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# Major Emitters Among Hardest Hit by Ocean Acidification

## An Analysis of the Impacts of Acidification on the Countries of the World

### Introduction

Billions of tons of carbon dioxide are pumped into the atmosphere every year, predominantly from the burning of fossil fuels such as coal and oil. The oceans provide a great service by absorbing almost a third of these emissions,<sup>1</sup> thus lessening the impact of climate change.<sup>2</sup> However, the massive amount of carbon dioxide entering the oceans is dramatically altering seawater chemistry, which has been stable for millions of years,<sup>3</sup> and has allowed the oceans to flourish and evolve into the diverse, life-giving waters we know and rely upon today.

As carbon dioxide is absorbed by the oceans they become more acidic. This higher acidity disrupts marine organisms' abilities to grow, reproduce, respire, and complete other important biological and physiological functions, as well as to fight off disease and predators.<sup>4</sup> Disruptions in the way animals live and function could result in ripple effects through food webs and ecosystems, which will result in drastic changes throughout the world's oceans<sup>5</sup> – changes that will affect the economic health and prosperity of many nations that are dependent on reefs for food, coastal protection and revenues from tourism and fisheries.

One of the impacts of rising ocean acidity is a decrease in the availability of carbonate ions – a vital building block in calcium carbonate shells and skeletons. As these building blocks become more scarce, corals, pteropods, some plankton, urchins, oysters, clams and mussels will all have more difficulty creating their shells and skeletons. If the availability of carbonate ions drops further below a certain threshold, calcium carbonate structures will then dissolve.<sup>6</sup>

This is not just a possible scenario for the far-off future. The oceans are already thirty percent more acidic than they were prior to the industrial revolution.<sup>7</sup> As a result some marine animals that use calcium carbonate to build their shells and skeletons are already having difficulty carrying out this critical process.<sup>8</sup> In fact, scientists have predicted a likely mass extinction of corals by the middle to end of this century as a result of carbon dioxide emissions.<sup>9</sup>

The loss of coral reefs and other marine calcifiers would be felt throughout the oceans. Corals provide habitat to a quarter of all species in the oceans and are critical to the lives and livelihoods of hundreds of millions of people.<sup>10</sup> Coral reefs not only offer spawning, nursery, feeding and resting grounds to many commercially important species, they also provide protection to coastlines from storm surges, tsunamis, and erosion.<sup>11</sup> It has been estimated that coral reefs provide some 30 billion dollars annually to the global economy through coastal protection, tourism, fishing and other goods and services.<sup>12</sup> As ocean acidity increases, these critical benefits provided for free by coral reefs are at stake.

Many of the areas where acidification is predicted to be most severe within the coming century are highly productive and support some of the world's most important commercial fisheries.<sup>13</sup> These fisheries are likely to be threatened by ocean acidification either directly, through biological and physiological changes resulting from increased acidity, or indirectly through changes in habitat and food availability. Besides fish, many shellfish economies will also be in economic danger.<sup>14</sup>

As ocean acidification worsens and coral reefs and fisheries begin to collapse, many nations will suffer increased economic and food security threats. Nations with large coral reef areas, or that catch and consume large amounts of fish and shellfish, and those located at higher latitudes are likely to be most vulnerable to ocean acidification.

This analysis evaluated the likely vulnerability of different countries to continued ocean acidification based on the magnitude of their fish and shellfish catch, their level of seafood consumption, the percentage of coral reefs within their exclusive economic zones (EEZ) and the projected level of ocean acidification in their coastal waters in 2050.<sup>1</sup>

<sup>1</sup> The term "acidification" refers to the shifting of the ocean's pH towards the acidic side of the pH scale (below 7), not whether or not it reaches it. The terms "highly acidified" and "extremely acidified" denote the magnitude of this shift, with the consequence that carbonate ions in these waters are becoming more scarce as they shift towards under-saturation. Extremely acidified waters have lower levels of carbonate ions than highly acidified waters.

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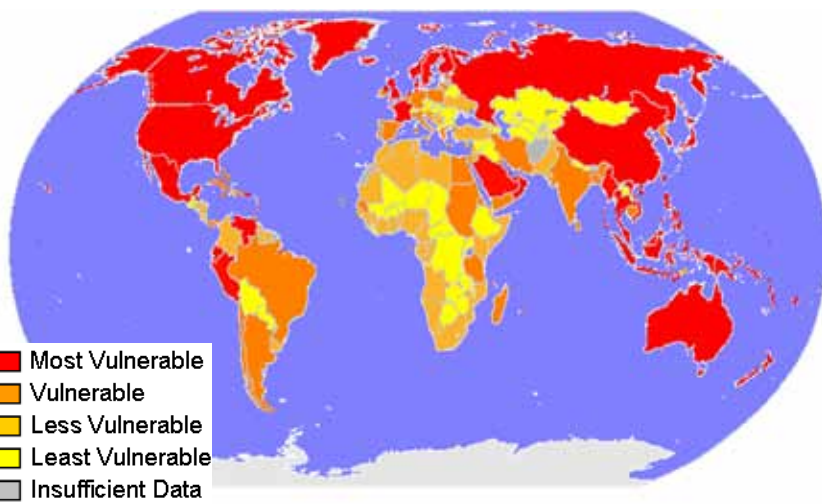
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## Summary of Key Findings

The results of this Oceana analysis challenge the common assumption that developed nations will be insulated from the effects of climate change, as evidenced by the following findings:

- More than a third of the world's population will be strongly affected by acidification. The 25 most vulnerable nations alone account for more than 37 percent of the global population.
- The world's largest carbon dioxide emitters are likely to be among those countries most affected by acidification.
- Impacts of climate change are not limited to either the tropics or the poles -- ocean acidification is a threat to all nations that catch or eat fish, or depend on coral reefs for tourism, storm protection or food.



## Summary of Country Rankings

- Six of the ten largest carbon dioxide emitters are among the 25 nations most vulnerable to ocean acidification, including China, the United States, Japan, Canada, the United Kingdom, and the Republic of Korea. These six nations alone were responsible for 51% of carbon dioxide emissions in 2007.
- Japan ranks as the most vulnerable nation to the impacts of ocean acidification out of the 187 nations considered. This is due to Japan's high levels of fish consumption and fish catch combined with its considerable coral reef coverage and the highly acidified ocean waters expected later in the century.
- France ranked second due to its high level of fish consumption, the large fish catch within its EEZ, the area of its coral reefs as a percentage of its EEZ and the extremely acidified water along its coast.
- The United Kingdom ranked third due, in large part, to its high catch within its EEZ and extremely acidified water along its coast in 2050.
- The Netherlands ranked fourth due to its extremely acidified waters by 2050 and its rank in the top quarter of nations for both coral reef area and fish catch within the EEZ.
- Australia rounded out the top five most vulnerable nations due to its large area of coral reefs and highly acidified waters.
- The first and second highest carbon dioxide emitting nations, China and the United States, ranked 13th and 8th, respectively, in terms of vulnerability to ocean acidification.

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## Results

This study evaluated the likely vulnerability of different countries to continued ocean acidification based on four criteria. These include: 1) Their fish and shellfish catch, 2) their consumption of seafood per capita, 3) the importance of coral reefs within their exclusive economic zones (EEZ) expressed as the percentage of the EEZ and 4) the projected level of ocean acidification in their coastal waters in 2050 (based on aragonite saturation states).

### Major Emitters and Major Economies Among the Top 25 Most Vulnerable Nations To Acidification

Acidification Vulnerability Rank	Country	Carbon Dioxide Emissions Rank	GDP Rank
1	Japan	5	2
2	France*	16	6
3	United Kingdom*	8	5
4	Netherlands*	24	16
5	Australia	12	14
6	New Zealand*	65	53
7	Philippines, Republic of the	45	47
8	United States*	2	1
8	Malaysia	31	41
10	Indonesia, Republic of	20	22
11	Taiwan, Province of China	21	23
12	Thailand, Kingdom of	25	35
13	China	1	4
14	Iceland	134	94
15	Mexico	13	15
16	Norway	66	25
17	Greenland	180	152
18	Korea, Republic of	9	13
18	United Arab Emirates	28	38
20	Vietnam, Socialist Republic of	44	60
21	Singapore, Republic of	32	45
22	Canada	7	9
23	Belize	170	158
24	Papua New Guinea	126	133
25	Maldives, Republic of	173	161

\* Territories were included for assessing coral reef area as percent of EEZ. See note on page 11.

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**Based on this analysis, Japan is the most vulnerable nation to the impacts of ocean acidification.** Japan is among the ten largest consumers of fish and also is one of the top ten countries catching fish and shellfish within its EEZ. Japan also has the 32nd largest percentage of coral reef area in the world, and its northern latitude places it in a zone where low aragonite saturation could cause great difficulty for species affected by highly acidified waters.<sup>ii</sup>



**France ranked second in this analysis due to its high vulnerability in each category considered.** France has the 29th largest catch within its EEZ and is the 33rd largest per capita consumer of fish. Its coral reef area is the 53rd largest as percent of EEZ and by 2050 its extremely acidified waters.



**The United Kingdom ranks as the third most vulnerable to ocean acidification.** This is due in large part to its having the 10th largest fishery catch within its EEZ and, like France, having extremely acidified waters 2050. The U.K.'s consumption of fish per capita and area of coral reef as percentage of EEZ were ranked 56th and 58th largest, respectively.



**The Netherlands ranked as the fourth most vulnerable nation to ocean acidification.** The Netherlands has a high potential for extremely acidified waters by 2050 and it also has large coral reef areas (due to its overseas territories) and high fish catches. The Netherlands is also ranked within the top third of all nations based on fish consumption.



**Australia rounded out the top five most vulnerable nations.** Australia is vulnerable to ocean acidification due to its large area of coral reefs (28th largest in the world) and highly acidified waters. Both its fish catch and consumption levels ranked within the third highest of all nations.



**The United States ranked eighth.** The world's second largest emitter of carbon dioxide and the highest historical emitter, the United States tied with Malaysia as the eighth most vulnerable to ocean acidification.



**China ranks thirteenth.** China, which is currently the largest carbon dioxide emitter in the world, ranked 13th in terms of vulnerability to ocean acidification, out of a total of 187 countries ranked.



<sup>ii</sup> It should be noted that it is unlikely that ocean waters will ever become actual acid. The term "acidification" refers to the shifting of the ocean's pH towards the acidic side of the pH scale (below 7), not whether or not it reaches it. The terms "highly acidified" and "extremely acidified" denote the magnitude of this shift, with the consequence that carbonate ions in these waters are becoming scarcer as they shift towards undersaturation. Extremely acidified waters have lower levels of carbonate ions than highly acidified waters.

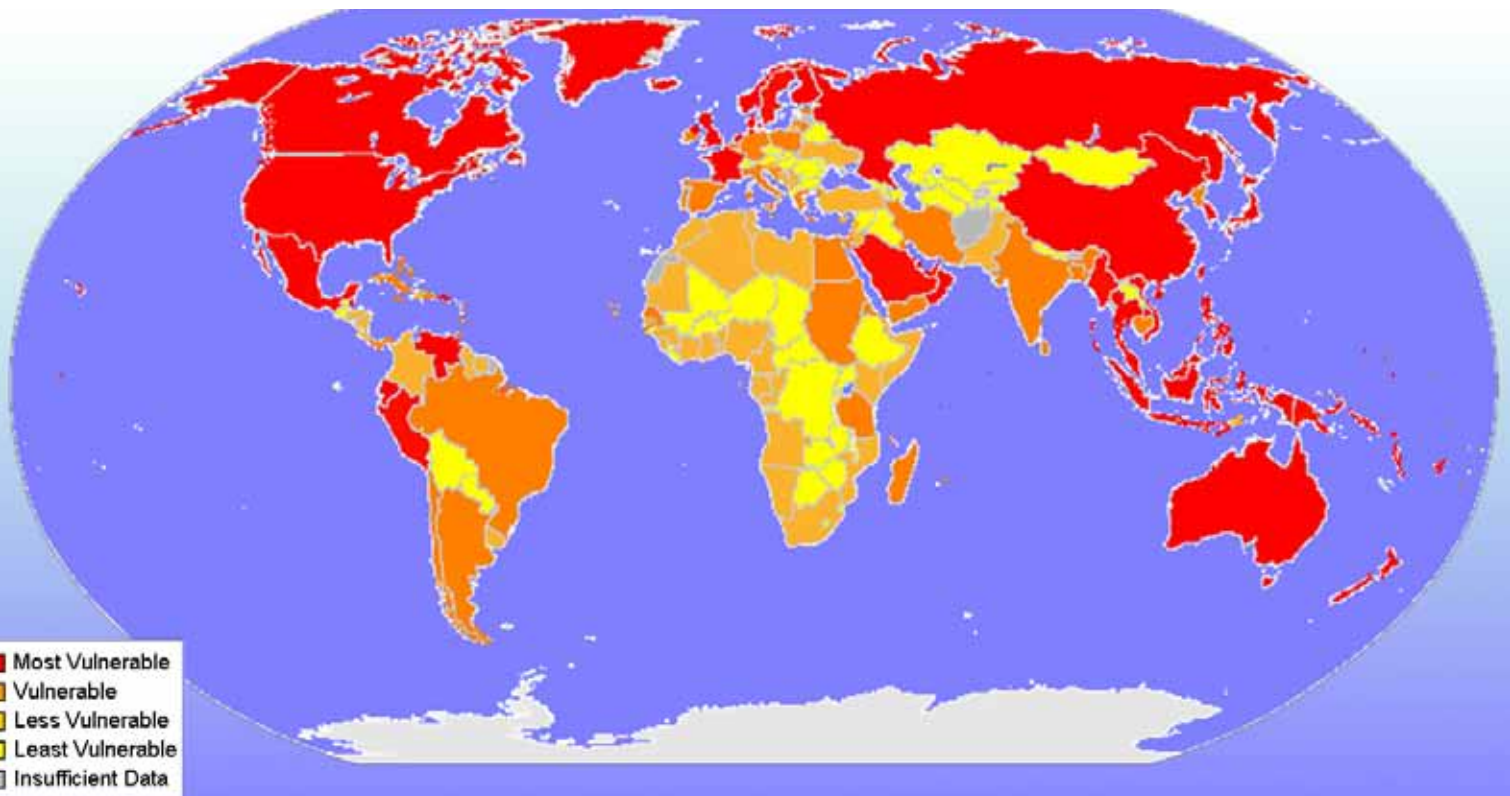
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**Much of the global population resides in nations that are likely to be hit hardest by the increasing acidity of the ocean.** The 25 most vulnerable nations identified in this analysis account for just over 37 percent of the global population.

**Six of the ten largest CO2 emitters are among the 25 nations most vulnerable to ocean acidification.** These include China, the United States, Japan, Canada, United Kingdom, and the Republic of Korea. These six nations alone were responsible for 51% of carbon dioxide emissions in 2007. These nations are thus not only among the most vulnerable to ocean acidification, they are also among the most responsible for causing it and most able to stop it.

**Six of the world's ten largest economies are also represented among the 25 most vulnerable nations, including the United States, Japan, China, the United Kingdom, France, and Canada.** As some of the world's richest nations, these countries are essential to the success of emissions reductions and are also most able to assist less developed nations make the transition to clean, carbon-free energy systems. Choosing to halt ocean acidification and climate change will be less expensive and less damaging to national and global economies than allowing these threats to continue unchecked.<sup>15</sup>

**Of the ten most vulnerable nations, seven are Annex I nations.** These include Japan, France, the United Kingdom, the Netherlands, Australia, New Zealand, and the United States. These countries are deemed the best equipped to mitigate climate change, and actions in these countries, among others, are necessary to prevent ocean acidification.



## Most Vulnerable to Least Vulnerable Nations to Ocean Acidification

Ranked nations were placed in the four categories of Most Vulnerable (red), Vulnerable (deep orange), Less Vulnerable (orange), and Least Vulnerable (yellow). Each category represents a quarter of the nations studied, hence the “Most Vulnerable” counties are those that fell in the top 25 percent.

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## Criteria for Determining Vulnerability

Four different variables were evaluated for the 187 nations for which information was available. These variables were weighted equally and ranked largest to smallest. The sum of the four variables was calculated for each nation. Those with the highest total were considered most vulnerable to ocean acidification.

### Coral Reef Area as Percentage of EEZ

Coral reefs provide important resources and services to nations that have them within their EEZs, including habitat for important fisheries, coastal protection, food and other resources for subsistence, and tourism. Each of these goods and services that is provided for free by coral reefs translates to economic benefits such as income from fisheries and/or tourism, a source of food, and protection for coastal infrastructure. Those nations that have large areas of coral reefs within their EEZs are vulnerable to the loss of these economic benefits as ocean acidification worsens. The territorial regions of France, U.K., U.S.A., New Zealand and the Netherlands were included in this indicator as they provide important coral reef resource for these nations. For this analysis, the area of a country's coral reefs<sup>16</sup> was normalized as a percentage of EEZ,<sup>17</sup> to provide a clearer indication of the degree to which a country depends on its reefs. Doing so also made comparison between large and small countries more effective.

### Total Catch within EEZ

Both domestic and foreign catch within a nation's EEZ<sup>18</sup> provide important food resources and economic revenue. Since increasing ocean acidity threatens the viability of fish and shellfish stocks both directly and indirectly, it may cause population collapses of important species. As a result, nations with large catches within their EEZ's are more vulnerable to economic disruption due to the fishery-related impacts of ocean acidification. Catch within the EEZ includes all fish caught in a country's EEZ whether they are caught by domestic or foreign fleets as we considered both to have economic benefits to the country in question.

### Level of Aragonite Saturation in EEZ in 2050

Aragonite is the form of calcium carbonate that is used by corals, pteropods and other marine calcifiers to create their skeletons and shells. Water that is more acidic has lower levels of aragonite, and is considered less "saturated" meaning that it will be more difficult for marine animals to obtain the materials they need to build their shells and skeletons. Therefore, aragonite saturation,<sup>19</sup> which varies with acidity, is an indication of how easy or difficult it is for species to build their aragonite shells and skeletons. Species in under-saturated, and more acidic, waters are less able to get the materials they need to make their shells and skeletons.

Besides impacts on corals, more acidic waters will also be a threat to fisheries and shellfish fisheries as shellfish use calcium carbonate to build or harden their shells. For fish, food may be less available in under-saturated waters, and respiration and reproduction may be more difficult under more acidic conditions. Nations with more acidic coastal waters will therefore be most at risk of losses of the goods and services provided by coral reefs and impacts to fisheries than those with higher aragonite saturation and less acid waters. The waters of countries in the highest and lowest latitudes are projected to show the largest and earliest declines. It is important to note, however, that by 2050 aragonite saturation is projected to decline to a large degree throughout the entire ocean realm.<sup>20</sup>

### Consumption of Fish Per Capita

Per capita consumption of fish<sup>21</sup> is an indication of how much a nation chooses fish as a protein source. For many, fish consumption is culturally important and intimately tied to people's way of life. As ocean acidification increases, and fisheries are threatened, nations with high fish consumption per capita will be most vulnerable to disruption of their food options, due to the impacts of ocean acidification.

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## Impacts of Ocean Acidification on Fisheries and Fish-Based Diets

There are a variety of ways to view a nation's vulnerability with respect to fishing. One is to look at the degree to which fish provide a commercial economy for the country. Another is to look at the degree to which fish is consumed by its citizens, which includes imported fish caught anywhere in the world. In either case, a high-ranking country will be most vulnerable to the impacts of acidification on either its economy, or its diet. We considered both factors "total catch within the EEZ" and "consumption of fish per capita" in this analysis. Other indicators might include fish caught within the EEZ as well as other parts of the world, or fish as a percentage of protein in the diet. We encourage others to consider other indices of vulnerability and to make similar comparisons of the nations of the world.

Island Nations Top Others for Fish Consumed per Capita (Rank based on kg/capita/year)	
1	Maldives, Republic of
2	Independent State of Western Samoa
3	Iceland
4	Greenland
5	Kiribati
6	Japan
7	Seychelles, Republic of
8	Lithuania
9	Portugal
10	Korea, Republic of
11	Palau, Republic of
12	Malaysia
13	Nauru, Republic of
14	Norway
15	Tonga, Kingdom of
16	Guyana
17	Grenada
18	Malta
19	Barbados
20	Spain
20	Micronesia, Federated States of
22	Tuvalu
23	Dominica, Commonwealth of
24	Gabon
25	Antigua and Barbuda

### Fish Consumption Per Capita

Many island nations rank highest with respect to fish consumption. The Maldives rank first, followed by Western Samoa, with Iceland, Greenland and Kirabati rounding out the top five. Japan and the Seychelles follow, with Lithuania, Portugal and the Republic of Korea completing the top ten.

Asia and South America Depend Heavily on Fisheries (Rank based on Average tonnes caught 2000-2005)	
1	Peru
2	China
3	Japan
4	Indonesia, Republic of
5	Chile
6	Norway
7	United States of America
8	India, Republic of
9	Korea, Republic of
10	United Kingdom
11	Iceland
12	Malaysia
13	Viet Nam, Socialist Republic of
14	Philippines, Republic of the
15	Morocco
16	Denmark
17	Myanmar, Union of
18	Canada
19	Mexico
20	Argentina
21	South Africa
22	Ireland
23	Thailand, Kingdom of
24	Turkey
25	New Zealand

### Fish Catch within the EEZ

With respect to total catch within the EEZ, the countries most affected include many Asian and South American nations. Peru ranks first in fish catch, followed by China, Japan, Indonesia, and Chile. Norway follows in sixth place, followed by the United States, India and Korea, with the United Kingdom rounding out the top ten.

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## Solution

To protect coral reefs from rising carbon dioxide, scientists have determined that atmospheric carbon dioxide levels will need to be stabilized at or below 350 parts per million.<sup>22</sup> To achieve this, the Intergovernmental Panel on Climate Change (IPCC) recommends that global emissions be reduced by at least 85 percent below 2000 levels by 2050.<sup>23</sup> To make this happen Annex 1 nations must reduce their greenhouse gas emissions 25 to 40 percent below 1990 levels by 2020 and 80 to 95 percent below 1990 levels by 2050.<sup>24</sup> To prevent future ocean acidification we need to switch from a trajectory of rapidly increasing carbon dioxide emissions to one in which net emissions have been reduced to nearly zero.<sup>25</sup>

Some alternative measures have been suggested to address ocean acidification, such as adding chemicals to ocean waters to counteract their acidity. But these are at best short-term, local stop-gap measures, which will not prevent ocean acidification on a global scale.<sup>26</sup>

Geoengineering solutions have also been proposed to use the oceans to reduce atmospheric carbon emissions. Some suggestions include iron fertilization and deep ocean sequestration, both of which are likely to exacerbate ocean acidification.<sup>27</sup> Finally, geoengineering schemes aimed at reducing global temperatures without reducing global carbon dioxide emissions, such as seeding the atmosphere with sulfur will do nothing to alleviate rising ocean acidity.<sup>28</sup> Geoengineering programs could wreak havoc on already fragile ecosystems and could cause a host of unintended and unforeseen consequences. These approaches should be viewed with caution and only employed if and when they are proven effective and their impacts on the oceans are understood and known to be negligible. At this time the only truly effective way to stop ocean acidification is to significantly reduce human carbon dioxide emissions.

## Conclusion

All countries are threatened by increasing ocean acidity because their populations either eat or catch and sell fish and shellfish, have a coral reef tourism industry or depend on coral reefs for other goods and services such as coastal protection. Even land-locked countries that consume fish are vulnerable to the threats of ocean acidification. However, some nations are more vulnerable than others. Many of the most vulnerable nations are the largest producers of carbon dioxide – the cause of ocean acidification – and have the greatest ability to stop it from worsening.





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## Appendix 1 - Acidification Vulnerability Rankings, by Country

1	Japan	47	Grenada	95	Latvia	142	Liberia
2	France *	49	Italy	96	Ghana	143	Congo, Democratic Republic of the
3	United Kingdom*	49	Ireland	97	Nicaragua, Republic of	144	Albania
4	Netherlands*	51	Dominica, Commonwealth of	98	Guyana	145	Guinea-Bissau
5	Australia	51	Lithuania	99	Jordan, Hashemite Kingdom of	146	Syrian Arab Republic
6	New Zealand*	53	Chile	100	Colombia	147	Guatemala
7	Philippines, Republic of the	54	Bahamas, Commonwealth of the	100	Gabon	148	Iraq
8	United States of America*	55	Nauru, Republic of	102	Mozambique, Republic of	149	Switzerland
8	Malaysia	56	Independent State of Western Samoa	103	East Timor (Timor Leste)	150	Lao People's Democratic Republic
10	Indonesia, Republic of	56	Panama, Republic of	104	Somali Democratic Republic	151	Austria
11	Taiwan, Province of China	58	Mauritius, Republic of	105	Namibia	152	Belarus
12	Thailand, Kingdom of	59	Greece	106	Angola	153	Czech Republic
13	China	60	Cambodia	107	Costa Rica, Republic of	154	Bulgaria
14	Iceland	61	Kuwait, State of	108	Morocco	155	Romania
15	Mexico	62	Marshall Islands, Republic of the	109	El Salvador	156	Mali
16	Norway	62	Sri Lanka, Democratic Socialist Republic of	110	Gambia	157	Uganda
17	Greenland	64	Saint Kitts and Nevis	111	South Africa	157	Slovakia
18	United Arab Emirates	65	Iran, Islamic Republic of	112	Djibouti, Republic of	159	Moldova, Republic of
18	Korea, Republic of	65	Bangladesh, Peoples Republic of	112	Malta	160	Chad
20	Viet Nam, Socialist Republic of	67	Madagascar, Republic of	114	Haiti, Republic of	161	Zambia
21	Singapore, Republic of	67	Tonga, Kingdom of	115	Kenya, Republic of	162	Swaziland
22	Canada	67	Germany	116	Mauritania	163	Hungary
23	Belize	70	Estonia	117	Turkey	164	Georgia
24	Papua New Guinea	71	Cuba, Republic of	118	Sierra Leone	165	Paraguay
25	Maldives, Republic of	71	Argentina	119	Cyprus	165	Botswana
26	Fiji, Republic of	73	Antigua and Barbuda	120	Tunisia	167	Macedonia, Republic of
27	Myanmar, Union of	74	Sudan, Republic of the	121	Cape Verde	168	Kazakhstan
28	Kiribati	75	Tuvalu	122	Suriname	168	Central African Republic
29	Seychelles, Republic of	76	Tanzania, United Republic of	123	Cameroon	170	Malawi
30	Sweden	76	Jamaica	124	Nigeria	171	Turkmenistan
31	Peru	78	India, Republic of	125	Cote d'Ivoire	172	Bolivia
32	Saudi Arabia, Kingdom of	79	Spain	126	Slovenia	173	Burkina Faso
32	Denmark	80	Egypt, Arab Republic of	127	Congo Rep	174	Zimbabwe
34	Solomon Islands	80	Portugal	128	Equatorial Guinea	174	Nepal
35	Bahrain, State of	82	Comoros, Islamic Federal Republic of	129	Honduras, Republic of	174	Burundi
36	Russian Federation	82	Barbados	130	Uruguay	177	Armenia
37	Oman, Sultanate of	84	Brazil, Federative Republic of	131	Serbia and Montenegro	178	Rwanda
38	Brunei Darussalam	85	Israel, State of	132	Bosnia and Herzegovina	178	Kyrgyzstan
39	Vanuatu, Republic of	86	Yemen, Republic of	133	Pakistan	178	Azerbaijan
39	Micronesia, Federated States of	87	Poland	134	Sao Tome & Principe	181	Palestinian Territories
41	Venezuela, Republic of	88	Senegal	134	Togo	182	Niger
42	Saint Lucia	89	Croatia	136	Lebanon	183	Mongolia
42	Ecuador, Republic of	90	Korea, Democratic People's Republic of	137	Algeria	184	Uzbekistan
44	Finland	90	Belgium	138	Libyan Arab Jamahiriya	185	Ethiopia
45	Palau, Republic of	92	Saint Vincent and the Grenadines	138	Ukraine	186	Tajikistan
46	Qatar, State of	93	Dominican Republic	140	Benin	187	Lesotho
47	Eritrea	93	Trinidad and Tobago, Republic of	141	Guinea		

\*See page 11 note

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## Appendix 2 - Alphabetical List of Countries and Acidification Vulnerability Ranking

Albania	144	East Timor (Timor Leste)	103	Lebanon	136	Saint Lucia	42
Algeria	137	Ecuador, Republic of	42	Lesotho	187	Saint Vincent and the Grenadines	92
Angola	106	Egypt, Arab Republic of	80	Liberia	142	Sao Tome & Principe	134
Antigua and Barbuda	73	El Salvador	109	Libyan Arab Jamahiriya	138	Saudi Arabia, Kingdom of	32
Argentina	71	Eq Guinea	128	Lithuania	51	Senegal	88
Armenia	177	Eritrea	47	Macedonia, Republic of	167	Serbia and Montenegro	131
Australia	5	Estonia	70	Madagascar, Republic of	67	Seychelles, Republic of	29
Austria	151	Ethiopia	185	Malawi	170	Sierra Leone	118
Azerbaijan	178	Fiji, Republic of	26	Malaysia	8	Singapore, Republic of	21
Bahamas, Commonwealth of the	54	Finland	44	Maldives, Republic of	25	Slovakia	157
Bahrain, State of	35	France *	2	Mali	156	Slovenia	126
Bangladesh, Peoples Republic of	65	Gabon	100	Malta	112	Solomon Islands	34
Barbados	82	Gambia	110	Marshall Islands, Republic of the	62	Somali Democratic Republic	104
Belarus	152	Georgia	164	Mauritania	116	South Africa	111
Belgium	90	Germany	67	Mauritius, Republic of	58	Spain	79
Belize	23	Ghana	96	Mexico	15	Sri Lanka, Democratic Socialist Republic of	62
Benin	140	Greece	59	Micronesia, Federated States of	39	Sudan, Republic of the	74
Bolivia	172	Greenland	17	Moldova, Rep	159	Suriname	122
Bosnia and Herzegovina	132	Grenada	47	Mongolia	183	Swaziland	162
Botswana	165	Guatemala	147	Morocco	108	Sweden	30
Brazil, Federative Republic of	84	Guinea	141	Mozambique, Republic of	102	Switzerland	149
Brunei Darussalam	38	Guinea-Bissau	145	Myanmar, Union of	27	Syrian Arab Republic	146
Bulgaria	154	Guyana	98	Namibia	105	Taiwan, Province of China	11
Burkina Faso	173	Haiti, Republic of	114	Nauru, Republic of	55	Tajikistan	186
Burundi	174	Honduras, Republic of	129	Nepal	174	Tanzania, United Republic of	76
Cambodia	60	Hungary	163	Netherlands*	4	Thailand, Kingdom of	12
Cameroon	123	Iceland	14	New Zealand*	6	Togo	134
Canada	22	Independent State of Western Samoa	56	Nicaragua, Republic of	97	Tonga, Kingdom of	67
Cape Verde	121	India, Republic of	78	Niger	182	Trinidad and Tobago, Republic of	93
Central African Republic	168	Indonesia, Republic of	10	Nigeria	124	Tunisia	120
Chad	160	Iran, Islamic Republic of	65	Norway	16	Turkey	117
Chile	53	Iraq	148	Oman, Sultanate of	37	Turkmenistan	171
China	13	Ireland	49	Pakistan	133	Tuvalu	75
Colombia	100	Israel, State of	85	Palau, Republic of	45	Uganda	157
Comoros, Islamic Federal Republic of	82	Italy	49	Palestinian Territories	181	Ukraine	138
Congo, Republic of the	127	Jamaica	76	Panama, Republic of	56	United Arab Emirates	18
Congo, Democratic Republic of the	143	Japan	1	Papua New Guinea	24	United Kingdom*	3
Costa Rica, Republic of	107	Jordan, Hashemite Kingdom of	99	Paraguay	165	United States of America*	8
Cote d'Ivoire	125	Kazakhstan	168	Peru	31	Uruguay	130
Croatia	89	Kenya, Republic of	115	Philippines, Republic of the	7	Uzbekistan	184
Cuba, Republic of	71	Kiribati	28	Poland	87	Vanuatu, Republic of	39
Cyprus	119	Korea, Democratic People's Republic of	90	Portugal	80	Venezuela, Republic of	41
Czech Republic	153	Korea, Republic of	18	Qatar, State of	46	Viet Nam, Socialist Republic of	20
Denmark	32	Kuwait, State of	61	Romania	155	Yemen, Republic of	86
Djibouti, Republic of	112	Kyrgyzstan	178	Russian Federation	36	Zambia	161
Dominica, Commonwealth of	51	Lao People's Democratic Republic	150	Rwanda	178	Zimbabwe	174
Dominican Republic	93	Latvia	95	Saint Kitts and Nevis	64		

\*See page 11 note

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\* Included territories accounted for in the percentage of coral reef area per EEZ

France	Clipperton, Mayotte, Réunion, Guadeloupe, Martinique, New Caledonia, French Polynesia, Wallis and Futuna Islands
Netherlands	Aruba, Netherlands Antilles
New Zealand	Cook Islands, Niue, Tokelau
United Kingdom	British Indian Ocean Territory, Anguilla, Bermuda, Cayman Islands, Pitcairn, Turks and Caicos Islands, British Virgin Islands
United States	United States of America: Florida and Gulf of Mexico, Hawaii, United States Minor Outlying Islands, American Samoa, Puerto Rico, US Virgin Islands, Guam

## Endnotes

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