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Analysis

Managing tourism in the Galapagos Islands through price incentives: A choice experiment approach

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ABSTRACT

This study analyzes nature-based tourism in Ecuador's Galapagos National Park, which faces great risks of invasive species due to visitor contacts. The analysis uses visitors' preference data to evaluate the potential impacts of various pricing strategies on revenues. Data come from choice experiment surveys conducted in 2009, regarding four characteristics of a tour to the Galapagos: length of stay, depth of experience in the islands' ecosystem, level of protective measures taken against invasive species, and price. We found that the typical tourist would be willing to pay 2.5 times more for a tour with high-level of protection against invasive species than for a tour with the current level of protection and otherwise similar characteristics. The mean marginal willingness to pay for a tour with an in-depth natural experience is 1.8 times more than for a similar tour providing only an overview of the Galapagos' ecosystem. Further, we determined that differences in elasticity of demand between long and short tours suggest that a pricing strategy may be used to encourage tourists to take longer tours without affecting total revenue. Such a pricing strategy would decrease the number of unique island visitor contacts per year, thereby reducing the threat to the islands' unique ecosystem.

1. Introduction

Nature-based tourism, once seen as a compromise between conservation and economic development, may in fact be contributing to the loss of biodiversity in fragile ecosystems. Tourism can affect the environment directly, through the development of infrastructure such as restaurants and hotels, but also indirectly, by introducing non-native species into previously isolated or relatively protected areas. The latter can have a substantial effect on the environment. The introduction of non-native species has been blamed for one-half of all documented extinctions in Galapagos since 1600 (Rogg et al., 2005). Island ecosystems are particularly vulnerable to non-native invasions, precisely because they evolved in general isolation (Cook et al., 2006). Hawaii, for example, home to 25,000 endemic species, has more species listed as endangered or threatened than does the entire continental United States (Vitousek, 1988).

The number of visitors to the Galapagos Islands must be limited for three reasons (Plan de Manejo Parque Nacional Galapagos, 2005; Causton et al., 2000). First, each visitor represents a unique contact between the islands and an outsider who carries with him/her the potential to introduce non-native species. Second, the transport of each individual tourist, by plane or ship, constitutes an additional pathway for non-native species invasion. Through these channels, an increase in individual visitors increases the number of vectors carrying invasive species and, accordingly, the risk of a successful new invasion. Third, the recent shift in Galapagos tourism from long tours to short tours increases the number of unique visitor-island contacts while decreasing the quality of the tourism experience and failing the park's mandate to educate visitors on the importance of its ecosystem. Several strategies exist to balance a growing demand for visits to the islands with the limits imposed by biodiversity conservation goals, but to be effective these strategies must be adapted to tourist preferences.

This study examines one particular tourism management technique: a pricing strategy to manipulate tourist choices. It provides quantitative data about tourist preferences as well as potential impacts of pricing strategies on park revenues and on overall levels and types of Galapagos tourism. We present data from a choice experiment performed in the summer of 2009 by 252 tourists who had just completed a tour of the Galapagos Islands. The experiment presented participants with hypothetical tours of the Galapagos described by four varying characteristics: length of stay, depth of experience in the natural environment of the islands, level of protective measures taken against the risk of invasive species to the islands, and price. Participants were asked which of any of the various tours presented they would select. We used their responses to estimate a choice model and the resulting marginal valuation of each tour characteristic. We found that tourists highly value measures taken on a tour to protect against invasive species. On average, they are willing to pay 2.5 times as much for a high level of protection

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against invasive species compared to a medium level and otherwise similar characteristics. Our estimates also show that demand for a short tour in particular is elastic, whereas demand for taking a tour of some kind is inelastic. This difference in elasticity can be exploited by pricing strategy to achieve three often-competing policy goals simultaneously: reduce the total number of tours to the islands, shift the distribution of remaining tours to long tours rather than short, and maintain total revenues.

Our research extends the literature concerning the valuation of ecosystems by examining declines in biodiversity explicitly linked to individual behavior—namely, the risk of invasive species due to tourism. Previous valuation studies have examined biodiversity itself (Christie et al., 2006) and the degradation of biodiversity though public externalities such as acid rain (Macmillan et al., 1996). Further, we use data from a choice experiment to model the effects of pricing strategies as a mechanism to decrease negative externalities; this contributes to the existing literature on affecting demand for tourism using entrance or access fees (Becker, 2009; Alpízar, 2006; Tobias and Mendelsohn, 1991; Navrud and Mungatana, 1994; Willis, 2003; Chase et al, 1998; McLean and Johnson, 1997). Last, this study differs from previous WTP studies in the Galapagos (Machado, 2001; Oleas, 2008) in its use of a choice experiment methodology rather than an open-ended contingent valuation question.

2. Regulating Visits to Sensitive Areas and the Galapagos Islands

The Galapagos Islands are emblematic of the unique flora and fauna that can flourish in isolated ecosystems. Scientists estimate that at least 7000 species live in the Galapagos, making the ecosystem one of the most distinctive on Earth. Of the species found in the islands, 97% of reptiles and mammals, 80% of land birds, 50% of insects and 30% of plants are endemic to the islands (Rogg et al., 2005). Beyond their biological value, the islands are a powerful symbol of the biodiversity that inspired Charles Darwin's theory of evolution (UNESCO, 2014). The isolation that created this local biodiversity also makes it vulnerable to invasive species (Cook et al., 2006). Currently, 60% of the 180 endemic plants are in danger of extinction, according to the standard IUCN Red List of Threatened Species. Of the thirteen documented species extinctions on the islands, eleven were attributed to invasive species (Bensted-Smith et al., 2002; Rogg et al., 2005). In 2007, 1321 non-native species were reported on the islands (Watkins and Cruz, 2007).

The consensus in the literature is that tourism is primarily responsible for the influx of invasive species to the Galapagos Islands (Jones, 2013; McNeill et al., 2011; Trueman et al., 2010; González et al., 2008; Usher, 1988). This belief is echoed by current park managers and experts at conservation organizations on the Galapagos Islands (F. Cruz, personal communication, July, 2009). The invasive species arrive by means of the tourists' physical bodies and accouterment (Chown et al., 2012; McNeill et al., 2011; Pickering and Mount, 2010; Lee and Chown, 2009; Wichmann et al., 2009), airplanes or ships transporting the tourists (Kilpatrick et al., 2006; Bataille et al., 2009), the importation of goods for tourists (González et al., 2008; Causton and Sevilla, 2008), and the emigration of labor from the mainland to support the tourism industry (Trueman et al., 2010). Although tourists are not the only people who could potentially introduce invasive species—scientists and residents returning from travel could too—they create by far the single largest risk. The number of tourists (173,000 in 2008) dwarfs that of scientists visiting the island, approximately 240 per year (author's calculations based on annual scientific permits in 2013), as well as the island's roughly 25,000 permanent residents (Ecuadorian National Census, 2010).

In quantifying the risk of invasive species to an ecosystem, ecologists consider the likelihood that those non-native species will become established, a concept termed "propagule pressure" or "effort of introduction." Three variables determine propagule pressure: the quantity of specimens in each release, the quality of each of these specimens (hardiness), and the frequency of release (Drake et al., 2005; Lockwood et al., 2005; Lonsdale, 1999; Colautti et al., 2006; Ricciardi et al., 2011). Of these three aspects, the frequency of release is essential for establishment of the non-native species (Lockwood et al., 2005; Ricciardi et al., 2011).

Applying this formula to the issue of invasive species in the Galapagos, each tourist's arrival represents one release event, regardless of that tourist's length of stay, because the majority of non-native species are released in the initial contact between tourist and island (Wichmann et al., 2009; Pickering et al., 2011; Ansong and Pickering, 2013; Ansong and Pickering, 2014). Thus a tourist on a two-day tour has the same impact on invasive species risk as does a tourist on a seven-day tour. Accordingly, when expressing the burden on an ecosystem of non-native releases, ecologists multiply the mean number of seeds that a visitor carries (the measure of quantity) by the number of visitors (the measure of frequency) (Ansong and Pickering, 2013; Chown et al., 2012; Ware et al., 2012; Whittmann et al., 2014). Similarly, economic studies of tourism model the risks of invasive species as the number of unique tourists times the measure of frequency of releases (Warziniack et al., 2013; Perrings et al., 2002; Timar and Phaneuf, 2009).

Given which factors are used to quantify the risk of invasive species, it is clear why that risk has increased alongside the extraordinary growth of the tourism industry and the shift from longer to shorter tours in the Galapagos Islands in recent decades. In the late 1960s a single cruise ship took visitors to the island; by 2006, 80 cruise ships were licensed to do so. The number of tourists has simultaneously grown from 2,000 in the late 1960s to 11,657 ten years later, then to 18,000 by the mid-1980s. The number of visitors rose exponentially in the late 1990s, later reaching 78,000 in 2001 and 173,000 in 2008, an upward trend expected to continue.

Along with an increase in the number of tours, there has been a shift from conservation-focused visitors to more "causal tourists" who are more demanding on the ecosystem (Quiroga, 2009; Watkins and Cruz, 2007). The majority of these visitors (70%) were foreign tourists, predominantly North Americans (Plan de Manejo Parque Nacional Galapagos, 2005).

Current attempts to reduce the risk of invasive species due to tourism are believed to have actually worsened the problem. The National Park of the Galapagos imposed a limit on the number of visitors a cruise ship can carry. Tour operators responded to these capacity limits by reducing the average length of tours given and increasing the number of tours sold (Epler, 2007). The net result was an increase in the number of unique visitor-island contacts (Quiroga, 2009; Grenier, 2007).

Managers are now tasked with counteracting these unintended consequences as well as balancing the policy goal of reducing the risk of invasive species against other concerns. Competing demands for conservation, preservation of "traditional uses of natural resources," promotion of economic growth, and tensions between different lines of business within the tourism industry have rendered any relevant regulation highly contentious (Quiroga, 2009; Heylings and Bravo, 2007). Any policy, therefore, which seeks to reduce the risk of invasive species, must simultaneously maintain revenues while also catering to non-economic goals such as the educational mission of the National Park.

Our study shows that pricing strategies may accomplish just that. Park managers can exploit differences in elasticity in tourist preferences to decrease the total number of tours while shifting remaining demand from short to long tours (Alegre and Pou, 2006). Such a strategy is currently under discussion among many policymakers, scientists and non-governmental organizations (Gardener and Grenier, 2011).

Reducing the total number of tourists would reduce all of the avenues for invasive species introduction that tourism brings with it. While these changes may not reduce the risk of invasive species caused by the demand tourism places on imported goods or by the increased population due to tourism, it *does* reduce the propagule pressure attributable to tourists' physical bodies, accouterments, and transportation to the islands—the largest contributing factor to the overall risk

(Chaloupka and Domm, 1986; Lonsdale, 1999). For this reason, having a smaller number of visitors staying longer in the islands presents less risk of invasive species than having a greater number of visitors staying shorter amounts of time.

At the same time, because long tours produce more revenue than short tours, tourism revenues will be maintained despite the drop in total number of visitors. Further, long tours are thought to keep a higher percentage of revenues local, as compared to shorter tours (Sandbrook, 2010). Keeping revenues in the local economy makes any policy change more socially acceptable (Quiroga, 2009; Epler and Proaño, 2008). A long tour is also consistent with the educational mandates of the National Park to inform its visitors about the ecological value of its biodiversity (Powell and Ham, 2008); short tours are believed to be favored by casual tourists (Lindberg, 1991; Watkins and Cruz, 2007) unlikely to gain much appreciation for the islands' ecological value during their visit.

Our conclusion that a pricing strategy best satisfies the variety of demands placed on tourism management is consistent with the literature. Studies on regulating the flow and type of visitors to a fragile site have examined a number of controlling tactics: pricing strategies, queuing, waiting lists, lottery, time allotment, voucher, capacity limits and others (McLean and Johnson, 1997; Schwartz et al., 2012). Of these options, a pricing strategy is theoretically superior because it maximizes social benefit (Schwartz et al., 2012; Cullen, 1985; Fractor, 1982). In one example of its successful use, policy-makers in the archipelago Fernando de Noronha in Pernambuco have made use of an "environmental tax" to incentivize tourists to take longer rather than shorter visits (Fernando de Noronha, 2014; Estima et al., 2014). Although there remain equity and ethical concerns surrounding pricing access to ecosystems (Manning, 2004; Becker, 2009; Quiroga, 2009), a significant advantage of the pricing strategy tactic is its flexibility in meeting one or more of a wide range of objectives. Price differentiation between different tourists or tours can be used to privilege certain groups over others, cover costs, maximize revenue, or, as we suggest, manipulate tourist behavior (Becker, 2009; Alpízar, 2006; Tobias and Mendelsohn, 1991; Navrud and Mungatana, 1994; Willis, 2003; Chase et al, 1998; McLean and Johnson, 1997).

In the following sections, we describe the methodology used to elicit the valuation of various characteristics of a visit to the Galapagos. We then analyze how this information could be utilized to design policies to change demand for tours to the islands, maintain revenues and decrease the unique contacts which threaten the islands' ecosystem.

3. Methods

This study uses a stated choice method, specifically a choice experiment, to estimate an individual's willingness to pay for different characteristics of a visit to the Galapagos. A choice experiment, unlike alternative valuation methods such as travel cost and contingent valuation, has the advantage of allowing us to estimate the value of marginal changes to environmental attributes, to overcome the embedding issue, and to improve the statistical robustness of the estimated models (Hanley et al., 1998). Previous studies have used choice experiments to evaluate individual preferences regarding the likelihood of observing wildlife and landscape features during a visit to a national park (Juutinen et al., 2011; Birol et al., 2006; Christie et al., 2006; Naidoo and Adamowicz, 2005), as well as changes in the quality of accommodations, recreational services, water quality (Kosenius, 2010; Alvarez-Farizo et al., 2007), and risk of overcrowding (Brau and Cao, 2006; Hearne and Salinas, 2002).

Most importantly, the choice experiment data allows us to model how demand is related to more than one characteristic of the tour. We can simulate the demand for long and short tours under alternative pricing strategies and then test whether the effect of a given strategy is the same for different types of tours. For example, does a surcharge on short tours yield the same decrease in demand for in-depth tours as it does for overview tours? Modeling the change in demand when more than one characteristic changes is not feasible with contingent valuation or travel cost data. Using these data on preferences we then simulate demand under different pricing strategies and shifting tour characteristics.

To identify which tour characteristics influence visitors' choice of a tour, we conducted twenty in-depth, semi-structured interviews of representatives from a variety of key groups, including scientists from the Charles Darwin Station ($n = 2$), academics in the field of tourism ($n = 3$), environmental advocates ($n = 3$), industry organizations ($n = 9$), and Galapagos National Park officials ($n = 3$).[1] We also reviewed tourism promotional materials and compiled a list of terms used to describe tour packages. In these interviews we asked which characteristics of an experience in the islands were relevant to them as stakeholders in island conservation, and which they perceived were relevant to potential visitors. We identified the four major characteristics relevant to tourists considering a tour to the islands: the length of the tour, the depth of exposure to the unique biological and geophysical characteristics of the Galapagos, protective measures taken against the risk of invasive species, and the price. We then used one on-line pilot survey ($n = 16$) and two field pilot surveys ($n = 20$ and $n = 24$) to refine the descriptions of these characteristics and verify that they indeed reflect the elements most important to the majority of respondents.

The length of the tour is an obvious observable characteristic important both to respondents and to managers concerned with invasive species risk. Depth of naturalistic experience is an implicit characteristic which tourists gauge by the language used to describe a given tour package. In our survey, however, we made this characteristic explicit. As park managers are charged with an educational mission, this feature is relevant to their objectives. Protection against invasive species is a crucial focus of conservation, but is not currently an attribute easily apparent to potential tourists; rather, it is the non-market characteristic that we are attempting to value. For this reason, we included it as a quantifiable characteristic in our hypothetical tours.

We defined two tour lengths, "long" and "short," based on our finding that the typical advertised tour length is bimodal (3-to-5 nights or 7-to-10 nights). While "depth of experience" is usually implicit in a tour's description, we made it explicit by presenting respondents with two defined levels, "overview" and "in-depth," terms which capture how park managers, who are charged with educating tourists about the islands, conceptualize whether a tour does or does not meet this goal. These levels reflect the current types of tours available. We next described three degrees of measures taken to reduce the risk of invasive species: medium (the average measures taken in current tours), low, and high.

Responses to potential participant questions were scripted during pilot testing. The final survey included the four characteristics described above and the possible choices for each as listed in Table 1. We also included the option "no tour"—allowing the respondent to choose to take no tour at all—in order to mirror the actual choices available to a potential Galapagos tourist (Haaijer et al., 2001).

The full factorial of this design was 192 possible combinations, and we selected a fractional factorial design that excluded dominated and dominant alternatives to ensure variability in the data (Louviere et al., 2000). The design comprises only main effects.[2] We used SAS software to draw a fractional factorial design of thirteen alternatives and arranged the options in four sets of alternatives using a blocking technique (Hensher et al., 2005). The choice sets were arranged in four

[1] The two representatives from the Charles Darwin Station were the Planning Director and the Chief of Social Sciences. Academics were from the Galapagos campus of the University San Francisco de Quito. Environmental advocates included the World Wildlife Fund, The Nature Conservancy, and Conservation International. Industry representatives were from Tour Operators of Galapagos, Provincial Chamber of Tourism, and guide associations. The officials from the national park were the National Park Director, the Chief of Tourism Department, and a Tourism Consultant.

[2] A cross-effect design would allow for the many potential interactions among the attributes, but this was not possible given the sample size.

Table 1
Characteristics and levels of the choice experiment.

Attribute	Levels
1. The depth of tour: the recreation and learning experiences available on the tour.	Overview: provides an overview of the most famous sites around the archipelago. The guides will not elaborate on individual species. In-depth: comprises an in-depth visit to all of the most famous sites of the archipelago. These visits will include educational commentary by the guides that describes the evolutionary processes of the islands.
2. The length of tour: number of nights spent touring the islands.	Short tours: 5 nights or fewer. Long tours: 7 nights or more.
3. Level of protective measures taken against invasive species: three possible levels of invasive species protection related to the scale of tourism operations.	High protection (small scale tourism): only boats that carry 40 or fewer tourists allowed. High value, low volume model that minimizes ecological impacts. Medium protection (current average tourism): a mix of medium-size boats (40 to 100 passengers) and smaller boats (up to 40 passengers). Medium flow volume model that poses manageable challenges to the biodiversity of the archipelago. Low protection (large scale tourism): approximately 90% of all boats would carry over 100 passengers. High volume model that constantly opens new windows for invasive species.
4. The tour cost within the islands: includes transport (no airfares), accommodation, food /drinks/tips and entrance fee.	The tour price options per person are: \$1000, \$3000, \$5000, or \$7000.

different sequences and assigned randomly to respondents to control for bias due to order. We failed to reject the null hypothesis that the choice was independent of the order of the choice set.

The payment vehicle was the purchase of the tour package excluding air tickets. In addition to the choice experiment section, the survey included questions regarding: i) the characteristics of the Galapagos tour the respondent just returned from; ii) respondent's level of satisfaction with tour guide services and visits to the national park on that prior tour; iii) attitudes and opinions of respondents; and iv) socio-demographics of respondents.

All of the survey materials were approved by the Institutional Review Board[3] of the University of Massachusetts Amherst. The questionnaire took an average of twenty minutes to complete. The survey was implemented by the lead researcher and two interviewers during June and July 2009. The interviewers were trained in how to conduct the surveys in a six-hour workshop that included a series of mock surveys. They also completed on-line training in the protection of human research subjects. Great care was taken to minimize interviewer bias and other variations that could introduce inconsistencies (Whittington, 2002). Interviewers were instructed to follow the script exactly and to note any difficulties that might arise.

The surveys were performed in three areas of the airport: the lobby before the security checkpoint, the economy class waiting area after the security checkpoint, and the VIP waiting area after the security checkpoint. Potential respondents were approached by interviewers and screened based on three criteria: i) if they were returning from a tour to the Galapagos Islands; ii) if they had visited the islands as tourists; and iii) if they had traveled around the islands on a cruise boat. Our decision to interview visitors who had just finished tours to the islands involved the risk of self-selection bias, but had the advantage of ensuring the participants' familiarity with the choice environment (Brau and Cao, 2006). We sampled only non-Ecuadorian visitors, because they contribute the majority of industry revenues.[4]

After the preliminary questions were completed, the interviewer handed the respondent a written explanation of the choice experiment (see Fig. 1). The interviewer waited silently while the respondent read the information, and then used the script to highlight the main points and to field any questions.

During June and July 2009, we initiated 300 surveys and collected 252 surveys with complete and valid observations.[5] Table 2 summarizes the characteristics of our respondents. The refusal rate was near 11%, close to those in a similar study by Naidoo and Adamowicz (2005).[6]

4. Statistical Model

We assume that the systematic component and random component of the utility function are linear and additively separable. Furthermore we assume that the systematic component (V) is linear and additively separable in the tour characteristics and that the random component (ε) is distributed logistically. The probability that an individual picks alternative j over all alternatives k in the choice set C is written as:

$$P(j|C) = \Pr[U_j > U_k] = \Pr[(V_j + \varepsilon_j) > (V_k + \varepsilon_k)] \\ = P[(\beta' x_j + \varepsilon_j) > (\beta' x_k + \varepsilon_k)], \forall k \in C.$$

We estimated both a simple conditional logit and a mixed logit, with qualitatively similar results. Here we report the mixed logit because it provides two advantages over the conditional logit. First, the conditional logit model requires fulfilling the independence of irrelevant alternatives (IIA) condition, an assumption not needed in the mixed logit. Second, our data includes multiple responses by each individual, which the mixed logit accommodates. The mixed logit also allows correlations in unobserved utility over repeated choices by each individual (Train, 1980). The simple mixed logit allows for heterogeneity in preferences but does not explain the source of the variation. To model the heterogeneity in preferences, we estimated a mixed logit that includes individual socio-demographic and attitudinal-opinion variables interacted with the attributes included in the previous models (Revelt and Train, 1998; Hess and Rose, 2009; Baskaran et al., 2007). Another alternative was a latent class model, but the literature suggests that a mixed logit might be preferable in the case of heterogeneity over both individuals and classes (Kosenius, 2010; Yanga and Sung, 2010; Greene and Hensher, 2003).

The utility that individual n gets from choosing alternative j in period t is:

$$U_{njt} = b' x_{njt} + \eta_n' x_{njt} + \varepsilon_{njt}$$

where b is the population mean for the coefficient vector; η_n is the stochastic deviation representing the individual's preferences relative to the average responses of the population; x_{njt} is the vector of observed variables; and ε_{njt} is an unobserved random term that is identically and independently distributed as extreme value Type 1. The stochastic portion of the utility, $\eta_n' x_{njt} + \varepsilon_{njt}$, is in general correlated over alternatives and time due to the common influence of η_n. Thus the model explicitly allows correlation in unobserved utility over repeated choices by each respondent (Revelt and Train, 1998). Second, the model incorporates unexplained preference heterogeneity through the random terms in the distributions of parameters (Hess and Rose, 2009). The

[3] The Institutional Review Board is a federally mandated committee which reviews all sponsored research involving human subjects.

[4] Foreign visitors represent around 81% of visitors and 84% of tourism revenues (Epler, 2007).

[5] Persons who met the selection criteria but elected not to complete the consent form are characterized as refusing to participate. In most cases, respondents who completed the consent form but who did not complete the questionnaires did so because their flights were departing or they were required to move from the lobby to the embarking zones.

[6] Naidoo and Adamowicz (2005) had a 13% rate of incomplete surveys from 1000 surveys handed out in the departure lounge of the international airport in Uganda.

Characteristics	Package A	Package B	Package C	Decline to take a tour
Tour depth	In-depth (Following Darwin)	In-depth (Following Darwin)	Overview (Highlights of Galapagos)	Under these circumstances I would not travel
Length of tour	Long 7 nights or more	Short 5 nights or fewer	Short 5 nights or fewer	
Level of protection against invasive species	Low protection (Large scale tourism)	Medium protection (Current average tourism)	High protection (Small scale tourism)	
Cost of the tour	US$ 7,000 per person	US$ 5,000 per person	US$ 3,000 per person	
On my next tour, I would choose:	☐	☐	☐	☐

Fig. 1. Example of choice set.

Table 2
Socioeconomic characteristics of the sample.

Variable	Obs. (#)	Mean	St. Dev.
Age	246	46.9	15.9
Family size	248	1.2	1.1
Tour expenses (US $)	204	3122.3	1907.4
Length of stay (days)	256	6.7	2.7
	Obs. (#)	%	
% of females	249	54.6%	
% of North-Americans	248	54%	
% with grad school or professional training	248	50.8%	

parameters are estimated by simulations that maximize the log-likelihood function. This maximization requires an assumption about the distributional form of the vector of coefficients on the attributes of the choice: We assume the normal distribution.[7]

The marginal willingness to pay was calculated using the estimated coefficients (Haab and McConnell, 2003):

$$MWTP = \left(e^{\frac{\beta_{attribute}}{\beta_{cost}}} - 1\right)$$

Bivariate analysis suggested that those respondents who preferred a long and in-depth tour were more likely to have some post-graduate education (61% versus 50%), more likely to fall into the highest income bracket (67% versus 41% had income greater than $100 K), and less likely to have time constraints on the length of their tour (33% were retired versus 19%). Based on these bivariate relationships, we created four variables that are interactions between an attribute of the respondent and a characteristic describing the tour in the choice model: nationality and depth of tour, amount spent on current visit and price of tour, amount spent in the local economy and length of tour, participation in outdoor hobbies and length of tour. A fifth interaction variable was education and amount spent on current visit.

We estimated random parameters for two variables, depth of tour and the interaction between nationality and depth of tour, and for the constant for the opt-out option (decline all tours options in choice experiment). While we had many possible choices for combinations of interactions and random parameters, we present the model that had the best goodness of fit according to the log likelihood value. Table 3 presents the variables in the vector of tour attributes (x_i), our interaction variables, and an indicator for coefficients allowed to be random.

5. Results

Table 4 presents the results of the mixed logit estimations without interactions (first column) and with interactions between tour attributes and respondent attributes (second column). The results of the estimations are consistent across models with and without interactions. Each variable's coefficients are significant at the 99% level and have the expected sign. The models are statistically significant, and they explain a substantial amount of the variation.[8] The mean coefficients and standard deviations for the random coefficients in the mixed logit models are reported together with their standard errors. The standard deviations for each of the random coefficients representing the heterogeneity of individual preferences relative to those of the population are significant at 99% of confidence and have the expected signs.

In summary, the typical respondent prefers a long tour to a short one, a high level of protection against invasive species over a low level of protection, and a lower price, all else constant. We do find a segment of the sample that consistently prefers short tours over long. Although the typical preference is for an "in-depth" tour over an "overview," the mixed logit reveals heterogeneity in these preferences. The main sources of heterogeneity in preferences appear to be the respondent's nationality, the total spent on respondent's previous tour to the islands (which may be a proxy for income), and the respondent's level of education.

[7] We assume a normal distribution because there is no theoretical reason to expect that the random coefficients are one-sided. As a check, we estimated numerous forms of the model and reported the form with the best measures of goodness of fit. As a reviewer pointed out, there are cases when the assumption of a normal distribution can be problematic.

[8] Both models explain about 90% of the variation. We used an empirical method to approximate this measure (Domencich and McFadden, 1975).

Table 3
Variables used in the estimations.

Variable	Description	Random parameter
SHORT	Length of the tour short (5 days or fewer). SHORT = 1 if the tour is short; zero otherwise.	No
INDEPTH	In-depth learning experience from your tour. INDEPTH = 1 if experience is in-depth; zero otherwise.	Yes
LOW_PROTECTION	Low level of protection against invasive species. LOW_PROTECTION = 1 if level of protection is low; zero otherwise.	No
HIGH_PROTECTION	High level of protection against invasive species. HIGH_PROTECTION = 1 if level of protection is high; zero otherwise.	No
LN_PRICE	Natural logarithm of the price of the tour presented in the experiment.	No
CONSTANT_NO_TOUR	Constant parameter of opt-out option. CONSTANT_NO_TOUR = 1 if the respondent declines to take a tour; zero otherwise.	Yes
NATIONALITY_INDEPTH:	Interaction of depth of tour "in-depth" and the country of origin of the individual. NATIONALITY_INDEPTH = 1 if the individual is from North-America (USA or Canada) and has chosen an in-depth tour. NATIONALITY_INDEPTH = 0 if the individual is from another country and has chosen an in-depth tour.	Yes
EXPENSES_LN_PRICE	Interaction of the natural logarithm of price of the tour in the experiment and the amount spent during the individual's tour (includes cost of flights, tours, etc.).	No
LOCAL_EXPENSES_SHORT	Interaction of length of tour "short" and the amount spent in the local economy of the Galapagos (in US $).	No
HOBBY_SHORT	Interaction of length of tour "short" and the variable hobby. HOBBY_SHORT = 1 if the individual engages in an outdoor activity as his/her main hobby during free time and has chosen a short tour. HOBBY_SHORT = 0 if the individual does not engage in an outdoor activity as his/her main hobby during free time and has chosen a short tour.	No
EDUCATION_LN_PRICE	Interaction of the natural logarithm of price of the tour in the experiment and the individual's level of education. EDUCATION_LN_PRICE > 0, if the individual has completed graduate or professional school. EDUCATION_LN_PRICE = 0 if the individual has not completed graduate or professional school.	No

To calculate the marginal willingness to pay (MWTP), we designated the characteristics of a baseline tour: long, overview, and a medium or current level of protective measures taken against the risk of invasive species. The baseline reflects popular current tourism options in the islands. We set the baseline level of tour length as "long" (seven nights or more) to reflect the most popular type of tour taken to the Galapagos. We set the baseline level to "overview" so that we could then estimate respondents' WTP for a more in-depth experience. The baseline level of measures taken to reduce the risk of invasive species was defined as "medium" to communicate that, while some protective measures are in place, there is significant room for change in either direction. We then set the price baseline to $1000.

The MWTP in Table 5 represents the proportional change in the price the visitor is willing to pay with respect to a change in a given characteristic. We report the MWTP for the model without interactions because the results are consistent across the models.

Of first-order interest is the MWTP for a change in the level of protective measures taken against the risk of invasive species relative to the current average. All amounts are in 2009 US dollars. On average, a Galapagos tourist would be willing to pay 2.5 times the cost of a tour with a "medium" level of protective measures taken against the risk of invasive species for a tour with greater protective measures (1.93 to 3.33, CI). At the current mean price for tours, this implicit MWTP is at least $1927. Conversely, *reducing* the level of protective measures leads to a loss in MWTP of approximately 82% of the value of the baseline tour (−89% to −74%, CI), or $820. The difference between the

Table 4
Estimation results.

Variable	Mixed logit model[a]	Mixed logit with interactions[a]
SHORT	−0.7368** (0.1254)	−0.8827** (0.2748)
INDEPTH	1.1591** (0.1627)	0.9507** (0.23300)
St. Dev. INDEPTH	1.2323** (0.1842)	
LOW_PROTECTION	−1.9597** (0.1640)	−2.2864** (0.2339)
HIGH_PROTECTION	1.4349** (0.1424)	1.7601** (0.2005)
LN_PRICE	−1.1415** (0.1103)	−1.5719** (0.1666)
CONSTANT_NO_TOUR	−9.6426** (0.9240)	−11.8484** (1.2272)
St. Dev. CONST_NO_TOUR	2.1981** (0.2276)	2.4230** (0.3117)
Interactions with socioeconomic variables		
NATIONALITY_INDEPTH		1.0630** (0.2729)
St. Dev. NATIONALITY_INDEPTH		1.3914** (0.2945)
EXPENSES_LN_PRICE		0.000079** (0.000018)
LOCAL_EXPENSES_SHORT		−0.0002 (0.0006)
HOBBY_SHORT		−0.3545 (0.2591)
EDUCATION_LN_PRICE		−0.1775** (0.0580)
Model statistics		
Number of observations	4301	2839[b]
Log L	−1172.396	−718.843
LR Chi^2	3389.631**	2347.488**
Pseudo R^2	0.5911	0.6203

** Denotes significance at the 1% level.
[a] Standard errors in parentheses.
[b] The number of observations for the model with interactions is less than without interactions due to missing data.

Table 5
Individual marginal willingness to pay.

Variable	MWTP[a]	Lower	Upper
SHORT	−0.474** (0.060)	−0.592	−0.352
INDEPTH[b]	1.790** (0.360)	1.175	2.582
LOW_PROTECTION	−0.819** (0.040)	−0.890	−0.737
HIGH_PROTECTION	2.543** (0.360)	1.927	3.330

Notes: Confidence intervals at 95% confidence were calculated using the Krinsky–Robb method as it is described in Hole (2007) and included 10 K draws from a multivariate normal distribution.
** Denotes significance at the 1% level.
[a] Standard error in parentheses.
[b] Confidence intervals reflect the sampling variability only. Given the parameter for variable INDEPTH, estimates of MWTP are equal to the mean of the distribution of the random parameters.

MWTP gained with added protection compared to the MWTP lost with lessened protection is worthy of additional research; it could be the result of an under-appreciation of the implications of the "low protection" description, or a reflection of respondents' view of the adequacy of current protective measures.

The MWTP for an "in-depth" tour is 1.79 times (1.18 to 2.59, CI) the cost of the "overview" level provided in the baseline tour, or an additional $1790. The typical decrease in MWTP that results from shortening the length of the tour relative to that in the baseline tour was 47% (−59% to −35%, CI), or $470.

6. Policy Simulations

Our econometric model demonstrates that tourism managers in the Galapagos can satisfy a number of competing goals by manipulating the prices of short and long tours. More specifically, managers can reduce the total number of tours taken, reduce the proportion of short tours and still maintain park revenues. However, we find that there are limits to using prices to reduce the proportion of short tours. Managers and policy makers in the Galapagos have indeed been discussing pricing tactics, including a surcharge on short tours (Gardener and Grenier, 2011); our model thus provides key data for pending policy decisions.

Using our survey responses to predict future tourism demands of course requires a few assumptions, most notably that our respondents are representative of future tourists. While mindful of those limitations, we do believe that we can give a sense of the scale of the effects of price changes. We estimated the demand for both long and short tours under two hypothetical pricing strategies—equal prices for short and long tours and a surcharge for short tours.

Nine different tours can be described by combining variations of the three tour characteristics: length (short/long), depth (in-depth/overview) and protective measures taken against the risk of invasive species (low/medium/high); note that a short tour is mutually exclusive with an in-depth experience. We sought to describe how demand for tours would differ under different levels of protective measures against the risk of invasive species. In other words, would the elasticity of demand differ between tours with high versus low protective measures? Thus we modeled the choice between the subset of three tours defined by length and depth (short with overview, long with overview, or long with in-depth) under the current or medium level of measures taken against invasive species, and then under low and high levels in turn. For each respondent we calculated which tour the respondent would have selected using the estimates in Table 4 for the mixed logit model with interactions. To reflect the heterogeneity of preferences we took 11,000 random draws using the estimated distribution for the parameters. We used the fitted values to compute the indirect utility of the simulated tour packages for each individual in our data set. The option with the highest indirect utility was identified as the tour the individual would choose. Using that set of decisions, we calculated the distribution over each of the three possible tours conditional on a tour being taken. This process was repeated for tour options with low protective measures against risk of invasive species and again for those with high measures.

The first column of Table 6 reports the prices for the simulation. The second column reports the percentage of total demand for each of the tours (short with overview, long with overview, long with in-depth, or no tour) with the current level of protective measures against risk of invasive species (medium). The third and fourth columns report the same for low and high levels of protective measures against invasive species. The top panel of Table 6 reports the demand under the current prices. The second and third panels report the results for two hypothetical pricing regimes that could meet the objective of park managers to reduce absolute number of visitors and to shift the distribution of tours towards long tours: price of short tour equals price of long tour (middle panel, $3200 for both length of tours) (our "equal pricing strategy"), and price of a short tour is greater than price of long tour (last panel, $3200 for long tour and $6872 for short tour) (the "surcharge strategy"). For the surcharge strategy, we set the prices to keep the same ratio between the two prices as in the current prices (currently long tour price is approximately 2.1 times larger than short tour price).

Table 6
Simulated market shares of tour options.

	Price (US $)	Market share		
		Medium protective measures (current level)	Low protective measures	High protective measures
Current prices				
Short/Overview	1500	0.12	0.07	0.15
Long/In-depth	3200	0.52	0.35	0.61
Long/Overview	3200	0.12	0.08	0.15
No tour		0.23	0.50	0.10
Hypothetical strategy 1: equal prices				
Short/overview	3200	0.04	0.03	0.05
Long/in-depth	3200	0.57	0.37	0.67
Long/overview	3200	0.14	0.08	0.17
No tour		0.25	0.52	0.11
Hypothetical strategy 2: surcharge on short tour				
Short/overview	6872	0.02	0.01	0.02
Long/in-depth	3200	0.58	0.38	0.69
Long/overview	3200	0.15	0.09	0.18
No tour		0.25	0.52	0.11

A higher price for a short tour than for a long tour may seem counterintuitive if the tour is a normal good; however, we consider a surcharge for a short tour to address current policy discussions in the Galapagos. It is also consistent with the results of the choice model. The standard deviation for the coefficient on the type of tour (INDEPTH) is larger than its point estimate for the mean coefficient (Table 4), suggesting a negative relationship for a segment of the visitors. This result means that approximately 4% of respondents prefer an "overview" tour (our base scenario) to an otherwise similar "in-depth" tour. These are likely what Lindberg (1991) describes as "causal" tourists, those perhaps trying to maximize the number of locations visited on a tour rather than seeking to thoroughly explore one particular destination. Our results are consistent with previous studies that have found that a segment of tourists prefer short tours over long tours, all else equal (Alegre and Pou, 2006; Martinez-Garcia and Raya, 2008; Nicolau and Más, 2009; Salmasi et al., 2012; Grigolon et al., 2014). The empirically observed preference for short tours among some individuals does not seem to be due to income constraints—other researchers have found that those who prefer short tours tend to have higher income than those who prefer longer tours (Kwan et al., 2008). Within the group that prefers short tours, researchers have found that price has little effect to shift individuals to longer lengths of stay (Alegre et al, 2011). Thus we used a large surcharge to explore the limits to shifting demand away from short tours.

In the baseline scenario with mean current prices, 52% of respondents would select a long with in-depth experience tour, 23% would opt for no tour, 12% would select a short with overview tour, and 12% would select a long with overview tour. With the same prices but with a lower level of protection against invasive species (third column of top panel of Table 6), the percentage selecting "no tour" increased to 50%, and those selecting short and overview, long and in-depth, long and overview fell to 7%, 35% and 8%, respectively. In contrast, increasing the measure of protection against invasive species decreases the percentage selecting "no tour" to only 10%, while 76% of those choosing a tour select a long one and 15% a short one. However, conditional on a tour being chosen, the distribution between long tours and short tours is equivalent across the levels of protective measures taken against invasive species—83% to 86% select a long tour and 14% to 16% a short tour. Thus implementing more measures to protect against invasive species while maintaining current prices could increase total demand for both short and long tours—a counterproductive effect from the perspective of park managers.

When comparing the tours chosen under the two pricing regimes with the medium level of protective measures to the tours chosen under the current prices and medium level of protective measures, we found that in each case there was a slight increase in the choice of "no tour" (2 percentage points) and small increases in both the long with overview and long with in-depth (2–3 and 5–6 percentage points respectively). The proportion of short tours fell in both cases. The direction and magnitude of the effect of low protective measures or high protective measures compared to medium protective measures are roughly the same regardless of the price regime.

We then calculated the elasticities of these hypothetical demand curves as a ratio: the change in the number of a type of tour taken over the change in price of that tour (Table 7). Demand for a tour of some kind (as opposed to no tour at all) is inelastic across both pricing regimes and the three levels of protection. Under the current level of protection, the price elasticity for taking a tour if the pricing regime were changed from current prices to the hypothetical equal price regime is almost the same as for the hypothetical surcharge pricing regime: 0.22 vs. 0.23 (first column of Table 7). The effects of increasing or decreasing the level of protection are of the same magnitude and in the same direction across both hypothetical pricing regimes (second and third columns of Table 7). In summary, under both pricing regimes, lowering the level of protective measures makes demand for all tours *more elastic*, while increasing the level makes demand for all tours *less elastic*.

Demand for short tours is of particular policy concern. The demand for short tours is price elastic under each pricing strategy, although it is more elastic under the equal prices strategy. The change in price elasticity for short tours when either increasing or decreasing protective measures is very small in magnitude—only ± 0.01.

In summary: the demand for a tour of some kind is inelastic, but the demand for a short tour is elastic. The change in price elasticity for taking a tour of some kind when moving from current levels of protective measures to either high or low levels is greater than the change in price elasticity for short tours in both hypothetical pricing regimes. This result suggests that the level of protective measures taken is less important for those who select a short tour than those who select a long one. This result resonates with the characterization that the "casual tourist" taking short tours tends to be less engaged with the conservation aspect of the Galapagos. Further, the preference for shorter tours is elastic because respondents were able to readily substitute shorter tours with longer tours. The preference to travel to the Galapagos in the first place is inelastic, because respondents have no equivalent substitutes readily available.

We interpret this final finding to mean that a higher level of protection against invasive species differentiates a tour to the Galapagos as a unique market good. In contrast, this quality is compromised when lower protective measures are taken, thus forcing the archipelago to compete with alternative destinations. Taken together, the results suggest that pricing strategies can reduce the number of visitors to the islands without reducing tourism revenues. We turn to this topic next.

Table 7
Price elasticities.

	Medium protective measure (current level)	Low protective measures	High protective measures
Hypothetical strategy 1: equal prices			
Short/overview	1.29	1.30	1.28
All tours	0.22	0.41	0.11
Hypothetical strategy 2: surcharge on short tour			
Short/overview	1.12	1.11	1.13
All tours	0.23	0.39	0.11

We use the midpoint method for calculations.

We considered the prices of short and long tours that could reduce the total number of tours by 2%, 5%, 12% and 20% relative to the current number of tours. Table 8 reports the prices that would be needed to reach these reductions in the number of tours, the total revenues, and the proportion of short, long or no tours. The results unambiguously show that raising the price of a tour to the Galapagos will raise total revenues—a result that would please both those seeking to slow (or reverse) the increase in visitors and industry in aggregate. Under the equal price strategies, the proportion of short tours falls from 16% to 6%. The proportion of short tours can only be reduced further (to 3%) if the price of a short tour is set *higher* than that of a long tour. There are practical and ethical limits, however, to how much the price can be raised. Conflicts within the tourism industry over who benefits from conservation regulation (Quiroga, 2009), concerns over concentration in the industry (Epler and Proaño, 2008), environmental and equity concerns over very high prices (Rice, 2007; Manning, 2004; Becker, 2009), and general resistance to regulation (Quiroga, 2009; Heylings and Bravo, 2007) suggest that modest changes are more likely to be acceptable than large changes in prices. Our analysis thus provides various pricing scenarios that achieve a range of decreases in tours, but suggests a natural lower bound to the proportion of short tours.

7. Discussion

Our experiments extend the work of previous related valuation studies by examining how individual preferences affect biodiversity (Juutinen et al., 2011; Birol et al., 2006; Christie et al., 2006; Naidoo and Adamowicz, 2005), and by using the choice experiment data to model a differential price strategy to alleviate the threats against biodiversity (Becker, 2009; Alpízar, 2006; Tobias and Mendelsohn, 1991; Navrud and Mungatana, 1994; Willis, 2003; Chase et al, 1998). Our results show that visitors to the Galapagos highly value the biodiversity of the islands: the mean marginal WTP for a higher level of protective measures against invasive species is \$2543. Preserving this biodiversity is thus critical to maintaining tourism revenues. We found that the typical respondent had a mean marginal WTP for an "in-depth" tour (as opposed to an "overview" tour) of \$1790. We also identified a small group of individuals (4% of the sample) who preferred the overview experience to the in-depth one. This finding substantiates the concern of conservation experts that some current visitors are less interested in the environmental significance of the park than experts would like. Educational messages about the lesser-known risks of environmental tourism, as well as the promotion of in-depth tours, could substantially benefit the Galapagos National Park.

Reducing the threats against biodiversity involves reducing the number of visitors arriving year by year, as propagule pressure or "effort of introduction" of new invasive species is positively related to the frequency of release of new species into the islands. As discussed, the vast majority of specimens are released in the initial contact, so the number of visitors arriving each year, rather than the length those visitors stay, is what most determines the risk of invasive species.

While the overall price demand elasticity for visiting Galapagos is very inelastic, the observed differences in elasticity based in the duration of the tour vary. Long tours are relatively inelastic, while short tours are more elastic. A pricing regime either imposing an equal price or a surcharge on short tours capitalizes on this difference, reducing the net number of tours to the islands and shifting some short tours to long tours. Because a long tour imposes little or no additional risk of invasive species over a short tour, this shift does not implicate conservation concerns. Instead, it increases revenues because long tours bring more revenues to the island.[9] This increase in revenues entirely offsets

[9] It is correct that under these hypothetical pricing regimes, long tours are not more expensive than short tours. The correct comparison, however, is between long tours as priced under the hypothetical pricing regimes and short tours as priced under the current pricing regime used in the Galapagos.

Table 8
Simulated demand and aggregate revenues of tour options.

	Current prices[c]	Price of short tour > price of long tour	Price of short tour = price of long tour			
% decrease in total tours	NA	2%	2%	5%	12%	20%
Price of short tour	$1500	$6827	$3200	$4000	$6000	$10,000
Price of long tour	$3200	$3200	$3200	$4000	$6000	$10,000
Total number of tours	86,500	84,770	84,770	82,175	76,120	69,200
Total revenues[a]	$253	$279	$271	$329	$457	$692
Long tour proportion[b]	0.84	0.97	0.94	0.94	0.94	0.94
Short tour proportion[b]	0.16	0.03	0.06	0.06	0.06	0.06
No tour proportion	0.23	0.25	0.25	0.28	0.35	0.43

[a] Total revenues in millions of $US dollars.
[b] Proportion of tours is conditional on a tour being selected.
[c] Current prices are those prices in 2008.

the revenues lost from the would-be short-tour takers who take no tour at all. Long tours also help meet the islands' educational objectives (Gardener and Grenier, 2011). As a caveat, we note that our results are silent as to *how* to apply tour surcharges; our data are based on tour prices paid by tourists to tour operators. Warziniack et al. (2013) suggest that taxes on visitor arrivals or on their consumption could produce ripple effects throughout the whole economy; thus further research and discussion are needed to define the most appropriate mechanism for applying various pricing strategies.

Long and in-depth tours are aligned with the conservation and educational objectives of the National Park (Powell and Ham, 2008). The pricing strategies would successfully shift demand from short to long tours, but there is a concurrent need to promote tours that are in-depth as well as long. Thus, a pricing policy should be coupled with increased standards for naturalist guides and an investment in the education of local residents who may someday serve as naturalist guides. This approach has been advocated by the National Park, scientists, and guides, but has not yet been implemented consistently (G. Reck, C. Moine, and C. Gernier, personal communication, 2009).

A final result of our policy simulations is that the magnitude of tourists' willingness to pay for a change in the level of protection against invasive species suggests strongly that the threat of invasive species imposes a real cost on consumer welfare. Furthermore, it suggests that if tourism negatively impacts the unique environment of the islands, rendering them a standard sun-and-sea destination, the Galapagos will no longer be able to command a tourism premium.

8. Conclusion

Tourism in the Galapagos has dramatically evolved over the past two decades. Not only has the volume of tourism increased, but tourists today take shorter tours and demand more recreational amenities than before. These changes have accelerated immigration and exacerbated pressures on local resources. This increase in the number of island-visitor contacts increases the risk of introducing non-native species—one of the greatest concerns of biodiversity experts. This risk remains despite the islands' permit system, because the observed industry response to such a system is to provide shorter—yet a greater number of—tours. A new approach to tourism is needed to meet economic demands within environmental limitations (Gardener and Grenier, 2011; González et al., 2008). The essential feature of this new approach must be a decrease in the potential pathways of entry for invasive species—pathways such as unique visitors to the islands, and the transportation of goods to the islands (Lee and Chown, 2009; Chown et al., 2012; Pickering and Mount, 2010; Wichmann et al., 2009; Kilpatrick et al., 2006; Bataille et al., 2009; Causton and Sevilla, 2008).

Long and in-depth tours best meet the mandates of the National Park to educate visitors and preserve biodiversity (Powell and Ham, 2008). In short, we found that the elasticity of demand for short tours combined with the inelastic demand for long tours suggest that tourism managers could modify access fees to reduce the risk of introduction of invasive species without negatively affecting revenues. These results suggest that market mechanisms are a promising strategy for reducing risks to the ecosystem while meeting economic demands. Finally, while our research focuses on the Galapagos islands, our results are consistent with those from other tourist destinations such as the Balearic Islands and the coast of Turkey (Alegre and Pou, 2006; Gokovali and Bahar, 2006). Our findings may be relevant to other ecologically fragile tourism destinations that face equivalent threats in the face of changing tourism (Naidoo and Adamowicz, 2005; de Groot, 1983; Alegre and Pou, 2006; Fleischer and Pizamb, 2002; McElroy, 2003; Gokovali and Bahar, 2006) and may benefit from similar solutions.

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