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The Economics of "Eco-Tourism:" A Galapagos Island Economy-wide Perspective*

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Eco-tourism, the fastest growing sector of the largest industry on earth, is strongly advocated by major conservation groups as a way to help conserve nature.[1] Its potential to generate income while creating incentives for conservation has sparked academic discussion of the meaning of eco-tourism and the design of integrated conservation and tourism projects.[2] With few exceptions, economists have been absent from this discussion.

The World Conservation Union (IUCN) and the Ecotourism Society define eco-tourism as "responsible travel to natural areas that conserves the environment and sustains the well-being of local people."[3] A basic premise of this research is that there may be tradeoffs between these two goals. Expanding tourism can generate pressures for demographic growth by widening the economic disparities between tourist destinations and outside economies, stimulating migration to fill jobs linked directly or indirectly to tourism. This may create a tourism-income-population growth spiral at nature-tourist destinations. Researchers observe what appears to be a strong association between tourism and local population growth.[4]

A few economists have assessed eco-tourism's potential to generate income, but economic research into eco-tourism's impacts and potential to create incentives for conservation is sparse.[5] Current insights come primarily from non-

economists. Wunder notes, "When economic aspects are treated, it is mostly without quantification that would allow for a proper test of the hypotheses."[6] The few cases where quantitative approaches are employed are partial, missing many, if not most, of the impacts they seek to quantify.

Research shortcomings may explain opposing perspectives of researchers and environmental activists over the impacts of tourism, as well as complaints that residents receive few benefits from tourism, even when local economic growth would suggest otherwise. In Ecuador's Galapagos Islands, both census data and obvious changes in the build environment bear witness to a robust and growing island economy and population linked to tourism; however, island residents and researchers generally concur that little of the income generated by tourism enters the local economy.[7] At the same time, there is growing concern about the compatibility of growth and conservation in the Galapagos. The World Wildlife Federation reports:

> Human population growth, invader species and commercial fishing threaten to destroy the fragile ecological balance in the world famous Galapagos islands…Although 97 percent of the island's land area has National Park status, the population of the Galapagos islands has more than doubled in the last 10 years, mainly due to migration from the Ecuadorian mainland. With this migration, many foreign plant and animal species are being introduced. Their estimated numbers have grown from about 77 in 1971 to more than 260 today."[8]

In this paper, we argue that hitherto unstudied interactions between tourism and local economies create income and demographic impacts at nature tourist destinations with potentially far-reaching ramifications for the conservation of fragile ecosystems. These impacts are both larger and more complex than suggested by past studies. We support this argument with empirical analysis using local economy-wide modeling techniques and original survey data from tourists, businesses, and households in the Galapagos Islands. The focus of this article is economic. Other (e.g., cultural, ecological, political) factors may interact with tourism in complex ways and should be included in overall assessments of eco-tourism. However, recognizing the spectrum of economic interactions is fundamental to understanding how tourism influences local regions, and ultimately, the impacts of eco-tourism on local environments.

We begin by presenting an overview of economic impacts of eco-tourism, documenting the limitations of existing analytical approaches. We then detail the alternative economic systems or "local economy-wide modeling" approach we use to estimate the impacts of tourists on the economy and demographics of Ecuador's Galapagos Islands. We compare our findings to those from studies using traditional, partial approaches. The conclusion summarizes findings and discusses challenges for designing eco-tourism policies.

"Eco-tourism" and Its Impacts

Little research has attempted to quantitatively analyze the impact of tourism on economies at eco-tourist destinations. Most existing economic studies

of eco-tourism lack a quantitative element capable of supporting hypothesis tests. An exception is Wunder, who combines a tourist survey with interviews of individuals involved in tourism activities in an effort to test specific hypotheses about impacts of tourism revenues on local development in the Ecuadorian Amazon.[9] Other researchers have studied the value of eco-tourism venues through either the travel cost method[10] or the contingent valuation method.[11] By determining how much eco-tourists value a specific site, managers can better price—and thus better financially manage—eco-tourism venues. So far, this has proven difficult to do. Revenue disparities among comparable eco-tourist spaces in developing countries are significant, and, with the exception of the Galapagos Islands in Ecuador, revenues do not even cover costs of maintaining the protected areas.[12]

Some researchers have attributed this revenue disparity to definitions that fail to distinguish between ecological and other forms of tourism.[13] Two elements are common to definitions of eco-tourism: conserving the local environment and channeling economic benefits to the local human population.[14]

The feasibility and compatibility of these two goals is controversial. A majority, optimistic view in the literature is that eco-tourism presents an opportunity to stimulate local economies as an alternative to extractive industries and environmental degradation. In theory, increased tourism in developing countries could increase local incomes. Higher local incomes, in turn, would create incentives for conservation. Wunder argues that "there is no doubt that tourism has contributed significantly to the conservation of the Cuyabeno

Reserve" in the Ecuadorian Amazon, but he also raises doubts about the consistency of criteria for eco-tourism as outlined above.[15] The general consensus among researchers is that eco-tourism thus far has been problematic, because communities often capture few of the economic benefits of eco-tourism, and therefore have no vested interest in eco-tourism development and are reluctant to forego profligate land and hunting practices.[16]

A minority of researchers argues that eco-tourism cannot lead to sustainable development. Yu et al. signal conditions under which the standard model of eco-tourism, which presents eco-tourism as "a self-sustaining cycle of increased tourism, increased incomes, and increased incentives for conservation," might break down.[17] Eco-tourism employment could simply complement extractive resource practices such as turn-and-burn agriculture, fishing, and land-extensive livestock production, with locals diversifying their employment between these and tourism-related activities at different times of year. In fact, tourism could intensify this complementarity by creating new markets for the output of environmentally sensitive production activities, from food to souvenirs.

The demographic consequences of eco-tourism have not been a subject of quantitative research. Demographic-environmental interactions are complex,[18] and some forms of environmental degradation in fragile ecologies have been linked to population growth fed primarily by migration.[19] Increasing wages, fueled by labor-intensive tourist services, create a stimulus to migration from surrounding areas. In one of the few studies addressing both immigration and eco-tourism, Wallace states that eco-tourism in the Galapagos Islands is failing

because authorities have not succeeded in controlling the migrant influx.[20] Although casual observation suggests a strong correlation between tourism and population growth, no study to our knowledge has quantified the tourism-migration link, in the Galapagos or elsewhere.

According to census data, the population of the Galapagos Islands increased at an average annual rate of 5.9 percent between 1982 and 1990. The populations of the three main islands—Santa Cruz, San Cristóbal and Isabela—grew by almost 70, 55 and 34 percent respectively in the 1980s, and these islands' combined population appears to have nearly doubled in the 1990s, to just over 16,000.[21] Almost 70 percent of the islands' adult inhabitants in 1999 were migrants from other provinces of Ecuador. The strong links among tourism, economic growth, and migration have created political pressures to restrict tourism and migration in an effort to preserve the islands' unique ecology.[22]

The Galapagos Islands are a magnet for nature tourists as well as for environmental researchers. The total number of visitors to the islands increased from 17,500 in 1980 to 71,500 in 2000.[23] The few existing studies of tourism's influence in the archipelago use partial approaches that are almost certain to understate tourism's influences. De Miras used a survey of Galapagos tourists to estimate that only 7.6 percent of tourist expenditures enter the island economy.[24] Zador argues that more than 90 percent of the income generated by Galapagos tourism is absorbed directly by the two airlines serving the islands and by cruise ships based physically on the islands but owned by local operators or entities in mainland Ecuador.[25] (Cruise ships based in outside ports are no longer permitted

in the Galapagos.) Wurtz *et al.* and Southgate, researching tourists' perceptions and preferences, conclude that the spillover of tourist incomes into the island economy depends upon where tourists are lodged, that is, whether in hotels on the islands or on cruise ships (disparagingly referred to by some locals as *hoteles flotantes,* or "floating hotels").[26] Those who stay on cruise ships, Wurtz et al. conclude, spend much less in the local economy. This has led some researchers to promote cruise-ship-based tourism as a way to minimize impacts on the local economy and ecology.[27]

An Economic Systems Approach to Measuring Impacts of Tourism

Estimates of tourist expenditures on local goods and services represent, at best, the initial or first-round influences of tourism in local economies. Complex economic linkages transmit impacts from the directly affected agents (e.g., those who sell goods and services to tourists) to others in the local economy (e.g., those who sell goods and services to the directly affected agents, etc.), in ways that may be nonlinear and shaped by resource constraints. Figure 1 illustrates these linkages. Panel A of the Figure represents the tourist, who demands goods and services from local and outside economic agents (Panel B). Local agents might include hotels, restaurants, bars, and souvenir shops. Outside agents include tour operators based elsewhere in the country or abroad. All estimates of tourism's impacts reported earlier stop at Panel B.

Nevertheless, island residents providing tourist services are connected with others in the local economy. For example, hotels, restaurants, and bars hire

local workers, pay rents to locals, and purchase local "intermediate inputs"—fruits and vegetables from farmers, fish from Galapagos fishermen, and meat from local livestock producers. Outside agents, including operators of cruise ships (whose voyages always begin and end at one of the islands) also purchase locally supplied goods and hire local workers. Payments for these goods and services enter the Galapagos economy, influencing incomes of local agents who may not have any direct contact with tourists (for example, the fisherman or farmer who sells to restaurants, cruise ships, or families of ship crewmembers residing on the islands). These agents, in turn, stimulate new rounds of local expenditures that influence the incomes of still more local agents. High costs of transacting with the mainland ensure that most island residents spend their salaries locally. These second and higher-round effects of tourist expenditures are illustrated in Panel C of the Figure.

At each round, some—perhaps the majority—of incremental income escapes from the local economy in the form of demand for goods or services supplied outside the local region, federal taxes not spent in the province, savings in extra-regional banks, etc. Along the way, however, each round of progressively dampened expenditures creates new impacts of tourism on the local economy. Demand that is not satisfied by markets outside the islands either stimulates supply, leading to real economic growth, or, if supply is constrained, creates inflationary pressures on the islands. Most likely, it leads to a combination of expansion in real economic output and higher prices of goods whose demand is stimulated, directly or indirectly, by tourism.

Price effects are most pronounced for nontradable or partially tradable goods or factors whose local supply is inelastic, or not very responsive to own-price increases. These goods and factors include land, and, if policies limit mainland-to-island migration, labor. The more high transaction costs isolate the local economy from outside markets and the more constrained the local resource base, the more likely tourism will be accompanied by local price inflation. Rising prices transmit the benefits of tourism to suppliers of goods and services that are in high demand but limited supply. They also create incentives to expand local supplies by bringing new goods or services, especially labor, into the local economy.

A widening wage gap between island and mainland increases pressures to migrate from towns and villages along Ecuador's west coast. The entire workforce in this nature-tourist economy can be traced originally to migration.[28]

Even those dedicated to protecting the unique resources of fragile ecological systems may stimulate the local economy through their conservation activities. Research on tourists' willingness to pay for conservation of local resources suggests the existence of a "consumer surplus" that could be taxed to support local conservation efforts.[29] Nevertheless, it is difficult to design conservation efforts that do not, as a by-product, stimulate the local economy, and ultimately, population growth. For example, workers are hired to construct trails so that nature tourists do not tread on fragile terrain. The wages paid to these nature workers then enter the local economy as demand for goods and services, and a new local income multiplier is born of conservation investments.

Modeling Tourism Linkages

The isolation that created the Galapagos Islands' unique eco-system also creates high transactions costs in trading with the Ecuadorian mainland. Because of this, businesses and households on the islands supply many of the goods and services demanded by the tourist economy and by island residents. The result is a web of local economic linkages that transmit influences of tourism among households and firms and unleash general-equilibrium effects in the local economy. Microeconomic models focusing on households, firms, or household-firms,[30] including those in imperfect market environments, miss these general-equilibrium effects.[31] Economy wide models, including computable general equilibrium (CGE) models, are designed to capture the second and higher-round feedbacks of policy changes. However, national CGE models abstract from local economies, and they do not provide the detail needed to reliably uncover the full impact of policy changes on small economies, particularly when households are simultaneously engaged in a "portfolio" of diverse activities.

Our Galapagos economy-wide model uses an adaptation of village-wide modeling techniques presented in Taylor and Adelman .[32] It blends microeconomic analysis with economy-wide modeling, offering an alternative to both micro (household, firm, and household-farm) and aggregate CGE models.

Consider the effect of a change in an exogenous variable Z (e.g., a change in the number of tourists) on an endogenous variable (or vector) Y (e.g.,

production, income of a household group, or migration). Let P denote a vector of local input and output prices. The full impact of the change in Z on Y is given by:

$$dY/dZ = \partial Y/\partial Z + \partial Y/\partial P \; dP/dZ \qquad (1)$$

The first term represents direct income effects, an economy-wide analogue to the partial effects in a microeconomic model in which all prices are held constant. The second term represents the indirect, general-equilibrium effects of the exogenous shock through endogenous local prices. If all goods and factors are tradable (that is, all prices are given to the local economy by outside markets), or if supplies of all goods and services are perfectly elastic (as in a Social Accounting Matrix multiplier model), the second term vanishes. In this case, a series of microeconomic models of households and firms (or, in the case of perfectly elastic supplies, a SAM multiplier model) may be sufficient to estimate local production, marketed-surplus, and income effects of the policy change. However, if some goods (e.g., labor, output) are non-tradable and supplies are not perfectly elastic, the second term in Equation (1) may be nonzero. Market linkages resulting from endogenous prices alter the effects of policy reforms on small economies.

The Galapagos Economy-wide Model

The Galapagos economy-wide model consists of three separate micro or regional computable general equilibrium models, one for each of the archipelago's major population centers (the islands of Santa Cruz, the commercial center; San Cristóbal, the administrative center; and Isabela, a secondary tourist destination). These three models are linked together spatially, through tourism

and trade. The building block of each island model is a series of models of firms and households engaged in a variety of economic activities linked, directly or indirectly, with tourism.

The model includes a large variety of economic actors, illustrated in Table 1. The production side of the model includes a focus on environmentally sensitive activities: agriculture and livestock, including household gardens and small-scale animal production; fishing, broken down by fish species (lobster, bacalao or white fish, and deep-sea fishing); fishing cooperatives; other resource extraction (hunting and forestry); and water production. Service sectors include tourist services (hotels, local tourist agencies, and island-based tours) as well as restaurants, bars, transportation, and commerce, which serve both the tourist and resident island populations. In addition to these island-specific activities, the model encompasses production sectors common to the three islands, including cruise ships.

The production activities purchase factor inputs explicitly or, in the case of family inputs, implicitly, from the island and mainland and generate value-added. The technological relationship between factor inputs and output in each sector is nonlinear, increasing with quantity of factor inputs but at a decreasing rate, as described by sector-specific production functions. The model disaggregates island value-added into five factors: unpaid family factors, skilled wage labor, less skilled wage labor, capital, and land. Family-factor value-added was calculated as the difference between gross value of production and the cost of all

purchased inputs. Skilled labor includes workers with more than six years of completed schooling.

The factor accounts in the model channel value-added into households, in proportion to households' shares of factor supplies. The model contains five household groups, classified according to principal income source: agricultural households, fishing households, commercial households, private-sector salaried households, and public-sector salaried households.

Six common accounts represent activities shared among the three islands. They include island-based and mainland-based cruise ships, domestic and foreign tourists, and Ecuadorian and foreign tourist services.

In addition to the endogenous accounts summarized above, the model contains four groups of exogenous accounts: government, environmental, savings-investment, and the rest of the world. The government accounts include federal, provincial, and municipal governments, as well as public environmental institutions (including the National Park Service). These public institutions tax island residents and tourists and channel revenue into local public-sector activities (including some services) or else into public expenditures on the mainland. Environmental institutions include an assortment of non-government agencies dedicated to environmental preservation. Savings accounts gather savings from activities and households, channeling them into investments in physical as well as human capital (schooling) activities. The rest of Ecuador is made up of three sub-accounts: tourist expenditures on mainland-based air transport, Galapagos tourist expenditures in other parts of Ecuador (en route to and from the islands), and

island purchases of goods and services from the mainland. The rest of the world outside Ecuador distinguishes between foreign tourists' expenditures on transport based outside of Ecuador and island commerce with the rest of the world. These sub-accounts make it possible to include a complete profile of tourist expenditures in the model.

When the demand for a particular skill-level of labor, summed across all production activities, exceeds the existing labor supply on the islands, one of two things can happen, depending upon how open the islands' labor markets are to mainland Ecuador. The first possibility is that new labor migrates to the islands to fill the excess demand at existing wages (the open island labor market scenario). As mentioned previously, mainland-to-island migration has been responsible for significant population increases in the Galapagos over the past 4 decades and the target of recent policy measures to restrict demographic growth. The second possibility is that policies are successful in curtailing migration (the closed island labor market scenario). In this case, increasing demand for labor on the islands exerts upward pressure on island wages instead of triggering migration. Because migration restrictions are recent, it is not clear which of these scenarios more accurately depicts the future of Galapagos island labor markets.[33] We explore the ramifications of these alternative labor market closure scenarios in our policy experiments, described below.

Variables and equations in the island economy-wide models are summarized in Tables 2 and 3, respectively. The core of the model consists of production and input-demand functions for all production activities; household

income, savings, and consumer-demand equations; and general-equilibrium closure equations, including local market-clearing conditions for factors and goods, an island savings-investment balance, and trade balance equations. The market-clearing conditions determine equilibrium quantities and prices. The savings-investment balance determines island net borrowing from the mainland. (Net borrowing is analogous to foreign savings in a national CGE model; mainland banks are represented on the islands, and the island economy is assumed to be open to outside credit markets). The trade equation constrains the value of island "imports" of goods and services from the outside world to equal total island "exports," minus island net borrowing. The islands supply few goods or services to the outside world apart from tourist services; thus, their trade deficit is filled almost entirely by tourism receipts. Inter-island trade links the three island CGE models, transmitting impacts of tourism and policy changes throughout the archipelago. The trade equation represents the redundant equation in our Galapagos CGE system.

Production technologies are specified as Cobb-Douglas, and consumption demands are modeled using a linear expenditure system (LES) approach. Although more complicated functional forms are possible, our experience with micro economy-wide models suggests that little is gained from the use of alternative functional forms (and necessary "guestimates" of accompanying elasticities). We have found the results of our policy experiments using similar models robust to the specification of functional forms.[34] This is not surprising, inasmuch as the model is always calibrated at the same point given by the survey

data, and most policy experiments involve marginal changes in exogenous variables. An advantage of Cobb-Douglas production functions is that they are nonlinear yet relatively simple to implement; under the assumption of profit maximization, output elasticities are equivalent to factor value-added shares obtained directly from establishment and household survey data. The base models solve for local equilibrium prices and quantities of all goods and factors. The tourism experiments are then run on this base.

Micro computable general equilibrium models overcome the principal limitations of fixed-price, including social accounting matrix (SAM) multiplier models, by incorporating price effects, nonlinearities, and resource constraints. All parameters in the Galapagos micro CGE model were estimated using survey data. We view this as an advantage over aggregate (e.g., national) CGE models, which often rely on assumed parameters and outmoded data.

In any general equilibrium model, results tend to be sensitive to model closure assumptions. In our experiments, we explore the sensitivity of findings to labor market closure specifications (migration versus endogenous island wage). Sensitivity analysis of other market specifications can be explored. As with labor markets, in general, the more open Galapagos commodity markets are to mainland Ecuador, the more the economic benefits of tourism are transferred outside the island economy. The complete base model in GAMS code is available in the Data and Models area of http://www.reap.ucdavis.edu.

Data and Findings

Data to estimate the Galapagos economy-wide model are from a 1999 survey of tourists, establishments, and households carried out by a team of researchers from UC Davis and El Colegio de Mexico in Mexico City as part of the Economic Study of the Galapagos.[35] The objectives of this study were to document the evolution of major economic activities in the islands and explore how policy changes, including new environmental regulations, are likely to influence economic and population growth via migration. The study's objectives called for economy-wide modeling tools capable of taking into account complex linkages among economic and environmental actors on the islands. The tourist surveys gathered detailed expenditure information, by item and locale, from 514 individuals departing from the province's two airports (on Santa Cruz and San Cristóbal). The household survey collected detailed data on socio-demographic characteristics, assets, time use, net income from all production activities (computed from detailed listings of inputs and outputs), salaries, transfers, and expenditures. A total of 267 households were surveyed on the three islands (152 on Santa Cruz, 80 on San Cristóbal, and 35 on Isabela). Establishment surveys were administered to 89 businesses (60 on Santa Cruz, 24 on San Cristóbal, and 5 on Isabela, where very few establishments exist). They were designed to permit a detailed accounting of inputs, outputs, and incomes in these activities.

Data from the tourist, household, and establishment surveys were first used to construct a Social Accounting Matrix (SAM) for each of the three islands, as a prelude to the computable general equilibrium (CGE) analysis presented here.

The SAM is presented in Taylor and Yunez[36] and available on the web at http://www.reap.ucdavis.edu. The present study represents the first effort to our knowledge to estimate intra-national impacts of tourism in a general-equilibrium context.

Selected household and occupational characteristics from the household component of the survey appear in Table 4. Three quarters of the adult populations of the three main islands were born outside their island of residence. On Santa Cruz, the commercial center of the Galapagos, only 12 percent of adults were native to the island. There is little evidence of inter-island migration: only 4 percent of adults had migrated from another island in the archipelago. Just under 70 percent of adults were from mainland Ecuador, mostly from the sierra or coastal villages.

Table 5 presents the sector composition of the "gross island product" (GIP), which was estimated from value-added data gathered from the establishment and household surveys. The cruise ship industry accounts for the largest share of value-added in the Galapagos economy. Cruise ships owned by entities on the mainland generated 46 percent of total value-added on the islands. Despite being based on the mainland, these ships channeled some value-added into the island economy (principally by paying wages to crew members whose families were residents of the islands). They also generated local growth linkages by demanding inputs supplied by islanders. Locally based cruise ships accounted for 17 percent of the GIP, followed by fishing (8 percent), commerce (7.5 percent), and farming (5 percent). The Table reveals large differences in the

composition of value added among islands. For example, the cruise ship share ranges from 0 on Isabela to 83 percent on San Cristóbal, and the fishing share ranges from 2 percent on San Cristóbal to 61 percent on Isabela. Santa Cruz has both the largest and most diversified of the three island economies.[37]

The Ecuadorian government does not officially establish global tourist quotas for the Galapagos Islands. Nevertheless, it influences tourist numbers in several indirect ways, for example, by limiting the numbers of tourists who can disembark at specific destinations in the Galapagos National Park, by requiring all national park visitors to be accompanied by tour guides, and especially through a licensing system for cruise ships that places a quota on berths. Through these actions, the government creates *de facto* tourist quotas, which in turn are the key intervening policy variable between the islands and tourism. They are the focus of our policy analysis, presented below.

Impacts of Tourism on the Galapagos Economy

We used the Galapagos CGE model to simulate an autonomous increase in tourist expenditures as a way to explore the impacts of tourism (or the *de facto* or prospective tourist quota) on the Galapagos economy and on mainland-to-island migration. An increase in the tourism stimulates the island economy, by increasing demand by tourists and all members of the island population who are linked in any way to tourism. As the island economy expands, the demand for labor increases. This results either in an increase in local wages (if migration is effectively restricted) or in an increase in migration, whether temporary or

permanent (as new employment and income opportunities attract workers from the mainland).

Tables 6 and 7 report impacts of a simulated 10-percent increase in tourist expenditures on each of the archipelago's three main islands. Table 6 reports impacts on production; Table 7 on household incomes, trade, migration and wages. All but the wage results assume that migration responds to increased labor demand on the islands. This assumption reflects what actually has occurred on the islands in recent decades. Our intent in making this assumption is not to question the future effectiveness of government restrictions on internal migration, but rather, to illustrate potential influences of tourism on migration. The migration response estimated below may be viewed as an indicator of migration pressure or "potential" in this nature tourist economy. The bottom panel of Table 7 reports the impact on island wages under the alternative assumption that the migration restriction is binding. A widening gap between island and mainland wages is likely to generate migration pressures and make it difficult to enforce restrictions on migration flows.

Expansion of tourism directly stimulates tourist activities, the production of which expands by more than 8 percent on the main island of Santa Cruz and 2 to 4 percent on the other two islands. Tourist activities include hotels, restaurants and bars, local tours, and travel agencies. With the exception of restaurants and bars, few of these activities cater to the demands of island households; changes in their output primarily reflect direct effects of tourist expenditures. However, these tourist activities demand locally supplied inputs and generate value-added,

increasing incomes of Galapagos households and stimulating the demand for locally supplied goods and services. The result is an increase in output by activities that do not normally sell directly to tourists. Agriculture and livestock production increases by an estimated 1.8 percent, and fishing output increases by 3 percent. The increased fishing is almost entirely of species harvested in coastal waters, including lobster and cod, which represent 73 to 75 percent of total fishing-sector output on San Cristóbal and Santa Cruz and 95 percent of output on Isabela. The focus on coastal waters reflects both patterns of demand and a lack of capital to exploit deep-water fisheries around the islands. Only "artisanal" fishing is permitted within the marine reserve.

Tourism stimulates other environmentally sensitive production activities, as well. Resource extraction activities (primarily processing and sale of drinking water and logging) increase by nearly 4 percent on the main island and between 0.4 and 0.9 percent in the two smaller islands. Commerce-sector output, principally sales to local residents, increases by 1.0 to 4.3 percent, and other services, including transportation, increase by 1.2 to 3.0 percent.

Incomes of all major household groups on the islands increase (Table 7). On Santa Cruz, the archipelago's commercial and tourist center, the income increases range from 3 to 4 percent in households where the primary income earner is employed in agriculture, self employed, or salaried to more than 4.5 percent in fishing households. Smaller increases in income on the other two islands reflect the unequal distribution of total (direct plus indirect) benefits from tourism among the three islands.

Despite high transaction costs, income and production growth on the islands create substantial economic linkages with mainland Ecuador; economic agents on the mainland become inserted into the Galapagos tourist economy indirectly, through trade. Net island "imports" from the mainland increase nearly 4 percent in Santa Cruz and around 1 percent in the other two islands. Sales of goods and services to the rest of Ecuador are minimal. The islands' "trade deficit" with the rest of Ecuador is financed almost exclusively by tourism income.

Increased production to satisfy the demands of tourists and island households requires labor, and this, in turn, stimulates migration to the islands (unless government policies restrict migration flows). If migration is permitted or cannot be controlled, the 10-percent increase in tourism triggers an amount of migration equivalent to (depending on skill type) between 4.8 and 5.7 percent of the total existing workforce on Santa Cruz, the main commercial island, and between 1 and 2 percent of the workforces on San Cristóbal and Isabela. If migration is effectively controlled, island wages increase by an estimated 7 to 9 percent on Santa Cruz and between 2 and 3 percent for most labor types on the other two islands. This is likely to increase migration pressure and enforcement costs by widening the island-mainland wage gap.

Conclusions

Our findings document linkages that transmit the impacts of tourism through local economies and magnify the influences of tourist expenditures on local incomes. By creating economic disparities between tourist destinations and the economies that surround them, the expansionary influences of tourism also create pressures for population growth through migration to fill jobs linked directly or indirectly to tourism. This can lead to a tourism-income-population growth spiral at nature-tourist destinations. Expansionary economic impacts are often viewed as a "good" in the case of non-nature tourism (e.g., income growth in Mayan villages supplying labor to beach resorts in Mexico). However, they are viewed ambivalently at nature-tourist destinations, where tourism may create incentives to either conserve or exploit the natural resource base.

Our micro economy-wide analysis of nature-tourist impacts in Ecuador's Galapagos Islands reveals income effects much larger than those predicted by studies relying on analysis of tourist expenditures. It also illustrates potentially strong complementarities between tourism and environmentally sensitive island production activities, including agriculture and livestock, fishing, and other types of natural resource extraction. Most striking, perhaps, is the demographic impact of tourism on the archipelago. By raising wages on the islands relative to the mainland, a 10-percent increase in tourism stimulates migration by an amount equivalent to five percent of the existing island workforce. Even conservation activities can stimulate local income growth and migration. Our tourist and household surveys reveal that a larger share of local salaries than of tourist

expenditures enter the local economy directly, through purchases of locally supplied goods and services. This means that spending by conservation workers, like other local residents, ironically may have a greater stimulating effect on the Galapagos economy than spending by tourists.[38]

These findings point to difficult tradeoffs between the objectives of preserving fragile eco-systems and insuring the participation of locals in the economic benefits of nature tourism. Facilitating trade between the local and outside economies can reduce the stimulus to income and demographic growth at nature tourist destinations. In other tourism experiments that we have performed, the marginal impacts of tourism on the local economy decrease sharply when local commodity markets are opened up to trade. However, promoting trade to reduce local impacts of tourism contradicts one of the widely held criteria defining eco-tourism: enabling local residents to participate in the economic benefits of tourism. Trade shifts the benefits of tourism to actors outside the local economy. It also may diminish incentives to conserve fragile ecosystems, as locals may resent channeling benefits elsewhere. The perception that fishermen were deprived of the economic benefits of tourism (and more generally, constrained by new environmental regulations) underlay uprisings by Galapagos fishermen and the inclusion of tourism alternatives for fishermen in the Special Law for Galapagos.[39] Among environmentalists, there is concern that agricultural trade will result in the introduction of new competitive species to the fragile Galapagos ecology. This was the chief motivation behind efforts to reduce agricultural "imports" to the islands.[40] Restrictions on food trade, however, would

put upward pressure on local food prices and production, shifting ecological concerns from the introduction of new species (through trade) to competition in resource use between food producers (principally farmers, ranchers, and fishermen) and conservation objectives (the creation and enforcement of protected zones). These political-economic considerations make it difficult to implement new policies aimed at mitigating the complex impacts of tourism on income and population growth. Nevertheless, *ex-ante* analysis is critical for anticipating the local economy-wide effects of alternative policies and providing a basis to assess environmental risks.

Figure 1. Illustration of Linkages between Tourism and Local Economies

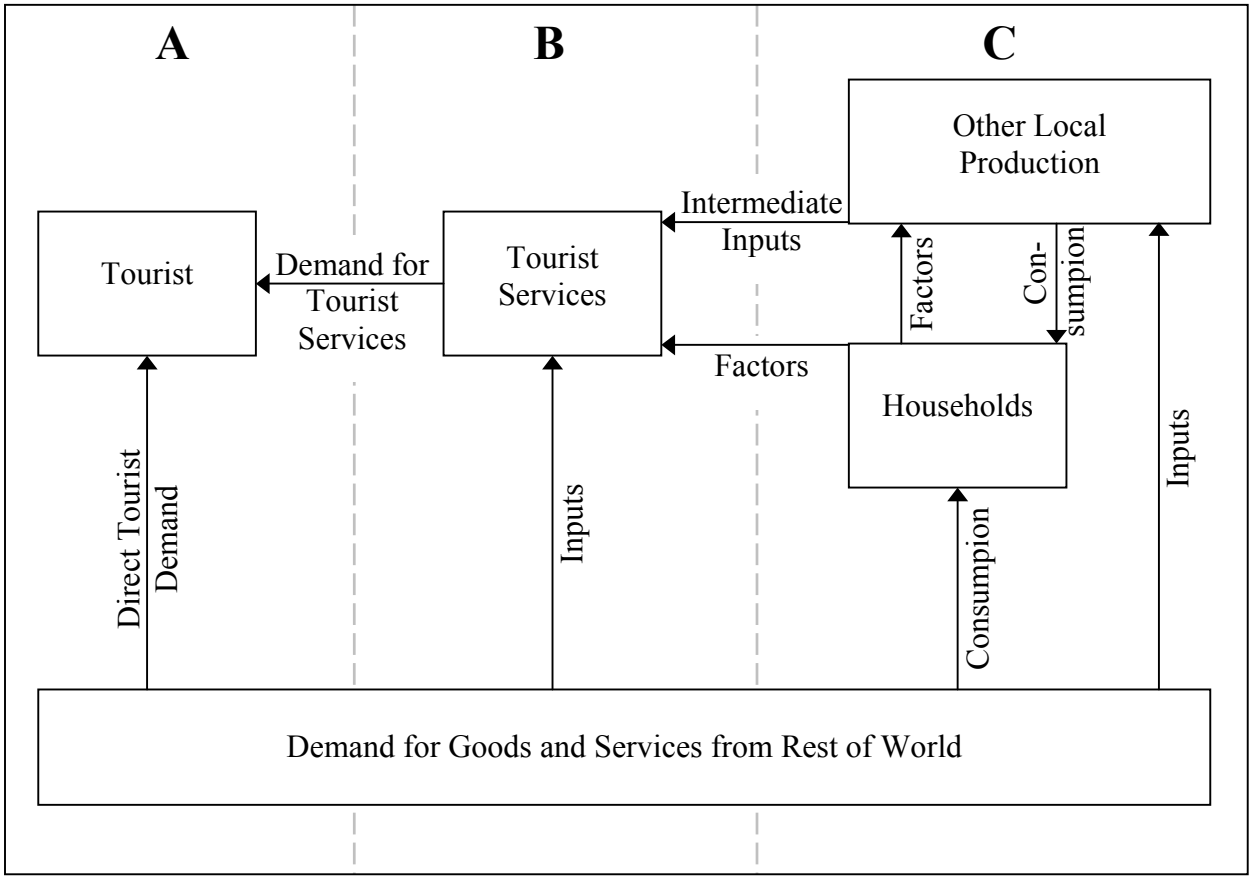

Table 1. Accounts in Galapagos Economy-wide Model

Activities	*Factors*	*Households*	*Shared Accounts*
ENDOGENOUS ACCOUNTS			
Agriculture and Livestock	Family Factors	Agricultural and Livestock	Locally Based Cruise Ships
Fishing (Lobster, Cod, White Fish, Deep-sea)	Skilled Wage Labor	Fishing	Mainland Based Cruise
Fishing Cooperatives	Unskilled Wage Labor	Commercial	Ships
Household Resource Extraction (Hunting,	Physical Capital	Salaried, Private Sector	Domestic Tourists
Forestry)	Land	Salaried, Public Sector	Foreign Tourists
Water Collection and Processing			Tourist Services, Ecuador
Other Production Activities			Foreign Tourist Services
Restaurants and Bars			
Hotels			
Commerce			
Local Tourist Services (Equipment Rental			
and Day Tours, Travel Agencies)			
Transport			
Other Services			

EXOGENOUS ACCOUNTS				
Government	*Private Environmental*	*Savings*	*Rest of Ecuador*	*Rest of World*
Environmental	Darwin Research	Physical	Rest of Ecuador	Air Transport (Foreign)
National Park	Station	Capital	Air Transport	Commercial Flows
INGALA	Other	Human Capital	(Ecuador)	
(Desalinized	Organizations		Other Tourist	
Water, Other			Expenditures	
Services)			Commercial Flows	
Regional				
Municipal (Water,				
Other Services)				
Provincial				
National				

Table 2: Variable and Set Definitions for Galapagos Economy-wide Model

Index or Sector Variable	*Definition*
ip	Production Sector
f	Factor
h	Household Type
Q_{ip}	Output, Sector ip
$FD_{f,ip}$	Demand for Factor f by Sector ip
TFD_f	Total Factor Demand, all Sectors
FVA_f	Factor Value Added, Factor f
TFY_f	Total Factor Income, Factor f
RGDP	Real Gross Domestic Product - Galapagos
W_f	Wage, Factor f
P_{ip}	Equilibrium Price, Sector ip
Y_h	Income, Household h
$YBAR_h$	Exogenous Household Income
$CD_{ip,h}$	Consumption Demand by Household h for Sector ip Output
DD_{ip}	Galapagos Demand for Sector ip Output
MS_{ip}	Market Surplus, Sector ip
IN_{ip}	Intermediate Demand for Sector ip Output
MIG_f	Net Migration of (labor) Factor f (= labor supply from mainland)
FS_f	Island Factor Supply

Table 3: Core Equations in Galapagos Economy-wide Model

Relation	*Equation*
Production Functions	$Q_{ip} = Q_{ip}(FD_{f,ip}, f=1,\ldots,nf; ip=1,\ldots,np)$
Intermediate Demands	$IN_{ip} = IN_{ip}(Q_{ip}, ip=1,\ldots,np)$
Factor Demand	$FD_{f,ip} = FD_{f,ip}(Q_{ip},P_{ip},W_{f,jp}, f=1,\ldots,nf; ip=1,\ldots,np)$
Total Factor Demand	$TFD_f = \Sigma_{ip} (FD_{f,ip}),\ f=1,\ldots,nf; ip=1,\ldots,np$
Factor Value Added	$FVA_f = \Sigma_{ip} (FD_{f,ip}W_{f,ip}),\ f=1,\ldots,nf; ip=1,\ldots,np$
Total Factor Income	$TFY_h = F(FVA_f, f=1,\ldots,nf)$
Household Total Income	$Y_h = TFY_h + YBAR_h$
Household Consumption Demand	$CD_{ip,h} = CD_{ip,h}(P_{ip},Y_h, ip=1,\ldots,np; h=1,\ldots,nh)$
Galapagos Demand	$DD_{ip} = IN_{ip}+\Sigma_h CD_{ip,h}, ip=1,\ldots,np; h=1,\ldots,nh$
Product Market Equilibrium	$MS_{ip} = Q_{ip}-DD_{ip}, ip=1,\ldots,np$
Factor Market Equilibrium	$TFD_f = FS_f+MIG_f, f=1,\ldots,nf$
Real Gross Domestic Product, Galapagos	$RGDP = \Sigma_f(FVA_f), f=1,\ldots,nf$

Table 4: Galapagos Household Survey, Socio-demographic Characteristics

Characteristic	*Island* *Santa Cruz*	*San Cristóbal*	*Isabela*	*Total*
Household Sample Size	152	80	35	267
Total Household Members	613	369	160	1,142
Average Members Per Household	4.0	4.6	4.6	4.4
Adults Per Household*	2.5	2.6	3.0	2.7
Average Ages				
Household Heads	37.0	44.7	41.3	41.0
Household Members	22.6	24.6	25.5	24.2
Percentage of Adults...				
Born on Island	12	37	52	26
Born on Other Galapagos Island	4.6	1.9	3.8	3.7
Born on Mainland	81.6	60.6	44.1	69.8
Born Abroad	1.9	1.0	1.0	1.5

*18 years or older and workers between 15 and 17 years of age.

Table 5: Galapagos: Composition of Gross Island Product, 1997-1998

	Island (% of Gross Island Product)			
Sector	*Santa Cruz*	*San Cristóbal*	*Isabela*	*Total*
Agriculture and Livestock	5.4%	3.3%	5.8%	4.8%
Fishing	6.5%	2.2%	60.7%	7.8%
Fishing Cooperative	0.4%	0.0%	0.0%	0.2%
Household Resource Extraction	2.7%	0.1%	1.8%	1.8%
Water Collection and Processing	1.4%	0.1%	0.7%	0.9%
Other Production Activities	1.0%	3.8%	0.5%	1.9%
Restaurants, Bars, Hotels	5.5%	0.6%	5.3%	3.9%
Commerce	10.4%	0.5%	15.9%	7.5%
Tourist Services				
Equipment Rental and Day Tours	1.1%	0.2%	0.6%	0.8%
Travel Agencies	3.1%	0.0%	3.0%	2.1%
Locally Based Cruise Ships	20.8%	10.7%	0.0%	16.6%
Mainland Based Cruise Ships	36.1%	72.1%	0.0%	45.9%
Transport	3.5%	1.4%	1.4%	2.7%
Other Services	2.1%	4.9%	4.4%	3.1%
Total	100.0%	100.0%	100.0%	100.0%

Table 6. Estimated Percentage Production Effects of a 10% Increase in Tourism in the Galapagos Islands

Variable	*Island*		
	Santa Cruz	*San Cristóbal*	*Isabela*
Production			
Agriculture	1.82	0.48	1.18
(Price)	(2.16)	(0.36)	(0.26)
Fishing	3.04	0.62	1.49
(Price)	(0.14)	(0.16)	(0.02)
Environmental Activities	3.92	0.43	0.92
(Price)	(0.09)	(0.00)	(0.00)
Other Production	2.62	0.52	1.45
(Price)	(0.42)	(0.11)	(0.04)
Tourist Activities	8.22	2.5	4.08
(Price)	(0.19)	(0.05)	(0.09)
Other Services	3.01	1.56	1.18
(Price)	(0.23)	(0.04)	(0.06)
Commerce	4.3	1.03	1.34
(Price)	(0.16)	(0.04)	(0.03)

Table 7. Estimated Percentage Effects on Incomes, Trade, Migration, and Wages of a 10% Increase in Tourism in the Galapagos Islands

Variable	*Island*		
	Santa Cruz	*San Cristóbal*	*Isabela*
Household Real Income			
Agricultural	3.94	0.99	1.46
Fishing	4.69	0.93	1.52
Self Employed	3.47	0.85	0.98
Private Salaried	3.84	0.49	1.39
Public Salaried	3.29	0.47	1.43
Net Imports from Rest of Ecuador	3.93	0.83	1.31
Migration	5.02	1.28	1.71
Wage Labor	5.72	1.51	1.57
Family Labor	4.83	1.21	1.76
Wage (without Migration)			
Skilled Workers	9.16	0.00	2.61
Unskilled Workers	6.72	2.75	2.67

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1.Conservation International (2002) http://www.conservation.org/xp/CIWEB/programs/ecotourism/ecotourism.xml; The Nature Conservancy (2002) http://nature.org/aboutus/travel/ecotourism/about/art667.html.

2. Stefan Gössling, "Ecotourism: A Means to Safeguard Biodiversity and Ecosystem Functions," *Ecological Economics* 29 (1999): 303-320; Sven Wunder, "Ecotourism and Economic Incentives: An Empirical Approach," *Ecological Economics* 32 (2000): 465-479.

3. S. Blangy and M.E. Wood, *Developing and Implementing Ecotourism Guidelines for Wildlands and Neighboring Communities*. In *Ecotourism : A Guide for Planners and Managers*, edited by Kreg Lindberg and Donald E. Hawkins (The Ecotourism Society, 1993).

[4] For example, Gormsen reported that the number of residents in Cancún, Mexico, increased from 426 to 177,300 between 1970 and 1990, largely as a result of migration stimulated by tourist infrastructure development by the Mexican government, and Gössling describes how tourism-driven migration nearly doubled the local population and altered the coastal environment in Kiwengwa, Unguja Island, Tanzania (E. Gormsen, "The Impact of Tourism on Coastal Areas," *GeoJournal* 42(1):39-54 (1997); S. Gössling, "Tourism, Environmental Degradation and Economic Transition: Interacting Processes in a Tanzanian Coastal Community," *Tourism Geographies* 3(4):230-254).

5. Dave Tobias and Robert Mendelsohn, "Valuing Ecotourism in a Tropical Rain-Forest Reserve," *AMBIO* 20 (1991): 91-93; P. Maille and Robert Mendelsohn, "Valuing Ecotourism in Madagascar," *Journal of Environmental Management* 38 (1993): 213-218; Susan Menkhaus and Douglas J. Lober, "International Ecotourism and the Valuation of Tropical Rainforests in Costa Rica," *Journal of Environmental Management* 47 (1996): 1-10; L.C. Chase, D.R. Lee, W.D. Schulze and D.J. Anderson, "Ecotourism Demand and Differential Pricing of National Park Access in Costa Rica," *Land Economics* 74 (1998): 466-482; B.R. Tershy, L. Bourillon, L. Metzler and J. Barnes, "A Survey of Ecotourism on Islands in Northwestern Mexico," *Environmental Conservation* 26 (1999): 212-217; I. Maharana, S.C. Rai and E. Sharma, "Valuing Ecotourism in a Sacred Lake of Sikkim Himalaya, India," *Environmental Conservation* 27 (2000): 269-

277.

6. See Wunder (n.2 above).

7. Claude de Miras, *Las Islas Galápagos, Un Reto Económico: Tres Contradicciones Básicas*. Fundación Charles Darwin para la Islas Galápagos (FChD) y Institute Francais de Recherche Scientifique pour le Développement en Coopération (ORSTOM), Quito (1995).

8. Environmental News Network (2002) http://www.enn.com/enn-news-archive/1997/07/071897/07189711.asp.

9. See Wunder (n.2 above).

10. Tobias and Mendelsohn; Maille and Mendelsohn; Menkhaus and Lober (n.3 above).

11. Maharana et al.; Tershy et al.; Chase et al (n.3 above).

12. E. Boo, *Ecotourism: The Potentials and Pitfalls* vol. 1 and 2 (Washington D.C.: World Wildlife Fund, 1990).

13. K. Lindberg, *Policies for Maximizing Nature Tourism's Ecological and Economic Benefits* (Washington D.C.: World Resource Institute, 1991); H. Ceballos-Lascurain, *Tourism, Ecotourism, and Protected Areas: The State of Nature Based Tourism Around the World and Guidelines for its Development* (Gland, Switzerland: IUCN, 1996).

14 It has been argued that eco-tourism cannot lead to sustainable development in a global sense, because of environmental impacts associated with travel (S. Gössling, "Sustainable Tourism Development in Developing Countries: Some Aspects of Energy-Use," *Journal of Sustainable Tourism* 8(5):410-425; K.G. Hoyer, "Sustainable Tourism or Sustainable Mobility? The Norwegian Case," *Journal of Sustainable Tourism* 8(2):147-160.) The present study focuses on local impacts.

15. Wunder (n.2 above).

16. K. Theophile, "The Forest as a Business: Is Ecotourism the Answer?" *Journal of Forestry* 93 (1995): 25-27.

17. Douglas W. Yu, Thomas Hendrickson, and A. Castillo, "Ecotourism and Conservation in Amazonian Perú: Short-Term and Long-Term Challenges," *Environmental Conservation* 24 (1997): 130-138.

18. Michael Lipton, "Accelerated Resource Degradation by Agriculture in Developing Countries? The Role of Population Change and Responses to It," in *Sustainability, Growth, and Poverty Alleviation: A Policy and Agroecological Perspective*, ed. Steve Vosti and Thomas Reardon (Baltimore: John Hopkins University Press, 1997).

19. Thomas Reardon and Steve Vosti, "Poverty-Environment Links in Rural Areas of Developing Countries," in *Sustainability, Growth, and Poverty Alleviation: A Policy and Agroecological Perspective*, ed. Steve Vosti and Thomas Reardon (Baltimore: John Hopkins University Press, 1997).

20. G.N. Wallace, "Wildlands and Ecotourism in Latin America: Investing in Protected Areas," *Journal of Forestry* 91 (1993): 37-40. The authority responsible for controlling migration is INGALA (Instituto Nacional Galápagos), which coordinates policies and planning throughout Galápagos.

21. Charles Darwin Foundation, *Online Annual Report for 1999* (2002) http://darwinfoundation.org/Ourwork/social.html

22. The *Ley de Régimen Especial para la Conservación y Desarrollo Sustentable de la Provincia de Galápagos* (Special Law for Galapagos) includes efforts to limit migration to the islands and establishes a board to recommend tourism policies (Quito: Congreso

Nacional, Registro Oficial No. 278, March 18, 1998).

23 Fundación Charles Darwin, *La Pesca Industrial del Atún y Galápagos* (Unpublished Report, February 1999); Fundación Natura, *The Galapagos Report* (Quito, 1999 and 2001).

24. De Miras (n.5 above).

25. Michele Zador, Galápagos Marine Resources Reserve: A Pre-Investment Analysis for the Parks in Peril Program. Unpublished Report prepared for The Nature Conservancy (1994).

26. Southgate; James Wurz, George N. Wallace y José Cárdenas, *Motivaciones, Experiencias Deseadas y Preferencias para Técnicas de Manejo de los Visitantes al Parque Nacional Galápagos, Ecuador*. Puerto Ayora: Charles Darwin Foundation, 1994.

27. In recent years there has been debate about opening locally based tourism to boost the local economy. The Charles Darwin Research Station, hub of Galapagos environmental research, has been active in this debate because of what it perceives as potentially greater impacts of local-based tourism on the environment (new roads being built into virgin areas, garbage, transport of species between areas, etc.; personal correspondence with Roslyn Cameron, Head of Public Relations, CDRC, cdrs@fcdarwin.org.ec).

28. Eighty-eight percent of the adult population living on the main island of Santa Cruz, 63 percent of those on San Cristóbal and 47 percent on Isabela were born outside the Galapagos (estimates from household survey). All of these islands' populations can be traced originally to earlier migrations of the 1930s-1980s.

29. E.g., Tobias and Mendelsohn (n.3 above).

30. E.g., Inderjit Singh, Lyn Squire, and John Strauss, *Agricultural Household Models: Extensions, Applications, and Policy* (Baltimore: John Hopkins University Press; Washington, D.C.: The World Bank, 1986).

31 Alain de Janvry, Marcel Fafchamps, and Elizabeth Sadoulet, "Peasant Household

Behaviour with Missing Markets: Some Paradoxes Explained," *Economic Journal* 101(1991):1400-1417.

32 J. Edward Taylor and Irma Adelman. *Village Economies: The Design, Estimation and Use of Villagewide Economic Models* (Cambridge: Cambridge University Press, 1996).

33 . In addition to permanent residents, there are several categories of non-residents who are permitted to work in the islands. Probably the most common related to the tourist sector are temporary residents. These essentially are guest workers permitted into the islands when it is deemed that the local (resident) labor market cannot provide island employers with workers having the skills they demand. Temporary residents are only permitted to work for the company that brought them to the islands and can stay for the duration of the contract without gaining any residency rights. There is also a transient category for workers who are in the Galapagos for fewer than three months.

34J. Edward Taylor, Antonio Yunez-Naude and Steve Hampton, "Agricultural Policy Reforms and Village Economies: A Computable General Equilibrium Analisys from Mexico," *Journal of Policy Modeling* 21(1999): 453-480.

35 The survey and initial data analysis were sponsored by the Inter-American Development Bank.

36 J. Edward Taylor and Antonio Yunez-Naude, *Estudio Económico de las Islas Galápagos* (Economic Study of the Galápagos Islands) (Documento de Trabajo, Banco Interamericano de Desarrollo, Washington, D.C., 1999).

37 Disparities in development among the islands may diminish under the Special Law for Galapagos, which earmarks Isabela for tourism development to reduce its dependency on

fishing.

[38] This observation is intended only to illustrate the pervasiveness of growth linkages in local economies. Approximately 500 conservation workers are employed by Park Service and CDRS, a relatively small share of the total Galapagos workforce.

39 E.g., see Jim Weiss, "Turmoil in Paradise: Galapagos Fishermen Revolt Against Strict Quota on Lobster," *San Francisco Chronicle* (December 10, 2000) http://www.mindfully.org/Water/Galapagos-Fishermen-Revolt.htm; Dan Ferber, "Galapagos Station Survives Latest Attack by Fishers" *Science* 290 (2000): 2059-2061.

[40] Quarantine Program, Special Law for Galapagos, 1998.