four subcomponents for Oil Production, Oil Reserves, Gas Production, and Gas Reserves.

Offshore Oil and Offshore Gas Indicators

Our first step was to ascertain the percentage of each country's oil industry and gas industry focused on offshore resources. We consider offshore resources to include those off the coasts in oceans and adjacent seas. We do not include activity in major inland lakes and seas. Using EIA's country profiles and industry reports specific to each country and oil field, we estimated offshore resources as a percentage of a country's total oil and gas industry, placing them in a range from 0 to 1. Each country received one score for oil and another for gas.

Total Petroleum and Other Liquids Production, 2016 (Thousands of Barrels Per Day)[35]

The EIA measures oil production in thousands of barrels per day and this measure is highly skewed toward the world's largest producers. In 2016, only 46 countries produced at least 100,000 barrels a day and only 20 produced at least 1 million. The data are skewed by the three countries producing in excess of 10 million barrels per day: Saudi Arabia, the United States, and Russia.

To rescale these estimates between a minimum of 0 and a maximum of 1, we first convert to billions of barrels per year by multiplying by 365.25 and dividing by 1,000,000. Next, we use a logged ratio transformation, as is used in other parts of this report. The global 90th percentile for oil production is approximately 0.34 billion barrels per year, but experts estimate roughly 30 percent is produced offshore. We use these figures to identify a high benchmark of 0.1 billion barrels, or 100 million barrels per year. Any country producing more receives the maximum value of 1. Where P is production in billions of barrels per year and W is the offshore oil weight, Oil Production is:

$$\text{Oil Production Subcomponent} = \min(1, \ln(PW+1) / \ln(0.1+1))$$

Crude Oil Proved Reserves, 2016 (Billion Barrels)[36]

The EIA estimate of proved reserves captures untapped oil that is feasible to extract with current extraction technology. Production captures profitability in the present, but reserves indicate future potential and the likelihood of future investment.

Proved reserves are measured in billions of barrels and, like production figures, are highly skewed. In 2016 only 29 countries had at least 3 billion barrels. Of these, 12 had at least 30 billion barrels and Venezuela had 300 billion barrels—nearly a fifth of the world's proved reserves.

Just as we did above, we rescaled these estimates by setting a high benchmark of 2 billion barrels (the global 90th percentile is approximately 5 billion barrels and some 30 to 40 percent of global proved reserves are believed to be offshore). Then, we perform a logged ratio after weighting each country's reserves R by the Offshore Oil Weight W:

$$\text{Oil Reserves Subcomponent} = \min(1, \ln(RW+1)/\ln(2+1))$$

Gross Natural Gas Production (Billion Cubic Feet), 2015[37]

Natural gas is measured in cubic feet, rather than in barrels, but we use the same process described above to rescale gas production to the 0 to 1 interval. First, we convert production and reserves to the same unit, trillions of cubic feet, by dividing Natural Gas Production by 1,000. We calculate the global 90th percentile at around 1.5 trillion cubic feet per year and then reduce this by two-thirds to 500 billion because the EIA estimates only one-third of proved natural gas lies offshore. Where G is gas product in trillions of cubic feet and W is the offshore gas weight:

$$\text{Gas Production Subcomponent} = \min(1, \ln(GW+1) / \ln(.5+1))$$

35 See https://www.eia.gov/beta/international/rankings/#?iso=VEN&cy=2016&tl_id=5-A.
36 See https://www.eia.gov/beta/international/rankings/#?iso=VEN&cy=2016&tl_id=5-A&aid=6&pid=57.
37 See https://www.eia.gov/beta/international/rankings/#?iso=VEN&cy=2015&tl_id=3002-A&pid=3.

Proved Reserves of Natural Gas (Trillion Cubic Feet), 2016[38]

Finally, the same process is applied to natural gas reserves. We set a high benchmark at one-third the global 90th percentile, or 15 trillion cubic feet. Then, where R represents a country's gas reserves and W is the offshore gas weight:

$$\text{Gas Reserves Subcomponent} = \min\left(1, \frac{\ln(RW+1)}{\ln(15+1)}\right)$$

Calculating the Oil and Gas Component

Oil and gas often, though not always, occur in the same geographic space. This is common in West Africa, whereas East Africa has abundant natural gas and very little oil. One consequence of this is that taking an average score across both resources would greatly penalize countries that have extensive industries around one resource but not the other. This problem is exacerbated by the log-transformations; a country like Mozambique can have one of the largest gas reserves in the world and no oil yet receive a lower score than a country like Ghana, which has moderate reserves of both resources but nowhere near the economic potential of Mozambique.

We correct for this by creating an Oil and Gas Component that accounts for both industries while weighting a country's better of the two industries more heavily. The component is calculated from two terms; the first is the average of the four subcomponents (oil production and reserves, gas production and reserves) and the second is the average of production and reserves in the stronger industry. Mathematically, this is calculated as:

$$\text{Oil and Gas} = (OR+OP+GR+GP) / 8 + \\ MAX(OR+OP, GR+GP) / 4$$

The first term shows the four subcomponents divided by 8. This produces a value ranging from 0 to 0.5. The second term identifies whether oil or gas is the higher-scoring resource in a given country, sums the resources and production scores for that resource, and then divides that sum by 4. This also results in a score that will range

from 0 for a country with neither oil nor gas to 0.5 for a country that exceeds the maximum benchmarks in both production and reserves of its stronger resource. When these are summed to create the Oil and Gas Component, we have, in effect, a measure that is weighted 75 percent toward a country's more important resource and 25 percent toward its less important of the two resources.

Adjusted Net Savings Component

Adjusted Net Savings (ANS) is a measure of true savings in a country after taking into account depletion of natural resources and damages as well as investments in human capital. Many economists have adopted ANS as a metric that overcomes some shortfalls in using Gross Domestic Product to measure economic growth and development. ANS is derived from the standard national accounting measure of gross saving by making four adjustments: consumption of fixed capital is deducted to obtain net national saving; current public expenditure on education is added to account for investment in human capital; estimates of the depletion of a variety of natural resources are deducted to reflect the decline in asset values associated with extraction and depletion; and deductions are made for damages from carbon dioxide and particulate emissions.

We use ANS measures from the World Bank's World Development Indicators Little Green Book.[39] Values for 23 of the 30 countries evaluated here were available, and the regional average was used for countries without ANS values. Raw scores for our countries ranged from -47.8 (Guinea) to 20.3 (Cabo Verde). We first standardized scores to range from 0–1 according to the maximum and minimum regional values. This results in the country with the highest regional score earning a perfect 1.0. Consequently, we benchmarked the range of regional values to the global range of -47.8 to 36.9 (Singapore). Cabo Verde, with the highest ANS value in the 30 nations comprising the Stable Seas Index, is in the 89th percentile of all ANS values. Therefore, each country's standardized score was multiplied by 0.89.

---

38 See https://www.eia.gov/beta/international/rankings/#?iso=VEN&cy=2016&tl_id=3002-A&pid=3&aid=6.

39 See https://data.worldbank.org/products/data-books/little-green-data-book

Our final ANS Component for country *n* was

$$ANS_n = (X_n + abs(X_{min})) / (X_{max} + X_{min}) * 0.89$$

where the minimum and maximum ANS values were calculated from the list of 30 Stable Seas Maritime Security Index countries.

Climate Vulnerability Component

Several components of the Blue Economy, such as fisheries and tourism, may be affected by global climate change. To account for this risk, we included an indicator of vulnerability to climate change. We used the University of Notre Dame's Global Adaptation Index [40] (known as ND-GAIN), which is calculated at a national scale and updated annually. The index measures a country's vulnerability to climate change based on: 1) exposure to climate-related or climate-exacerbated hazards, 2) sensitivity to the hazard's impacts, and 3) capacity to adapt or manage to the impacts. We use the ND-GAIN score from 2016. ND-GAIN ranges from 0–1 so we did not adjust the numbers.

Calculating the Blue Economy Score

The final Blue Economy Score equally weights the six components described above: Fisheries, Marine and Coastal Tourism, Maritime Transportation and Shipping, Offshore Oil and Gas, Adjusted Net Savings, and Climate

Blue Economy Variables in the Data File

BE_FINAL	Blue Economy Score
BE_FISHERIES	Fisheries Component
BE_WILD_FISH	Per Capita Value of Wild Fish Catch
BE_MARICULTURE	Per Capita Value of Mariculture
BE_TOURISM	Marine And Coastal Tourism Component
BE_TRANSPORTATION	Maritime Transportation and Shipping Component
BE_TRANSPORT_QUANT	Port Quantity Indicator
BE_TRANSPORT_QUAL	Port Services and Quality Indicator

BE_OILGAS	Offshore Oil and Gas Component
BE_OIL_PRO-DUCTION	Total Petroleum and Other Liquids Production
BE_OIL_RE-SERVES	Crude Oil Proved Reserves
BE_OIL_OFF-SHORE_WT	Offshore Weighting for Oil
BE_GAS_PRO-DUCTION	Gross Natural Gas Production
BE_GAS_RE-SERVES	Natural Gas Proved Reserves
BE_GAS_OFF-SHORE_WT	Offshore Weighting for Gas
BE_ANS	Adjusted Net Savings Component
BE_ANS_RAW	Raw ANS Score from World Bank
BE_CLIMATE	Climate Vulnerability Component

Vulnerability. The six components were averaged and multiplied by 100 to achieve a final score between 0 and 100.

Blue Economy Scores range from 18 (the Democratic Republic of the Congo) to 60 (Cabo Verde) with an average of 40. In general, small island nations scored highly. The strongest relationship between our components is between fisheries and tourism and between climate vulnerability and tourism: countries with strong fisheries components of the Blue Economy had stronger tourism sectors, and countries with lower climate vulnerability had stronger tourism sectors.

VII. FISHERIES

Maritime security includes the ocean having the capacity to provide food and livelihoods to coastal people. The health of marine fisheries is a critical component of food and livelihood provision. Threats to fisheries include pollution, over-exploitation, and poor governance capacity. When fisheries are abundant and well-managed, they can contribute to maritime security by improving national economies, local livelihoods, and nutrition. Nations that engage in formal governance mechanisms and have strong fisheries laws are better able to monitor

---

40   See https://gain.nd.edu/our-work/country-index/

and enforce policies that support healthy fisheries. Likewise, clean waters and healthy fish stocks support economic growth and reinforce governance norms. Nations that do not prioritize fisheries management and governance are not fully leveraging a critical natural resource and may lose profit and food to larger, faster foreign and distant-water fishing fleets.

We measure the Fisheries Score with five equally weighted components: Fishery Health, Foreign Fishing, Fisheries Legislation, Regional Fisheries Management Organizations (RFMOs), and Ocean Pollution.

Fishery Health Component

Fishery health refers to the status of fish stocks from the perspective of sustainable harvesting of fisheries resources. We used the value of the Wild Caught Fisheries sub-goal of the Food Provision goal in the Ocean Health Index. The Ocean Health Index[41] measures countries on biological, physical, economic, and social factors to assess how sustainably humans are using the ocean. The Wild Caught Fisheries sub-goal measures how

well a nation achieves optimal sustainable production of seafood compared to a biological baseline. The target is for a given nation to maintain a fish population at the level that produces Maximum Sustainable Yield (known as B_{MSY}). Countries are penalized for both underfishing and overfishing. Thus, this metric is not solely one of conservation—a nation that does not fish will not earn the highest score because they are leaving potential revenue in the water. We divided the Wild Caught Fisheries sub-goal by 100 to achieve a Fishery Health Component between 0 and 1.

Foreign Fishing Component

The presence of foreign fishing vessels in EEZ waters can be a cause of maritime insecurity and conflict. In African waters, domestic fishing fleets tend to be small-scale and artisanal, using small boats and gear. Foreign vessels, especially those from distant-water fleets that have traveled thousands of miles to fish, are larger, faster, and use larger sets of gear. This can cause direct conflict between domestic and foreign vessels. In some African countries, foreign vessels have been accused of destroying

Table 6 Components of the Fisheries Score

Component	Justification	Measurement Strategy
FISHERY HEALTH	Fish stocks produce the highest economic and livelihood gains when they are sustainably utilized (e.g., not overfished).	Ocean Health Index sub-goal for Wild Caught Fisheries
FOREIGN FISHING	The presence of foreign fishing vessels can be a destabilizing factor and reduce maritime security through direct interactions with domestic fleets or competition for finite fish stocks.	Percent of fishing conducted by foreign-flagged vessels from catch data from The Sea Around Us
FISHERIES LEGISLATION	Fisheries laws that have strong provisions for management, enforcement, and defined access are more productive and sustainable.	Original scoring of domestic fisheries legislation archived with the UN Food and Agriculture Organization
RFMOs	Members of regional fisheries management organizations have better reporting and enforcement mechanisms and have signaled willingness to work with recognized international institutions on fisheries management.	Binary factor where 1 = yes and 0 = no if a country is a member of an RFMO whose jurisdiction overlaps that specific EEZ
OCEAN POLLUTION	Waters with less pollution support healthier fisheries, which contributes to the food supply, the economy, and fisheries livelihoods.	Ocean Health Index Clean Waters goal

---

41 See Oceanhealthindex.org.

artisanal gear, crowding out smaller boats, destroying marine habitat, and depleting fisheries resources. Case studies in both East and West Africa demonstrate that illegal, unreported, and unregulated (IUU) fishing is often related to, and even caused by, the presence of foreign fishing vessels in a nation's waters. This is not universally true, and some nations that have large foreign fleets have low levels of IUU fishing. Likewise, not all foreign vessels perpetuate conflict. Given the lack of a comprehensive and comparative estimate of the amount of IUU fishing in EEZs, we calculate the percent of total fish catch made by foreign vessels within an EEZ.

We use data collected and maintained by the Sea Around Us[42] that assigns all reported or reconstructed fish catch in an EEZ to a given country based on the flag of the ship catching fish. Total catch reported in 2014 was divided into domestic catch and foreign catch using the identifying category "Entity," which identifies by flag the country responsible for fish catch and measures in metric tons. Foreign catch was divided by total catch to get a percentage. Foreign fishing as a percent of total reported or reconstructed catch in an EEZ ranges from 0 percent (Comoros, Mozambique, Nigeria, South Africa, and Tanzania) to 96 percent (Guinea-Bissau) with an average of 33 percent. This was then subtracted from 1 to reverse the order of the scale so that lower component values aligned with higher percentages of foreign fishing and higher component values aligned with lower percentages of foreign fishing.

Fisheries Legislation Component

Strong domestic fisheries laws include clear directives for management, provisions for enforcement, and mandates for data collection that inform fisheries management plans. When governments have strong fisheries laws, conflict is minimized through having clear guidelines on access rights and approved fishing methods. We measure the strength of domestic fisheries laws by coding each country's fisheries legislation, which is housed online by the UN Food and Agriculture Organization,[43] for mandates on the following:

- an observer program
- data collection
- foreign vessel licensing
- restrictions on foreign vessels
- gear restrictions
- endangered species protections
- protections for artisanal (domestic) fishers
- catch limits based on Maximum Sustainable Yield

A country received one point for each related mandate in their domestic legislation, and the Fisheries Legislation Component was calculated by dividing each country's point total by 8 (the maximum possible value). This created a component that ranged from 0 to 1. The component scores range from 0 (Cameroon, the Democratic Republic of the Congo, Equatorial Guinea, Gabon) to 0.88 (Sierra Leone, South Africa, The Gambia, and Togo) with an average of 0.56.

Regional Fisheries Management Organization Component

Governments that engage and collaborate with international fisheries bodies are more likely to adopt norms around fisheries management and scientific data collection and to adopt best practices for monitoring, control, and surveillance. Regional fisheries management organizations are international bodies with voluntary membership by those countries whose fishing interests fall within the RFMO's jurisdiction. Some RFMOs are defined solely by geographic extent, while others are defined by the scope of the fishes they manage (e.g., tuna and other highly migratory species). We used maps showing the boundaries of four RFMOs—the Indian Ocean Tuna Commission, the International Commission for the Conservation of Atlantic Tunas, the Commission for the Conservation of Southern Bluefin Tuna, and the South East Atlantic Fisheries Organisation—to identify overlap between RFMO jurisdictions and EEZs. Scores were calculated by counting the number of RFMO memberships a country had from the pool of RFMOs that had overlapping jurisdictions (i.e., countries did not

---

42   Data available for download at seaaroundus.org
43   See the FAO Document Depository available at http://www.fao.org/documents/search/en/.

get penalized for not joining RFMOs outside their EEZs and we assume countries should be members of those RFMOs that touch or overlap their EEZs). The total of points earned was then divided by total possible points to scale the component between 0 and 1.

[Note: ratification of the Port State Measures Agreement is relevant to this topic, but it was included in our International Cooperation Score.]

Ocean Pollution Component

Marine pollution can negatively impact fisheries by disrupting breeding or feeding areas, reducing reproduction, or introducing diseases. It is also a proxy for coastal development which disrupts marine habitat such as seagrass beds and coral reefs. We used the score from the Clean Waters goal in the Ocean Health Index. The Clean Waters goal measures pollution from chemicals, nutrients (agriculture), pathogens, and trash (including plastics) in EEZ waters. We divided the Clean Waters score by 100 to get a value between 0 and 1. The component ranges from 0.28 (Togo) to a best of 0.84 (Namibia) with an average of 0.53.

Calculating the Fisheries Score

Fisheries Variables in the Data File

FI_FINAL	Fisheries Score
FI_HEALTH	Fishery Health Component
FI_FOREIGN	Foreign Fishing Component
FI_FOREIGN_PERCENT	Percentage of Total Catch by Foreign-Flagged Vessels
FI_LEGISLATION	Fisheries Legislation Component
FI_LEGIS_RAW	Total Points Given to Domestic Fisheries Legislation
FI_RFMO	RFMO Component
FI_POLLUTION	Ocean Pollution Component

The final Fisheries Score equally weights the five components described: Fishery Health, Foreign Fishing, Fisheries Legislation, RFMOs, and Ocean Pollution.

The five components were averaged and multiplied by 100 to achieve a final score between 0 and 100. The Fishery Score ranges from 24 (Democratic Republic of the Congo) to 86 (South Africa) with an average of 59. In general, countries in southern and eastern Africa scored highly. The strongest relationship between components is between foreign fishing and fishery health: nations with lower levels of foreign fishing in their EEZs had, on average, healthier fish stocks.

VIII. PIRACY AND ARMED ROBBERY AT SEA

The Piracy and Armed Robbery at Sea Score measures the instances of piracy occurring in proximity to a country's EEZ. Following international legal definitions established in UNCLOS, we define piracy and armed robbery at sea as follows.

> *Piracy: "Any illegal acts of violence or detention, or any act of depredation, committed for private ends by the crew or the passengers of a private ship or a private aircraft, and directed: (i) on the high seas, against another ship or aircraft, or against persons on property on board such ship or aircraft; (ii) against a ship, aircraft, persons, or property in a place outside the jurisdiction of any State."*

> *Armed Robbery: "Unlawful act of violence or detention or any act of depredation, or threat thereof, other than an act of piracy, committed for private ends and directed against a ship or against persons or property on board such a ship, within a state's internal waters, archipelagic waters, and territorial sea."*

Legally, these activities are mainly distinguished by where they occur. Events occurring within the territorial waters of a state, typically within 12 nautical miles of the baseline, are acts of armed robbery at sea. Incidents occurring farther from the coast, including those occurring within an EEZ, are acts of piracy. Our data cover events occurring on the high seas, within EEZs, and within territorial waters. They do not include port crimes or incidents in states' internal waters with the exception

Table 7 Components of the Piracy and Armed Robbery Score

Component	Justification	Measurement Strategy
PROXIMITY	Many attacks occur against international vessels operating just beyond a state's EEZ. To capture these incidents as well as those occurring in a country's EEZ, we measure the country's proximity to incidents of piracy and armed robbery rather than a simple count of events within an EEZ.	2016 data on incidents of piracy and armed robbery at sea from Oceans Beyond Piracy

of events that occur within the High Risk Area (Gulf of Guinea) defined by the International Transport Workers Federation.

We measure Piracy and Armed Robbery at Sea with one component: Proximity.

In 2016, there were 105 qualifying incidents of piracy and armed robbery at sea off the coast of sub-Saharan Africa according to Oceans Beyond Piracy. Using geographic information system (GIS) data, we calculated the minimum distance between every country's EEZ and each incident of piracy or armed robbery at sea occurring around the African continent in 2016. Distances were measured as the minimum length from the latitude and longitude of the incident to the closest border of the EEZ. Distances for events occurring within an EEZ were measured as 0.

Then, we identified each country's set of closest incidents and rank-ordered them according to distance. We measured distances in hundreds of kilometers and set a maximum distance of 1,000 kilometers, meaning anything occurring farther away than that cannot count against a state's score. To scale these distances to the 0 to 1 interval and to account for the diminishing importance of increased distance (10 vs. 50 kilometers is more relevant than 210 vs. 250 kilometers, for example), we log-transformed each distance with the following equation:

$$\text{Transformed Event Distance} = \ln(\text{distance}/100+1) / \ln(1000/100+1)$$

Finally, we calculated the Proximity Component for each country based on the transformed distances for events of piracy and armed robbery at sea by keeping

the transformed distances for the nearest 25 events and then weighting them in reverse order.[44] In other words, we multiplied the transformed distance of the closest event by 25, the second-closest by 24, and so on until we multiplied the 25th-closest event by 1. We then summed these weighted distances for each country and divided by 325 (the sum of all whole numbers between 1 and 25) to arrive at the final Proximity Component.

We multiplied by 100 so that scores would range from 0 to 100, with 0 reserved for states with at least 25 events within their EEZ and 100 for states without a single event within 1,000 kilometers of their EEZ boundary.

Piracy and Armed Robbery Variables in the Data File

PAR_FINAL	Piracy and Armed Robbery at Sea Score

IX. ILLICIT TRADES

Forces of globalization, such as advancements in communication and transportation technologies, have facilitated the integration of formerly isolated domestic markets. However, these same forces have also fueled the rise of transnational organized crime, including in the maritime domain. As transnational criminal networks become entrenched, some expand and diversify their activities. It is not uncommon to find linkages between various trafficking activities. Some criminal networks directly fund non-state actors engaged in rebellion and terror.

Illicit trades are a problem nearly everywhere, but the goods being trafficked vary by region. To capture

---

44   The threshold of 25 events is admittedly arbitrary, but because there is a diminishing effect for each additional event, increasing this threshold does not dramatically change the score.

Table 8 Components of the Illicit Trades Score

Component	Justification	Measurement Strategy
BREADTH OF MARITIME ILLICIT TRADES	In the absence of reliable economic data about the size of the illicit trade in any particular good, we instead measure the number of major illicit trades that are present in a country's maritime space and the relative severity of those trades.	Expert evaluation of severity of illicit trade across seven trades: arms, cannabis, coca, contraband, opiates, synthetic narcotics, and wildlife products
DEPTH OF MOST SEVERE MARITIME ILLICIT TRADES	Some countries may not be major players in many trades, but may be a global hotspot for one of them. By measuring the "depth" of the most severe trade, we can further penalize scores for global leaders in a specific illicit trade.	Using the same assessment, we create a penalty for the worst of the seven scores given for the illicit goods mentioned above

the breadth of the maritime illicit trades, we created scorecards evaluating each country's participation in the illicit maritime movement of the following products: coca and its derivatives, opiates, cannabis, synthetic narcotics, small arms and light weapons, wildlife products, and miscellaneous contraband. The nature of the shadow economy means precise estimates of the scale of these trades are impossible to obtain. However, we can evaluate the relative severity of each trade and the diversity of illicit goods moving through each country's waters.

We build the Illicit Trade Score with two components: Breadth of Maritime Illicit Trades and Depth of Most Severe Maritime Illicit Trades.

Assessment

For each of the seven illicit trades and the 30 countries, in-house respondents assessed the severity of the problem and the extent to which each trade is a maritime issue (rather than land-based or air-based). Respondents worked together to identify the most reliable and recent sources, and each assessment is linked to sources in the scorecards available for download. The following is a brief summary of the goods covered.

Arms

This score focuses on illegal transfers of weapons and ammunition across country borders. It does not cover legal arms sales between governments, but instead aims to capture illegal flows that primarily involve non-state

actors. Most of these arms are categorized as small arms and light weapons. The buyers are often—though not always—violent non-state actors operating in the region.

Drugs

The drug-trafficking analysis is divided into the same four categories that organize major publications like the United Nations Office on Drugs and Crime's World Drug Report: cannabis, coca, opiates, and synthetic narcotics. Africa is not only a transcontinental transport hub, it has recently transitioned to also being a major consumer of these drugs, and increasingly a producer of methamphetamines.

Contraband

Contraband trafficking is the illegal trade or movement of other illicit goods, like counterfeits, and of legal products, such as black-market livestock. These products vary widely around the continent, but include pharmaceuticals, sugar, charcoal, and electronics. The quantitative scores show the severity of any one of these trades in a country's maritime space, but the scorecards also highlight several discrete problems that are specific to particular countries or sub-regions.

Wildlife

The final issue area analyzed, wildlife trafficking, covers poaching of protected species and illicit transfers of animals (e.g., exotic pets) as well as animal products (e.g., ivory and pelts) acquired through illegal means.

Though the illegal trade in rhinoceros and elephant ivory is the most publicized outside of Africa, our assessment also includes lesser-known issues like the poaching of abalone in southern Africa and of pangolins in central and western Africa.

Each of the areas is evaluated with two rubrics. Specific sources are listed on the country scorecards.

Question 1: The Presence of an Illicit Trade in a Country

0: We could find no credible evidence that this occurs here.

1: We could find limited reporting on this, possibly indicating this is a minor problem.

2: There is some evidence that this is a significant problem, but it is far from universally accepted as a major problem.

3: There is widespread acceptance that this is a significant and uncontained problem.

4: This country is nearly universally recognized as a global hotspot for this activity and the severity of the problem is substantially worse than it is in most other countries.

Question 2: The Extent to Which This Trade is a Maritime Problem

0: We could find no credible evidence that this occurs in the maritime space. Goods are moved almost exclusively by land or air.

1: Goods are mostly moved by land or air, with minor sea-based transit.

2: There is significant movement of goods by land, air, and sea.

3: Most known illicit traffic moves by sea, with limited reporting of land or air routes.

4: This country is recognized as a major shipping hub for this illicit product and nearly all known transit of this good is by sea.

As this is a score of maritime illicit trade, we scale the first question using the second. In this way, a state that has a significant land-based trafficking problem will not be penalized to the same extent as a country with a significant sea-based trafficking problem. Land-based problems are relevant because routes often shift and land or air traffic can make a maritime space more vulnerable to the emergence or expansion of sea-based traffic. Our primary objective is to focus on the most severe sea-based trades in the present, though land or air trafficking means there is a higher risk for a rapid shift to maritime trafficking than there is in countries without these routes. We accomplish this with the following formula, where P is the response to Question 1 and M is the response to Question 2:

$$\text{Trade Score} = (P + M*P) / 20$$

If a country is coded as a global leader in a trade ($P = 4$) and that trade is nearly exclusively sea-based ($M = 4$), the numerator will equal 20 and the country will receive the maximum score of 1. This score is sharply reduced if the problem is mostly ($M = 1$, score = 8) or exclusively ($M = 0$, score = 4) land- or air-based.

Breadth of Trade Component

We evaluate the breadth and severity of maritime illicit trades by summing a country's score for each of the seven goods and then dividing that sum by seven. Countries with many severe and sea-based trades will receive much higher scores than those that have fewer trades or more land or air activity.

Depth of Trade Component

A drawback of the breadth score is that it overlooks countries that may not be involved in many trades but which are a global hotspot for a specific good like cocaine or opiates. Accordingly, we create an additional indicator for a country's most severe illicit maritime trade by recording the worst score. This is calculated simply as the maximum of the seven scores for each illicit trade.

Calculating the Illicit Trades Score

Finally, we create the final score from these components.

Illicit Trade Variables in the Data File

IT_FINAL	Illicit Trades Score
IT_WORST	Worst Trade Score
IT_SUM	Sum of All Trade Scores
IT_MAR	Average of Maritime Activity Scores
IT_ARMS_T	Country-wide Trade in Arms
IT_ARMS_M	Maritime Arms Trade Score
IT_ARMS	Total Arms Trade Score
IT_CAN_T	Country-wide Trade in Cannabis
IT_CAN_M	Maritime Cannabis Trade Score
IT_CAN	Total Cannabis Trade Score
IT_COC_T	Country-wide Trade in Coca
IT_COC_M	Maritime Coca Trade Score
IT_COC	Total Coca Trade Score
IT_OPI_T	Country-wide Trade in Opiates
IT_OPI_M	Maritime Opiates Trade Score
IT_OPI	Total Opiates Trade Score
IT_SYN_T	Country-wide Trade in Synthetic Drugs
IT_SYN_M	Maritime Synthetic Drugs Trade Score
IT_SYN	Total Synthetic Drugs Trade Score
IT_WILD_T	Country-wide Trade in Wildlife Products
IT_WILD_M	Maritime Wildlife Products Trade Score
IT_WILD	Total Wildlife Products Trade Score
IT_CONTRA1_T	Country-wide Trade in Contraband #1
IT_CONTRA1_M	Maritime Contraband #1 Trade Score

IT_CONTRA1	Total Contraband #1 Trade Score
IT_CONTRA2_T	Country-wide Trade in Contraband #2
IT_CONTRA2_M	Maritime Contraband #2 Trade Score
IT_CONTRA2	Total Contraband #2 Trade Score
IT_CONTRA3_T	Country-wide Trade in Contraband #3
IT_CONTRA3_M	Maritime Contraband #3 Trade Score
IT_CONTRA3	Total Contraband #3 Trade Score

Greater numbers of trades indicate deeper and more entrenched transnational criminal networks with deeper connections to more corners of the global illicit economy, so the Breadth Component is weighted at ⅔ and the Depth Component is weighted at ⅓. To align this score with the others, which are coded so that high values represent better maritime security situations, we multiply this value by 100 and then subtract it from 100. Consequently, countries with high scores have the least-significant maritime illicit trades and countries with low scores are major shipping hubs for several illicit goods.

Illicit Trades Score = 100 - 100*(Breadth*⅔ + Depth*⅓)

X. MARITIME MIXED MIGRATION

Mixed migration is a complex and rapidly evolving issue, and this complicates efforts to measure it even where some data on migration, trafficking, and human smuggling are available. Our effort to measure mixed migration focuses less on raw numbers of people involved in some aspect of mixed migration and more on the variety of activities known to occur in each country, the role of the sea in these activities, each country's international and domestic legal efforts, and a population's baseline vulnerability to exploitation based on relevant socioeconomic factors. We adopt a definition of mixed migration from the International Organization for Migration, which uses the following:[45]

---

45   See the full document at https://www.iom.int/files/live/sites/iom/files/Country/docs/Mixed-Migration-HOA.pdf.

Table 9 Components of the Mixed Maritime Migration Score

Component	Justification	Measurement Strategy
MARITIME TRAFFICKING	Where more sea-based trafficking activities occur, maritime mixed migration is a more substantial problem.	We develop an original indicator of these activities and weight the indicator by mentions of maritime routes or industries.
MARITIME TRANSIT	Countries with large outflows of migrants and established sea routes are much more likely to host human smuggling and trafficking networks.	We use refugee rates and weight these by the prevalence of maritime routes in each country.
LEGAL PROTECTIONS	International and domestic legal efforts help protect migrants and victims of forced labor or sex trafficking.	We adopt domestic legislation indicators from the U.S. Department of State's Trafficking in Persons report and score participation in seven global agreements.
SOCIOECONOMIC VULNERABILITY	Socioeconomic characteristics can make some populations more vulnerable to forced work and trafficking, including low levels of education, weak political rights, and endemic poverty.	We combine primary-education completion rates and a slavery vulnerability index to capture a population's vulnerability to forced labor and human trafficking.

"The principal characteristics of mixed migration flows include the irregular nature of and the multiplicity of factors driving such movements, and the differentiated needs and profiles of the persons involved. Mixed flows have been defined as 'complex population movements including refugees, asylum seekers, economic migrants and other migrants.' Unaccompanied minors, environmental migrants, smuggled persons, victims of trafficking and stranded migrants, among others, may also form part of a mixed flow."

We measure the Mixed Maritime Migration Score with four equally weighted components: Maritime Trafficking, Maritime Transit, Legal Protections, and Socioeconomic Vulnerability.

Maritime Trafficking Component

The first component captures the severity of human trafficking in each country, as well as the extent to which problems occur in a country's maritime space. We accomplish this by scoring the severity and breadth of forced labor and sex trafficking and the role of the country as an international "transit hub" for smuggled and trafficked persons and then weighting these scores according to whether they occur exclusively, predominantly, or rarely at sea.

The following describes these three indicators in greater detail.

Types of Trafficking

Rather than rely on inconsistent estimates of the number of victims, we account for the diversity in the types of trafficking occurring in a given country. More specifically, we use the 2017 Trafficking in Persons Report (TiP) from the United States Department of State to create eight scores corresponding to the two types of trafficking (sex and forced labor) across four populations: men, women, boys, and girls. If these country reports elaborate on a specific form of trafficking against a specific population (e.g., sex trafficking of girls, boys trafficked for forced labor, etc.), then we code this as a significant activity. Three coders worked independently to code these data according to the following rubric:

0: This activity/population was not mentioned in the 2017 TiP report.

1: This activity/population was mentioned but was either briefly mentioned or was qualified as a relatively minor or poorly understood problem.

2: This activity/population was mentioned and the activity was emphasized as a significant problem.

After initial coding, the coders resolved the few differences by meeting and reviewing sources. The coders found that very small differences in sentence structure could result in a disagreement between a 0 and 1, so we only code activities that are discussed enough to warrant a score of 2 in the above rubric. This score is the share of the eight scores for which a country received a score of 2. For example, a country with a profile that discusses, to the degree of a 2 score, forced labor affecting men and boys, forced domestic servitude for women and girls, and sex trafficking of children (boys and girls) would receive a score of 6/8, or 0.75.

Possible scores range from 0 (no discussion of any kind of trafficking) to 8 (significant numbers of men, women, girls, and boys are victims of both sex trafficking and forced labor). We divide this score by 8 to set all scores within the 0 to 1 interval. The only state in the Stable Seas Maritime Security Index that is not included in the Trafficking in Persons report is São Tomé and Príncipe. We set São Tomé and Príncipe's value to the regional mean.

Transit Countries

Migrants and other vulnerable populations are most likely to be subjected to a form of trafficking in the countries recognized as crucial transit hubs in the Trafficking in Persons report. Countries are classified as "transit countries" when international migrants commonly pass through in their journeys to be smuggled to other countries. For example, Libya is an important transit country for migrants making their way from West Africa to Europe via the Mediterranean routes. This variable is coded 0 (not named as a transit hub) or 1.

Maritime Activities

The Trafficking in Persons report does not systematically report on maritime activities, so we broadened our search to find resources that could describe where these trafficking activities occur. We then created an original four-value scale:

0: We could find no evidence that this country's trafficking activities are occurring at sea or in maritime industries.

1: We could find some mention of maritime activities, such as forced labor in the fishing industry or sex trafficking in port facilities, but this issue is poorly understood and the available evidence is weak.

2: This is a well-documented activity occurring at sea or in service of maritime industries in this country.

3: All available evidence suggests forced labor, sex trafficking, and the transit of trafficked persons are occurring nearly exclusively at sea or in maritime industries.

We divide this outcome by 3 to obtain a score that ranges from 0 to 1. Our supplementary materials provide sources and scorecards for all countries.

Calculating the Maritime Trafficking Component

Finally, we calculate the Maritime Trafficking Component using the same methodology described for the Illicit Trades section with the following formula where A is the Types score, B is the Transit score, and C is the Maritime score:

$$\text{Maritime Trafficking} = (A+B)*(1+C) / 4$$

First, we sum the types and transit scores so that countries with extensive forced labor, sex trafficking, and international transit of persons receive a maximum of 2, while countries with no known problems receive the minimum of 0. This is captured by the term $(A+B)$ in the above formula.

Second, just as land-based problems are relevant to illicit trades in goods due to the potential for shifting routes and smuggling networks, these problems are relevant here even if maritime activities are minimal at present. We capture this with the second term, $(1+C)$. If there is no known maritime activity, a country's Types/Transit

score is unchanged by this term. However, if there is good evidence of existing maritime activity, the score increases with the strength of the evidence for maritime transit and trafficking. Note that the maximum score of 4 would only apply to an international mixed-migration transit-hub country (B = 1) with severe forced labor and sex trafficking affecting men, boys, girls, and women (A = 1) that occurs nearly exclusively in the maritime domain (C = 1).

As a final step, we divide this product by 4 so that the score will range from 0 (no known problems, no maritime problems) to 1 (severe trafficking of every kind concentrated in the maritime space).

Because these scores focus on maritime activity, they will not always align with other reports that focus on onshore smuggling, trafficking, internally displaced persons, and refugees. The Democratic Republic of the Congo, for example, has well-known challenges in these areas; however, there is very little maritime smuggling and trafficking due to the coastal area of the country being small, remote, and very far from the humanitarian challenges occurring in the distant eastern part of the country.

Maritime Transit Component

Whereas the Maritime Trafficking Score aims to capture the extent of trafficking at sea, the Maritime Transit Component focuses on the movement of people in the maritime space, rather than their exploitation. Many persons who are not being trafficked transit by sea as they pay smugglers to take them to their destinations. We approximate the extent of this kind of maritime transit by considering a country's refugee rate and the prevalence of maritime routes relative to routes by land or air.

UNHCR Refugee Rate

We use data from the United Nations High Commissioner for Refugees (UNHCR) to calculate a logged per capita refugee rate. The score is higher when a greater share of a country's population has sought refugee status in another country in the last year. The rate is calculated as

the logged refugee rate (refugees per million) divided by the log of 100,000. This gives us a score ranging from 0 (no refugees) to 1 (10 percent of the population). This is a reasonable benchmark because it approximates the region's observed maximum.[46]

$$\text{Refugee Rate} = \ln(\text{Refugees}/(\text{Population in Millions})+1) / \ln(100000+1)$$

Maritime Transit Weight

Accurately and consistently calculating the number of people crossing a specific maritime route is impossible due to the inherently evasive nature of smuggling and other forms of mixed migration. However, we can create a proxy measure by using a country's refugee rate (described above) and an assessment of whether most migration from a country occurs by land (as in the Democratic Republic of the Congo) or by sea (as in Comoros). We code each country on a four-point scale ranging from 0 (exclusively land-based transit) to 3 (exclusively maritime transit) with the following rubric:

> *0: We could find no evidence that persons transiting this space move by sea; land and air routes are much more likely.*
>
> *1: We could find some mention of maritime routes, but most move from or through this country by land or air.*
>
> *2: Maritime routes are well-documented and mixed migration occurs by sea in addition to significant land and air routes.*
>
> *3: This country is a major regional or global hub for maritime mixed migration and sea-based routes are more commonly used than land or air routes.*

We divide this score by 3 to achieve a 0 to 1 interval before calculating the final Maritime Transit Component. Using the same methodology we use to create the Maritime Trafficking Component, we derive the Maritime Transit Component from the following formula:

$$\text{Maritime Transit Component} = \{(\text{Refugee Rate})*(1+\text{Maritime Weight})\} / 2$$

---

46   Data are available for download at http://data.un.org/Data.aspx?d=UNHCR&f=indID%3AType-Ref.

The result is a metric that ranges from 1, which is earned only by countries with very high numbers of refugees and predominantly sea-based routes, to 0, which is earned only by countries with minimal refugee populations and minimal transit through the maritime domain.

Legal Protections Components

The legal protections portion of the score is comprised of an international agreements indicator and a domestic legislation indicator. These indicators are averaged to create a single component for this section.

International Agreements

As in the International Cooperation section, we identify relevant agreements, code whether states have signed or ratified them, and then transform them so that states earn 0 if they have not signed, 0.33 if they have signed but not ratified, and 1 if they have both signed and ratified. This score examines seven agreements. Scores are summed and divided by 7 to arrive at a value from 0 to 1.

The seven agreements are:

- The Office of the United Nations High Commissioner for Human Rights Optional Protocol to the Convention on the Rights of the Child on the sale of children, child prostitution and child pornography
- The Office of the United Nations High Commissioner for Human Rights Optional Protocol to the Convention on the Rights of the Child on the involvement of children in armed conflict
- The International Labour Organization Forced Labour Convention of 1930
- The International Labour Organization Abolition of Forced Labour Convention of 1957
- The International Labour Organization Worst Forms of Child Labour Convention of 1999
- The International Labour Organization Domestic Workers Convention of 2011
- The International Labour Organization Work in Fishing Convention of 2007

Domestic Legislation

The domestic portion of the score is adapted from the "3P Anti-trafficking Policy Index" by Seo-Young Cho.[47] This index uses the Trafficking in Persons report to annually score a state's legal efforts in the areas of prosecuting traffickers, protecting potential victims, and preventing trafficking networks. The most recent version of these data, from 2015, are coded on a scale of 0 to 15 (5 possible points per "p"). We divide these scores by 15 to rescale the score from 0 to 1, with 1 indicating the country has the ideal package of domestic legislation to support victims of human trafficking.

Finally, we calculate the Legal Protections Component as the average of Domestic Legislation and International Agreements.

Socioeconomic Vulnerability Component

Finally, populations are more vulnerable to trafficking where political systems are ineffective, human capital is low, and socioeconomic conditions are poor. We operationalize a population's vulnerability with two indicators: the primary-school completion rate as recorded by the World Bank, and the Vulnerability to Slavery score calculated by the Walk Free Foundation as part of its Global Slavery Index. Both indicators are transformed before they are averaged into the Socioeconomic Vulnerability Component.

Primary Education

These data, derived from the World Bank, record the primary-school completion rate in each country in 2016. We eliminate the influence of extreme outliers and rescale to be between 0 and 1 by setting 50 percent as the minimum threshold and then subtracting 0.02 from 1 for each percent of the population failing to complete primary school. For example, a country with a 75 percent completion rate will receive 0.50 points (25*0.02) and a country with a 90 percent completion rate will receive 0.80 (10*0.02).

---

47   Data are available for download at http://www.economics-human-trafficking.org/anti-trafficking-3p.html. As with all resources linked to the Trafficking in Persons report, Sao Tome and Principe is missing. We imputed using regional averages.

Global Slavery Index Vulnerability Indicators

The Walk Free Foundation assesses a population's vulnerability to slavery with an index that includes 24 political, economic, and demographic statistics.[48]

This indicator ostensibly ranges from 0 to 100, but in practice 65 is an appropriate high benchmark as the only states to eclipse that number are among the world's most dangerous places for vulnerable populations. Somalia (67.1) and the Democratic Republic of the Congo (68.5) were the only countries above this threshold in the latest version of the Global Slavery Index. Nigeria, plagued by Boko Haram and child sex-trafficking, scores a 62.3. To convert to a scale of 0 to 1, we divide each country's score by 65 and set any country with a score above 65 at the maximum value of 1. We impute missing values using the regional average.

Finally, the rescaled Primary Education and Global Slavery Index Vulnerability indicators are averaged to create a single Socioeconomic Vulnerability Component that varies from 0 (least vulnerable) to 1 (most vulnerable). To do this, we first reversed the direction of the Primary Education measure so that a higher score would indicate a higher level of vulnerability.

Calculating the Maritime Mixed Migration Score

We calculate the Maritime Mixed Migration Score as the average of the Maritime Activity, Maritime Transit, Legal Protections, and Socioeconomic Vulnerability Components. Because the other components of the Maritime Mixed Migration Score are coded so that higher scores represent more severe problems, we reverse the direction of the Legal Protections score before combining it with the others. In the final score, countries with low scores have the weakest legal protections, the most vulnerable populations, and the greatest existing challenges related to maritime mixed migration, smuggling, and trafficking at sea. High scores represent less vulnerability and less maritime activity, as well as stronger domestic and international legal efforts.

Maritime Mixed Migration Variables in the Data File

MMM_FINAL	Maritime Mixed Migration Score
MMM_FORMS	Maritime Trafficking Score
MMM_MAR_ACT	Maritime Trafficking Activity Weight
MMM_TIP_TRANSIT	Transit Country Indicator
MMM_ACTIVITY	Maritime Activity Component
MMM_REFUGEE	Logged Per Capita Refugee Rate
MMM_MAR_TRANS	Maritime Transit Weight
MMM_TRANS_TOT	Maritime Transit Component
MMM_EDUC	Primary Education Rate (World Bank)
MMM_WFF	Walk Free Foundation Vulnerability Score
MMM_VULN	Vulnerability Component
MMM_DOMESTIC	Rescaled Domestic Efforts Indicator
MMM_INTLAW	Rescaled International Legal Indicator
MMM_LEGAL	Final Legal Efforts Component

---

48   More information about their methodology can be found at globalslaveryindex.org/methodology/.

Stable Seas Maritime Security Index Codebook | 35