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# **Evaluating the potential for transboundary management of marine biodiversity in the Western Indian Ocean**

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## **Abstract**

The economic and socio-political interactions between countries can have major impacts on transboundary conservation decisions and outcomes. Here, we examined for 14 Western Indian Ocean continental and island nations the extent of their marine coral reef species, fisheries and marine protected areas (MPAs), in the context of their geopolitical and socioeconomic connections. We also examined the role of external countries and organisations in collaboration within the region. We found large variation between the different countries in their protected area size, and management, which result from different interests in establishing of the MPAs, ranging from fisheries management, biodiversity conservation to asserting sovereignty claims. Seventy four per cent of the 154 MPAs in the region belong to island nations; however, the largest MPAs in the Western Indian Ocean were established by European powers, and include Mayotte and Glorioso Islands (France) and Chagos (UK). While the majority of MPAs are managed by individual countries, between-country collaboration within and outside the region is key if the aim is to achieve effective conservation of ecosystems and species across island and mainland nations in the region. This may be advanced by creating trans-boundary MPAs and by regional conservation investment by external powers that benefit from the region's resources.

**Keywords:** Western Indian Ocean; island nations; cross-boundary conservation; international trade; coral reefs

## Introduction

Effective conservation of ecosystems and species with spatial distributions that cross international boundaries often requires coordinated plans and actions at both the regional and national scales (Sandwith et al. 2001; Beger et al. 2015; Kark et al. 2015). Coordinated efforts can potentially reduce costs of protecting biodiversity and improve the efficient allocation of limited conservation resources (Kark et al. 2009; Punt et al. 2012; Mazor et al. 2013; Pouzols et al. 2014; Dallimer & Strange 2015). When countries have good relations (e.g., economically), collaboration to address shared conservation issues may be easier and for achieving international treaty goals (Levin et al. 2013).

Successful transboundary conservation depends on meeting ecological and biodiversity objectives and enhancing the economic ties and necessary political cooperation and will (Sale 2015; Levin et al. 2013). Building on existing between-country and institutional ties may reduce transaction costs of planning and resource management (Guerrero et al. 2013; Levin et al. 2013). Therefore, coordinated conservation is expected to be most applicable, effective and likely to take place when partners both share biodiversity features, conservation targets and have sound political and economic interactions. A first step towards assessing the potential cost-benefit of regional conservation collaboration is to evaluate the shared biodiversity, administrative structures, and political and trade relations among neighbouring countries. The Western Indian Ocean (WIO) region, which includes five mainland countries and nine island countries and territories is examined here to evaluate the potential for multi-lateral collaborative conservation of biodiversity in a region that historically has had weak government and economic ties (Chircop et al. 2010; McClanahan et al. 2011a).

The coral reefs of the WIO region comprise a marine biodiversity hotspot that crosses international boundaries and several distinct ecoregions, such as the Mascarene Islands, which contain high numbers of endemic species (Allen 2008; McClanahan et al. 2011a; Obura 2012; Selig et al. 2014). WIO coral reefs support many people that rely primarily on natural resources, and this results in a range of intense human use and environmental impacts such as unsustainable fishing and sedimentation (van der Elst et al. 2005; Hicks 2011; Maina et al., 2013; Parravicini et al. 2014; UNEP-Nairobi Convention & WIOMSA 2015). Coral reefs are threatened by both oceanic and land derived factors; thus, land-sea connections play an important role in sustainable use and biodiversity conservation (Klein et al., 2012). Most WIO nations are highly dependent on their fisheries (Allison et al. 2009), with about three million people in the region directly dependent on artisanal fishing for their livelihood (van der Elst et al. 2005; Tobey & Torell 2006). Per capita seafood consumption is much higher in WIO island states than in mainland states (Groeneveld, 2015a). A number of studies indicate that coral reef health, biodiversity, fish biomass and coral cover are in decline in the region (McClanahan et al. 2011b,; Selig et al., 2014). While the region's economic situation often poses constraints on resource management, and economic security needs often receive precedence over biodiversity conservation (Hicks,

2011), the high resource dependency and low functional redundancy among fish communities (Cinner et al., 2012a; Parravicini et al., 2014) underscores the need for strategies that increase the capacity of these poor economies to adapt to threats posed by fisheries (Worm & Branch 2012; McClanahan & Cinner 2012). In addition to direct human threats posed to coral reef biodiversity by fisheries, terrestrial land uses (e.g., deforestation) have been shown to clearly impact marine ecosystems (Klein et al. 2012).

Fisheries form an important component of the GDP of many island nations (Gillett & Lightfoot, 2001); however, many coral reef fisheries are unsustainable (Newton et al. 2007). Many recent efforts have focused on local fisheries management, which may be important for sustainable fisheries (Cinner et al. 2012b; McClanahan 2012; Roccliffe et al. 2014) but many key species cross international boundaries and regional collaboration will be important for their long-term protection (Berg et al. 2002). Tracked sea turtles for example have been shown to migrate in  $21 \pm 16$  days over distances of  $1359 \pm 832$  km from their nesting site to their foraging grounds, going through two to seven exclusive economic zones (Obura, 2015), and the tracks of seabirds that cross boundaries have been suggested as a tool for identifying candidate marine protected areas in the WIO (Le Corre et al. 2012). Transboundary MPAs are a mechanism by which such species can be protected efficiently and reduces the conservation burden of each country; but this requires coordination of national and regional conservation activities (Guerreiro et al. 2011; Grilo et al. 2012; Kark et al. 2015). It is within this context that we examined the challenges and opportunities for between-country collaboration among the 14 countries/territories composing the WIO. Between-country collaboration has also been identified as key for enhancing marine conservation in the recent Regional State of the Coast Report of the Western Indian Ocean (UNEP-Nairobi Convention & WIOMSA 2015).

In this framework, we hypothesized that countries/territories with stronger existing political, trade and governance ties would have a greater incentive, opportunity and potential to collaborate (Levin et al. 2013; Mazor et al. 2013; Kark et al. 2015). We also hypothesized that given that the region's countries are relatively weak economically, external powers representing strong countries will have an important role to play in marine conservation efforts. We assess the distribution and overlap of key proxies for biodiversity and socio-political linkages among countries/territories, aiming to identify mismatches and priorities for multi-lateral conservation collaboration.

## **Methods**

### **Study area**

The WIO is defined by the Southwest Indian Ocean Fisheries Commission (SWIOFC) as east of longitude 30°E and south of 10°N and includes 14 countries/territories (Figure 1). This includes a large island nation (Madagascar), a range of independent small island nations (Maldives, Seychelles, Mauritius and Comoros), and

four island entities under European sovereignty (The British Indian Ocean Territory, Mayotte, Reunion and the Îles Éparses (the Scattered Islands, here termed as the French Southern Territories, to which they belong), and five African countries that have a coast on the western boundary of the Indian Ocean (Somalia, Kenya, Tanzania, Mozambique, South Africa). The three island entities belonging to France show large variation in each of their social-economic status, population density and geography. Considering that MPAs often have linked social and ecological dynamics (Pollnac et al. 2010), in our analyses we treated these three French entities independently.

### Biodiversity and socioeconomic data

To portray the characteristics of the WIO nations and their inter-relationships, we collated a database of biological, socio-economic, and political features of all countries in the study area using a range of sources (Table 1). Data collected for each country included: biodiversity (marine fish and coral species range distributions), spatial conservation efforts (existing protected areas: Protected Planet 2017), demography (human population size), governance (rule of law index: Kaufmann et al. 2011; multilateral and bilateral maritime and conservation agreements), economy (gross domestic product [GDP], trade, foreign aid), tourism (coastal tourism being highly important in the region, e.g., accounting for 60 - 70% of the national tourism industry of Kenya; Odido, 1998), and politics (history of conflicts, anti-shipping [piracy] activities) (Table 1).

After compiling these datasets, we calculated the magnitude of interactions among paired countries. These measures were then used as proxies for biodiversity linkages (number of shared fish and coral species between paired countries), trade (combined annual import and export value), tourism (number of tourists) and governance (number of shared agreements). We created symmetric matrices of the values representing these linkages for each pair of countries. We used trade statistics from the Trade Map database covering 220 countries and territories and 5300 products of the Harmonized System (Trade Map 2014), which are based on statistics from the United Nations Commodity Trade Statistics Database (UN Comtrade Database 2017). We constructed matrices between countries for all commodity types as well as for trade only in marine products (including fish, crustaceans, molluscs, aquatic invertebrates; also from Trade Map). Total trade between countries is important as it indicates the strength of their economic ties. We tested the linkages among countries with a correlation analysis using Pearson's correlation coefficient. We also created matrix maps to visualize the level of shared biodiversity and the intensity of existing interactions.

## Mapping connections between countries

Following the framework developed in our earlier work for the Mediterranean Sea (Levin et al., 2013), we evaluated the potential prospects for between country collaboration in conservation based on the biodiversity, socio-economic and political variables collected. We used the EEZ boundaries to create a layer of Thiessen polygons (Thiessen, 1911) representing “areas of dual influence”, using the ALLOCATE algorithm within Idrisi Selva 17.0 GIS software (Clark Labs, USA). Thiessen polygons define individual areas of influence around sets of points, defined by the EEZ boundaries. Using the Thiessen polygon layer of areas of dual influence, we allocated marine areas to the nearest boundary between two adjacent exclusive economic zones. We hypothesized that neighbouring countries sharing an EEZ boundary will collaborate more when they are geographically closer and share similar challenges. At the country level, we hypothesized that countries with more tourism, a higher GDP, a higher rule of law index and high fish exports will have higher incentive to establish MPAs. As these variables are essentially at the single country level, to calculate them for paired-countries, we calculated the mean of these variables for each pair of countries (e.g., for GDP, we calculated the mean GDP of each pair of countries).

For pair-wise country connections, we hypothesized that the fundamentals (or indicators) for collaboration in conservation were: (1) shared marine species, (2) bilateral agreements, and (3) strong trade relations, such that paired countries with more of these fundamentals were more likely to collaborate. We then ranked each of these indicators for each pair of neighbouring countries (from high to low, giving a rank of 1 for the strongest connection), and calculated a mean rank as a proxy for collaboration potential between the two countries. Ranking was done separately for the biodiversity variables and for the socio-economic-political variables, as there may be misfits between institutional and ecological networks (Tremblay et al. 2015). To examine the correspondence between those networks, we calculated the correlations between matrices of biological, commercial and political connections among the WIO countries.

## Results

### Shared coral reef species

Madagascar has the largest coral reef area (3773 km<sup>2</sup>; Table 2) and the highest coral species richness (348 species), while Mauritius has the highest fish richness (195 species, based on spatial data of the International Union for the Conservation of Nature – IUCN). Due to its high latitude, South Africa had the smallest area of coral reefs (3.2 km<sup>2</sup>), followed by Reunion (12 km<sup>2</sup>) (Table 2). Overall, coral reef area (16,000 km<sup>2</sup>) covered 0.2 per cent of the entire EEZ area in the region. The number of shared species (between paired countries) in the IUCN list for all WIO countries ranged between 78 and 338 for the coral species and between 108 and 185 for the fish species. The percent of shared species (out of the total number of species) of each pair of WIO countries

ranged between 26 per cent and 100 per cent for the coral species and between 52 per cent and 100 per cent for the fish species. South Africa was the least similar country to all others in the number of shared coral species, followed by the Maldives (Figure 2). The countries sharing the highest number of coral species (both in absolute numbers and in per cent shared species) were Madagascar and the French Southern Territories (338, 95%, respectively), and Mayotte and the Comoros (317, 100%, respectively) (Figure 2).

### Marine protected areas in the Western Indian Ocean

As of 2017, 154 MPAs have been designated in the WIO, covering a total area of 782,794 km<sup>2</sup> (9.3% of the total EEZ of the region's countries; Table 2). However, there was considerable spatial variation among the countries in the size, distribution and coverage of their MPAs (Table 2, Figure 1). Of all WIO MPAs, 114 of 154 (74%) were located within island nations covering 97 per cent of the total area of WIO MPAs. For example, in Mayotte and the British Indian Ocean Territory, the entire territorial waters and exclusive economic zones were designated as MPAs in 2010, whereas in the Glorioso Islands, the entire territorial waters and exclusive economic zones were designated as MPAs in 2012. Conversely, other countries in the region (Somalia and Comoros) had no designated MPAs. In the remaining countries, the area declared as MPAs ranged between 0.003 per cent of the whole EEZ in Mauritius (40 km<sup>2</sup>), to 2.3 per cent in Tanzania (5564 km<sup>2</sup>). However, only a few of the existing MPAs offer no-take protection, and in Somalia, Seychelles, Mauritius and Maldives, less than five per cent of their coral reefs were included within designated protected areas.

### Trade connections within the region and beyond

In general, bilateral trade among WIO nations and territories was low compared with their international trade with partners outside the region (Figure 3). On average, the share of imports and exports among WIO nations was less than 13 per cent of their total trade. France, China and India were the three most important trade partners, each supplying on average 10 per cent of the imports to the WIO region in total (Figure 3, Table S1). France especially was found to be a key trade partner, receiving on average 11.7 per cent of the total export of WIO countries (Figure 3, Table S2).

South Africa was found to be the WIO's strongest economic power, with a total GDP of \$384 billion (as of 2012), 74 per cent of the total GDP of all the region's countries combined (Table 2; South Africa's GDP per capita was not the highest in the region, see Figure S1). South Africa was also the most important trade partner for most other WIO countries, especially with Mozambique and Tanzania (Figure 3).



WIO countries have strong economic ties with foreign countries and have a negative trade balance with imports for all countries' being greater than exports. The lowest import/export ratio was found in South Africa (117%) and Seychelles (141%) and the greatest import/export ratios was found in Mayotte (1,281%) and Maldives (962%) (Figure S2, Table 2). Total foreign aid to WIO countries amounted to 1.9 per cent of their overall GDP. For some countries (e.g., Mayotte, Somalia and Mozambique) a substantial amount of their GDP (10% or more) was from foreign aid (Figure S2, Table 2). Tourism is an important industry in most countries, with an annual average of over 500,000 tourists in each of six of the WIO countries, and over 0.4 tourists per person in the island states of Reunion (0.46), Mauritius (0.55), Seychelles (1.65) and Maldives (1.74) (Figure S2). Economically, income from international tourists is highly important in some of the island countries, being the largest revenue generator in the Maldives (about 80% of the GDP), and a major source of revenue in Mauritius (about 16% of the GDP).

Marine products are a large proportion of the total exports of Mayotte (63%), Reunion (32%) and Seychelles (25%) (Table 2). The greatest fishing fleets within WIO nations (by ship flag, on average between 2000 and 2013) belonged to the Maldives (241 vessels) and Seychelles (45 vessels). However, most fishing within the WIO (as defined by the IOTC boundaries) was by foreign countries, with only 23 per cent of the total catches by WIO nations themselves.

### Geopolitical and environmental relationships among Western Indian Ocean countries

The countries varied widely in their governance levels, ranging from Somalia, where effective central governance is absent, to the highly developed islands belonging to France. We found positive correlation between the Rule of Law index and the number of international maritime and environmental agreements that countries signed (Figure S3). Most countries were signatories on general environmental treaties (92% on average) and on wildlife/heritage conventions (70% on average); however, only 56 per cent of the countries were signatories on general marine, marine pollution and shipping conventions, 50 per cent were signatories to regional conventions, and 48 per cent on average were signatories to global fisheries conventions (Table S3). Somalia and the Maldives have signed the least number of international agreements and had the lowest numbers of shared international maritime and environmental agreements with other WIO countries (Tables 2, S3, Figure S4). There were very few cross-border armed conflicts among WIO nations, apart from cross-border conflicts in Somalia and Kenya. However, armed conflicts within countries' borders were abundant in Somalia and Kenya in the last decade (Figure S4). In addition, there were numerous anti-shipping activities (piracy), located within the EEZs of Somalia, Kenya, Tanzania and Seychelles and in high seas of the northern Indian Ocean (Figure S4). Disputed claims over maritime sovereignty were found between Somalia and Kenya, Comoros and France

(conflict over governance of Mayotte), France, Madagascar and Mauritius (over the French Southern Territories), the United Kingdom and Mauritius (over the Chagos islands) (Figure S4).

### Congruence of international connections

The highest correlations between matrices of biological, commercial and political connections among countries (such as those shown in Figures 2, 3 and 4) were found for numbers of shared fish species and numbers of shared coral species, and between the number of tourists and magnitude of import/export, as well as shared treaties (Figure 5). There was no correlation between the two human proxies: import/export and number of shared trade agreements. Numbers of shared fishes or corals were not correlated with any human socio-political proxies (Figure 5).

### Identifying pairs of countries for potential collaboration in conservation

Ranks of dual influences based on the country-level and connection-level statistics using biodiversity and economic-political variables were not correlated (Figures S5, 6). The two mostly highly ranked countries in terms of their shared marine biodiversity and economic-political connections were Reunion and Mauritius (Figures S5, 6). Reunion and Mauritius, Madagascar and France (through its overseas territories), and Seychelles and Mauritius (Figures 6, S5) were among the country pairs with the highest dual influence rankings.

## **Discussion**

While conservation actions are very often planned and undertaken by individual countries independently of their neighbouring countries, cross boundary collaborations and conflicts can be key in determining conservation outcomes (Kark et al. 2009, 2015, Mazor et al. 2013). This can be the case for both island and continental nations, yet the impact of collaboration on conservation planning and outcomes has not been examined for most areas around the world. Some of Earth's richest marine and coastal biodiversity is found in the WIO nations, especially around their coral reefs and coasts, which provide subsistence living for millions of people (van der Elst et al., 2005; Tobey & Torell, 2006; Allison et al., 2009). Here, we identified and quantified for the first time the potential biodiversity, economic and political connectedness that might promote cross-country collaboration in marine resource management in the WIO region. In this region, nine of the countries are islands, ranging from very large ones (e.g., Madagascar, etc.) to small island nations and territories. We found the strongest bi-lateral relationships between Reunion and Mauritius, and Seychelles and Mauritius (Figure 6), which likely reflect their shared colonial histories with France and England.

Overall, there were stronger linkages in shared coral reef species between countries, compared to their social, political and economic linkages (Figure 5). Most countries showed stronger social linkages with their former colonial nations but also with emerging regional continental economies, such as India and China. Despite the weak history of socioeconomic ties, a decision of the Nairobi Convention Conference of Parties indicated willingness to establish a regional cohesive system of MPAs (COP08, 2015). There has, however, been little evidence to indicate specific recent actions (Chircop et al., 2010). Therefore, further socio-economic and political linkages may be required to develop the proposed cross-country management collaborations.

### Status of protected areas

Efforts to increase WIO's coral reef biodiversity conservation increased since the early 1980s, when only 15 coral reef MPAs were in Kenya, Mozambique and Seychelles (Salm 1983; Wells et al. 2007; Rocliffe et al. 2014). Most countries in the region have reached the Convention on Biological Diversity 1993 target of protecting at least 10 per cent of marine areas for the coral reef habitat. In about half of the countries, 10 per cent of the continental shelf is covered by MPAs and by locally managed marine areas (Rocliffe et al. 2014). However, only three MPAs, one in Madagascar and three in the Seychelles, belong to categories of the highest level of protection (classes Ia ["Strict nature reserve"] and Ib ["Wilderness area"] of the IUCN classification of protected areas, and only 19 additional MPAs are in IUCN class II ("National Park"). Furthermore, as many as 40 per cent of the MPAs in the region have been classified as having low compliance in terms of their fisheries closures and others as allowing fishing, which reduces the fish resources and conservation value (McClanahan et al. 2015).

Weak governance and high subsistence fishing may explain the lack of MPAs in Somalia and the existence of just two proposed marine parks in the Comoros. In the Maldives, on the other hand, reef fisheries are not heavily exploited because the population largely eats pelagic tuna (McClanahan 2011; McClanahan et al., 2011b), but recent demand by tourist resorts for reef fish indicates imminent change (Maria Beger, unpublished data). While 42 MPAs have been declared around key diving sites in the Maldives, there is little direct active management (Rajasuriya et al. 2004). In contrast to the large number of small MPAs in the Indian Ocean (< 10 km<sup>2</sup>), two extensive marine reserves were established in 2010 in the Chagos (640,000 km<sup>2</sup>) and Mayotte (68,000 km<sup>2</sup>) (Kaplan et al. 2013; Pala 2013), and an additional extensive marine reserve was established in 2012 in the Glorioso Islands (45,000 km<sup>2</sup>). These new marine reserves are important as countries, extending the management of fisheries into open sea areas, may be better off in taking advantage of the new emerging "Blue Economy" (Obura 2015). The Maldivian government pledged to make the whole country a UNESCO Biosphere Reserve by 2017 (Shakeela 2013). Similarly, plans for enlarging the protected areas by millions of hectares of

land and marine areas have been developed in Madagascar (Allnut et al. 2012) and in the Seychelles (Kelleher 2015).

Two transboundary MPAs have been proposed in East Africa, one for the border area between Mozambique and South Africa (the Lubombo Ponta do Ouro-Kosi Bay Marine and Coastal Transfrontier Conservation and Resource Area, established in 2009 – the first transboundary MPA in Africa) and another between Mozambique and Tanzania (the future Ruvuma-Palma National Reserve; Guerreiro et al. 2010; Grilo et al. 2012). Indeed, as shown in the matrices (Figure 5), the trade and tourism connections between South Africa and Mozambique were higher than between any other pair of countries in the WIO. One of the main drivers for the transboundary MPA, established by these two countries, was to support tourism-driven economic development (Grilo et al. 2012) following the example of the terrestrial Great Limpopo Transfrontier Park (Wolmer 2003).

#### The potential for regional and international cooperation

While conservation actions are mostly taken at the national or local level, not all countries are equally inclined or able to designate, monitor and effectively manage marine conservation areas. Global conventions, such as the Convention on the Conservation of Migratory Species of Wild Animals 1983, seek to answer conservation challenges that relate to boundary crossing species. However, global guidelines may not meet regional issues and concerns, and it has been suggested by Prideaux (2002) that a regional agreement to protect small cetaceans should be implemented for the Indian Ocean, following successful examples such as the Agreement on the Conservation of Cetaceans of the Black Sea, Mediterranean Sea and Contiguous Atlantic Areas 1996, and regional initiatives enable the sharing of expertise among countries in the region, and improving management effectiveness (Francis et al. 2002). Several existing regional examples can be given in this respect. The region's fishery body is the Southwest Indian Ocean Fisheries Commission (SWIOFC), established in 2004 by the UN Food and Agriculture Organization. The main objective of the SWIOFC is to promote the sustainable utilization of the living marine resources of the Southwest Indian Ocean region. The Western Indian Ocean Marine Science Association (WIOMSA), which has membership of conservation professionals across the region, was formed along the regional political and economic setting (i.e., East African Community, and Southern African Development Community and the Small Islands Developing States; Western Indian Ocean Marine Science Association, 2017). The UNDP led initiative, the Agulhas and Somali Current Large Marine Ecosystems Project (ASCLME) has as its main objective to enhance and to facilitate the governments in the region to implement multilateral and bilateral agreements on conservation of marine biodiversity (Vousden et al. 2008). Additionally, a regional Coral Reef Task Force has been attempting to coordinate reef adaptation programs at the regional level.

While there are very few cross-boundary management areas, regional bodies have promoted collaboration among research and biodiversity conservation institutions in WIO countries, including supporting multi-country research projects and policy harmonization, which are some of the prerequisites for joint management actions (Table S4). Broadly, other efforts being led by the IUCN through the East Africa Community (EAC; Guerreiro et al. 2011) have seen the establishment of key institutions such as the Lake Victoria Basin Commission and the Lake Victoria Fisheries Organization for the protection of the Lake Victoria transboundary ecosystem. Similarly, the EAC is currently spearheading a process for the establishment of the first jointly managed MPA along Kenya- Tanzania border. Therefore, a continued support by the international community and conservation organization is key for the realization of these existing initiatives.

The economic-political ties among countries were not correlated with biological connectedness. McClanahan et al. (2016) found that regional collaboration can indeed reduce recovery times of fish in the WIO (compared with a no collaboration scenario). However, they also noted that in their modelled collaboration scenario, conservation responsibilities are unevenly distributed among countries, which might undermine collaboration. While the economic and political ties were found to be stronger in the southern part of the study area, species similarity was higher in the northern part of our study area (Figure 5). Whereas biodiversity similarity between countries is driven by distance between countries as well as by environmental factors (Keil et al. 2012), socio-economic and political ties between countries are often shaped by history and by shared cultural values or economic interests (Matthews et al. 2016). As the designation of MPAs and their effectiveness depend on economic and political factors (such as governance and compliance; Edgar et al. 2014), these seem to be of key importance for determining areas for collaboration in marine conservation. Therefore, collaboration based on biological similarity and socioeconomics can require new political and socio-economic links that are historically weak in this region.

#### Areas of potential conflict between countries

Conflicts between countries hampers potential collaboration for common conservation goals (Hammill et al. 2016). Conflicts between citizens of neighbouring countries in East Africa are often associated with conflicts between national and migratory fishermen over limited marine resources (van der Elst et al. 2005; Crona & Rosendo, 2011; WIOMSA, 2011; McClanahan et al., 2013b). Armed conflicts are likely to have negative impacts on protected areas (Dudley et al. 2002; Hanson et al. 2009) due to the lack of rule of law during active conflicts. However, conflicting maritime boundary claims may sometimes have the opposite effect when countries chose to exercise their sovereignty (e.g., by designating a marine protected area in a contested area). Nonetheless, there have been relatively few armed conflicts between countries over marine resources in the Indian Ocean and such conflicts are not likely to be inhibiting regional collaboration (McDorman 1988).

Conflicts over sovereignty and fishing rights of the Chagos Archipelago have continued between the British colony and Mauritius, and the establishment of the US Military base make this a strategic location (Dunne et al. 2014; Gifford & Dunne, 2014). Mauritius claims the Chagos Archipelago and conflicts over fishing and the original inhabitants' rights continue with the no-take maritime reserve establishment (Koldewey et al. 2010; De Santo et al. 2011).

Mayotte's recent designation of a large marine reserve bares some similarities to the Chagos. Mayotte voted to separate from the Comoros Archipelago and remain under French sovereignty (Saint-Mézard 2013). While the Comoros and Mayotte share considerable amounts of marine biodiversity, their economic and conservation status are different due to different international socioeconomic associations. The Comoros have stronger ties with Middle Eastern countries and do not recognize French sovereignty over Mayotte (Yoon 2009). French designation of the entire EEZ of Mayotte as an MPA in 2010 was suggested to be a strategy of France to assert more control over the area. Consequently, large designated protected areas in this region have political incentives and repercussions that are expected to influence regional biodiversity collaborations.

Within the scattered islands of the French Southern Territories (where French sovereignty is challenged by neighbouring countries), France and Mauritius have agreed on the common management of the high sea fisheries and environmental protection at Tromelin Island in 2010 (Bouchard & Crumplin 2011). This agreement partly corresponds with our predicted ranking, in which France and Mauritius were highly ranked for their likelihood in collaborating in conservation. In addition, fishing was prohibited in December 2010 in the territorial sea of Bassas da India, Europa Island, Juan de Nova Island and the Glorioso Islands (making them all de-facto reserves, given their isolation and lack of permanent human populations). Europa Island is also being planned for marine park status (Bouchard & Crumplin 2011), and is also the focus of terrestrial conservation together with Glorioso Islands whose EEZ was designated as an MPA in 2012 (Russell & Le Corre 2009; Russell et al. 2016).

### Comparison with other regions

Regional Seas Programs have been established by UNEP (from 1974) to manage the seas as shared resources, and at present almost 150 states across 18 regions participate in them (Rochette et al. 2015). Political and ecological regions outside the WIO show similar political complexities, where multiple countries, which are highly diverse socio-economically, share marine space and species. For example, the Mediterranean Sea has high diversity, is shared by 20 countries, and is subject to multiple anthropogenic threats (Coll et al. 2012). While both the Mediterranean Sea and the WIO incorporate a large number of countries of varying economic power and political organization, there are significant differences between the two regions. The GDP per capita

of six of the WIO nations is lower than \$1000, whereas in the Mediterranean Basin, no country has a GDP per capita lower than \$2000 (Levin et al. 2013). Correspondingly, trade and commerce within the Mediterranean Sea are strong, whereas in the WIO the volume of trade among the region's countries is small, and there is a greater reliance on foreign capital.

The Pacific Islands area is an example of a region where the full implementation of conservation and management agreements is constrained by limited financial and technical resources (Wright et al. 2006). Precedents of international collaboration for the conservation of natural resources exist and represent powerful initiatives that have improved regional conservation outcomes and awareness. For example, the Micronesia Challenge (2017) is a union of Micronesian countries working towards the sustainable management and effective conservation of marine and terrestrial areas (Goldberg et al., 2008), driven by each country within the regional goals of effectively managing 30 per cent of their marine and 20 per cent of terrestrial estate (Baker et al. 2011). The Coral Triangle Initiative (CTI; 2017) for Coral Reefs, Fisheries and Food Security (shared by six countries: Indonesia, Malaysia, Papua New Guinea, Philippines, Solomon Islands and Timor Leste) aims to coordinate efforts on the conservation and sustainable use of coral reef ecosystems and resources (Walton et al. 2014; Beger et al. 2015). The CTI has developed specific regional goals to achieve their vision of improved coral reef biodiversity, sustainable fisheries, and food security, and regional priority areas can provide guidance for nations and provinces to integrate national needs with regional goal (Beger et al. 2015).

#### The role of foreign aid in collaborative conservation

MPAs in least-developed countries require local to national taxes (on fisheries and tourism) as well as serial donor support (McClanahan 1999). Further, reports indicate that increased management effectiveness in Kenya, Tanzania and Mozambique is paralleled by major donor investments (Wells et al. 2007). Large scale fisheries in the Indian Ocean is an area of concern for the international community (Worm & Branch 2012). Considering that large-scale fisheries of Europe and North America are fully or overly developed, these countries have become more dependent on developing countries for wild-caught fish. Fishing effort has recently shifted towards developing nations in the South, including Africa (Worm et al. 2009; McClanahan & Cinner, 2011). Indeed, the total catch (reported landings) has significantly increased in the south WIO between 1985-2012, with an increase in large pelagic fish landings in Seychelles after 1997, due to the development of its fishing port as a centre for the international tuna industry (Groeneveld 2015b). Therefore, developed countries ought to support the formation of MPAs, promote sustainable fisheries, and food security in the WIO (McClanahan et al. 2013a).

The World Bank's Global Environmental Facility (GEF) is one of the largest public funder of environmental projects globally, and has also funded trans-frontier conservation areas in southern Africa (Duffy 2006). Within the WIO, funding of marine environmental projects is given by the GEF to 20 national projects at a total budget of \$78 million (with co-financing of \$387 million; Table S4), and to 32 regional projects (including the ASCLME for example) at a total budget of \$269 million (with co-financing of \$1481 million; Table S5) (Global Environmental Facility, 2017) (Table S5). This funding by the GEF (and there are many non-GEF projects as well, such as WIOMSA) demonstrates a funding bias towards regional projects, thus favouring between country collaboration.

Because of France's colonial history in the region, its administrated areas in the WIO (Reunion, Mayotte and the scattered islands of the French Southern Territories) combined to cover 15 per cent of the total EEZ areas (and 32% of the area of the EEZ areas of dual influence) and 79 per cent of all MPAs in the region (when excluding the British Indian Ocean Territories), as well as through its dominant place in trade and tourism (more than 800,000 French tourists a year), France could play a key role in advancing marine conservation in the WIO. Given the colonial past and economic ties, low levels of multi-national international governance bilateral agreements and transboundary MPAs are more likely to be the next modest step in collaboration (Guerreiro et al. 2011). Without local and stakeholder involvement, these transboundary agreements may be viewed as overly centralized and fail to benefit local resource users and garner their support (Yates & Schoeman 2015; McClanahan & Abunge 2016). Consequently, there is a need to create local involvement and incentives to collaborate with international planning to avoid many of the previous donor-driven conflicts and failures (Western 2003; Duffy 2006; Kamat 2014).

## **Conclusion**

The WIO has a number of characteristics and challenges that make it unique and a global priority for conservation and sustainable management (Allen 2008; McClanahan & Cinner 2012; Worm & Branch 2012; Parravicini et al. 2014). This may be achieved by expanding the MPAs through international collaboration but these plans need to be considered in the context of the challenges related to environmental change, subsistence economies, poor fisheries-dependent coastal populations, and the international composition of the pelagic fisheries industry. Collaboration is expected to involve foreign stakeholders and to recognize the socio-economic and political factors that have created and sustain the current economies. Nevertheless, poor integration of socio-economic and political groups within and among countries is expected to continue producing low compliance with proposed MPA rules and regulations, which frequently arise from top-down planning in poor countries. Avoiding this disconnect requires a good understanding of the social-ecological context and creating context-appropriate management systems. We suggest that future work should examine in



more detail the role of cross-boundary collaboration among countries and across districts, organisation and regions and the role of land-sea connectivity, as well as socio-economic, political connections in marine and coastal conservation for both island and mainland regions.

### **Disclosure statement**

No potential conflict of interest was reported by the authors.

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### **Supplementary files**

Supplementary files will be available once the paper is accepted in a specified website link for the readers. They are now given at the end of the paper for the reviewers.

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Table 1: Datasets used in this study. For each dataset, either a website or reference are provided.

Variable group	Variable name	Reference
Biodiversity and conservation	Species range maps of marine fish	IUCN Red List of Threatened Species, 2017
	Species range maps of corals	IUCN Red List of Threatened Species, 2017
	2010 Global Distribution of Coral Reefs	Ocean Data Viewer, 2017 IMaRS-USF, 2005; IMaRS-USF, IRD, 2005; Spalding et al., 2001; UNEP-WCMC et al., 2010
	World database of protected areas	Protected Planet, 2017
Economic data	Gross domestic product (GDP)	World Bank Open Data, 2014
	Trade between countries	Trade Map, 2014
	Trade data for Reunion	Ministère de l'Economie et des Finances, 2014
	Pelagic fisheries	Indian Ocean Tuna Commission, 2014
	Tourism between countries	UNWTO, 2011
	Domestic and international tourist numbers	Bigano et al., 2007
	Population size	World Bank Open Data, 2014
Political data	Global Maritime Boundaries Database	GMBD, 2014
	International and regional agreements	Southwest Indian Ocean Fisheries, 2014

	<p>Rule of Law Index</p> <p>(an index which captures perceptions of the extent to which agents have confidence in and abide by the rules of society)</p>	<p>World Bank Open Data, 2014</p> <p>Kaufmann et al., 2011</p>
	<p>Military conflicts between and within countries</p>	<p>Uppsala Conflict Data Program, 2014</p> <p>Themnér and Wallensten, 2013</p>
	<p>Anti-shipping Activity Messages</p>	<p>Anti-shipping Activity Messages, 2014</p>

Table 2: General geographic, demographic, trade and conservation statistics for each of the western Indian Ocean countries. Area and number of MPAs includes only designated MPAs within the WDPA database as of 2017.

Indian Ocean	Area 1,000 km <sup>2</sup>	Pop 2012 10 <sup>6</sup>	GDP 2012 10 <sup>9</sup> \$	GDP 2012 per capita	Imports 10 <sup>9</sup> \$	Exports 10 <sup>9</sup> \$	Imports /Exports ratio %	Imports from Indian Ocean % of total	Exports to Indian Ocean % of total	Exports fish products % of total	Foreign aid % of GDP	No. of agreements	EEZ area 1,000 km <sup>2</sup>	No. of MPAs	Area of MPAs 1,000 km <sup>2</sup>	Area of MPAs % of EEZ	Coral areas km <sup>2</sup>
British Indian Ocean Territory	0.1	0.0	N/A	N/A	0.1	0.0	322	0	1	11.0	N/A	40	636	7	637.0	100	1,923
Comoros	1.7	0.7	0.6	831	0.2	0.1	355	14	3	2.1	9.4	27	164	0	0	0	221
French Southern Territories	7.9	-	N/A	N/A	-	-	N/A	0	0		N/A	47	623	2	45.6	7.3	131
Kenya	593.3	43.2	40.7	943	15.1	5.2	291	7	13	1.7	4.9	41	111	9	0.5	0.49	506
Madagascar	590.3	22.3	10.0	447	2.7	1.2	217	10	8	6.0	5.2	36	1,191	42	8.8	0.7	3,773
Maldives	0.3	0.3	2.2	6,567	1.6	0.2	962	0	0	0.0	2.7	23	915	42	0.5	0.05	2,696
Mauritius	2.0	1.3	10.5	8,120	5.8	2.3	256	9	22	3.4	1.4	41	1,270	7	0.04	0.003	716
Mayotte (FR)	0.4	0.2	1.0	4,484	0.4	0.0	1281	12	22	63.2	56.8	47	63	3	68.3	100	295
Mozambique	786.0	25.2	14.2	565	6.2	3.5	178	32	20	0.7	14.2	33	566	5	12.7	2.2	2,090
Reunion (FR)	2.5	0.8	18.8	22,355	2.3	0.3	843	9	25	32.6	N/A	47	315	1	0.03	0.01	12
Seychelles	0.5	0.1	1.1	12,783	0.7	0.5	141	12	6	25.1	2.6	34	1,329	10	0.2	0.02	1,572
Somalia	632.7	10.2	5.9	578	1.3	0.2	777	0	0	0.5	13.6	18	665	0	0	0	248
South Africa	1,220	52.3	384.3	7,352	101.6	86.7	117	2	5	0.5	0.3	45	317	5	1.4	0.45	3
Tanzania	939.8	47.8	28.2	609	11.7	5.5	211	13	25	3.0	9.6	35	240	21	5.5	2.3	2,413



## Figure legends

**Figure 1:** Spatial distribution of coral reefs and of marine protected areas in the western Indian Ocean showing countries' exclusive economic zones.

**Figure 2:** Shared coral species between western Indian Ocean countries, in absolute numbers (top panel) and in percentages (bottom panel). Line thickness represents relative number of shared species between two countries.

**Figure 3:** Trade connections (import, export) between a) western Indian Ocean countries, in millions \$ (top right panel) and in percent of total trade (bottom right panel) (as of 2012), and b) between western Indian Ocean countries and selected foreign countries, in millions \$ (as of 2012).

**Figure 4:** Shared international maritime and environmental agreements between western Indian Ocean countries (top panel), armed conflicts within African countries and anti-shipping activities (bottom panel).

**Figure 5:** Matrix map of interactions among countries in the Western Indian Ocean: South Africa (SA), Mozambique (Moz), Tanzania (Tan), Kenya (Ken), Somalia (Som), Madagascar (Mad), French Southern Territories (FST), Mayotte (May), Comoros (Com), Seychelles (Sey), Reunion (Reu), Mauritius (Mau), British Indian Ocean Territories (BIOT), and Maldives (Mal). Depicting interactions of a) total and shared fish species, b) total and shared coral species, c) import and export, d) total and shared environmental treaties and agreements, and e) total and shared number of tourists. Pearson's correlation coefficient tests show substantial differences between ecological and socio-political interactions (f).

**Figure 6:** Thiessen polygons dividing the western Indian Ocean area, based on the nearest exclusive economic zone boundary (shown in thick black lines). The colors of the Thiessen polygon were assigned on the basis of the mean ranking of countries' characteristics. The top panel shows the mean ranking based on economic and political variables at the country level (tourism, GDP, rule of law, % of fish product exports) and based on between-country connections (shared international agreements and total trade). The bottom panel shows the mean ranking based on shared marine species (fish and corals, in both absolute numbers and percent shared species). EEZ areas adjacent to high seas areas were not included here. Low values stand for high ranking (i.e. a value of 1 stands for the strongest interaction).

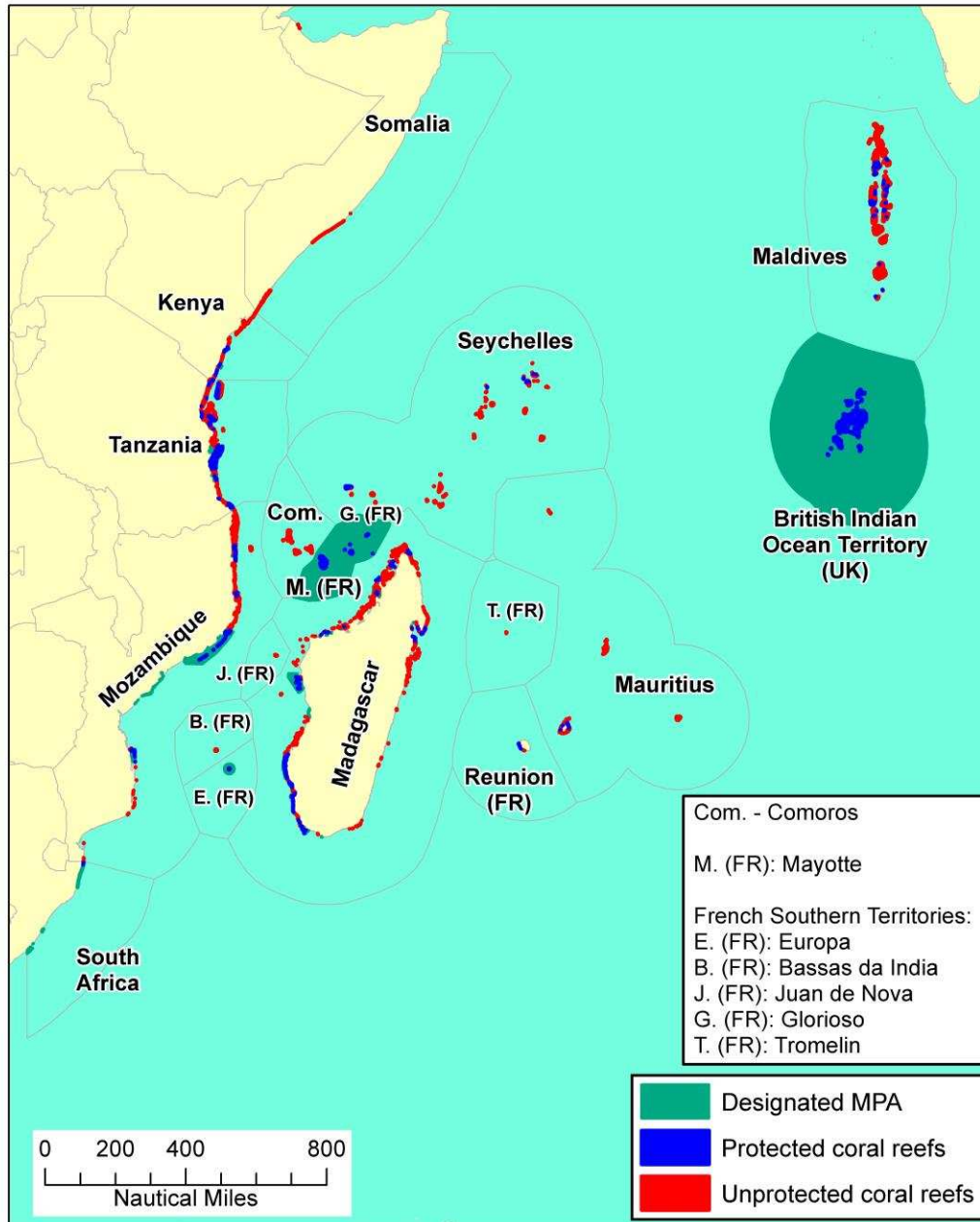


Figure 1

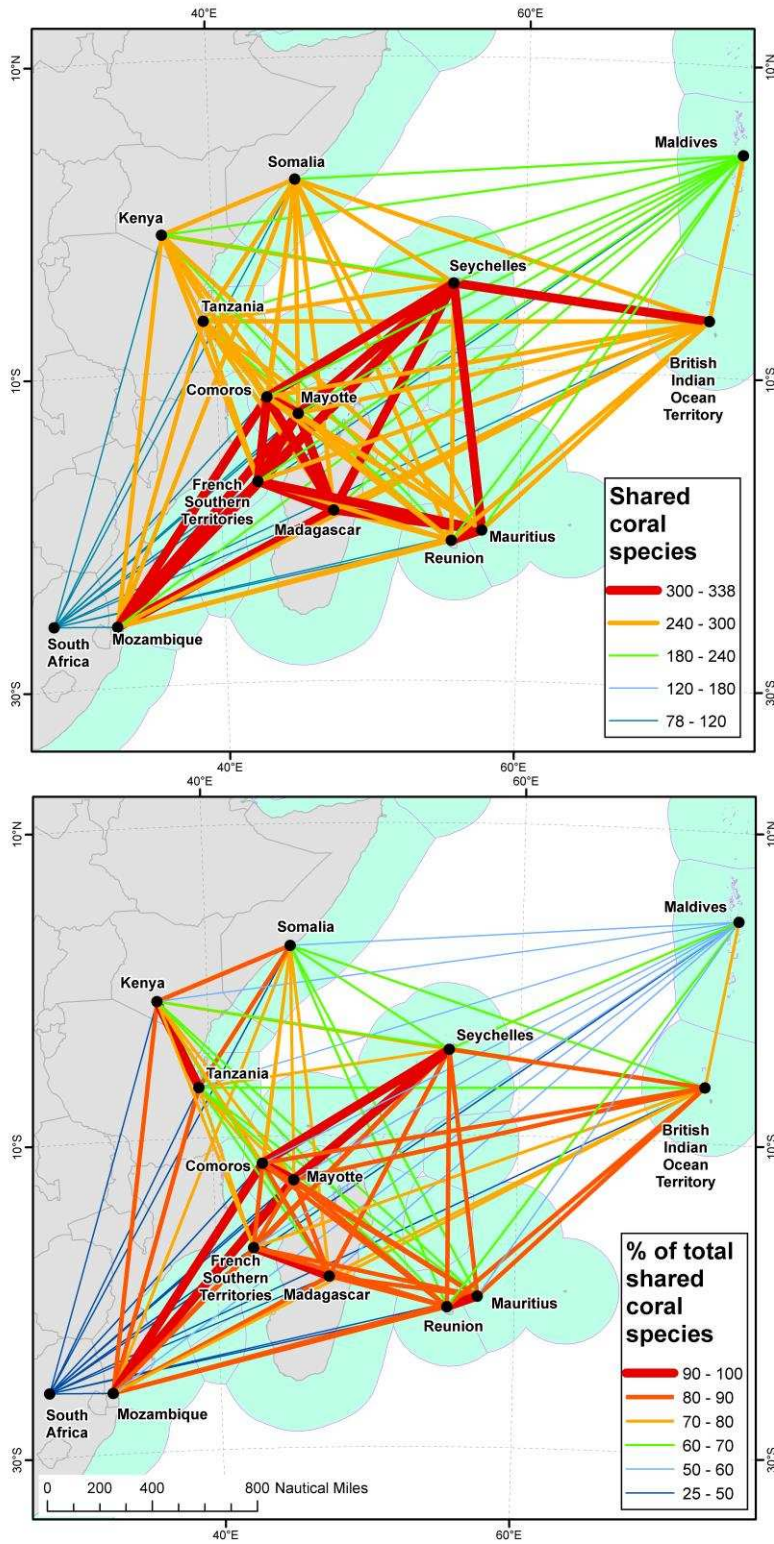
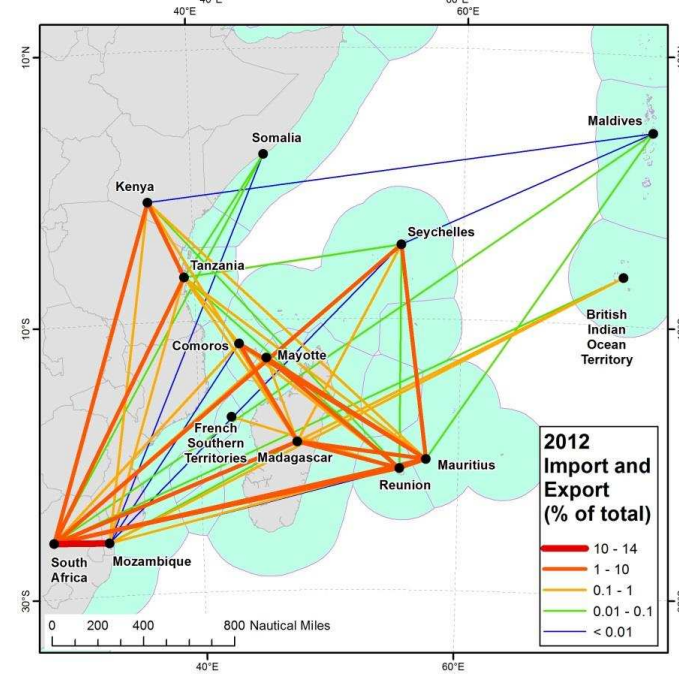
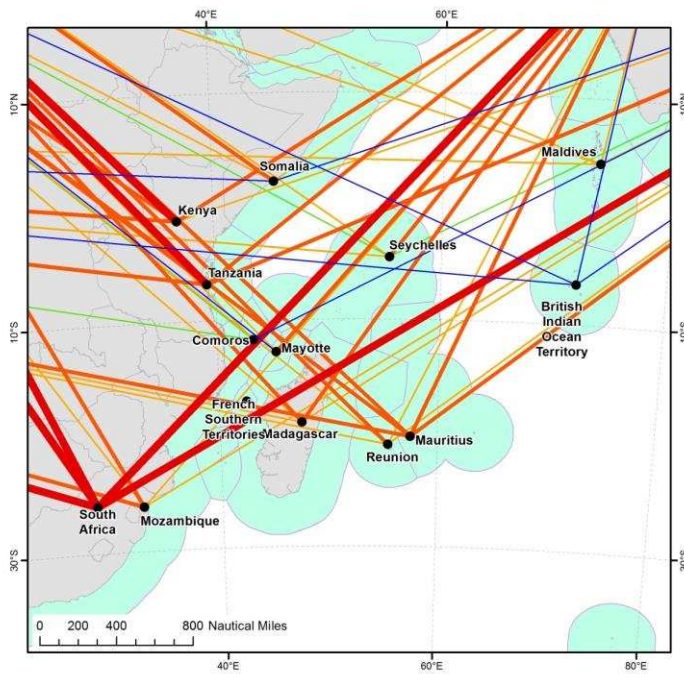
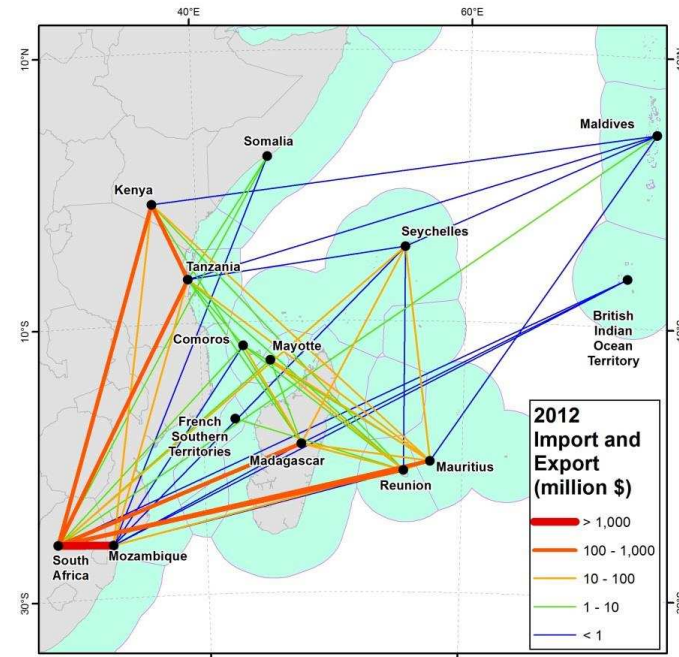
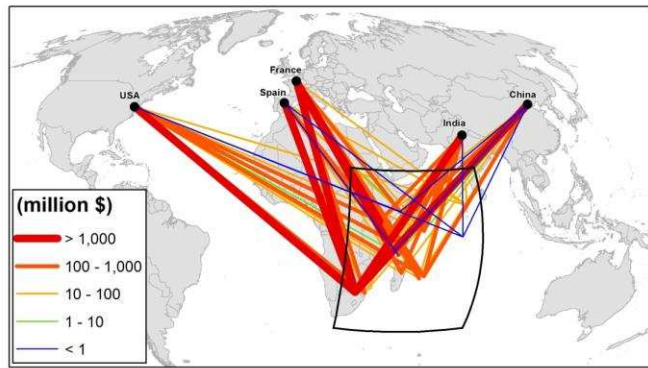


Figure 2

Figure 3





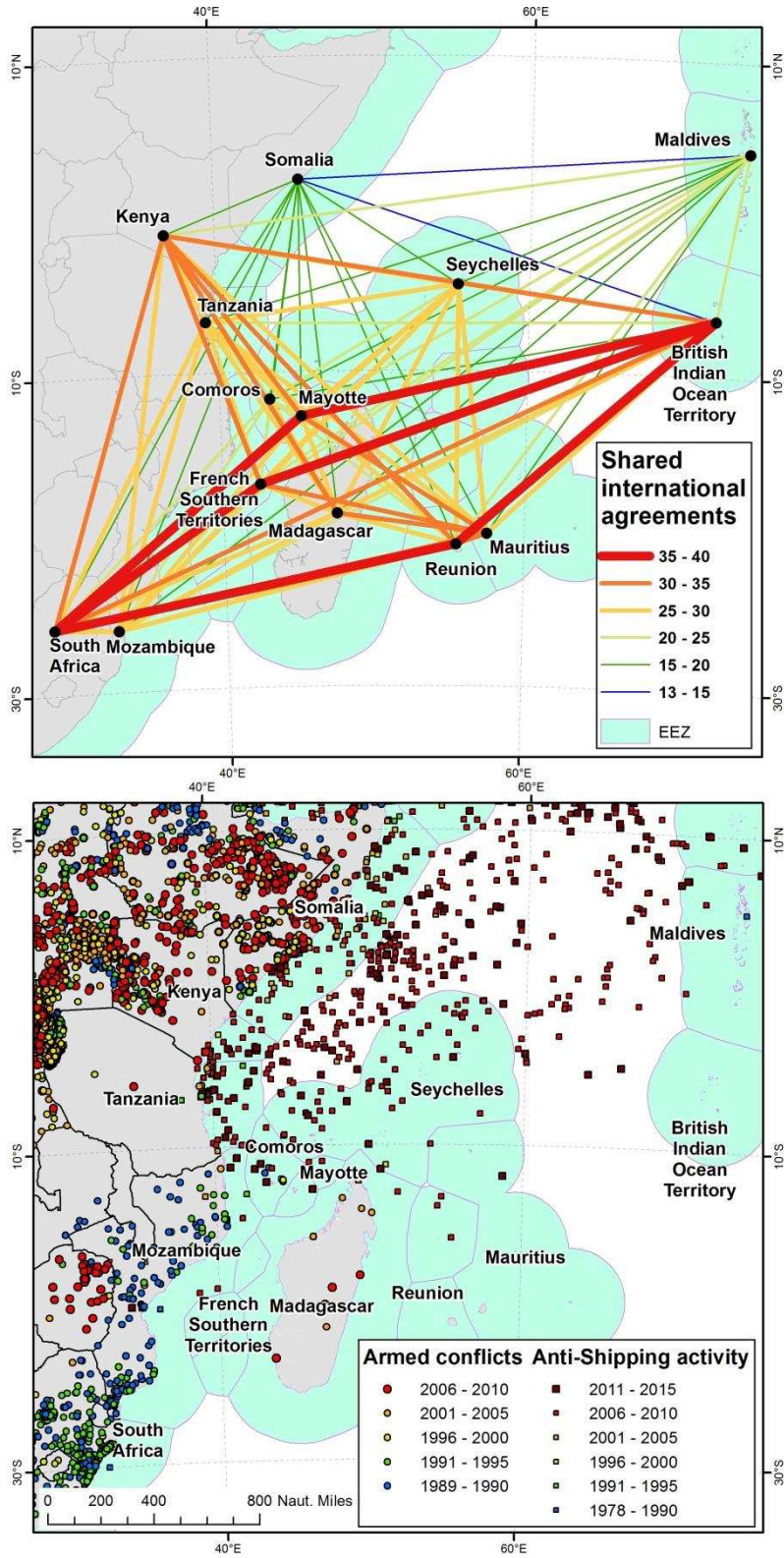


Figure 4

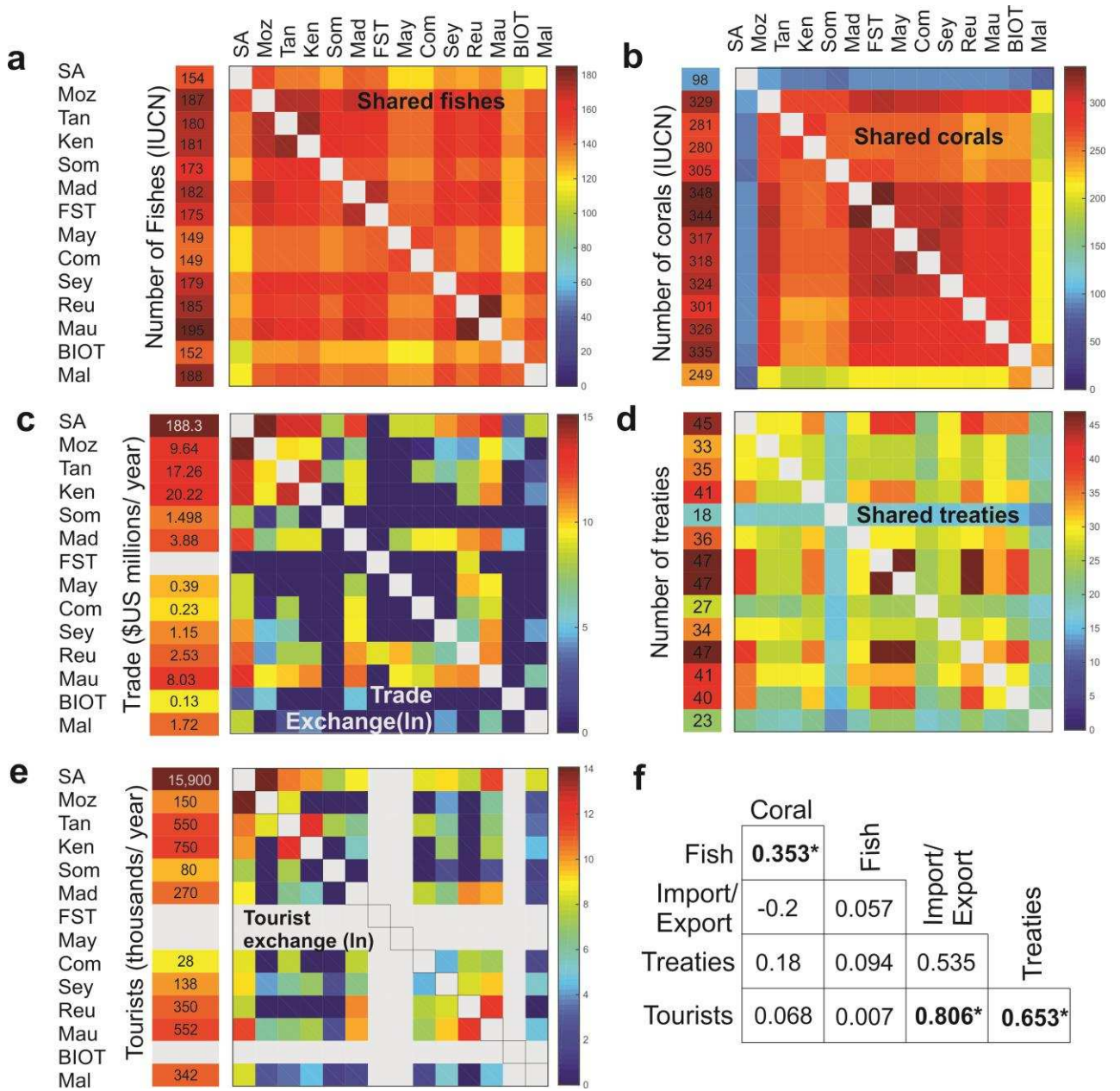


Figure 5

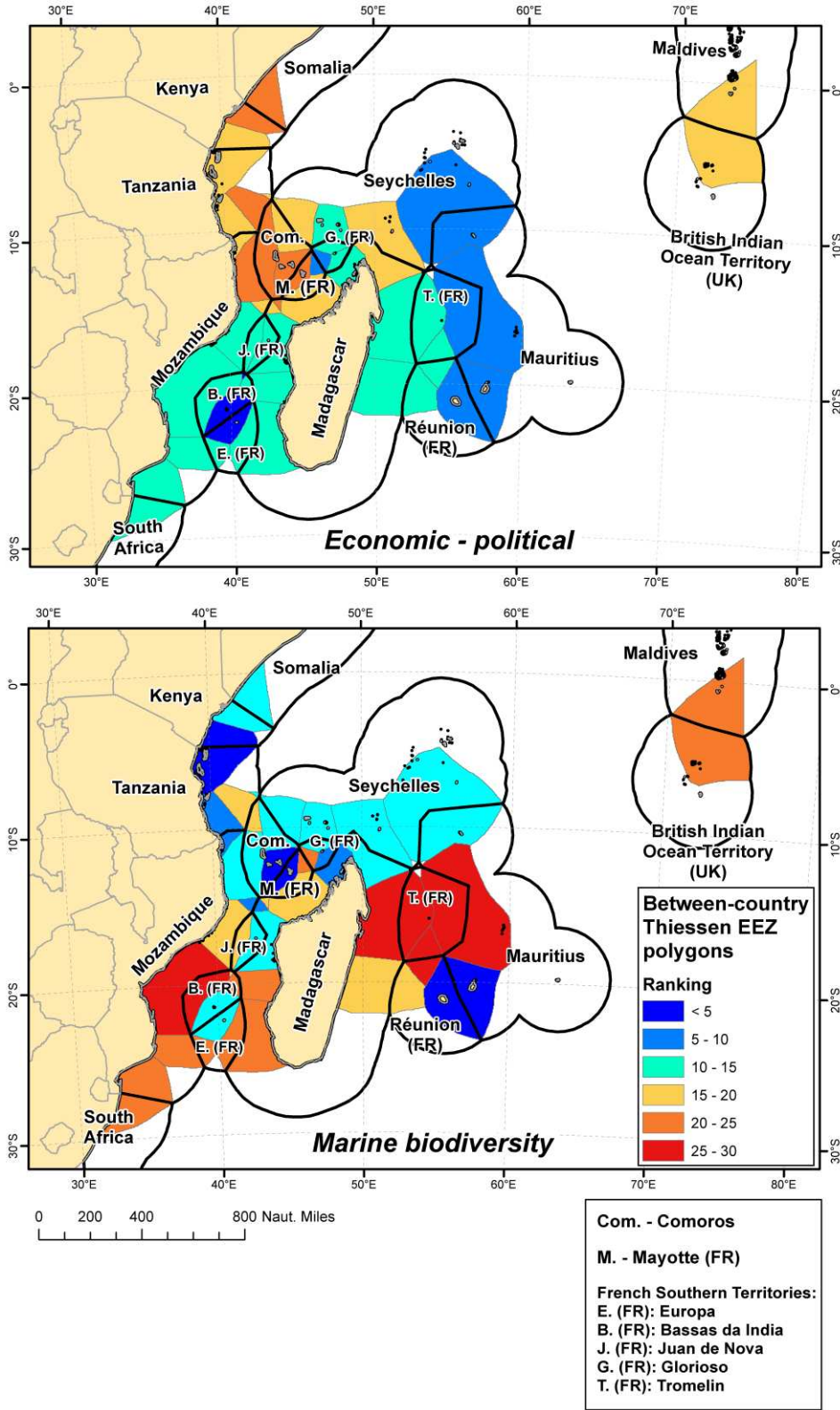


Figure 6



## Supplementary Methods

**Biodiversity data.** In order to evaluate the shared biodiversity (fish and coral species) between countries that is likely to form a basis for collaboration, we quantified species concurrence among Western Indian Ocean countries (existence of the same species in pairs of countries). To achieve this, we used data on the extent of occupancy of marine fish species and coral species compiled from the IUCN Red List of Threatened Species (2017), comprising of 274 fish species and 433 coral species. While the extent of occupancy of marine fish species data of the IUCN is not comprehensive, it is the best publicly available dataset of marine fish occupancy. The spatial extent of occupancy maps tends to overestimate species' geographic ranges (Jetz et al., 2008), yet our goal of determining presences of each species in the Indian Ocean countries was not affected because small island states are centrally located for most ranges. Based on these data, we derived a matrix of the number of shared species as well as the percent of shared species (out of the total number of the species) of each pair of Western Indian Ocean countries. In addition, we examined the total area of coral reefs under the jurisdiction of each country from 2010 Global Distribution of Coral Reefs data (UNEP-WCMC et al., 2010).

**Marine protected areas.** To examine the existing set of marine protected areas (MPAs) in the study area, we used the May 2014 version of the World Database of Protected Areas (WDPA; Protected Planet, 2014). Data for MPAs within the Comoros and the Maldives was derived from other sources as they were not included in the May 2014 edition of the WDPA (Comoros, 2001; EPA Maldives, 2014). We identified the number of all MPAs within each country (regardless of their IUCN level), the percent protected

area of each country's EEZ, and the percent of coral reef area contained within protected areas.

**Economic data.** We collated GDP and foreign aid statistics of all Western Indian Ocean countries (World Bank as of 2012; <http://data.worldbank.org/>, accessed May 27<sup>th</sup>, 2014). We used trade volume between countries to examine their economic interdependencies. We used 2012 trade statistics from TRADE MAP (<http://www.trademap.org/>, accessed May 26<sup>th</sup>, 2014). Trade data for Reunion was collected from the French government data web portal (<http://www.data.gouv.fr/fr/dataset/statistiques-regionales-et-departementales-du-commerce-exterieur>, accessed May 26<sup>th</sup>, 2014). Trade matrices between countries were constructed for all commodity types as well as for trade in marine produce only (including fish, crustaceans, mollusks, aquatic invertebrates; also from TRADE MAP, see above).

Based on these matrices, we calculated the relative share of each country's import and export between paired Western Indian Ocean countries, as well as between Western Indian Ocean countries and major countries in the world economy (e.g., United Kingdom, USA, France and China), both in absolute numbers and relative to the country's total import and export. We used the import and export trade matrices to determine which countries were more dependent on countries outside the Indian Ocean for their trade ties than other Indian Ocean countries, and to what degree different countries were trading with other Indian Ocean countries, following Levin et al. (2013).

**Fisheries data.** Data of pelagic fisheries within the Indian Ocean were derived from the Indian Ocean Tuna Commission (IOTC), including the total number of active vessels,

and total number of all catches and of all tuna catches, by the flag of vessels involved in this industry (<http://www.iotc.org>, accessed May 27<sup>th</sup>, 2014).

**Tourism data.** We collected data on tourism, a major source of income in coastal areas, from the World Tourism Organization (UNWTO, 2013) for each Indian Ocean country between the years 1995 and 2012, showing the total number of tourists arriving (inbound) and departing (outbound) between each pair of Indian Ocean countries. We calculated both the proportion of tourists per capita and the percentage of tourists coming from all African and European countries to each of the Indian Ocean countries. Estimates of the total numbers of domestic and international tourists in each country were based on Bigano et al. (2007). National income from international tourists was derived from the World Bank (<http://data.worldbank.org/>; accessed March 9<sup>th</sup>, 2015). We used 2012 demographic data (human population size) for all countries (<http://data.worldbank.org/>) for calculating the per capita values of trade and tourism factors.

**Political data.** To evaluate the political interactions between countries, we used the winter 2014 edition of the Global Maritime Boundaries Database (GMBD, 2014), to map maritime boundaries, claims, jurisdictions and conflicts within the Western Indian Ocean. We collated signatories of 59 major international and regional agreements and policies related to maritime conservation issues (based on [www.sWestern Indian Oceanfp.net/publications/appendix-v-treaties.xlsx](http://www.sWesternIndianOceanfp.net/publications/appendix-v-treaties.xlsx) from the South West Indian Ocean Fisheries Project, van der Elst et al., 2009; accessed on May 21<sup>st</sup>, 2014 and additional online sources), and created a matrix showing the number of shared international conservation agreements between Indian Ocean countries. The Rule of Law index of the World Bank captures perceptions of the extent to which agents have confidence in and

abide by the rules of society, and in particular the quality of contract enforcement, property rights, the police, and the courts, as well as the likelihood of crime and violence. We used the Rule of Law Index at the country level, derived from the World Bank (<http://databank.worldbank.org/> accessed June 12<sup>th</sup>, 2014), to quantify the effectiveness of governance at the country level. To complement this and to represent negative relationships between countries, we also collected information about military conflicts between Indian Ocean countries in the past 50 years (from 1964 onwards; Themnér and Wallensten, 2013; Uppsala Conflict Data Program, <http://www.pcr.uu.se/research/UCDP/>, accessed May 29<sup>th</sup>, 2014). This included information on the total number and length in time of military conflicts amongst Indian Ocean countries. For mapping maritime piracy, we used the Anti-shipping Activity Messages database, which includes the locations and descriptive accounts of specific hostile acts against ships and mariners (available from [http://msi.nga.mil/NGAPortal/MSI.portal?nfpb=true&st=&pageLabel=msi\\_portal\\_page\\_65](http://msi.nga.mil/NGAPortal/MSI.portal?nfpb=true&st=&pageLabel=msi_portal_page_65); accessed June 13<sup>th</sup>, 2014).

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## Supplementary figure legends

Figure S1: Population size and GDP per capita (as of 2012) for the western Indian Ocean countries.

Figure S2: The dependency of western Indian Ocean countries on imports and on foreign aid (top panel); Tourism in western Indian Ocean countries (data was not available for Somalia and Mayotte) (bottom panel).

Figure S3: Governance and the number of signed international maritime and environmental agreements, in western Indian Ocean countries.

Figure S4: Maritime boundary claims and disputes in the western Indian Ocean (source: GMBD, 2014).

Figure S5: The correspondence of the mean ranking of the Indian Ocean Thiessen polygons (shown in Figure 12), comparing the marine biodiversity and economic-political rankings. The labels show the names of the two countries sharing a Thiessen EEZ polygon. Low values stand for high ranking.

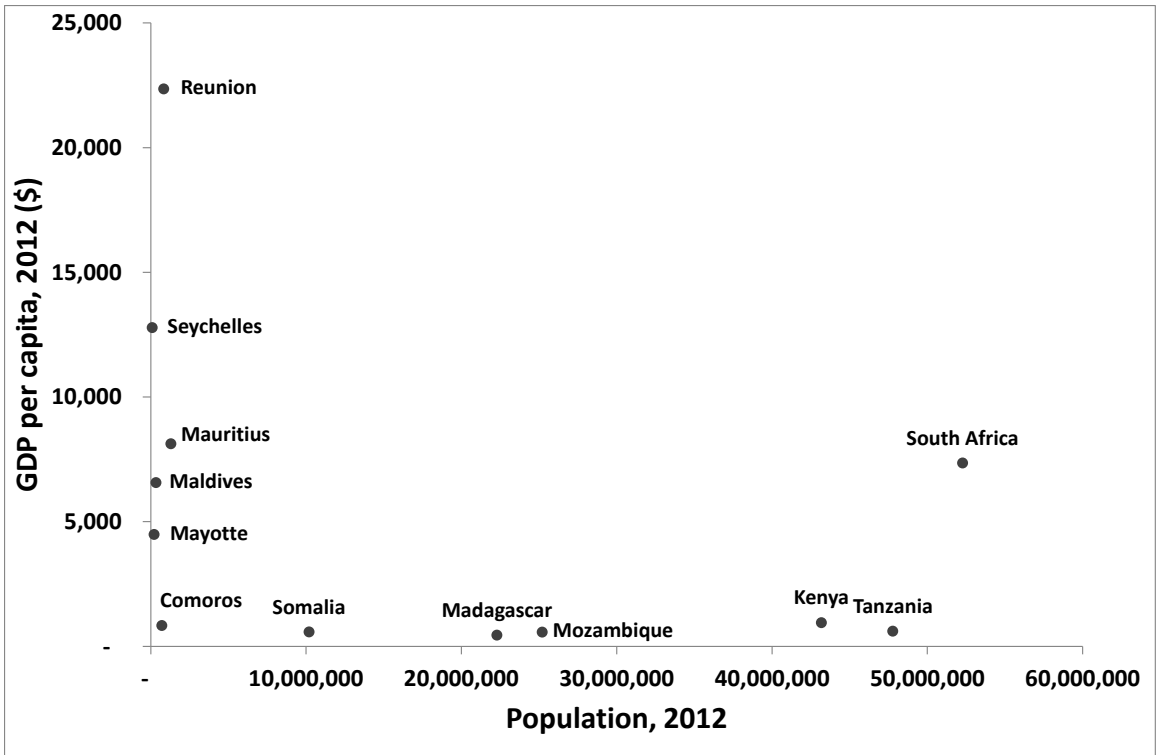


Figure S1



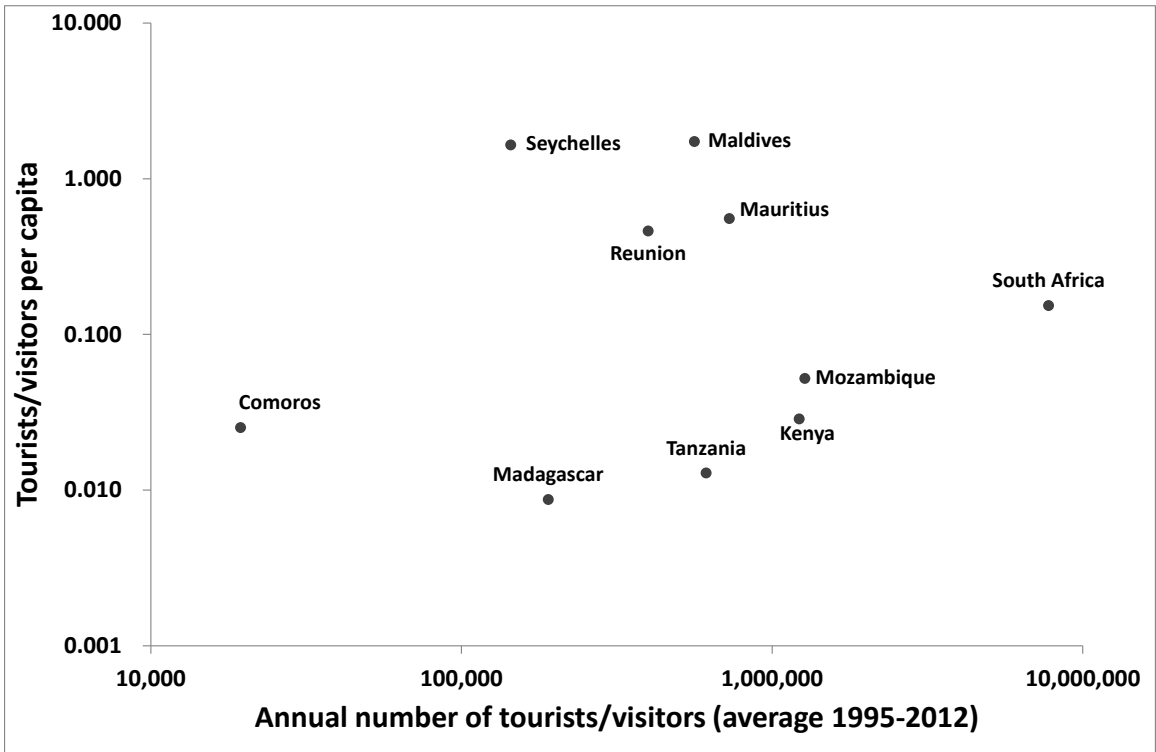
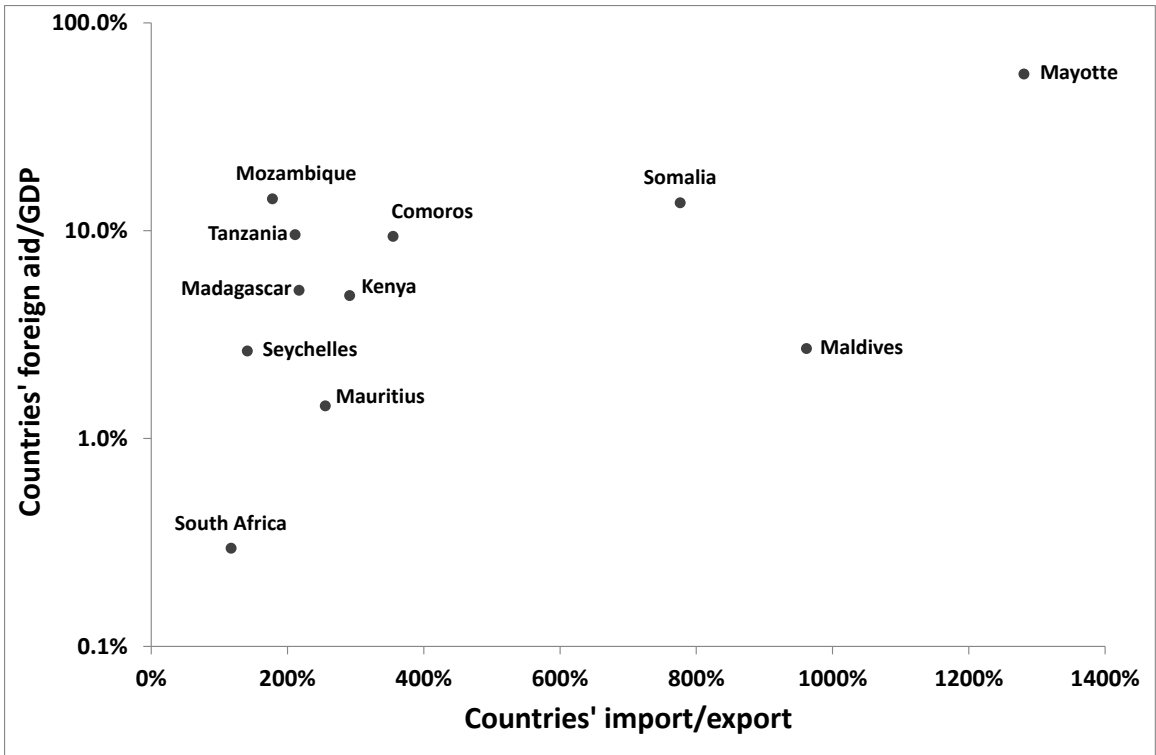


Figure S2

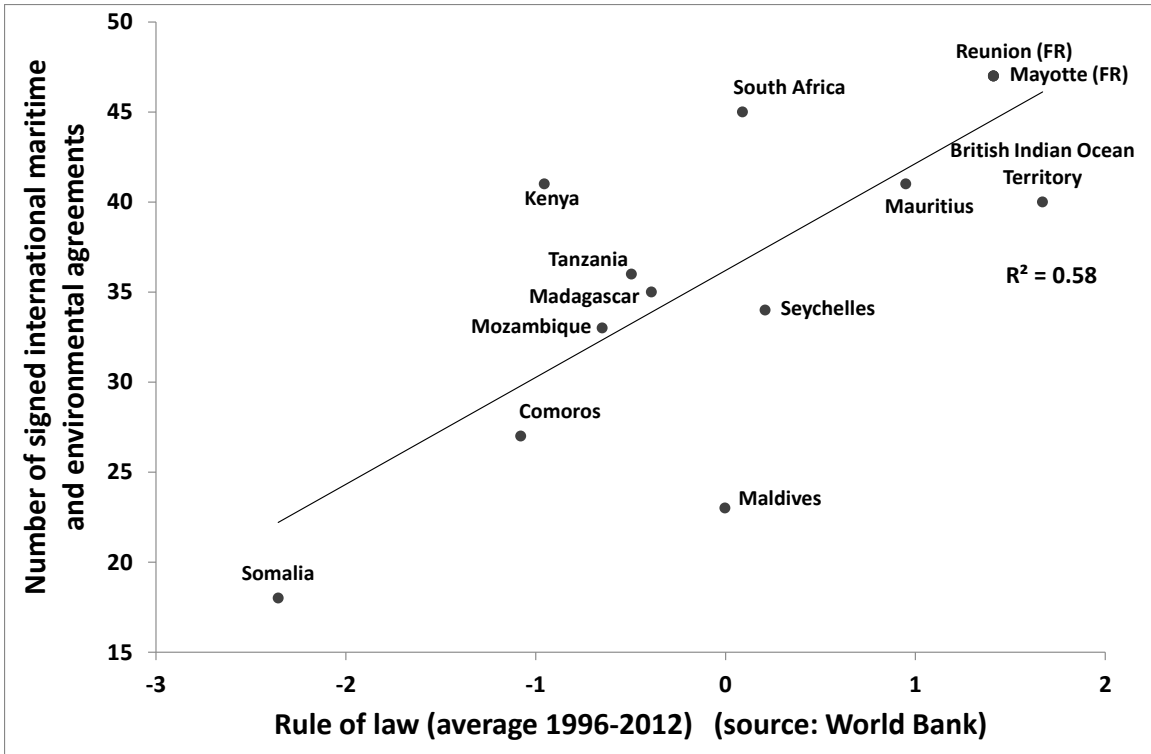


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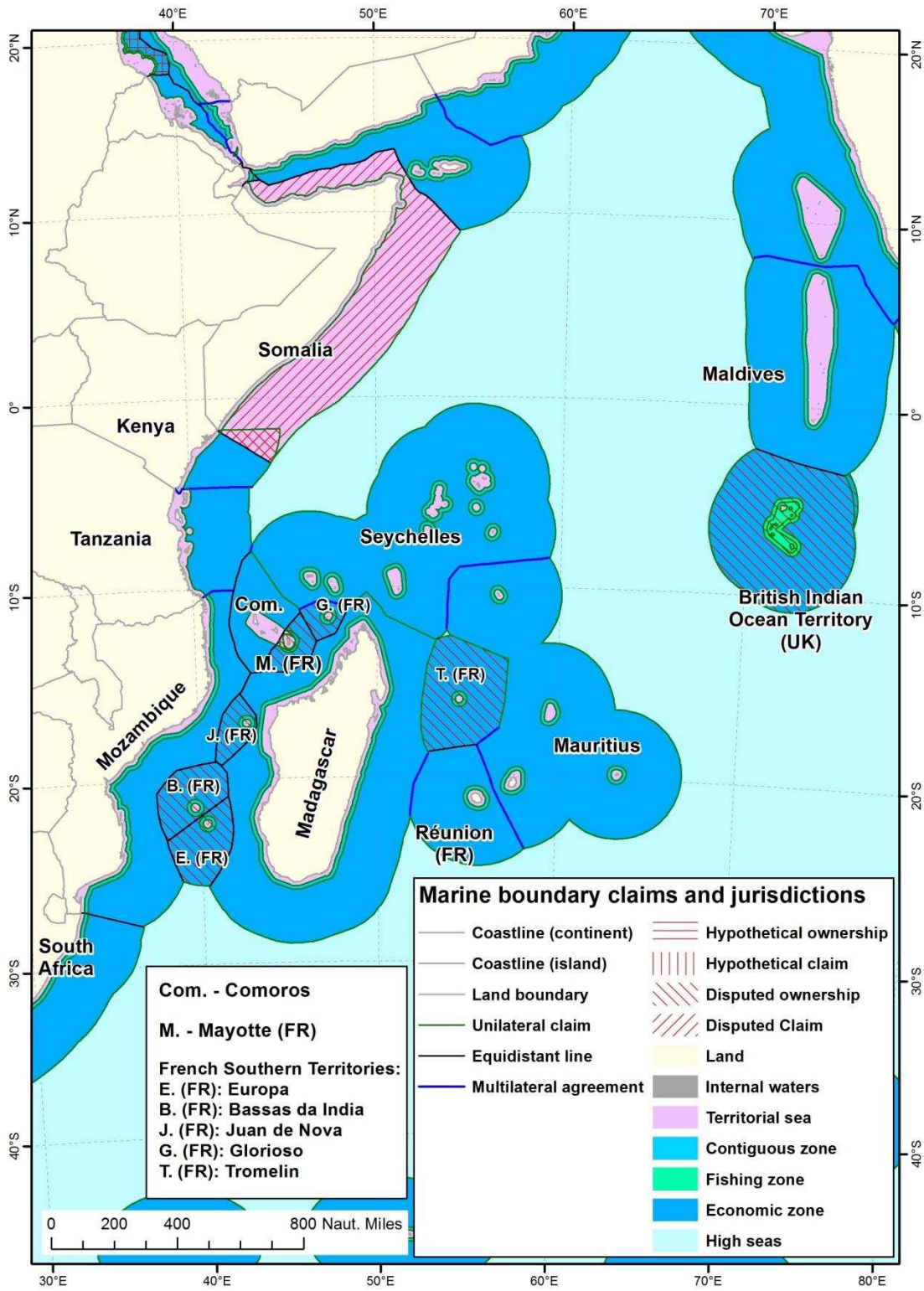


Figure S4

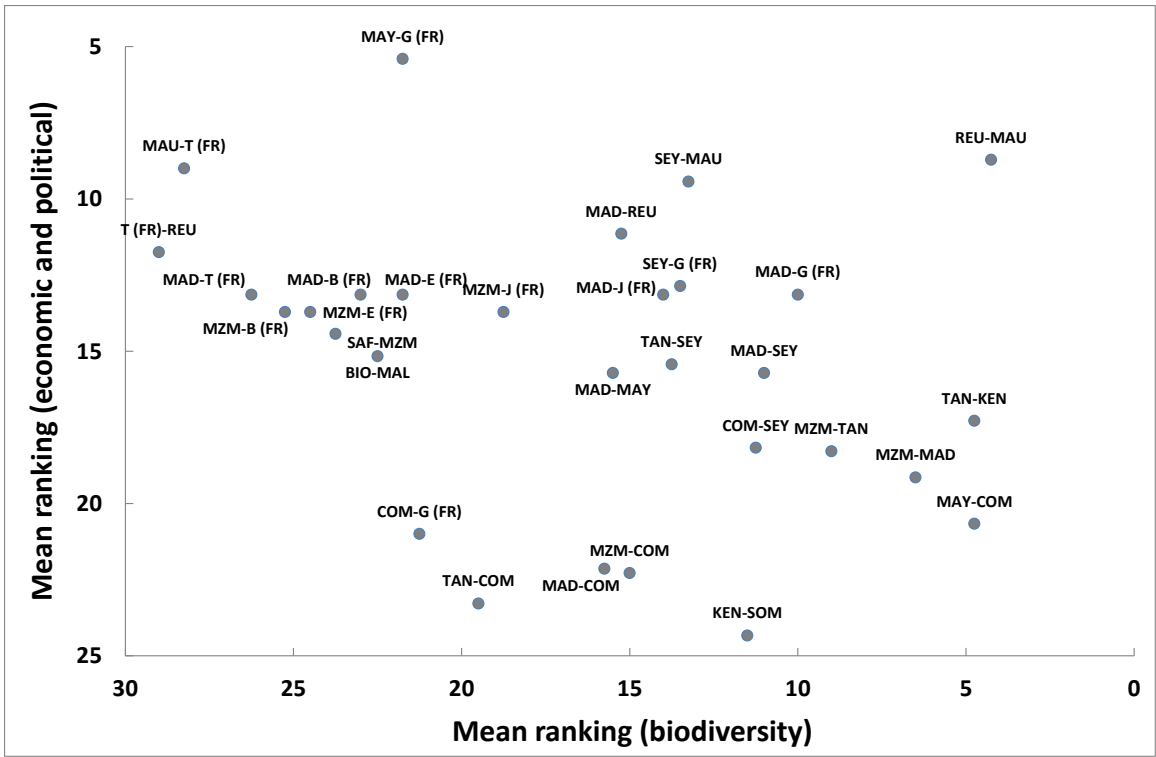


Figure S5

Table S1: The percent annual imports of countries shown in the top row of the table, by the country from which they import (values in % of total imports). Values above 5% are highlighted in red.

	British Indian Ocean Territories	Comoros	Kenya	Madagascar	Maldives	Mauritius	Mayotte (FR)	Mozambique	Reunion (FR)	Seychelles	Somalia	South Africa	Tanzania	Mean
British Indian Ocean Territories	#N/A	#N/A	#N/A	0.0%	#N/A	#N/A	#N/A	0.0%	0.0%	#N/A	#N/A	0.0%	#N/A	0.0%
Comoros	#N/A	#N/A	#N/A	0.0%	#N/A	0.0%	#N/A	0.0%	0.0%	#N/A	#N/A	0.0%	0.0%	0.0%
Kenya	#N/A	#N/A	#N/A	0.2%	0.0%	1.0%	#N/A	0.0%	0.1%	#N/A	#N/A	0.0%	4.8%	0.9%
Madagascar	0.0%	5.5%	0.0%	#N/A	#N/A	0.4%	0.7%	0.0%	0.9%	0.8%	#N/A	0.1%	0.0%	0.9%
Maldives	#N/A	#N/A	0.0%	#N/A	#N/A	0.0%	#N/A	#N/A	0.0%	0.0%	#N/A	0.0%	0.0%	0.0%
Mauritius	#N/A	3.0%	0.1%	2.9%	0.0%	#N/A	2.4%	0.1%	2.1%	4.4%	#N/A	0.2%	0.2%	1.5%
Mayotte (FR)	#N/A	#N/A	#N/A	0.0%	#N/A	0.1%	#N/A	#N/A	0.1%	#N/A	#N/A	0.0%	#N/A	0.0%
Mozambique	0.0%	0.0%	0.1%	0.1%	#N/A	0.5%	#N/A	#N/A	0.0%	0.0%	0.0%	1.2%	0.1%	0.3%
Reunion (FR)	0.0%	0.9%	0.0%	0.8%	0.0%	0.2%	7.7%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	1.2%
Seychelles	#N/A	#N/A	#N/A	0.4%	0.0%	0.3%	#N/A	0.0%	0.0%	#N/A	#N/A	0.0%	0.0%	0.1%
Somalia	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	0.0%	0.0%	#N/A	#N/A	0.0%	0.0%	0.0%
South Africa	0.0%	3.1%	4.8%	5.7%	0.3%	6.5%	1.6%	31.4%	5.7%	7.0%	0.2%	#N/A	8.0%	6.7%

Tanzania	#N/A	1.5%	2.3%	0.3%	#N/A	0.1%	#N/A	0.3%	0.1%	0.1%	0.1%	0.1%	#N/A	0.5%
Western Indian Ocean (total)	0.0%	14.0%	7.2%	10.4%	0.3%	9.1%	12.4%	31.9%	9.2%	12.2%	0.3%	1.6%	13.1%	10.1%
Australia	0.0%	0.1%	0.3%	0.7%	2.0%	2.2%	#N/A	0.6%	0.5%	0.8%	0.0%	1.4%	1.1%	0.9%
China	0.0%	8.2%	18.5%	14.3%	4.4%	16.1%	6.4%	5.7%	10.7%	4.9%	7.6%	14.4%	9.9%	10.1%
France	0.0%	17.4%	2.0%	6.0%	1.0%	8.3%	68.5%	0.4%	1.9%	9.8%	1.0%	2.4%	0.9%	10.0%
Germany	1.6%	2.5%	2.6%	2.4%	1.8%	2.4%	1.4%	0.7%	4.8%	2.4%	0.2%	10.1%	1.6%	2.6%
India	#N/A	10.5%	25.0%	4.9%	9.5%	22.5%	#N/A	3.3%	2.7%	4.6%	15.0%	4.5%	7.5%	10.0%
Singapore	86.8%	6.4%	0.7%	1.4%	18.1%	0.7%	0.1%	0.7%	26.9%	6.6%	0.1%	1.2%	1.3%	11.6%
Spain	0.0%	1.6%	1.0%	1.6%	0.2%	3.3%	0.9%	0.3%	4.3%	20.4%	0.0%	1.2%	0.4%	2.9%
UK	0.0%	0.5%	4.1%	1.0%	1.1%	2.0%	0.1%	6.0%	1.9%	4.8%	0.9%	3.5%	3.1%	2.4%
USA	2.4%	0.5%	3.9%	3.7%	2.9%	2.1%	3.2%	4.1%	0.6%	2.2%	1.2%	7.4%	2.0%	2.8%

Table S2: The percent annual exports of countries shown in the top row of the table, by the country to which they export (values in % of total exports). Values above 5% are highlighted in red.

	British Indian Ocean Territories	Comoros	Kenya	Madagascar	Maldives	Mauritius	Mayotte (FR)	Mozambique	Reunion (FR)	Seychelles	Somalia	South Africa	Tanzania	Mean
British Indian Ocean Territories	#N/A	#N/A	#N/A	0.0%	#N/A	#N/A	#N/A	0.0%	0.0%	#N/A	#N/A	0.0%	#N/A	
Comoros	#N/A	#N/A	#N/A	0.8%	#N/A	0.2%	#N/A	0.0%	0.6%	#N/A	#N/A	0.0%	0.0%	0.4%
Kenya	#N/A	#N/A	#N/A	0.3%	0.0%	0.4%	#N/A	0.2%	0.0%	#N/A	#N/A	0.8%	6.3%	1.3%
Madagascar	0.5%	0.4%	0.1%	#N/A	#N/A	6.9%	0.5%	0.0%	8.2%	2.0%	#N/A	0.2%	0.1%	1.9%
Maldives	#N/A	#N/A	0.0%	#N/A	#N/A	0.0%	#N/A	#N/A	0.0%	0.0%	#N/A	0.0%	0.0%	0.0%
Mauritius	#N/A	2.2%	1.1%	1.4%	0.0%	#N/A	15.5%	0.2%	4.4%	3.3%	#N/A	0.4%	0.1%	3.2%
Mayotte (FR)	#N/A	#N/A	#N/A	0.2%	#N/A	0.4%	#N/A	#N/A	10.4%	#N/A	#N/A	0.0%	#N/A	2.8%
Mozambique	0.6%	0.0%	0.1%	0.0%	#N/A	0.0%	#N/A	#N/A	0.0%	0.0%	0.0%	2.8%	1.0%	0.5%
Reunion (FR)	0.0%	0.1%	0.0%	1.6%	0.0%	2.1%	6.1%	0.0%	0.0%	0.1%	0.0%	0.1%	0.0%	1.1%
Seychelles	#N/A	#N/A	#N/A	0.4%	0.0%	1.3%	#N/A	0.0%	0.0%	#N/A	#N/A	0.1%	0.0%	0.4%
Somalia	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	0.0%	0.0%	#N/A	#N/A	0.0%	0.0%	0.0%
South Africa	0.1%	0.5%	0.6%	3.3%	0.0%	9.8%	0.0%	19.2%	0.2%	0.2%	0.0%	#N/A	17.7%	4.7%

Tanzania	#N/A	0.0%	10.9%	0.2%	#N/A	0.3%	#N/A	0.1%	0.0%	0.0%	0.0%	0.8%	#N/A	1.8%
Western Indian Ocean (total)	1.2%	3.2%	12.8%	8.2%	0.0%	21.5%	22.1%	19.7%	25.1%	5.7%	0.0%	5.2%	25.4%	12.5%
Australia	0.0%	0.0%	0.3%	0.1%	0.5%	0.4%	#N/A	0.0%	0.0%	0.5%	0.0%	1.0%	0.3%	0.3%
China	0.0%	0.0%	1.0%	8.4%	2.4%	0.4%	0.4%	18.4%	0.7%	0.1%	1.8%	11.7%	9.5%	4.6%
France	0.3%	12.7%	1.9%	29.1%	16.5%	16.0%	34.4%	0.1%	0.0%	26.3%	1.2%	1.0%	0.4%	11.7%
Germany	0.1%	7.0%	2.8%	6.2%	3.4%	1.8%	0.0%	0.5%	4.3%	0.5%	0.3%	4.8%	5.3%	3.1%
India	0.0%	11.1%	2.0%	5.5%	1.8%	0.8%	0.0%	4.5%	6.2%	0.5%	4.7%	4.2%	8.7%	4.5%
Singapore	28.7%	23.2%	0.2%	4.0%	0.1%	0.8%	0.0%	0.8%	1.2%	0.2%	0.0%	1.0%	0.5%	4.7%
Spain	0.4%	0.4%	0.7%	2.6%	2.3%	7.9%	36.6%	1.5%	11.4%	2.0%	0.1%	1.0%	0.3%	5.2%
UK	0.0%	0.6%	9.1%	1.9%	7.4%	18.8%	0.0%	5.1%	5.6%	17.1%	0.1%	3.9%	0.9%	6.4%
USA	61.7%	4.0%	7.8%	4.4%	3.1%	10.1%	0.1%	1.8%	4.7%	1.0%	0.2%	8.7%	1.3%	8.4%



**Table S3:** Environmental and marine treaties included in our analysis. Grey cells indicate that a country is a signatory side to a treaty. Treaties are organized by the following classes: General Environmental Treaties (11), General Marine, Marine Pollution and Shipping Conventions (23), Global Fisheries Conventions (4), Wildlife/Heritage Conventions (7) and Regional Conventions (15).

	South Africa	Mozambique	Tanzania	Kenya	Somalia	Madagascar	French Southern Territories	Mayotte	Comoros	Seychelles	Reunion	Mauritius	BIOT	Maldives
<b>General Environmental Treaties</b>														
Vienna Convention for the Protection of the Ozone Layer														
VCPOL - Montreal Protocol														
Basel Convention on the Control of Transboundary Movement of Hazardous Wastes and their Disposal														
1999 Protocol on Liability and Compensation for Damage resulting from Transboundary Movement of Hazardous Waste and their Disposal														

1992 United Nations Framework Convention on Climate Change														
1997 Kyoto Protocol to UNFCCC														
1992 Convention on Biological Diversity ( <a href="http://www.cbd.int/convention/parties/list/">http://www.cbd.int/convention/parties/list/</a> )														
Cartagena Protocol on Biosafety to the Convention on Biodiversity ( <a href="http://www.cbd.int/convention/parties/list/#tab=1">http://www.cbd.int/convention/parties/list/#tab=1</a> )														
1994 Convention to Combat Desertification in those Countries Experiencing Serious Drought and/or Desertification, Particularly in Africa														
1998 Rotterdam Convention on the Prior Informed Consent Procedure for certain														

Hazardous Chemicals and Pesticides in International Trade														
2001 Stockholm Convention on Persistent Organic Pollutants														
<b>General Marine, Marine Pollution and Shipping Conventions</b>														
1948 Convention on the International Maritime Organization														
1954 International Convention for the Prevention of Pollution of the Sea, (OILPOL) ( <a href="http://www.ilaw.com/ilaw/doc/view.htm?id=131747">http://www.ilaw.com/ilaw/doc/view.htm?id=131747</a> )														
1958 Geneva Convention on the Territorial Sea and Contiguous Zone ( <a href="http://www.ilaw.com/ilaw/doc">http://www.ilaw.com/ilaw/doc</a> )														

/view.htm?id=131565)														
1958 Geneva Convention on the High Seas, 1958 ( <a href="http://www.ilaw.com/ilaw/doc/view.htm?id=131563">http://www.ilaw.com/ilaw/doc/view.htm?id=131563</a> )														
1958 Geneva Convention on Fishing and Conservation of the Living Resources of the High Seas ( <a href="http://www.ilaw.com/ilaw/doc/view.htm?id=131564">http://www.ilaw.com/ilaw/doc/view.htm?id=131564</a> )														
1958 Convention on the Continental Shelf ( <a href="http://www.ilaw.com/ilaw/doc/view.htm?id=131566">http://www.ilaw.com/ilaw/doc/view.htm?id=131566</a> )														
1958 Optional Protocol of Signature concerning the Compulsory Settlement of Disputes ( <a href="http://www.i-">http://www.i-</a>														

law.com/ilaw/doc/view.htm?id=131567)														
1969 International Convention relating to intervention on the high seas in cases of oil pollution casualties( <a href="http://www.ilaw.com/ilaw/doc/view.htm?id=131756">http://www.ilaw.com/ilaw/doc/view.htm?id=131756</a> )														
1973 Protocol relating to intervention on the high seas in cases of pollution by substances other than oil ( <a href="http://www.ilaw.com/ilaw/doc/view.htm?id=131757">http://www.ilaw.com/ilaw/doc/view.htm?id=131757</a> )														
1969 International Convention on Civil Liability for Oil Pollution Damage ( <a href="http://www.ilaw.com/ilaw/doc/view.htm?id=131751">http://www.ilaw.com/ilaw/doc/view.htm?id=131751</a> )														

<p>1972 Convention on the prevention of marine pollution by dumping of wastes and other matter (<a href="http://www.ilaw.com/ilaw/doc/view.htm?id=131767">http://www.ilaw.com/ilaw/doc/view.htm?id=131767</a>)</p>														
<p>1996 Protocol to the 1972 Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (<a href="http://www.ilaw.com/ilaw/doc/view.htm?id=131768">http://www.ilaw.com/ilaw/doc/view.htm?id=131768</a>)</p>														
<p>Protocol of 1978 relating to the International Convention for the prevention of pollution from ships, 1973 (<a href="http://www.ilaw.com/ilaw/doc/view.htm?id=131769">http://www.ilaw.com/ilaw/doc/view.htm?id=131769</a>)</p>														
<p>1974 International Convention for the Safety of Life at Sea</p>														

( <a href="http://www.ilaw.com/ilaw/doc/view.htm?id=131611">http://www.ilaw.com/ilaw/doc/view.htm?id=131611</a> )														
1982 United Nations Convention on the Law of the Sea ( <a href="http://www.ilaw.com/ilaw/doc/view.htm?id=131568">http://www.ilaw.com/ilaw/doc/view.htm?id=131568</a> )														
1990 International Convention on oil pollution preparedness, response and cooperation ( <a href="http://www.ilaw.com/ilaw/doc/view.htm?id=131780">http://www.ilaw.com/ilaw/doc/view.htm?id=131780</a> )														
1996 International Convention on Liability and Compensation for Damage in Connection with the Carriage of Hazardous and Noxious Substances by Sea ( <a href="http://www.ilaw.com/ilaw/doc/view.htm?id=13">http://www.ilaw.com/ilaw/doc/view.htm?id=13</a> )														

1765)														
2001 Convention on Civil Liability for Bunker Oil Pollution Damage ( <a href="http://www.ilaw.com/ilaw/doc/view.htm?id=131766">http://www.ilaw.com/ilaw/doc/view.htm?id=131766</a> )														
2001 International Convention on the Control of Harmful Anti-Fouling Systems ( <a href="http://www.ilaw.com/ilaw/doc/view.htm?id=131782">http://www.ilaw.com/ilaw/doc/view.htm?id=131782</a> )														
2004 International Convention for the Control and Management of Ships' Ballast Water and Sediment ( <a href="http://www.ilaw.com/ilaw/doc/view.htm?id=131783">http://www.ilaw.com/ilaw/doc/view.htm?id=131783</a> )														



1992 Convention for the Suppression of Unlawful Acts against the Safety of Maritime Navigation ( <a href="http://www.ilaw.com/ilaw/doc/view.htm?id=131639">http://www.ilaw.com/ilaw/doc/view.htm?id=131639</a> )														
Protocol to the Convention of 10 March 1988 for the suppression of unlawful acts against the safety of fixed platforms located on the continental shelf ( <a href="http://www.ilaw.com/ilaw/doc/view.htm?id=131640">http://www.ilaw.com/ilaw/doc/view.htm?id=131640</a> )														
2007 Nairobi Convention on the Removal of Wrecks ( <a href="http://www.ilaw.com/ilaw/doc/view.htm?id=264798">http://www.ilaw.com/ilaw/doc/view.htm?id=264798</a> )														
<b>Global Fisheries Conventions</b>														
1946 Convention on the Regulation of Whaling														

( <a href="http://iwc.int/members">http://iwc.int/members</a> )														
1993 FAO Agreement to Promote Compliance with International Conservation and Management Measures by Fishing Vessels on the High Seas (Compliance Agreement) ( <a href="http://www.fao.org/fileadmin/user_upload/legal/docs/1_012s-e.pdf">http://www.fao.org/fileadmin/user_upload/legal/docs/1_012s-e.pdf</a> )														
UN Agreement for the Implementation of the Provisions of the 1982 Law of the Sea Convention relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks (title abbreviated: UN Fish Stocks Agreement)														

2009 FAO Convention on Port State Measures ( <a href="http://www.fao.org/fileadmin/user_upload/legal/docs/2_037s-e.pdf">http://www.fao.org/fileadmin/user_upload/legal/docs/2_037s-e.pdf</a> )														
<b>Wildlife/Heritage Conventions</b>														
1971 Convention on Wetlands of International Importance Especially as Waterfowl Habitat (“Ramsar”),														
1982 Protocol to amend the Convention on Wetlands of International Importance Especially as Waterfowl Habitat,														
1972 Convention Concerning the Protection of the World’s Cultural and Natural Heritage, ( <a href="http://whc.unesco.org/en/statesparties/">http://whc.unesco.org/en/statesparties/</a> )														

Convention on International Trade in Endangered Species of Wild Fauna and Flora, 1973, "CITES" ( <a href="http://www.cites.org/eng/disc/parties/chronolo.php">http://www.cites.org/eng/disc/parties/chronolo.php</a> )															
1979 Convention on the Conservation of Migratory Species of Wild Animals, 1979 ( <a href="http://www.cms.int/about/partylist_e.pdf">http://www.cms.int/about/partylist_e.pdf</a> )															
Convention on the Protection of the Underwater Cultural Heritage, ( <a href="http://www.unesco.org/eri/la/convention.asp?KO=13520&amp;language=E&amp;order=alpha">http://www.unesco.org/eri/la/convention.asp?KO=13520&amp;language=E&amp;order=alpha</a> )															
2001 Agreement on the Conservation of Albatrosses and Petrels, ( <a href="http://acap.aq/index.php/resources/parties-to-acap">http://acap.aq/index.php/resources/parties-to-acap</a> )															

<b>Regional Conventions</b>														
1968 African Convention on Conservation of Nature and Natural Resources														
1984 Indian Ocean Commission ( <a href="http://commissionoceanindien.org/membres/">http://commissionoceanindien.org/membres/</a> )														
1985 Convention for the Protection, Management and Development of the Marine and Coastal Environment of the Eastern African Region, 1985 "Nairobi" ( <a href="http://www.unep.org/NairobiConvention/The_Convention/index.asp">http://www.unep.org/NairobiConvention/The_Convention/index.asp</a> )														
1985 Protocol concerning Co-operation in Combating Marine Pollution in Cases of Emergency in the Eastern African Region (Emergency														

Protocol) ( <a href="http://www.unep.org/NairobiConvention/The_Convention/index.asp">http://www.unep.org/NairobiConvention/The_Convention/index.asp</a> )														
1985 Protocol Concerning Protected Areas and Wild Fauna and Flora in the Eastern African Region ( <a href="http://www.unep.org/NairobiConvention/The_Convention/index.asp">http://www.unep.org/NairobiConvention/The_Convention/index.asp</a> )														
1991 Bamako Convention on Control of Transboundary Movement and Management of Hazardous Waste within Africa														
1992 Treaty of the Southern African Development Community														
1993 Indian Ocean Tuna Commission (IOTC) ( <a href="http://en.wikipedia.org/wiki/Indian_Ocean_Tuna">http://en.wikipedia.org/wiki/Indian_Ocean_Tuna</a> )														

Commission)														
1994 Common Market for East and Southern Africa (COMESA)														
1994 Lusaka Agreement on Co-operative Enforcement Operations Directed at Illegal Trade in Wild Fauna and Flora, Lusaka, 1994 ( <a href="http://lusakaagreement.org/?page_id=24#">http://lusakaagreement.org/?page_id=24#</a> )														
1999 Port State MOU for the Indian Ocean region, ( <a href="http://www.iomou.org/historymain.htm">http://www.iomou.org/historymain.htm</a> )														
2000 East African Community ( <a href="http://en.wikipedia.org/wiki/East_African_Community_Treaty">http://en.wikipedia.org/wiki/East_African_Community_Treaty</a> )														

2001 Agreement Amending the Treaty of the Southern African Development Community,														
1995 Protocol on Shared Watercourse Systems in the Southern African Development Community,														
2000 Revised Protocol on Shared Watercourses in the Southern African Development Community Region,														



**Table S4:** National GEF marine projects in the Western Indian Ocean (\$US)

GEF_ID	Project Name	Country	Focal Area	Agency	GEF Grant	Co-financing	Status
535	Biodiversity Conservation and Marine Pollution Abatement	Seychelles	Biodiversity	The World Bank	1,800,000	200,000	Completed
648	Coastal and Marine Biodiversity Management Project	Mozambique	Biodiversity	The World Bank	3,730,000	6,400,000	Completed
780	Development of Mnazi Bay Marine Park	Tanzania	Biodiversity	United Nations Development Programme	1,495,424	2,073,800	Completed
800	Marine Ecosystem Management Project	Seychelles	Biodiversity	The World Bank	747,000	656,000	Completed
803	Jozani Chwaka Bay National Park Development	Tanzania	Biodiversity	United Nations Development Programme	747,500	845,050	Completed
1099	Atoll Ecosystem-based Conservation of Globally Significant Biological Diversity in the Maldives' Baa Atoll	Maldives	Biodiversity	United Nations Development Programme	2,370,100	4,653,370	Completed
1246	Partnerships for Marine Protected Areas in Mauritius	Mauritius	Biodiversity	United Nations Development Programme	978,000	3,365,260	Completed
2101	Marine and Coastal Environment Management Project (MACEMP)	Tanzania		The World Bank	10,000,000	52,750,000	Completed
3138	Applying an Ecosystem-based Approach to Fisheries Management: Focus on Seamounts in the Southern Indian Ocean	Global	International Waters	United Nations Development Programme	950,000	4,760,000	Project Approved
3313	SP-SFIF: Kenya Coastal Development Project	Kenya	International Waters	The World Bank	5,000,000	36,470,000	Project Approved

3363	SIP: Integrated Ecological Planning and Sustainable Land Management in Coastal Ecosystems in the Comoros in the Three Island of (Grand Comore, Anjouan, and Moheli)	Comoros	Biodiversity, Land Degradation	International Fund for Agricultural Development	1,000,000	1,872,000	Project Approved
4276	Adaptation in the Coastal Zones of Mozambique	Mozambique	Climate Change	United Nations Development Programme	4,433,000	9,677,000	Project Approved
4568	Adapting Coastal Zone Management to Climate Change in Madagascar Considering Ecosystem and Livelihoods	Madagascar	Climate Change	United Nations Environment Programme	5,337,500	12,050,000	Project Approved
4717	Expansion and Strengthening of the Protected Area Subsystem of the Outer Islands of Seychelles and its Integration into the Broader Land and Seascape	Seychelles	Biodiversity, Land Degradation	United Nations Development Programme	1,785,500	10,434,049	Project Approved
5062	Development of a National Network of Terrestrial and Marine Protected Areas Representative of the Comoros Unique Natural Heritage and Co-managed with Local Village Communities	Comoros	Biodiversity	United Nations Development Programme	4,246,000	21,630,314	Project Approved
5514	Mainstreaming Biodiversity into the Management of the Coastal Zone in the Republic of Mauritius	Mauritius	Biodiversity, Land Degradation	United Nations Development Programme	4,664,521	17,139,177	Project Approved
6983	Mozambique: Building Resilience in the Coastal Zone through Ecosystem Based Approaches to Adaptation (EbA).	Mozambique	Climate Change	United Nations Environment Programme	6,000,000	24,903,784	Concept Approved
9433	S3MR Sustainable Management of Madagascar's Marine Resources	Madagascar	International Waters, Biodiversity	World Wildlife Fund - US Chapter	6,284,404	39,962,250	Concept Approved

9563	Third South West Indian Ocean Fisheries Governance and Shared Growth Project (SWIOFish3)	Seychelles	Biodiversity, International Waters	The World Bank	10,292,110	54,000,000	Project Approved
9692	Second South West Indian Ocean Fisheries Governance and Shared Growth Project (SWIOFish2)	Madagascar	International Waters	The World Bank	6,422,018	83,729,400	Project Approved

**Table S5:** Regional GEF marine projects in the Western Indian Ocean (\$US)

GEF_ID	Project Name	Countries	Focal Area	Agency	GEF Grant	Co-financing	Status
88	Lake Victoria Environmental Management	Kenya, Tanzania, Uganda	International Waters	The World Bank	35,000,000	42,600,000	Completed
398	Pollution Control and Other Measures to Protect Biodiversity in Lake Tanganyika	Tanzania, Congo DR, Burundi, Zambia	International Waters	United Nations Development Programme	10000000	0	Completed
533	Western Indian Ocean Islands Oil Spill Contingency Planning	Comoros, Seychelles, Madagascar, Mauritius	International Waters	The World Bank	3,152,000	1,485,000	Completed
789	Implementation of the Strategic Action Programme (SAP) Toward Achievement of the Integrated Management of the Benguela Current Large Marine Ecosystem (LME)	Angola, Namibia, South Africa	International Waters	United Nations Development Programme	15,114,000	23,559,750	Completed
814	Coral Reef Monitoring Network in Member States of the Indian Ocean Commission (COI), within the Global Reef Monitoring Network (GCRMN)	Comoros, Mauritius, Seychelles, Madagascar	Biodiversity	The World Bank	737,240	623,847	Completed
849	Development and Protection of the Coastal and Marine Environment in Sub-Saharan Africa	Cote d'Ivoire, Ghana, Kenya, Mozambique, Nigeria, Seychelles, South Africa	International Waters	United Nations Environment Programme	750,000	975,000	Completed
970	Groundwater and Drought Management in SADC	Botswana, South Africa, Zimbabwe, Mozambique	International Waters	The World Bank	7,000,000	6,120,000	Completed

1017	Partnership Interventions for the Implementation of the Strategic Action Programme (SAP) for Lake Tanganyika	Burundi, Congo DR, Tanzania, Zambia	International Waters	United Nations Development Programme	13,500,000	43,500,000	Project Approved
1082	Southwest Indian Ocean Fisheries Project - SWIOFP	Comoros, Kenya, Mauritius, Mozambique, Seychelles, South Africa, Tanzania		The World Bank	12,000,000	17,510,000	Completed
1094	Nile Transboundary Environmental Action Project, Tranche 1	Burundi, Congo DR, Egypt, Eritrea, Ethiopia, Kenya, Rwanda, Sudan, Tanzania	International Waters	The World Bank	16,800,000	93,700,000	Completed
1223	Removal of Barriers to the Introduction of Cleaner Artisanal Gold Mining and Extraction Technologies	Brazil, Indonesia, Lao PDR, Sudan, Tanzania, Zimbabwe	International Waters	United Nations Development Programme	6,806,800	13,052,000	Completed
1247	Addressing Land-based Activities in the Western Indian Ocean (WIO-LaB)	Comoros, Kenya, Madagascar, Mauritius, Mozambique, Seychelles, South Africa, Tanzania	International Waters	United Nations Environment Programme	4,186,140	6,902,325	Completed
1247	Addressing Land-based Activities in the Western Indian Ocean (WIO-LaB)	Comoros, Kenya, Madagascar, Mauritius, Mozambique, Seychelles, South Africa, Tanzania	International Waters	United Nations Environment Programme	4,186,140	6,902,325	Completed
1252	Bay of Bengal Large Marine Ecosystem	Bangladesh, India, Indonesia, Malaysia, Maldives, Myanmar, Sri Lanka, Thailand	International Waters	Food and Agriculture Organization	12,082,100	18,911,400	Project Approved

1462	Programme for the Agulhas and Somali Current Large Marine Ecosystems: Agulhas and Somali Current Large Marine Ecosystems Project (ASCLMEs)	Comoros, Kenya, Madagascar, Mauritius, Mozambique, Seychelles, South Africa, Tanzania	International Waters	United Nations Development Programme	12,200,000	18,470,000	Project Approved
2098	Western Indian Ocean Marine Highway Development and Coastal and Marine Contamination Prevention Project	Comoros, Kenya, Madagascar, Mauritius, Mozambique, Seychelles, South Africa, Tanzania	International Waters	The World Bank	11,000,000	15,000,000	Completed
2129	Demonstrating and Capturing Best Practices and Technologies for the Reduction of Land-sourced Impacts Resulting from Coastal Tourism	Senegal, Nigeria, Ghana, Kenya, Mozambique, Seychelles, Tanzania, Cameroon, Gambia	International Waters	United Nations Environment Programme	5,388,200	23,456,816	Completed
2261	Building Partnerships to Assist Developing Countries to Reduce the Transfer of Harmful Aquatic Organisms in Ships' Ballast Water (GloBallast Partnerships)	China, Brazil, India, Mexico, Turkey, South Africa, Iran, Argentina, Venezuela, Chile, Algeria, Egypt, Ukraine, Peru, Morocco, Libya, Croatia, Ecuador, Guatemala, Angola, Sudan, Costa Rica, Cote d'Ivoire, Panama, Trinidad and Tobago, Yemen, Jordan, Ghana	International Waters	United Nations Development Programme	5,688,000	17,701,939	Project Approved
2405	Transboundary Diagnostic Analysis and Strategic Action Program Development for the Lake Victoria Basin	Kenya, Tanzania, Uganda, Burundi, Rwanda	International Waters	The World Bank	1,000,000	5,600,000	Completed
2571	Distance Learning and Information	Angola, Namibia, South	International	United Nations	748,000	797,800	Completed

	Sharing Tool for the Benguela Coastal Areas (DLIST-Benguela)	Africa	Waters	Development Programme			
2584	Nile Transboundary Environmental Action Project (NTEAP), Phase II	Burundi, Congo DR, Egypt, Ethiopia, Kenya, Rwanda, Sudan, Tanzania, Uganda	International Waters	United Nations Development Programme	6,700,000	71,990,000	Completed
2701	Development and Adoption of a Strategic Action Program for Balancing Water Uses and Sustainable Natural Resource Management in the Orange-Senqu River Transboundary Basin	Botswana, Lesotho, Namibia, South Africa	International Waters	United Nations Development Programme	6,300,000	32,060,000	Project Approved
2706	Implementing Integrated Water Resource and Wastewater Management in Atlantic and Indian Ocean SIDS	Comoros, Maldives, Mauritius, Sao Tome and Principe, Seychelles, Cabo Verde	International Waters	United Nations Environment Programme	9,700,000	39,422,535	Project Approved
3305	Implementation of the Benguela Current LME Action Program for Restoring Depleted Fisheries and Reducing Coastal Resources Degradation	Angola, Namibia, South Africa	International Waters	United Nations Development Programme	5,138,460	68,946,335	Completed
3321	Mainstreaming Groundwater Considerations into the Integrated Management of the Nile River Basin	Burundi, Congo, Egypt, Ethiopia, Kenya, Rwanda, Sudan, Tanzania, Uganda	International Waters	United Nations Development Programme	1,000,000	2,890,800	Completed
4487	LME-AF Strategic Partnership for Sustainable Fisheries Management in the Large Marine Ecosystems in Africa (PROGRAM)	Comoros, Mauritania, Mozambique, Tanzania	International Waters	The World Bank	500,000	135,000,000	Concept Approved

4930	Enhancing the Conservation Effectiveness of Seagrass Ecosystems Supporting Globally Significant Populations of Dugong Across the Indian and Pacific Ocean Basins (Short Title: The Dugong and Seagrass Conservation Project)	Indonesia, Sri Lanka, Madagascar, Malaysia, Mozambique, Solomon Islands, Timor Leste, Vanuatu	Biodiversity	United Nations Environment Programme	5,884,018	99,299,043	Project Approved
4940	Implementation of the Strategic Action Programme for the Protection of the Western Indian Ocean from Land-based Sources and Activities (WIO-SAP)	Kenya, Madagascar, Mauritius, Mozambique, Seychelles, South Africa, Tanzania, Somalia	International Waters	United Nations Environment Programme	10,867,000	77,686,341	Project Approved
4966	Sustainable Groundwater Management in SADC Member States	Seychelles, Swaziland, Tanzania, Malawi, Zimbabwe, South Africa, Angola, Namibia, Botswana, Congo DR, Zambia, Lesotho	International Waters	The World Bank	8,200,000	42,608,000	Project Approved
5513	Western Indian Ocean Large Marine Ecosystems Strategic Action Programme Policy Harmonization and Institutional Reforms (SAPPHIRE)	Comoros, Kenya, Madagascar, Mauritius, Mozambique, Seychelles, Somalia, South Africa, Tanzania	International Waters	United Nations Development Programme	10,976,891	333,428,294	Project Approved
5753	Realizing the Inclusive and Sustainable Development in the BCLME Region through the Improved Ocean Governance and the Integrated Management of Ocean use and Marine Resources. Short Title “Improving Ocean	Angola, Namibia, South Africa	International Waters	United Nations Development Programme	10,900,000	163,915,000	Project Approved



	Governance and Integrated Management in the...						
5905	First South West Indian Ocean Fisheries Governance and Shared Growth Project (SWIOFish 1)	Comoros, Mozambique, Tanzania	International Waters	The World Bank	15,500,000	57,399,471	Project Approved