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Ecotourism, conservation biology, and volunteer tourism: A mutually beneficial triumvirate

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ARTICLE INFO

Article history:

Received 7 November 2007

Received in revised form

7 August 2008

Accepted 8 August 2008

Available online 24 September 2008

Keywords:

Funding

Earthwatch Institute

Tourism

Parrot

Peru

Amazon

ABSTRACT

Funding for basic conservation research is chronically lacking. The potential for ecotourism to fund conservation research exists, but has been little explored. One branch of ecotourism with funding potential is volunteer tourism, where conservation scientists and recruiting agencies develop research projects and volunteers provide funding and labor. We examine the costs and benefits of a three-way partnership among a conservation research project (The Tambopata Macaw Project), an ecotourism operator (Rainforest Expeditions), and a volunteer-recruiting NGO (the Earthwatch Institute). From November 1999 to December 2006, Macaw Project researchers invested about 1700 h in giving research presentations and interacting with ecotourists and received from Rainforest Expeditions ~\$278,000 worth of salaries, transportation, food, and lodging (total cost to Rainforest Expeditions ~\$98,000). Since 2001, researchers invested 2300 h in training and supervising volunteers and related activities and received from Earthwatch 328 volunteers, ~13 000 h of volunteer labor and \$115,000 in research funding. Rainforest Expeditions received \$175,000 in fees from Earthwatch for food and lodging for volunteers. In this association, all parties benefited financially: the research received >\$400,000 in cash, goods and services, Earthwatch retained \$387,000 in volunteer fees, and Rainforest Expeditions received nearly \$300,000 in gross income. Additional benefits to Rainforest Expeditions included services for their guests and free marketing through research related publications and word of mouth. We discuss ways to structure projects to maximize the benefits and the potential of this model for funding other long-term conservation research projects.

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1. Introduction

Conservation biology, ecotourism, and volunteer tourism have become subjects of serious academic study only within the last three decades (Budowski, 1976; Soulé, 1987; Giannecchini,

1993; Primack, 1998; Clifton and Benson, 2006). These emerging areas all have great potential to aid in the conservation of ecosystems world wide: conservation biology can provide the scientific expertise for sound conservation; ecotourism can provide benefits to local communities and build local and

Abbreviation: TRC, Tambopata Research Center.

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doi:10.1016/j.biocon.2008.08.020

international support for protected areas (Langholz, 1996; Fennell and Weaver, 2005); and volunteer tourism can provide funding and labor (Campbell and Smith, 2006). These three activities are interacting daily in many areas of the world, but the potential synergistic relationships among these three are yet to be explored (López-Espinosa, 2002).

Conservation biology strives to develop the scientific and technical means for the protection, maintenance and restoration of biodiversity (Society for Conservation Biology, 1987). Yet even as this discipline was emerging in the 1980's scientists were lamenting that reductions in funding were making it harder to conduct the long-term monitoring and basic biological studies that provide the backbone of good conservation (Wilson, 1994). Unfortunately, traditional funding sources, such as government grants, universities, and private organizations cannot fund the research needed to understand and protect all ecosystems and species (Young, 2005). This problem is especially severe in the tropics where threats are greatest and our knowledge of basic natural history is poor, even for many charismatic species (Collar, 1998; Myers et al., 2000). In addition, conservation biology is most effective when its findings are shared with the general public to build conservation constituencies. As a result, conservation scientists can benefit by increasing their interactions with the general public.

Ecotourism has the threefold goal of generating income from nature-based attractions, channeling support to protected areas and local communities, and creating rewarding, educational experiences for tourists (Honey, 1999; Kruger, 2004). A fourth potential benefit from ecotourism is emerging through volunteerism. Companies are working with researchers to create volunteer opportunities, which are sold as “tourism with a conscience” or “conservation holidays”. In this way, tourism is attracting financial and human capital for conservation research (Wearing, 2001, 2004; Stebbins, 2004).

Increasingly, conservation biologists are partnering with the companies who specialize in volunteer tourism to raise funds and labor to implement field projects. These tours are emerging at a time when there are increased calls to involve citizens in science and environmental monitoring (Irwin, 1995). The tours also provide scientists with a captive audience for environmental messages and help build the global conservation constituency (Campbell and Smith, 2006). As recruiting paying volunteers can be difficult, scientists often team up with organizations that specialize in providing funding through matching volunteers to projects. The Earthwatch Institute is perhaps the best-known volunteer tourism organization and has worked with about 1350 scientists and placed 90000 volunteers since its founding in 1971 (Earthwatch Institute, 2008).

The numbers of volunteer tourists and available projects have risen greatly in the past three decades (Brown and Lehto, 2005). Most scholarly works conducted on volunteer tourism have focused on the quality of the data produced by volunteers, or the volunteers themselves (e.g. Markus and Blackshaw, 1998). The value of volunteer labor is greatly reduced if volunteer-collected data are not accurate enough to be usable, and studies of data quality have led some authors to express concern over the use of volunteer-collected data (Foster-Smith and Evans, 2003). However, when appropriate tasks are chosen and sufficient training given, many studies show

volunteers are able to collect high quality data useful for scientific publications and resource management planning (Darwall and Dulvy, 1996; Schmitt and Sullivan, 1996; Newman et al., 2003; Pattengill-Semmens and Semmens, 2003).

Studies of volunteers themselves have shown that many are attracted by the opportunity for cultural immersion, the desire to aid conservation, the chance to gain research experience, and the camaraderie that occurs on volunteer vacations (Brown and Lehto, 2005; Campbell and Smith, 2006). The volunteers also want to feel like they are making a difference while exploring new places safely (Wearing, 2001). Through volunteerism, the likelihood of seeing wildlife up close, interacting with local communities, and meeting new people are also enhanced. In some cases, the tax deductions also make volunteer tourism more attractive. This genre of travel has been most popular among Western Europeans, Australians, Poles, Japanese, and North Americans (Brown and Morrison, 2003). In Ellis, 2003 study of 39 volunteer tourism agencies, 77% were non-profits, followed by commercial operators, governments, and universities. The most popular trip subjects were marine mammals (29%), followed by terrestrial mammals, turtles, birds, and others. Most of the trips were offered in Central and South America (30%). Other scientists have evaluated the outcomes of volunteer experiences on the volunteers themselves. For example, in a survey of Earthwatch volunteers, Weiler and Richins (1995) characterized volunteers' desired level of intensity of interaction with the environment as very high. By participating in data collection, volunteers said they received “more intense experiences,” which distinguished them from other tourists.

As we gain understanding of tourists' motivations to volunteer, we need also to examine the motivations of local operators and scientists to host the tourists and guide them through volunteer experiences. Unfortunately, little research has been done on this (but see Gray and Campbell, 2007). Mustonen (2005) has called for more extensive research on volunteer tourism as a separate type of contemporary tourism. Economic and social benefits from ecotourism need to be channeled to local communities, and the authors of this paper have worked with local leaders to forward this goal (Johnson and Brightsmith, 2003; Stronza, 2005). However, this article focuses on the relationship between tour operators, volunteers, and scientists. As each have different interests and priorities, what are the costs and benefits of such programs for all three? What are the trade-offs between business and conservation? In this paper we present a case study of the costs and benefits of the interactions among a conservation research project—the Tambopata Macaw Project, an ecotourism company—Rainforest Expeditions, and a volunteer tourism NGO—the Earthwatch Institute to determine how such interactions can aid conservation biology, ecotourism companies, and conservation on the ground.

2. Methods

2.1. Study site

The Tambopata Macaw Project is headquartered at Tambopata Research Center (TRC, 13°07' S, 69°36' W, elevation: 250 m) in southeastern Peru on the border between the Tam-

bopata National Reserve (275 000 ha) and the Bahuaja–Sonene National Park (537 000 ha, Franke et al., 2005). Rainfall totals 3200 mm and is weakly seasonal (Brightsmith, 2004). Primary tropical moist forest, *Guadua* bamboo patches, *Mauritia* palm swamps, and riparian successional forest of differing ages surround the site (Griscom and Ashton, 2003). The lodge had 13 rooms that held 26 regular guests or Earthwatch volunteers and room for 16 staff and researchers from 1999 to February 2005. Since expansion in February 2005 the lodge has 18 rooms, which hold 36 guests and room for 34 researchers and staff. The lodge is located <1 km from a large “clay lick”, a 25–30 m tall river edge cliff where hundreds of parrots gather daily to consume soils rich in sodium and toxin-adsorbing clays (Gilardi et al., 1999; Brightsmith and Aramburú, 2004).

2.2. Rainforest Expeditions and the Tambopata Macaw Project

In 1989 Eduardo Nycander and KH founded TRC to host ecotourism and macaw conservation research (the Tambopata Macaw Project). In 1992, they founded the for-profit ecotourism company Rainforest Expeditions, S.A.C., of which TRC was their first lodge. The principal ecotourism activities at TRC include walking trails in primary rainforest, visiting a palm swamp with nesting Blue-and-yellow Macaws (*Ara ararauna*), visiting a rain forest pond, and observing the parrots and macaws at the clay lick. The company receives about 7500 paying guests per year among their three rainforest lodges, of which 1200 visit TRC (KH unpublished data). Guests pay about \$850 for the standard six-day tour to TRC. Shorter and less expensive trips are available to the other two lodges.

From 1989 to 1993 Nycander and KH simultaneously ran the ecotourism company and the macaw research. After 1993, the two focused on ecotourism and had little direct involvement with the macaw research. From 1993 to 1998 the macaw research was conducted by young Peruvians working simultaneously as guides and researchers, but no major publications were produced. In 1999, Rainforest Expeditions hired DJB to direct the macaw and parrot research. Since 1999, the project has studied parrot ecology and conservation, including nesting ecology (Brightsmith, 2005), nesting habitat management (Brightsmith and Bravo, 2006), diet, food availability, diseases, and reintroduction (Brightsmith et al., 2005) and provided samples for studies of population genetics (Gebhardt and Waits, 2008), systematics, and gut flora. At the clay lick, studies have examined behavior, ecotourism impacts and why birds consume soil (Brightsmith, 2004; Brightsmith and Aramburú, 2004; Brightsmith et al., 2008).

2.3. Earthwatch Institute

The Earthwatch Institute is an international non-profit organization that supports scientific field research through the use of volunteers (Gilmour and Saunders, 1995; Haag, 2005; Earthwatch Institute, 2008). Project funding levels are based on the number of volunteers who work on the project. Through a grant to DJB, Earthwatch provided 28 teams totaling 328 volunteers from January 2001 to February 2007 (Brightsmith, 2008). During this time, only one team had to be

canceled due to lack of participants. Team visits ranged from 10 days in 2001 and 2002 to 12 days in 2003–2007. Teams were usually 10–16 participants and one per month from November–February each season.

2.4. Data collection and analysis

The current study examines the period from November 1999 to February 2007. We estimated the monthly value of services provided by Rainforest Expeditions and time invested by researchers in tourism activities from research data, financial records, and interviews with research project field leaders and Rainforest Expeditions personnel. Daily records of the number and identity of assistants were kept by research project personnel from October 2002 to November 2006. These were used to calculate the amount of food, lodging, and transportation (boat and plane) to and from the site provided by Rainforest Expeditions. These daily records were also used to calculate proportion of labor provided by the different types of project workers (Earthwatch volunteers, young foreign biologists, volunteer Peruvians, and paid Peruvian assistants). We estimated the frequency of boat transportation around TRC by summing the number of boat movements needed to complete the required monthly research activities from November 1999 to January 2007. Dollar values for these boat movements were calculated based on the average cost of gasoline during this period. The monthly amount of logistical support provided to the researchers by the Rainforest Expeditions office, the numbers of scientific presentations given by the research staff to guests, the number of times researchers ate meals with guests, and the number of times normal lodge guests accompanied researchers in the field were estimated through interviews with the four research crew leaders who worked from 2002 to 2007.

The average monthly financial benefits to the research project from Rainforest Expeditions was determined using the average number of nights of free room and board, reduced cost room and board, and number of boat trips. Each of these was multiplied by the market value of these services. This amount was then added to the average monthly dollar value of salary payments, research donations, and airline flights. The cost to Rainforest Expeditions for providing services was calculated by multiplying the estimates of actual cost for room and board, salary, flights, and boat gasoline per trip (KH unpublished data) by the number units of each of these provided to the researchers. These calculations slightly underestimate the cost to Rainforest Expeditions as they do not include the cost incurred by adding the additional weight of a researcher and their gear to regularly scheduled boat trips. Nor does it include the cost of engine wear and boat drivers' time for boat trips that transported only researchers. In the case of reduced cost lodging, assistants paid \$10 per night. This is higher than the estimated cost for this service (\$6). So in this case, the \$4 per night value was deducted from the total cost to Rainforest Expeditions.

Data on the number of volunteers and financial contributions from the Earthwatch Institute were obtained from the Earthwatch project manager Heather Pruiksma. We tested if the percentage of volunteer fees retained by Earthwatch dif-

ferred significantly from 50% using a Wilcoxin signed-rank test (Gibbons, 1985).

During this study we did not run controlled experiments to test the accuracy of data collected by Earthwatch volunteers. However, the data were checked for internal consistency and we eliminated those data that were illogical, unintelligible, or did not follow the prescribed formats.

3. Results

3.1. Costs and benefits to research

The annual research budget for the Tambopata Macaw Project was approximately \$60,500 per year (\$424,000 over 7 years). This consisted of cash grants (33%), goods and services (48%), and salary for DJB (19%). The principal funders for the project were Rainforest Expeditions (65%) and Earthwatch Institute (30%). The remaining 5% was donated by bird clubs, zoos, and private individuals.

Earthwatch Institute provided \$115,427, representing over 85% of the total cash grants for the research (\$16,490 ± \$5246 per year, N = 7 years, minimum \$9210 in 2001, maximum \$22,085 in 2004, this does not include fees paid to Rainforest Expeditions, see below, Table 1). DJB used Earthwatch funds

to pay year-round salaries for project personnel. In this way the four months of Earthwatch expeditions kept researchers in the field all year. One additional Earthwatch related donation came when a volunteer arranged for her company, Shell Oil, to donate eight laptop computers (~\$4800 value).

Rainforest Expeditions provided about \$3282 worth of salary, goods, services, and discounts per month over the 84 months of the research project plus three months of salary to DJB while there were no researchers in the field (Table 2). This came to a total of about \$280,000 (~\$39,000 per year). From November 1999 to February 2007 Rainforest Expeditions purchased \$1900 of flights and paid \$76,560 of salary to DJB. From October 2002 to November 2006 the company provided about 4066 days worth of free food and lodging and 2364 days worth of food and lodging at \$10 per day. Also from October 2002 to November 2006, Rainforest Expeditions provided round trip boat transportation for assistants at least 220 times and local boat transportation around TRC about 35 times per month (~17.5 gal of gasoline per month, value \$35–\$50). Rainforest Expeditions' office in the nearest town (Puerto Maldonado) provided logistical support (about ten person hours per month, value \$30 per month). Rainforest Expeditions donated \$1000 in revenue from postcards sales and a guest made a one-time donation of \$2000 to the research.

Table 1 – Annual breakdown of the finances of volunteer groups from the Earthwatch Institute

Year	Volunteers	Groups	Trip days	Volunteer cost (\$)	Retained by EW (%)	EW total (\$)	RFE total (\$)	Research total (\$)
2001	29	3	10	1595	51	23,705	13,340	9210
2002	71	6	10	1662	54	62,975	32,865	21,505
2003	37	4	12	1745	52	33,135	18,310	12,570
2004	58	4	12	1928	52	57,540	31,900	22,085
2005	49	4	12	2295	58	65,790	28,322	18,343
2006	54	4	12	2595	63	88,220	31,806	20,104
2007	30	4	12	2849	65	55,470	18,390	11,610
Average	47	4	11	2083	56	55,262	24,990	16,490
Sum	328	29				386,835	174,933	115,427

"Volunteers" and "Groups" show the total number of volunteers and groups each year. "Trip days" indicates the total length of the volunteer groups. The table shows the annual percentage of the volunteer cost retained by Earthwatch (EW), the total retained by EW, the total paid by EW to Rainforest Expeditions (RFE) to host the volunteers, and the total given by EW to the Tambopata Macaw Project for research expenses.

Table 2 – Average monthly value of services offered and costs incurred through Rainforest Expeditions' (RFE) hosting of the Tambopata Macaw Project at Tambopata Research Center (TRC) from November 1999 to February 2007

	Units	Unit description	Market value of donation/discount (\$)	Cost incurred by RFE (\$)
Free room and board	81	Person days	1215	405
Room and board \$10 per day	47	Person days	705	-188 ^a
Salary	1	Monthly	880	880
Boat transportation to TRC	4.4	Round trips	220	0 ^b
Boat transportation around TRC	35	Round trips	175	19 ^c
Donations to research	\$35	Per month	35	0
Logistical support	10	Hours	30	0
Flights	0.3	Flights	23	21
Total			3282	1137

a Researchers paying \$10 per night generated a small monthly gross income.

b This does not include extra gasoline or engine wear due to the added weight of researchers and their gear.

c This does not include extra engine wear and boat drivers' time.

Earthwatch teams averaged 11.7 ± 3.1 participants (range 3–16, $N = 28$). Managing the Earthwatch teams was much easier for DJB because Rainforest Expeditions handled the logistics. Nearly all transportation of volunteers, food, and luggage was by boats with outboard motors, which are notoriously expensive and unreliable. If the researchers had been responsible for all the logistics it would have dissuaded DJB from working with Earthwatch. Volunteers from the general public traveling to foreign countries often require a great deal of advice and reassurance (DJB and H. Pruiksma pers. obs.). The staff at Earthwatch handled all of this and rarely requested help from DJB leaving him free to focus on other aspects of the project. The Earthwatch staff also provided effective support when the project unexpectedly needed items purchased and transported to Peru.

Earthwatch volunteers provided over 13 000 h of data collection (nest observations, clay lick observations, and video analysis), data entry, sample processing, and trail marking. This represents about 12% of the total project labor. No Earthwatch volunteers ever refused to do a requested task and only one volunteer (0.3% of the total) left because she felt unsuited for the project. The remaining 88% of the labor was provided by a combination of young foreign biologists who paid Rainforest Expeditions \$10 per day for food and lodging (56%), volunteer Peruvian biologists, foresters, and veterinarians (22%), and paid Peruvian assistants (10%).

Training the volunteers in data collection was important to the success of these expeditions. Before coming to Peru, volunteers were sent a 30-page packet explaining clay lick and nest observation data collection. In Peru, DJB worked through the packet with the group and the volunteers practiced data collection in the field. Volunteers were also required to complete written tests. These tests allowed DJB to find specific errors and provide additional training. The tests also identified two volunteers (0.6% of the total) unable to collect reliable data. After day two of data collection, DJB checked all the data sheets and reviewed errors with the entire group and with the individuals who committed them.

The training was a success as the vast majority of the data collected by the volunteers were usable. Clay lick data collection was either closely supervised by highly trained assistants, or quite simple (counting numbers of large macaws on the lick every 5 min, etc.). Some errors have been found in the data but they appear to be no more frequent than among the more highly trained, long-term volunteers. Video analysis consisted of 2–3 volunteers tracking individual birds' behavior on the clay lick under the supervision of a trained assistant and all data produced were useable. Nest observations were the only tasks in which Earthwatch volunteers did fairly complex observations without direct supervision. The majority of the nest observation data from the first two trips in 2000 were not useable as training was insufficient. Post 2000, about 85% of these observations were usable based on checks for internal consistency, logical progressions of known activities, and crosschecks with data from previous years.

Researchers spent approximately 21 h per month providing services to guests and guides for Rainforest Expeditions. Macaw Project researchers gave presentations on research and conservation (~30 min) to lodge visitors about 10.8 times

per month over 84 months from November 1999 to February 2007 (~450 h total). Over the same time period, researchers and assistants discussed research and conservation issues with the guests during meals about 20 times per month (~840 h). During the breeding season (mid December–mid March) small groups of guests (1–8 people) observed research teams as they weighed and measured macaw chicks about eight times per month (168 h). DJB was an instructor in eight or Rainforest Expeditions' guide courses, providing a total of 20 lectures and 65 field outings (~260 h total).

DJB invested about 2300 h on Earthwatch related activities from January 2001 to November 2006 (supervising volunteers, writing proposals, and preparing reports). DJB accompanied all volunteer teams (235 days) and worked about 78 h for each group: preparation (3 h), travel (21 h), training (9 h), research presentations (9 h), direct supervision of volunteers (10 h), reviewing data (2 h), and other team management (3 h). He also spent much time and energy conversing about the project with volunteers at meals (21 h).

3.2. Costs and benefits to Rainforest Expeditions

Earthwatch paid Rainforest Expeditions \$174,933 in gross income to host the volunteer groups ($\$575 \pm \64 per volunteer, $N = 7$ years, minimum \$460 in 2001, maximum \$613 in 2007). Rainforest Expeditions also sold tour extensions, souvenirs, and beverages to EW volunteers totaling about \$43,000 ($\$6247 \pm \2019 per year, $N = 7$ years). Rainforest Expeditions sold about \$8000 per year in domestic flights to EW volunteers and Macaw Project personnel. Approximately 15 guests who consider themselves "parrot lovers" visited TRC each year, generating about \$12,000 in annual gross income (KH pers. com.). The profit rates for the company over the past five years have been: flights 7%, extras sold to guests 25%, and guest food, lodging, transportation etc. 9%. Applying these profit rates shows that Rainforest Expeditions made nearly \$38,000 in profits from hosting the macaw research.

From November 1999 to February 2007 Rainforest Expeditions spent about \$1137 per month to host the Tambopata Macaw Project (Table 2). This totaled about \$98,000 in out of pocket expenses and included about \$1900 worth of flights and \$76,560 salary to DJB. From October 2002 to November 2006 the company provided about 4066 days worth of free food and lodging (cost about ~\$6 per day). This was somewhat offset by the 2364 days worth of researcher food and lodging for which they were paid \$10 per day. The company provided local boat transportation around TRC exclusively for researchers about 15 times per month (0.5 gal of gas per trip, \$15–\$20 per month).

In summary, the company received about \$300,000 in gross income from hosting the macaw research over the seven year period, of which about \$38,000 was profit (combining Earthwatch and "parrot lover" groups). The company spent ~\$98,000 to host the research resulting in a net "cost" of hosting the research of \$60,000 (~\$8600 per year). However, Earthwatch groups were hosted during the low season when the lodges were usually well below capacity, and about 80% of the gross income from Earthwatch paid for fixed expenses such as salaries.

Earthwatch excelled at two aspects important to Rainforest Expeditions: confirmation rate and satisfaction with preparation. Most group booking agencies have confirmation rates of 20–80% with 80% being very rare (KH unpublished data). Over the seven year history of the collaboration, Earthwatch cancelled only one group, a confirmation rate of 96% (KH unpublished data). In addition 27% of guests from most booking agencies report being unprepared or underprepared for the realities of their rain forest trip whereas only one of 325 Earthwatch volunteers had this complaint (KH unpublished data).

Rainforest Expeditions benefited in many ways from the researchers' presence. The researchers were willing and able to communicate with the general public, investing over 1500 h in interacting with guests during research presentations, field outings and meals (see above). Researchers also helped train the guides. DJB taught basic parrot natural history in the annual guide courses. Eleven guides worked as research assistants and three research assistants worked as guides, greatly increasing the guide staff's knowledge of macaws and parrots. The researchers were generally flexible and conformed to the company's normal logistics (boat movements, lodging, meals, etc.). Staff-researcher relations were mixed (Brightsmith, 2008), but with the exception of mid-level management, the vast majority of the interactions were positive.

The research itself also helped improve the quality of the ecotourism company by: (1) decreasing tourism impacts at the clay lick through guest management, (2) increasing abundance and visibility of macaws around the lodge through macaw nest site management, and (3) providing educational posters and other written information for display at the lodge (DJB unpublished data). Data from 1401 ± 85 tourists per year at TRC suggest that overall satisfaction in 1999 (before the beginning of the project) was 92.0%, but averaged $97.4 \pm 0.5\%$ per year from 2000 to 2007 (KH unpublished data). While it is difficult to establish a cause and effect relationship, KH and DJB believe that the presence of the active, high-profile research at the site was a major contributing factor to this increase.

The research project also provided valuable marketing for the company. Since 1999, the research project has yielded eleven peer reviewed journal articles (seven published and one in press and three submitted), twelve reports to governments, eight reports to funders, five reports for general audiences, and three manuscripts in conference proceedings (as of July 2008). In addition, at least 19 popular articles about the research have appeared in magazines in at least seven countries. The project has been featured in three television documentaries and two books. Since October 2003, Macaw Project researchers have given ~ 70 talks to over 4500 people in North America, South America, Europe, and Australia (not including talks given at the tourism lodges). Most of the written media are the direct result of work by the members of the research project, while the documentaries were initiated via contacts with Rainforest Expeditions but featured the research. All the written publications, TV documentaries, and presentations about the macaw research explicitly mention Rainforest Expeditions, TRC or both. In January 2007 "Brightsmith" + "Rainforest Expeditions" produced 356 hits

in the internet search engine Google. The long trip duration and good photo opportunities coupled with the Earthwatch volunteers' high levels of satisfaction (68% excellent, 27% good and 5% acceptable, $N = 40$ reviews from Earthwatch volunteers, KH unpublished data) and newly acquired knowledge about the rain forest generated positive word of mouth marketing for Rainforest Expeditions. The presence of the trip in Earthwatch's promotional materials also generated additional clients. The company also used research results (charts, graphs and reports) in their marketing materials. The value of this free international marketing is hard to measure, but is probably $> \$100,000$ (estimate by KH).

3.3. Earthwatch Institute

The 328 volunteers who worked on the Tambopata Macaw Project generated $\sim \$677,000$ in volunteer contributions, of which 27% was paid to Rainforest Expeditions for food, lodging and transportation and 18% was paid as funding for the research. The cost to volunteers averaged $\$2093 \pm \466 ($N = 28$ trips, minimum = $\$1595$ for 10 days in 2001, maximum = $\$2849$ for 12 days in 2007).

Earthwatch generated approximately $\$386,000$ in gross revenues over the seven years of the study by retaining $56\% \pm 6\%$ of the volunteer contributions ($N = 7$ years, Table 1). This was greater than the total cash received by the macaw research project ($\$219,800$ combined grants, donations, and DJB salary), or Rainforest Expeditions ($\$198,560$ gross payments from Earthwatch and international volunteers). The annual percent retained by Earthwatch increased steadily from 51% in 2001 to 65% by 2007 (Table 1). The per capita research and lodging budget averaged a 5% increase per year ($\$766$ in 2001– $\$1020$ in 2007) while the average cost to volunteers increased by over 10% per year ($\$1595$ in 2001– $\$2849$ in 2007). Earthwatch claims that roughly 50% of volunteer contribution goes to expedition field costs (Earthwatch Institute, 2008). However, the amount retained by Earthwatch (55% average, 64% maximum) was significantly greater than 50% over the seven year history of this project (Wilcoxon signed-rank test: $V = 1, p = 0.031$).

4. Discussion

Over the past seven years, the Earthwatch Institute, Rainforest Expeditions, and the Tambopata Macaw Project have all benefited from this three-way association. Here we evaluate the strengths and weaknesses of this triumvirate from the researcher's perspective and the ecotourism operator's perspective. We close with a discussion of possibilities for wider application of this model.

4.1. Research perspective

Rainforest Expeditions and Earthwatch Institute provided volunteer labor, logistical support and nearly $\$400,000$ in cash, goods, and services over seven years. Together they provided 95% of the total budget allowing the research to continue uninterrupted from 2001 through February 2007. Many conventional research grants last from 1 to 5 years, making it difficult for researchers to obtain long-term funding. However,

ecotourism companies and volunteer organizations benefit annually, so they can be effective partners in maintaining long-term projects.

The main benefits of working with Earthwatch in order of importance were research funding, volunteer labor, and interactions with volunteers. However, all of these also carried costs. Here we discuss the costs and benefits and recommendations for how to structure projects to maximize the benefits. The Earthwatch Institute provided 85% of the research project's total cash grants. This provided money for equipment and year-round assistant salaries. However, the annual grant was based on the number of volunteers that signed up for the project, so funding levels fluctuated and never reached the theoretical maximum. The unpredictable research budget did not hobble the Tambopata Macaw Project because the free room, board, and logistics from Rainforest Expeditions allowed the basic research to continue. However, we suggest that all researchers working with Earthwatch have mechanisms in place to deal with the fluctuating annual research grant and the incremental payments.

The proportion of volunteer fees retained by Earthwatch help cover the cost of volunteer recruitment and preparation and the recruitment of new scientists. The percent retained by Earthwatch increased at approximately twice the rate of the macaw research budget over the seven year period and was significantly greater than the 50% reported on the Earthwatch web page (Earthwatch Institute, 2008). This 50% retention apparently refers to the average retention across all projects at Earthwatch, not the average retention for a single project (M. Chandler, Earthwatch Institute pers. comm.). Despite a recent organization-wide increase in retention by Earthwatch, revenues generated by volunteers have been insufficient to cover the costs of running the volunteer program and the deficit has increased annually (M. Chandler, Earthwatch Institute pers. comm.). This deficit has been driven by increases in the cost of safety and logistics oversight. This being said, we feel that communication between researchers and Earthwatch should be improved. Earthwatch should better inform researchers how retained funds are spent and be more transparent when setting total volunteer costs. Researcher input is key to setting the annual research grant, but not the final cost to volunteers. The total cost is important to researchers, as price may determine how many volunteers can attend the project and the number that attends the project determines the total grant received. As a result of increased communication and negotiation between DJB and Earthwatch during the preparation of this article, Earthwatch dropped the 2008 retention rate to 54% and reduced the total cost to volunteers by 4%. We suggest that researchers take an active role in negotiating not only their research budget but also the final cost to volunteers.

Earthwatch volunteers were very eager workers (see also Foster-Smith and Evans, 2003) and collected a large amount of useful data. These data from Earthwatch volunteers were used in two of the project's eleven peer reviewed publications (Brightsmith, 2004; Tobias and Brightsmith, 2007) and provided important background information for interpreting nesting behavior.

The main costs associated with data collection by volunteers included choosing appropriate tasks and training.

Choosing appropriate tasks for volunteers is not trivial, as volunteer skills and abilities vary unpredictably. We only had volunteers collect data for which they could be trained quickly and reliably (see also Foster-Smith and Evans, 2003). Even with simplified protocols, most data were collected under the supervision of trained research assistants and only after intense training. While some researchers may see volunteers as predominantly a source of funding, researchers should not work with Earthwatch unless they have meaningful data that can be successfully collected by volunteers. Meaningful tasks are vital because the volunteers are relatively intolerant of doing tasks that they do not perceive as being important (DJB pers. obs, see also Gray and Campbell, 2007).

Training, while labor intensive for the researchers, was a vital part of these expeditions. Working through the 30-page training packet with its explanations, examples and written exams taught protocols and facilitated direct evaluation of volunteer abilities. The training also helped mould the group by focusing attention on the importance of accurate data collection and ensuring the group remained 'volunteer-minded' and not 'vacation-minded' (Brown and Lehto, 2005). DJB also benefited from training Earthwatch volunteers by improving his teaching methods and refining research protocols. As a result, we suggest that all researchers working with these types of volunteer groups prepare extensive and detailed training materials and dedicate sufficient time to training to ensure accurate data collection. In addition, the longer the volunteers stay, the better the payback of data collected per hour of training. For this reason, we lengthened the expeditions from 10 to 12 days as of 2003.

In comparison with the Earthwatch volunteers, the Peruvian and international students and young professionals who volunteered were more efficient data collectors. They stayed longer (6–12 weeks as compared to 10–12 days for Earthwatch), worked more hours per day (~10 as compared to 6 for Earthwatch) and averaged in better physical shape. During their first two weeks they were trained to do nearly all the project activities, including some activities not done by Earthwatch volunteers like climbing to macaw nests, measuring macaw chicks, and conducting parrot censuses. As with Earthwatch volunteers, they had to be trained carefully, but their longer stay provided more hours of work per hour of training. However, they were not able to provide research funding like the Earthwatch volunteers. As a result, the research project had both longer-term students and young professionals as volunteers and older shorter-term Earthwatch volunteers that engaged in distinct but complementary tasks.

Team supervision by DJB provided a complex mix of benefits and costs. Many volunteers came with special skills and DJB learned new skills from them and feels he could have learned more and explored new research avenues if he had been more adaptable (see also Gilmour and Saunders, 1995). Supervising was also rewarding for DJB because he saw many volunteers deeply affected by their experience (see also Foster-Smith and Evans, 2003; Brightsmith, 2008). Some volunteers went on to dedicate themselves to parrot conservation, became regular participants on other Earthwatch expeditions, and began small conservation campaigns in their home towns (see also Newman et al., 2003). This project provided

DJB the opportunity to disseminate research findings and conservation messages and help grow the global conservation constituency (Gilmour and Saunders, 1995).

The main cost of working with Earthwatch for DJB was the time and energy required to manage the teams. The group members were very interested in interacting with the lead researcher(s) and this, along with the intensive training and frequent formal and informal presentations, required a great deal of energy. Researchers with limited interpersonal skills and those unwilling to invest time and energy should avoid working with Earthwatch (see also Gilmour and Saunders, 1995).

Given the difficulty of finding traditional grants to support long-term biodiversity monitoring studies, Earthwatch was an attractive funding option for this project and may be a good option for researchers in similar positions. The 2300 h invested by the researchers resulted in over \$125,000 in funding (~\$52 per h). Another key advantage is that working with Earthwatch provided direct income for Rainforest Expeditions. This income allowed Rainforest Expeditions to better justify the levels of support they gave to the research. In this way, Earthwatch played an important role in strengthening the bond between the macaw research and Rainforest Expeditions.

However, the relatively small fraction of the volunteer costs that directly supports the research and the effort required to supervise a large number of unskilled volunteers may cause some researchers to become disillusioned with this model. While six Earthwatch research projects have run for over 20 years, the average project lasts for about 3–4 years ($N = 1348$ projects since 1971, Earthwatch unpublished data) suggesting that long-term funding is not the norm. Now that DJB is in a university position with better access to traditional grants and endowment funding, he has had graduate students and young professionals become increasingly responsible for the Earthwatch groups and receive the majority of the benefits.

From a researcher's perspective, Rainforest Expeditions made an excellent partner. The logistics, food and lodging allowed the research team to stay in the field year-round despite having only about \$20,000 a year in cash grants. This allowed us to document year-round natural history patterns and gain a much broader understanding of the system (Brightsmith, 2004). The support from Rainforest Expeditions was not only financially beneficial, but also freed the researchers from the time, effort and stress involved in logistical planning. Another benefit was that the frequent presentations to the guests allowed us not only to disseminate research findings and conservation messages but also to interact with well-to-do ecotourists and potential donors. DJB and his team did not systematically engage in fund raising from guests, but creative researchers could likely generate additional funding directly from ecotourists.

Working with Rainforest Expeditions was professionally satisfying for the most part, as the company recognized the researchers' role in improving their product and helping them fulfill the principles of ecotourism (see below). As a result, the company was willing to invest money and staff time in providing services for researchers despite the fact that this did not always provide immediate or direct monetary gain. The

company also deferred to the judgment of researchers when setting protocols for tourism activities that impacted wildlife resources. In general, the company did not attempt to limit researcher activities; in fact they frequently invited investigations of ecotourism impacts at their lodges (Stronza, 2007).

The main costs of working with Rainforest Expeditions were the time spent interacting with guests and the need to be flexible with regards to logistics (see also Brightsmith, 2008). The interactions with the guests required about 21 h per month of researcher time. These interactions could be done by DJB or experienced research assistants, so unlike working with Earthwatch, the demands on DJB were usually minimal. Logistical changes, though uncommon, occasionally required researchers to delay arrival or departure by a few days, miss data collection outings, or change accommodations unexpectedly. However, these problems were relatively minor and are similar to those found at dedicated research stations in the area.

In summary, working with Rainforest Expeditions was highly advantageous for the Tambopata Macaw Project. The average of 21 h a month of researcher time produced about \$3282 worth of funding, goods and services from Rainforest Expeditions per month (~\$156 per h). Rainforest Expeditions is somewhat of a special case, as the owner operators also began the macaw research and therefore have personal and professional interest in supporting the project. However, there may be a great deal of potential for expanding alliances between research and ecotourism businesses. In Panama, combining research and ecotourism has been proposed as part of a government-sponsored national economic development strategy (Ayala, 2000). In Mexico a survey of 21 tourism operators found 38% actively supported research with logistical or financial support and 75% of those that did not had never been invited to participate (López-Espinosa, 2002). We encourage more researchers to consider ecotourism companies as potential supporters, but only if the researchers are flexible with regards to logistics and willing to interact with guests. The researchers should also make sure that the company is truly interested in supporting the research, even if it does not lead to direct or immediate financial gain (see also Brightsmith, 2008).

4.2. Ecotourism perspective

Hosting the macaw research project was beneficial to Rainforest Expeditions in part because macaws and parrots are a vitally important part of the tourism packages offered (Rainforest Expeditions, 2007). As a result, the importance of studying and protecting these birds was clear to staff, management, and guests. Hosting the research was a direct economic benefit for Rainforest Expeditions. This is particularly noteworthy in light of the many indirect and non-monetary benefits received.

Problems with marketing and attracting guests are listed among the most important limits to profitability among ecotourism owners in the developing world (Sanders and Halpenny, 2000). The researchers helped with this problem by providing marketing for Rainforest Expeditions and the Tambopata region in general through their writings and presentations, and by providing topics for third-party articles and documentaries.

The researcher's work with Earthwatch also helped the company by providing direct income from volunteers and inclusion in the Earthwatch portfolio. Word of mouth marketing by ex-volunteers also generated interest in the company. The association with Earthwatch and academic institutions (like Duke University the home institution of DJB during this work) also improved the image of Rainforest Expeditions. Rainforest Expeditions' support of research helped them win at least one international ecotourism award. These types of marketing are very valuable, as all were generated by entities outside the company. In the highly competitive international ecotourism market, research projects and the results they generate can help companies strengthen their marketing materials and distinguish themselves from competitors (KH pers. obs.).

There is well justified concern about the credibility of the ecotourism industry, as many companies that market ecotourism products fail to live up to the principles of ecotourism (López-Espinosa, 2002; Fennell and Weaver, 2005). Twenty years after its inception, scholars continue to debate the definition of ecotourism (Weaver and Lawton, 2007). However, many agree that the principles of ecotourism include core criteria including nature-based attractions, learning opportunities, and sustainability (Fennell and Weaver, 2005). Rainforest Expeditions' fulfillment of all three was enhanced through hosting the macaw research. The research helped increase the abundance and visibility of the site's premier nature attraction, the large macaws (Nycander et al., 1995; Brightsmith et al., 2005; Brightsmith and Bravo, 2006). The researchers' direct interactions with guests also increased the guests' learning opportunities and helped guests put their personal observations in a broader context and appreciate the scientific and conservation importance of the site. Researchers also facilitated education by training the guide staff who in turn educated guests. The researchers also helped ensure ecological sustainability by helping protect the site's main attraction, the macaw and parrot clay lick (Brightsmith, 2004).

Rainforest Expeditions has an unusually high interest in the macaw research, as it is the flagship research for the company. As a result, the relationship between the research and the company is likely unusual. However, Earthwatch estimates that ~5% of their biological research projects may involve companies with interests and investment levels as high as those of Rainforest Expeditions (H. Pruiksma pers. com.). In addition, the history of the company and the owners' personal interest in the research does not change the financial reality that hosting the research is good for business.

4.3. Broader impacts

This mutually beneficial triumvirate allowed all three actors to successfully advance their own agendas of research, ecotourism, and volunteerism. However, the research project made possible by this triumvirate also produced benefits beyond just the three organizations. The project has trained young biologists, foresters, and veterinarians from Peru ($N = 34$) and abroad ($N = 51$). Some of these assistants have gone on for higher degrees, conducted their own conservation research projects, and advised government conservation projects. Local people have also received training and experience ($N = 12$, see also Clifton and Benson (2006) for positive outcomes of re-

search tourism on local communities). The scientific information has also produced additional benefits: Rainforest Expeditions has used the information to manage tourism impacts around their ecotourism lodges and Macaw Project researchers are helping the Peruvian government develop guidelines for tourism around sites where parrots congregate. In addition, the information generated by the Tambopata Macaw Project has been used by parrot conservation and management projects in Costa Rica, Mexico, Guatemala, Ecuador, Bolivia, Brazil, Puerto Rico, Indonesia and possibly others.

The potential benefits of ecotourism are often overstated (Bookbinder et al., 1998). However, the triumvirate model we describe should be broadly applicable in many geographic regions. Conservation researchers face a perennial shortage of funds, especially in the developing world where biodiversity is concentrated and local resources are scarcest (Myers et al., 2000). Fortunately there are hundreds of ecotourism lodges (Sanders and Halpenny, 2000) and many volunteer organizations recruiting for projects in the developing world (Clifton and Benson, 2006). Researchers can help these lodges fulfill the requirements of true ecotourism and distinguish themselves in the market. As a result there is great potential for the spread of partnerships between ecotourism and research. Most ecotourism companies are experts in transportation, food, and lodging, so free and reduced cost services can help researchers save time and money. Ecotourism operators and volunteer organizations have great potential to provide long-term funding for basic and applied research that may be difficult to fund through traditional sources. In turn these projects can benefit the direct participants while helping aid conservation and sustainable development.

Acknowledgements

Thanks to H. Pruiksma, M. Chandler, and the staff from Earthwatch for their continuing support and for compiling data for this paper. The staff of Rainforest Expeditions provides continual support for the research at TRC. Thanks to E. Nycander for helping make TRC a reality. Thanks also to the myriad of Earthwatch volunteers and the research assistants who collected the data, especially the field leaders B. Wilkerson, M. Dragiewicz, O. Gonzales, A. Figari, A. Bravo, A. Johnson, D. Matsufuji, G. Vigo, and K. Quinteros. Peru's Instituto Nacional de Recursos Naturales (INRENA) provided permission for the macaw research and the operation of TRC.

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