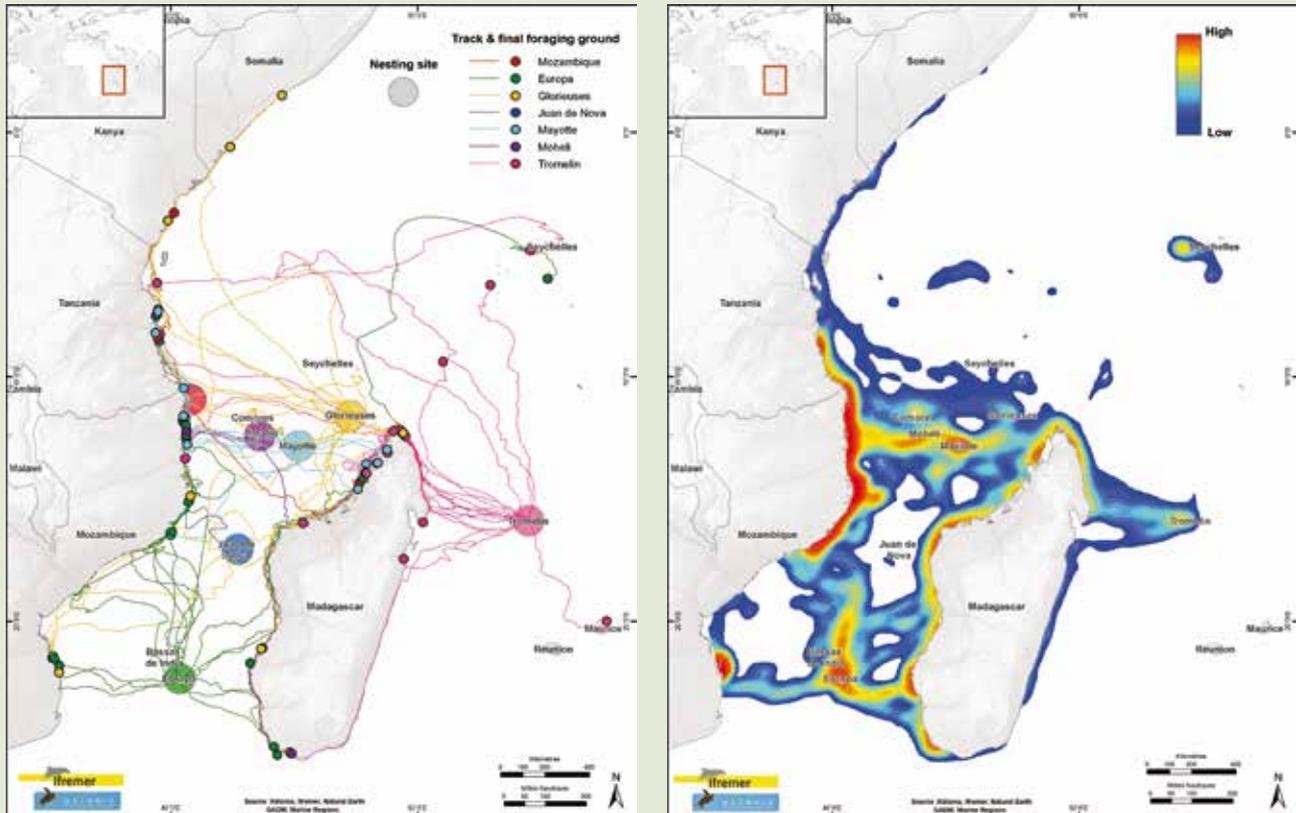


BOX 9.2. OCEANIC CONNECTIVITY BY GREEN TURTLES IN THE WIO by Jérôme Bourjea and Mayeul Dalleau

Tracks of green turtles from nesting to foraging grounds (left) and space utilization density during migration (right). Extracted from Bourjea and others (2013) and Dalleau (2013).

Sea turtles have migrated for millions of years between nesting sites and feeding grounds, sometimes swimming thousands of kilometers, passing through several countries and ecosystems, and interacting with human activities along the way—sometimes to their advantage but sometimes resulting in a premature end of their lives' journeys. So it is in the Southwest Indian Ocean (SWIO). This region hosts some of the most important green turtle (*Chelonia mydas*) nesting sites in the world, most of which are isolated on remote islands (for example, at Europa [Îles Eparses, France], Aldabra and Cosmoledo [Seychelles], and Mohéli [Union of the Comoros]). Nesting also occurs in significant numbers along the coasts of East Africa and Madagascar, which are better known for their vast seagrass pastures where green turtles graze. Mayotte (France), Grande Comoros, and Mauritius also have noteworthy foraging areas adjacent to their shores. However, very little is known about the migratory pathways that sea turtles ply between their nesting and feeding grounds—and even less is known about how they spend their time among the various countries in the SWIO.

To shed light on regional migratory issues related to interac-

tion with human activities, Ifremer and Kélonia, both based in Reunion, finished in 2013 an ambitious satellite tagging project that started in 2009 to better understand the spatial dynamics and connectivity of SWIO marine turtle populations. The project deployed 105 satellite tags on nesting green turtles at Europa, Juan de Nova, Mayotte, Glorieuses, Mohéli, and Tromelin (left map) and cooperated with Mozambique to gather tracks from Vamizi Island. Results showed that tracked turtles did their migration in $21,4 \pm 16,2$ days and travelled an average of 1359 ± 832 km from nesting site to their foraging ground, crossing from 2 to 7 different EEZ. This dataset also allowed identifying 5 key foraging hotspots in the SWIO, 2 in Mozambique (Bazaruto and Quirimbas archipelagos), 2 in Madagascar (northwest and south) and one in Tanzania (Mafia area). Thirty-five per cent of the final foraging grounds of tracked turtles were in Marine Protected Areas.

To better estimate migratory corridors, a Movement-based Kernel Density Estimation (MKDE) was used to characterize the space utilization density during the migration (right map). Results allowed highlighting hotspots of migration at the oce-

anic and coastal scales. Oceanic corridors are diffused all along the Mozambique Channel and migrating individuals most probably faced few threats from open sea fisheries, composed on purse-seiners and longliners that do not interact with adult green turtle. Coastal corridors are more interesting as they are very dense from the north of Mozambique to south Tanzania, in Bazaruto and all along the west Malagasy coast. Knowing

that interaction between East African and Malagasy artisanal fisheries and adults green turtles are very important in all the SWIO, and that coastal development due to the discovery of Gas fields in the Mozambique Channel (ie in the Quirimbas area, Mozambique) is increasing, such results are of great importance for management issues, allowing to identify areas of priority for the conservation of this endangered species.

fishing vessels.

Furthermore, the designation of Particularly Sensitive Sea Area (PSSA) under the International Maritime Organization (IMO) may be of assistance, particularly in limiting impacts from maritime operations. However, this designation has not yet been applied in the WIO, though its value has been recognized (Guerreiro and others, 2011). The provisions of the United Nations Convention on the Law of the Sea (UNCLOS) are also relevant, as they identify 'Special Areas' relative to their vulnerability to maritime pollution under MARPOL, and an ongoing process under UNCLOS to establish mechanisms for governance of Areas Under National Jurisdiction will make this increasingly relevant.

CONCLUSION

Until recently, countries of the WIO have taken few steps to fully use, or manage, open sea areas under their jurisdiction. However, with growing evidence of the limits to terrestrial resources, the oceans are being seen as a final frontier to support economic development. Use of these areas without their adequate protection and knowledge of the associated consequences could result in severe degradation of the open ocean resources. As countries begin to embrace a 'Blue Economy' for wealth creation, ensuring the sustainability and protection of deep sea assets that may support such growth will be essential.

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