Ecotourism in the Galapagos: Management of a Dynamic Emergent System

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Three hundred years after its discovery by Europeans in 1535, Charles Darwin visited the Galapagos and this sojourn became one of the factors that transformed the remote set of isolated islands from a place only visited by pirates and whalers to one of the most important natural spaces for the study of evolutionary biology and biogeography. Almost two hundred years after Darwin's visit, the natural laboratory has become the basis of a multimillion-dollar tourism industry. Few tourist destinations depend as heavily on science as part of their iconic character. The Galapagos are not only a destination where one can admire pristine nature and unique animals, but also a place where the idea that visitors can retrace Darwin's footsteps is part of the marketing scheme.

Just a few years before Darwin visited the Galapagos, Ecuador claimed the islands as part of the newly created republic. Thus, the basis was established in the first part of the 19th century for the evolution of the Galapagos as one of the most important natural destinations for international tourism. After the creation of Galapagos National Park in 1959, a series of conservation measures were established to control the impacts of humans on the islands. However, the rise in the number of tourists and the increased number of local residents has led to a surge in invasive species and the overuse of natural resources. These changes to the system, most of them generated outside of the Galapagos, are threatening the long-term sustainability of the islands.

Complexity and coupled human natural systems

Complex human ecological systems include non-linear system dynamics, emergent behaviors, feedback mechanisms, and critical thresholds. Uncertainty is an important characteristic of these systems. Levine (1998) has described the way complex adaptive systems contain a Darwinian bottom-up emergent process that includes three elements: (1) sustained diversity of components; (2) localized interaction among those components; and (3) an autonomous process that selects among the components on the basis of their interactions, including a subset for replication or enhancement. Both biophysical as well as socioeconomic environments must be taken into account as they generate the contexts to which emergent complex systems must adapt. Disturbances and changes to the system can be of internal or external origin,

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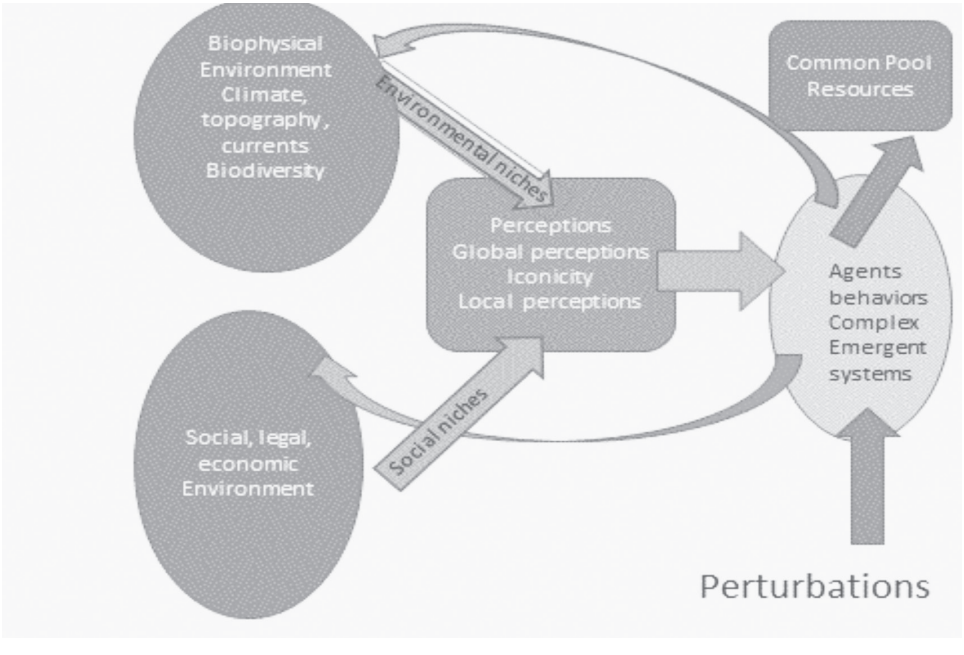
creating challenges to its stability. Resilience is a characteristic of these systems that is based on their capacity to reorganize themselves after major disturbances. Complex systems are characterized as having several points of equilibrium, with various levels of desirability from the point of view of the long-term sustainability of the environmental systems. The existence of multiple points of stability, threshold dynamics, and the high level of uncertainty present numerous challenges to managers.

In the case of the Galapagos, global changes have affected the biophysical and socioeconomic conditions, which in turn affect diverse subsystems, their resilience, and the status of the iconic features of the park and the inhabited areas. Tourism is the main economic activity in the Galapagos at the moment (Watkins and Cruz 2007) and the main driver of the economy (Taylor 2006; Epler 2007). Tourism based on the iconic features in the Galapagos has established different points of dynamic equilibrium that we will discuss below.

Tourism is one of the main factors that shapes the social and economic environment of the agents in the Galapagos. The agents, in this case local residents of the Galapagos, use and create different niches that result from the complex interdependence between natural and human phenomena and internal and external dynamics working at different scales. These niches emerge from the confluence of socioeconomic and biophysical environments (see Figure 1) with the creative and entrepreneurial activities of the local inhabitants. These environments are constantly changing. Much of the tourism industry has been dominated by large companies that operate expensive and often large boats. These boats host mostly wealthier, middle-aged Western European or North American tourists. In recent years, however, there have been a growing number of tourists that stay in the towns and have increased

Figure 1. Environments, perceptions, and emergent systems.



the demand for local services and tour packages. Most of the strategies developed by local people to attract tourists have resulted from the residents looking for new niches in a creative manner within the context of these environmental changes. In the Galapagos, small local tourism enterprises are agents that have used and created niches such as day tours, kayaking, scuba diving, and sport fishing.

Different oceanographic, terrestrial, and cultural conditions explain the existence of emblematic species, such as sea lions, tortoises, marine iguanas, and sharks. The socioeconomic environment within which tourism has flourished includes the changing demand for certain tourism products, the regulatory framework of Ecuador's national park system, access to credit and funding to provide more infrastructure, and the availability of new technologies and tools that mediate the different relations to the biophysical environment. Environments, whether biophysical or socioeconomic, are real and substantial, but they are also perceived environments, mediated by a series of culturally generated preconceptions and conditions. It is within these perceived environments and niches that emergent complexities can arise. Thus, emergent socioecological systems are dynamic entities that adapt to changing environments and may have different equilibrium points.

Human agents can influence some of the environments, but not others. This generates feedback loops as emergent systems begin to affect part of their environments. The feedback loops also create different degrees of the system's resilience, which influence the long-term sustainability of the common-pool resources (CPRs). Tourism can seriously affect the sustainability of the biophysical environment in many ways including: disturbing the animals, contaminating the waters, increasing human immigration, introducing non-native species, or destroying habitats to construct tourism infrastructure. People also shape the socioeconomic environment, of course. The Galapagos locals, for example, have had some influence on the laws and regulations as these laws must accommodate new tourist activities. These feedback loops generate complex adaptive systems that have different degrees of resilience (Berkes et al. 2003). The degree of resiliency of these emergent systems depends to a large extent on the way CPRs are managed (Ostrom 1990). Ostrom has listed the conditions under which emergent systems can evolve more sustainable interactions with the environment and protect the CPRs (Ostrom 1990; Wilson et al. 2013) (see Figure 1).

In a complex coupled system, such as the Galapagos, there is a relationship between subsystems: some structure the creative possibilities and limitations for other emergent systems. In the case of the socioecological systems, niches are partly the result of these power dynamics. They are created as the structuring components open and close possibilities for actions to take place. Thus, dynamic power relations between complex emergent systems need to be taken into account in order to account for changes and adaptations.

Biophysical environment

In the Galapagos, the primary island-building processes are related to volcanism and some uplifts. The archipelago emerged from volcanic activity only 3 million to less than 300,000 years ago (Geist and Harp 2009). Volcanism continues to this day, with the westernmost islands of Isabela and Fernandina the most active. The volcanic origin of the islands contrib-

utes to their isolation, a key factor which helps to account for the evolutionarily unique and iconographic flora and fauna found in the archipelago (Valle 2012), and for the scientific, conservation, and tourism concerns surrounding the islands.

The Galapagos marine environment is a very dynamic oceanic system shaped by several currents. The main ones are the South Equatorial Current, which affects the southeast trade winds; the eastward-traveling Equatorial Undercurrent; the westward-traveling Peru Current, which creates upwelling in the southeastern areas; and the warm Panama Current, which affects the northern islands (Houvenaghel 1984). These contrasting temperatures and other biophysical conditions vary during the year and across the various geographic areas. Key iconic species, such as penguins, flightless cormorants, sea lions, and the different species of boobies, depend to a large extent on the existence of the various currents and upwelling cells.

The islands' land climate also varies according to the topography and the amount of precipitation at the different altitudinal levels of the islands. Humidity and rain increase with altitude in the islands that have tall volcanoes and mountains that trap the clouds and the rain. Its isolation and the existence of diverse oceanographic, climatic, and geographic conditions are critical aspects that produce the biological uniqueness of the archipelago. The age and distribution of the islands, their distance from the mainland, the various altitudinal ecological zones, and the existence of different oceanographic and terrestrial regions created by the influence of diverse marine currents generate the physical and environmental conditions where rapid evolutionary processes occur. These biogeographical conditions and the process of adaptive radiation they generate in turn explain the high degree of endemism. Thus, in the case of land reptiles, 100% of the species are endemic, as are 84% of the terrestrial birds and all the terrestrial mammals (Snell 1999). Some of the most charismatic terrestrial species found in the islands are those that have been used to exemplify the Darwinian evolutionary process. Such is the case of the Galapagos finches, tortoises, and mocking birds.

The marine ecosystems of the Galapagos are also an important attraction for the tourists. The islands' marine megafauna have created a growing flow of tourists to scuba dive and snorkel. The currents provide a rich and productive set of conditions that support a diversity of marine species, including five of sharks, two of sea turtles, and many of reef fish and rays, all of which are relatively easy to see.

Ever since Darwin visited the islands, endemic species have been icons for science, becoming so later for conservation and, finally, for tourism. These organisms have become a classic illustration of important evolutionary processes, such as speciation through adaptive radiation, hybridization, and the founder effect (Grant 2008; Valle 2012b). The mockingbirds, tortoises, finches, and land and marine iguanas also constitute important elements in the constructs of the Galapagos in the global north and of the islands as a tourism product. Many of the scientific studies and publications about the evolution, distribution, biology and adaptations of these emblematic endemic animals and plants are now classic examples for evolutionary biology and a tribute to Darwin's legacy. These studies have been popularized in Western culture through books, documentaries, and magazine articles that potential tourists consume.

From a conservation point of view, one of the most important aspects of the islands is the fact that many of these iconic endemic and native species have low numbers of individuals, specific distribution ranges, and are highly vulnerable to predators or competitors. These conditions put these species at risk from introduced species, new diseases, oils spills, and land use changes, all of which are possible and real threats associated with the growing tourism industry.

Contrasting perceptions

For humans, natural and social environments are perceived environments (Berger and Luckmann 1966; Searle 1997) and our interaction with environments is mediated by socially produced constructs. The so called Cronon debate (Cronon 1995; Proctor 1998; Demeritt 2002) shows the need to take into account cognitive, normative, and emotive structures to understand the interaction between people and nature. The Galapagos has been constructed in different ways by diverse sets of actors. I consider here two general constructs that have generated different practices and emergent systems (Quiroga 2009). The global perspective regards the Galapagos as a unique and iconic place, a natural laboratory where the evolutionary process can be studied. However, the contrasting perspective of the local residents portrays the Galapagos as a frontier, a place where nature must be controlled, transformed, and humanized. Tourism, especially land-based tourism or what many call "ecotourism," is shaped by the hybridization of these two constructs (Quiroga 2009, 2012).

The global perspective and the iconic importance of the Galapagos can be traced to Darwin's visit in 1835 and his accomplishments and observations of the geology, geography, and animals and plants of the Galapagos (Larson 2001). Darwin's ideas have become the master narratives through which much of the Western secular world generates its worldview. The products and process of evolution are not only of interest to scientists, but they have become critical aspects of the paradigm through which the global north conceives the world and its origins (see Hodgson 2005). The Galapagos played an important role in this critical paradigmatic transformation. The emblematic trip of the *HMS Beagle* and the observations that Darwin made of the geology of the islands, the mockingbirds, the tortoises, and the finches, have become key elements for our understanding of the evolutionary process.

As part of this global paradigm of the Galapagos, conservationists and scientists developed schemes to protect the islands. Some scientists became aware of the challenges facing the Galapagos in the early 1930s when the first laws to protect the islands where passed (Larson 2001). An important transformation occurred in 1959— a century after the publication of *On the Origin of Species*—when the Charles Darwin Station was founded and the Ecuadorian government created Galapagos National Park, dedicating 97% of the area to conservation. In 1978, UNESCO declared the islands a World Heritage site and in 1985 named it a biosphere reserve (Durham 2008; Hearn 2008). In 1986, the first laws to protect the coastal areas were instituted and in 1998 the Galapagos Marine Reserve (GMR) was created, and 133,000 km^2 were placed under the protected area (Durham 2008; Hearn 2008).

Tourism companies use the singular aspects of the Galapagos to attract clients and create

a unique destination. Guides and tourism operators utilize Darwinian discourse and narratives to describe the landscape as well as the organisms that inhabit the islands. Names related to evolution, such as *The Beagle, Explorer, Darwin, Darwin Buddy*, and the *Finch*, are frequently used by boats, restaurants, and tourism agencies. Tour guides, many hastily trained in Darwinian sciences, facilitate the experience of the approximate 200,000 tourists that visit the islands every year. From the point of view of this global perspective, local people are either ignored or seen as invasive pests and a problem. Brochures, webpages, and other tourism advertisements often ignore or minimize the presence of the residents. To reduce the negative impact of large-scale tourism on the local population and the ecology of the islands, scientists and conservationists conceived in the 1960s a system of tourism that was based on large cruise boats touring from island to island and staying as little time as possible on the towns and inhabited areas. The military airport built in Baltra by the USA during World War II was refurbished to accommodate civilian planes; roads were built to facilitate the transport of tourists from the Baltra airport to the town of Puerto Ayora in Santa Cruz. The people who invested in these cruise boats accumulated power and wealth and had an important say in shaping the development of tourism in the islands. Paradoxically, they were also helping create new niches that would later be used by the local people and that resulted in a large migratory movement to the islands. An important goal of the system was an effort, which many locals consider to have failed, to lower the impact of tourism on the islands by controlling the growth of the towns and the movement of tourists.

The other prevalent construct of the islands is that held by local inhabitants. Many of the early visitors—starting with the Spaniards who first visited the islands in the 16th century—commented on the challenges that these islands represent for human inhabitants. The Ecuadorian colonists who settled in the Galapagos in the 19th century considered the islands as a remote, harsh, and unforgiving place (Quiroga 2009, 2013). For the early colonists and visitors, the Galapagos presented a series of challenges that they had to overcome. The distance between the islands and the mainland was one of the most critical aspects of their experience. To this day, freshwater is still one of the most limiting resources in the Galapagos—many of the inhabited islands have little freshwater and only one, San Cristobal, has any of good quality and in significant amounts. Thus, what for scientists and later for tourists was an interesting, iconic, and valuable natural laboratory, was, for the early visitors and colonists, a frontier that needed to be conquered and humanized. Local residents, one-third of whom are fourth-generation *galapagueños,* are proud of having successfully fought against the inhospitable environment. This local view reflects the experience of the local inhabitants that arrived as colonists to make a living in the Galapagos.

These contrasting views of the Galapagos are also manifested in the human perceptions of the different organisms. Thus, as in the case of the animals, the global community perceives the flora and fauna as unique and iconic examples of Darwinian evolution and classifies them as endemic, native, or introduced. Contrasting with this perception, the local people view them on the basis of their utilitarian value as useful, useless, or neutral. For the global community, which includes the tourists, conservationists, and scientists, charismatic animals such as

giant tortoises, sea lions, hawks, and sharks are considered distinctive and unique. However, to the local people, many of whom are still engaged in agriculture or fisheries, these animals are often seen as either pests, competitors for resources, or as a source of food.

Isolation also has two opposing meanings in the global and the local perspective. The rise of tourism and the increasing involvement of local people in activities related to this industry have led to the emergence of a new hybrid cultural symbolic system changing the views locals have of these animals. These one-of-a-kind animals are now seen by many local people as key elements for the attraction of tourists to the islands that in turn use many of the local services.

Social, legal, and economic environment

Between 1950 and 2000, the Galapagos resident population grew at a rate of 5–6% a year (Kerr et al. 2004). The 1998 Special Law of the Galapagos, Ley Organica de Regimen Especial para Galapagos (LOREG), established a series of regulations to try to stop this growth. However, by 2010 there were 25,140 local residents in the Galapagos, more than 60% of them living on the island of Santa Cruz, and almost 60% of the inhabitants were born outside of the Galapagos. Initially, most of the colonists lived in the highlands where they were involved in agriculture. In the 1950s, many of these inhabitants moved to the lowlands as fishing increased in importance. Different fisheries for export outside of Galapagos, starting with groupers in the 1960s, lobsters in the 1980s, and sea cucumbers in the 1990s, provided jobs and income for many of the local inhabitants. Often, these extractive activities contributed to environmental degradation and the fisheries had to adapt to the loss of the old niches, usually by extracting a new marine organism (Castrejon 2006; Hearn 2008). Thus, many of the emergent fishing activities resulted in the deterioration of the CPRs, which closed some niches for the fishermen. As the national park and the Charles Darwin Station tried to regulate the fisheries in the middle of the 1990s, riots and clashes occurred. This situation was partly resolved with the creation of the Galapagos Marine Reserve in 1998 and the Participatory Management Board (PMB). The PMB is composed of several stakeholders, including the large tourism sector, scientists and conservationists, the fishing sectors, and the national park. The PMB's main purpose was to lower tensions with respect of the management of the marine reserve. However, despite the efforts of the PMB, in the early part of the 2000s the economic collapse of the sea cucumber fishery meant that many fishermen began to explore new productive activities, especially in the tourism sector.

The Special Law of the Galapagos regulates many activities, such as residency, migration, fisheries, and tourism. A related regulation focused on tourism in protected areas, the Reglamento Especial de Turismo en Areas Naturales Protegidas, listed a series of possible tourism activities such as sport fishing, scuba diving, and daily tours open to local people. However, even before the passing of the law, the local people were already practicing some of these tourist activities. Galapagos National Park established controls on tourism in different ways, including the places that can be visited, the itineraries of the boats, the paths where tourists can walk, the training and guidelines that naturalist guides must follow, the number of cruise boats, and the number of berths on the cruise boats. Recently, the national park

managers have also started to regulate the smaller boats that provide day tours and scuba diving services. National park regulations were meant to diminish some of the negative effects that tourists have on the fragile environment; however, many tourist regulations originally did not include specific guidelines for activities. These guidelines either took a very long time to pass or have not yet been passed at all. This lack of regulation opened a gray legal area that has been used by the local residents to generate a series of tourism activities and enterprises.

Cruise boat tourism grew rapidly from 1970 to the 1990s, and this flourishing industry has been mainly based in Puerto Ayora. Commercial Galapagos tourism in the form of "floating hotels" began in the 1960s when New York-based Lindblad Travel began offering cruises on their 66-passenger ship, the *Lina A*. Later, other companies, such as Metropolitan Touring and Turismundial, brought other cruise boats to the island, and between 1974 and 1980, the cruise ship fleet more than tripled in numbers, growing from 13 to 42 (Hoyman and McCall 2012). Land-based tourism, which engaged mostly the local population, began in the 1970s with the availability of inter-island shuttles and small boats for charter (Epler 2007). In the 1980s, Galapagos National Park distributed tourism permits to fishermen and other local people, but many of these permits were bought or rented by outsiders who owned the cruise boats. This process resulted in an accumulation of permits and increased concentration of wealth in the hands of a few people who profited from tourism but do not live in the Galapagos (Epler 2007). By the early 2000s there were 80 licensed tour boats assisted by a large number of small boats called *pangas* that take visitors from tour boats to the shore. The relatively expensive tour boats are mostly owned by outsiders, from Quito, Guayaquil, or even outside of the country (Taylor 2006). The less-expensive boats are owned mostly by local residents. A number of official visitor destinations were established and most of them were assigned to the large companies. Thus, the local people had to accommodate to utilize the visiting places that were left unregulated or use areas illegally that were assigned to the cruise boats.

Local people have generated emergent complex adaptive systems in areas such as fisheries and new tourism operations that use the sociopolitical and biophysical niches opened by the changing social and ecological environments. After the 1970s, for example, fishermen had to adapt to new regulations and changes in the environment. The creation of the Galapagos Marine Reserve, new fishing regulations (Hearn 2009), and the introduction of new technologies, such as outboard engines, fiberglass boats, radios, GPS, and diving equipment, made it possible to fish for new products. In the case of locally based tourism, since the 1970s residents of the Galapagos have increasingly been developing new activities and options for tourists who decide to stay on the islands instead of taking a cruise. Local people established new hotels, sport fishing charters, daily tours, and scuba diving packages, and opened restaurants, tour agencies, and souvenir stores. These enterprises have emerged, often unregulated, and are using niches that the law, economic demand, technology, and natural resources have made possible. Whereas most of the older and wealthier foreign tourists stay on the cruise boats, visiting mostly the natural areas and occasionally a town (Mena et al. 2011), younger foreigners and Ecuadorian tourists stay in the towns and many participate and support the newly created activities. Most of these new tourist activities depend to a large extent on the

use of the images, vocabulary, and icons that are taken, albeit in a selective way, from the global Darwinian constructs of the Galapagos. Thus, as locally based tourism increases, the resources that benefit the local economy create a hybrid view of the Galapagos (Quiroga 2012).

The continuing scientific interest in the endemic species has helped to produce a number of educational and research centers on the islands. These include the Charles Darwin Research Station, Galapagos Academic Institute for the Arts and Sciences, and Galapagos Science Center; as well, there are research groups stationed elsewhere but which bring scientists to the islands. The number of groups of national and international students has increased and different organizations have also increased the inflow of volunteers that want to contribute to the conservation of the islands. These academic and "voluntourism" operations have grown in numbers and now constitute an important source of income for the local populations. Other groups of visitors that use the local accommodations and services include scuba divers, national tourists, international visitors (especially young backpackers), and sport fishermen.

In recent years, the government has tried to regulate many of these emergent tourism operations managed by the local people. Such is the case with boats that operate day tours to places like Kicker Rock in San Cristobal. In 2013, new regulations reduced the number of boats that can visit this special place, where tourists swim and dive with different species of sharks and other marine megafauna. Permits were only given to a relatively small number of boats. Furthermore, the number of passengers that each boat can carry, the length of the visit, and the day of the week when each boat can visit the sites became regulated by Galapagos National Park. These regulations that seek to protect CPRs have often proved difficult to enforce unless the people being regulated participate actively in their design and trust the process.

As with the fisheries, in the case of land-based tourism, top-down processes attempting to regulate the emergent activities of the local population have often failed. This is due, to a large extent, to the lack of confidence in the regulatory process of the local people who feel that outsiders, such as the owners of the large cruise boats and international nongovernmental organizations, are trying to control activities for their own benefit (Quiroga 2009). Furthermore, there is a complex and often contradictory system of governance with many different public institutions involved. Frequently, as new regulations are being implemented, emergent systems press on the environment and open new niches, many of which result in the degradation of the ecosystems. The old conflicts between the global and the local perceptions that were common during the sea cucumber boom years are re-emerging now in the case of tourism. The conflict with the large corporations is one of the main factors causing poor management of the CPRs, as many local residents perceive that there is an unfair distribution of obligations and benefits. Ecotourism's success in the management of CPRs depends on establishing a sense of trust and fairness in the distribution of the benefits. The sense of ownership must be created among the stakeholders. In order for the system to be more sustainable, the view has to change from one that perceives nature as a space to be conquered and dominated, to one that views nature as a resource to be preserved. This change will occur only when people see that there is a benefit for them from maintaining the CPRs. The emergence of the hybrid culture as a new worldview generates practices that lead to a

resilient, complex, adaptive system. Better management of CPRs can lead to increased resilience in the systems.

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