



Photo: Christophe Grenier

A geographic index to measure the carrying capacity for tourism in the populated centers of Galapagos

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Tourism is the driver of the Galapagos economy (Epler, 2007) and consequently of the constant increase in all kinds of flows between the archipelago and the rest of the world. This “geographic opening” of Galapagos (see Grenier, this publication) has negative consequences for the conservation and sustainable development of the archipelago. This article presents the principal results of the Geographic Footprint Index¹ (GFI), a technical tool designed to measure impacts of tourism in the populated areas of Galapagos (Grenier, 2008). Spatial, environmental, and “medial” impacts are discussed. Medial impacts describe the relationship between a society and its surroundings (space and nature).

Methods

An index provides a single number that characterizes a given situation, with the first calculation providing a baseline (reference time or place) that can be compared with future indices to evaluate trends over time. In this case, the GFI is constructed from 121 indicators of impact caused by various social actors connected to tourism at a given time (early 2008) and in a given place (rural and urban populated centers of Galapagos).

The data used to construct 114 of the 121 indicators were collected through surveys completed in December 2007 and January 2008 in all of the populated centers of Galapagos (except Floreana), in proportion to the population and the number of tourism businesses

¹ Geo-geographic is, literally, the science of the study of the footprints or tracks (« graphic ») that human activity leaves on the surface of the Earth (« Geo »).

in each area (Table 1). These 114 indicators or variables, numbered V1 to V114 are presented within five categories: (i) level and type of tourism; (ii) tourism

area; (iii) energy and transportation; (iv) environmental impact; and (v) medial impact (Table 2).

Table 1. Number of surveys completed by group and location.

Site	General Population	Guides	Hotels	Tourist Shops	Travel Agencies	Tourists
Puerto Ayora	55	60	29	13	15	0
Rural Santa Cruz	12	0	3	1	0	0
Puerto Baquerizo	30	0	20	9	8	0
Rural San Cristóbal	4	0	2	0	0	0
Puerto Villamil	15	0	12	1	2	0
Rural Isabela	4	0	1	0	0	0
Baltra	0	0	0	5	0	1000
TOTAL	120	60	67	29	25	1000

The seven additional indicators, designated VA to VG, were constructed from available official statistics². As with the numbered indicators, the lettered indicators are found under the appropriate category: VA under (i) level and type of tourism; VB to VE under (iii) energy and transportation, and VF and VG under (iv) environmental impact.

To construct the GFI, each indicator expresses human impacts using a numerical value (percentage, average, etc.). For example, the variable V1 is the average number of days a tourist spends in Galapagos, which is currently 6.6 days. Therefore the value of V1 is 6.6 (Table 1). The value of variable V2, which indicates that 60% of tourists surveyed spent nights only on boats, is thus 60, etc. In some cases, the average value is calculated with numbers between 1 and 5, when those surveyed were asked to classify their own responses from 1 (very important or positive) to 5 (not at all important or very negative). For example, when guides were asked their opinion regarding the interest of tourists in learning about nature (V11) using a number between 1 (high interest) and 5 (no interest), their responses averaged 2.6, which is then the value for V11.

Once the value is determined, each variable is given a grade that demonstrates the intensity of the impact, with 1 corresponding to the least impact and 5 the greatest. This grade is designated by the manager of the GFI and must be justified (for greater detail

on the justification of the grades, see Grenier, 2008). For example, if it is desirable to increase the time spent in Galapagos, a grade of "4" is given to V1 because the average length of stay of 6.6 days is considered insufficient. In some cases, a grade between 1 and 5 is given directly by those surveyed, as it is the numerical value of the variable (as for V11).

To limit subjectivity in the construction of the GFI, each variable was given equal importance. The scale describes the depth of the geographic footprint for each variable, from 1 (least impact) to 5 (greatest impact). The sum of the 121 grades with values between 1 and 5 is the Geographical Footprint Index for tourism in the populated areas of Galapagos in January 2008 (Table 2). This value expresses the depth of the geographic footprint: the greater the value, the deeper the footprint and the greater the impact.

² GNPS, PETROCOMERCIAL, Empresa Eléctrica Galápagos, Unidad de Gestión Ambiental del Municipio de Santa Cruz, Galapagos Report 2006-2007.

Table 2. Geographic Footprint Index for tourism in the populated centers of Galapagos.

Groups of Indicators	Actors	Variable N°	Variable	Value	Grade
1) Level and type of tourism	Official statistic	A	% increase in tourism in Galapagos 2000-2006	51	5
	Tourists	1	Average number of nights in Galapagos	6.6	4
		2	% staying only on boats	60	4
		3	Average number nights spent only onboard	6.2	4
		4	Average number of nights spent only in a hotel	4	4
		5	Average number of nights spent in a hotel	3.7	4
		6	% who wished to stay additional days	64	2
		7	% with monthly earnings > US\$10 000	28	3
	General population	8	% who want longer tourism visits	58	3
	Guides	9	% who prefer boats with < 16 passengers	47	3
		10	% who want longer tourism visits	68	2
		11	Opinion on tourists' interest in learning about nature	2.6	2.6
		12	Opinion on the change in the level of tourists' interest in learning about nature	2.9	2.9
		13	Opinion on tourists' interest in conservation	2.5	2.5
		14	Opinion on the change in the level of tourists' interest in learning about conservation	2.4	2.4
		15	Opinion on the interest of tourists in the towns	2.8	2.8
		16	Opinion on the change in the level of interest of tourists in the towns	2.4	2.4
		17	Opinion on tourists' need for comfort	2.7	2.7
		18	Opinion on the change in tourists' need for comfort	4.1	4.1
		19	Opinion on tourists' concern for safety	2.6	2.6
		20	Opinion on the change in tourists' concern for safety	4	4
		Hotels	21	Average number of beds	34
	22		Current average level of occupation (%)	45	4
	24		% with more clients than 3 years ago	54	3
	25		% with plans to increase capacity	60	5
	26		% with no knowledge of ecotourism	61	4
	27		% who want to limit the number of tourists	52	3
	28		% who want longer tourist visits	67	2
	Agencies and operators		29	% with more clients than 3 years ago	71
		30	% with no knowledge of ecotourism	40	3
		31	% who want to limit the number of tourists	37.5	4
		32	% who want longer tourist visits	66	2
	Tourism shops	33	% who want longer tourist visits	75	2
2) Tourism areas	Tourists	34	% of total nights in Galapagos spent in Puerto Ayora	68.7	4
		35	Opinion on pollution at visitor sites ³	1.5	1.5
		36	Opinion on noise at visitor sites	1.4	1.4
		37	Opinion on construction at visitor sites	1.8	1.8
		38	Opinion on the number of people at visitor sites	1.9	1.9
		39	Opinion on the disturbance of wildlife at visitor sites	1.7	1.7

³ Visitor sites mentioned here are those located close to the towns, designated for tourism-recreational use.

2) Tourism areas	General population	40	Opinion on pollution at recreational sites	2.2	2.2
		41	Opinion on noise at recreational sites	1.9	1.9
		42	Opinion on the number of residents at recreational sites	3.6	3.6
		43	Opinion on the number of tourists at recreational sites	2.9	2.9
3) Energy and mobility	Official statistic	B	% increase in gasoline consumption 2000-2007	45	5
		C	% increase in motorized vehicles 2001-2006	54	5
		D	% increase in flights to Galapagos 2001-2006	193	5
		E	% increase in electricity consumption 2000-2006	43	5
	Tourists	44	% who take the bus	79	2
		45	% who take a taxi	62	4
		46	Opinion on vehicle traffic in the towns	2.3	2.3
		47	Favor use of renewable energy	1.5	1.5
		48	Favor a reduction in traffic	2.2	2.2
	General population	49	% transport house-to-work by foot, bicycle, bus	56	3
		50	% who believe that traffic has increased	93	5
		51	% who own a car	15	3
		52	% who own a motorcycle	26	3
		53	% who use taxis several times per week	68	4
		54	% who travel to the continent 1 or more times per year	82	3
		55	% of monthly earnings spent on transportation	12	3
		56	Opinion on the amount of transportation continent-Galapagos	3.1	3.1
		57	% who use renewable energy	0	5
		58	% who use energy saving lights	68	2
		59	Average number of TVs per house	1.7	4
		60	% with domestic comforts: microwave, dryer, etc.	55	5
		61	Average number of air conditioners per house	0.1	1
		62	Opinion on traffic	4	4
	Hotels	63	% with a bus or pickup truck	22	3
		64	% who use energy saving lights	73	2
		65	Average number of TVs per hotel	7.5	5
		66	Average number of freezers per hotel	2	3
		67	Average number of air conditioners per hotel	7.3	5
		68	Average monthly costs for electricity (\$)	320	3
		69	Average number of gas cylinders per months	11	3
70		% increase in energy consumption in last 3 years	54	5	
71		% who do not use renewable energy	88	5	
72		% with no plans to invest in renewable energy	73	4	
Agencies and operators	73	% with bus or pickup truck	32	3	
	74	% with speed launch	48	3	
	75	% with boat	48	3	
	76	Average horsepower of launch motors	224	5	
	77	Average monthly fuel consumption (gallons)	1550	5	
	78	% increase ave. energy consumption in last 3 years	63	5	
Tourism shops	79	% with no air conditioning	82	1	

4) Environmental impact	Official statistic	F	% increase in waste in Santa Cruz 2000-2006	93	5	
		G	% increase in introduced plants 2000-2006	39	5	
	General population	Tourists	80	Opinion on pollution in the towns	2.3	2.3
		81	% who believe there is more pollution	91	5	
		82	Opinion on whether tourism is responsible for pollution	3.1	3.1	
		83	% who say they separate their garbage	74	2	
		84	% who believe that their sewage pollutes	94	5	
		85	% who use tanks to collect rainwater	21	4	
		86	% who believe that the quality of tap water is inadequate	23	2	
	Hotels	87	Opinion on pollution in urban zones	4	4	
		88	% with no plans to invest in water conservation	71	4	
		89	% who believe their sewage pollutes	70	4	
		90	% who say they separate their garbage	74	2	
		91	% who use fruits and vegetables from continent	96	5	
5) Medial impact	Tourists	92	Opinion on urban landscapes	2.6	2.6	
		93	Opinion on presence of native wildlife	2.3	2.3	
		94	Opinion on tranquility	2.3	2.3	
		95	Desire to limit urban growth	1.9	1.9	
		96	Desire to improve urban zoning	1.9	1.9	
		97	Favor use of lava rock in construction	2.2	2.2	
		98	Want towns to favor native flora and fauna	1.3	1.3	
		General population	99	Opinion on responsibility of tourism in more construction	2.9	3
	100		Opinion on tranquility	3.0	3.0	
	101		Opinion on the number of people	3.9	3.9	
	102		Opinion on landscaping	2.7	2.7	
	103		Opinion on urban zoning	3.1	3.1	
	104		% believe that the Galapagos lifestyle is like that on the continent	53	5	
	105		% believe that it is good that Galapagos is like the continent	40	5	
	106		% believe that nature makes Galapagos towns unique	86.5	1	
	Hotels	107	% who see fewer native animals in towns	69	4	
		108	Average size of structures (m ²)	576	3	
		109	Average number of floors	2	3	
		110	% that do not favor native/endemic plants	79	4	
	Tourist shops	111	% that do not use lava rock in construction	56	3	
		112	Average size of structures (m ²)	60.2	3	
113		Average number of floors	1	3		
		114	% that do not use lava rock in construction	96	5	
		GEOGRAPHIC FOOTPRINT JANUARY 2008			394.6	
		Average value			3.29	
		121 variables (114 V + 7 Official Statistics)				
		Theoretical maximum footprint (121 x 5)			605	
		Theoretical minimum footprint (121 x 1)			121	
Average footprint			363			
Difference Geographic Footprint/ave. footprint				+ 8.7 %		

Level and type of tourism

The results from this group of indicators confirm that tourism is undergoing sustained growth (VA, V24, and V29). Although the majority of tourists surveyed stayed only on boats (V2), there is ample evidence that land-based tourism is continuing to grow. Sixty percent of hotels plan to increase their capacity, which is surprising given that the average number of beds per hotel is high (V21) and the level of occupancy is less than 50% (V22).

The current tourism model in Galapagos is based on a rapid turnover of clients. The stays are short (V3, V4, and V5), which does not provide a firm foundation for the terrestrial tourism sector. For that reason, terrestrial tourism operators prefer tourists to stay longer, even though there may be fewer tourists (V28, V32, and V33). More than half of local residents (V8) and tourists (V6) surveyed would prefer longer stays. This shared desire could favor the implementation of ecotourism in Galapagos, although this term is little understood (V26 and V30). The lack of understanding of ecotourism, according to the guides, may result from today's tourists having less interest than previous tourists in learning about nature (V12) and greater concern for comfort (V18) and safety issues (V20)⁴.

Tourism areas

Sixty-nine percent of all tourist nights spent on land are concentrated in Puerto Ayora, the largest city of the archipelago with around 50% of the population. This high level limits opportunity for other towns and results in significant impacts in Puerto Ayora. However, the opinions of both tourists (V35-39) and residents (V40-43) concerning the visitor/recreational sites close to towns are generally positive, although there is a growing perception that these areas are going beyond their carrying capacity (V42).

Energy and mobility

In Galapagos, both tourism and the local lifestyle depend on a growing use of fuel (VB and VE; electricity is produced primarily by diesel generators). This is

a result of the continual growth in tourism, but also due to the increased mobility of tourists and residents, as well as the speed of travel.

Increased mobility has an obvious environmental impact, but also consequences for the general milieu of Galapagos, as it modifies the relationship between tourists and residents with their surroundings. For example, the increase in the number of motorized vehicles (VC) and their increased use in the population (V50-V53) indicate a lifestyle that is more and more like that on the continent. Although tourists consider the traffic level acceptable (V46), probably because it is less congested than where they live, they also believe that it should be reduced (V48). Residents believe that the traffic situation is bad (V62) and that the growth in tourism is partially responsible for it.

The increase in traffic reflects the extension of the area used by residents on a daily basis, most notably in Santa Cruz where a growing portion of the population lives in the highlands but works in Puerto Ayora. This expansion of the populated area explains the growing expenditures of residents on transportation (V55).

The high mobility associated with tourism in Galapagos affects the entire insular society and contributes to greater "continentalization" and the desire of residents to leave the islands from time to time. A large majority of residents travels to the continent at least once each year (V54) and considers the number of available flights as "average" (V56).

This mobility, based on rapid transportation, can also be seen in ever-increasing horsepower of launches (Photo 1), the major method of inter-island transportation (V76), as well as the high monthly fuel consumption of tourism operators (V77) and the huge increase in energy use in recent years (V78). All of these factors result in negative environmental and medial impacts that degrade the tourism experience.

Indicators for energy use in the hotels (V66-V72) and by the population (V57-V61) are poor. For example, the use of renewable energy is 0% in the population and only 12% in hotels. It is also of concern that hotel owners have no plans to invest in renewable energy (V72), even when it is important to tourists that renewable energy be used in Galapagos (V47). At the same time, energy use by hotels has increased

⁴The grades given to these variables (V11 to V20) are based on interviews with guides. For example, when a guide states that the interest of tourists in learning about nature has diminished, the variable is given a low grade (more than 3) because it signifies that the medial impact (the relationship with the environment) is negative. The average grade for this group is 2.9.

dramatically in recent years (V70). The use of air conditioners in hotels (V67) is a good indicator of energy use. Even hotels considered “lower class” have invest-

ed in air conditioners as a symbol of achieving “international standards.”



Photo 1. Ephemeral but harmful geographic footprint. Photo: C. Grenier.

Environmental impact

An increase of 93% in garbage (VF) and 39% in the number of introduced plants between 2000 and 2006 (VG) are of great concern for the sustainability of life in the islands as well as the conservation of the archipelago. An indicator of the relationship between tourism and introduced species is that 96% of hotels and restaurants in Galapagos import their organic food from the continent (V91).

The garbage problem is primarily due to the increase in the production of waste (VF) rather than a lack of effort by residents and businesses to recycle

solid waste (V83 and V90). The general view of water pollution is very negative, both on the part of residents (V81 and V84) as well as hotel owners (V89), but there is little appreciation of the need to conserve the water resource (V85 and V88).

Medial impact

The dominant geographic milieu in Galapagos, that is the relationship between a society and its surroundings, is “continental” in nature, with a mix of habits and behaviors that originate in other parts of Ecuador and the world. An indicator of the loss of a Galapagos geographic milieu is the decrease in the number of native



Photo 2. The Miguel Cifuentes Center in Puerto Ayora, an example of architecture with lava rock. Photo: C. Grenier.



Photo 3. Visitors at the Tintoreras visitor site, Isabela. Photo: Christophe Grenier

animals in the towns, especially lava lizards, marine iguanas, and finches.

The continentalization of the insular milieu signifies less space and greater disturbances for the native wildlife, even though its presence in the towns is a great tourist attraction, according to tourists (V97) as well as residents (V106).

Tourists believe that it is important to limit urban growth, improve urban zoning, encourage the presence of native species in the towns, and use lava rock in construction to achieve a greater integration between landscaping and the environment (V95-98). Hotel owners, however, show no interest for the latter two measures (V110-111). The case of lava rock illustrates the lack of general awareness of the importance of the integration of landscaping for ecotourism, even though there are buildings in the islands that demonstrate that local materials can be successfully used with both modern and functional architecture. Key examples include the Miguel Cifuentes Center in Puerto Ayora (Photo 2), the tourist dock in Puerto Villamil, and the Interpretation Center in Puerto Baquerizo Moreno.

The majority of residents believe that the lifestyle in Galapagos is increasingly similar to that of the continent (V104). Of even more concern is that for many

of these individuals, this is a good thing (V105). This continentalization undermines the conservation of the archipelago as well as the sustainability of an island society and its principal activity – tourism.

Conclusion

According to the GF indicators, the current geographical footprint of tourism in the populated areas of Galapagos is too deep, given that the index is 8.7% above the average. Even more worrying is that many of the indicators show that the trend in tourism in the populated areas is undergoing continual growth.

All tourism has impacts, but even more so in an ecosystem that was originally isolated from the rest of the world, as was Galapagos. This is especially true when you continue to increase the geographic opening of such an area through immigration, investment, biological invasion, and importation. The challenge is huge: it involves finding a tourism model that will leave the lightest footprint possible. This ecotourism model must be sold on the worldwide market and it must be the uniqueness of Galapagos that defines what is offered. This will result in a demand based on a light geographic footprint in the populated areas.