

Pollution in paradise: A conceptual model of beach pollution and tourism

- Links between beach pollution and tourism -

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ABSTRACT

The beach has traditionally been viewed as a place of recreation and healing, however pollution from marine debris is increasingly becoming a problem. A potential paradox is created where more attractive sites become more popular and subsequently more degraded due to pollution, which degrades the quality of experience. Although many studies have identified this as an issue, it is unknown how visitors, pollution, and other factors interact with one another. Here the Broker-Local-Tourist (BLT) model is used as a basic framework in an attempt to explore the interactions between tourism and beach pollution. What emerges is a rich description of the different groups contributing to beach pollution, and how this pollution impacts them in turn. This place-based conceptual model provides a useful tool for examining interactions between pollution and tourism and illuminates potential avenues for developing effective pollution prevention measures and avenues for future research.

Key words: marine debris, nature-based tourism, conceptual model, beach pollution, Broker-Local-Tourist (BLT) model

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1. Introduction

Since ancient times, the beach has been viewed as a place for recreation and healing. Modern ideas of the beach can be traced back to 19th century England, when a day trip or summer at the beach became an institution. In much of the modern world, beaches provide not only an important escape but also a crucial source of tourism revenue for beach communities.

However, tourists' beach experiences can be negatively impacted by modern pollutants including plastics and styrofoam. Rapid increases in population and the intensity of recreational beach use compound pollution issues and threaten the attractiveness of recreation areas (Sun and Walsh, 1998; Gregory, 1999). The paradox that beautiful locations attract tourists, who subsequently degrade the location leading to its abandonment as a desirable location has been noted by a number of writers (e.g. Gregory, 1999). In summary,

The exponential growth of tourist numbers and their spread to previously quite remote regions of the world has highlighted the potentially paradoxical character of nature-based tourism. The more attractive a site (usually due to its rich biological and/or cultural values), the more popular it may become, and the more likely it is that it will be degraded due to heavy visitation, which in turn may diminish the quality of the experience. Many studies have identified this as an issue of concern, yet it is still unclear how the various factors interact with each other, or indeed whether one necessarily leads to another. (Hillery et al., 2001)

Unfortunately, the problem is accelerating. Between 1994 and 1998 it has been shown that the debris on the coast of the UK doubled and increased 100 fold in parts of the Southern Ocean.

This paper lays out a framework that can be used to holistically examine the interactions between marine debris and tourism, as well as the impacts they have on each other. Using a broad literature review and building on Miller and Auyong's Broker-Local-Tourist (BLT) model, the conceptual model developed here begins to address the question of "how the various factors interact with each other" (Miller et al., 1999; Hillery et al., 2001).

2. Starting point

The conceptual model developed here builds on the Broker-Local-Tourist Model developed by Miller and Auyong (Miller *et al.*, 1999), and adapts it to focus on a particular issue (beach pollution) in a specific place (a beach). The model's components are briefly explained here to provide context for the model.

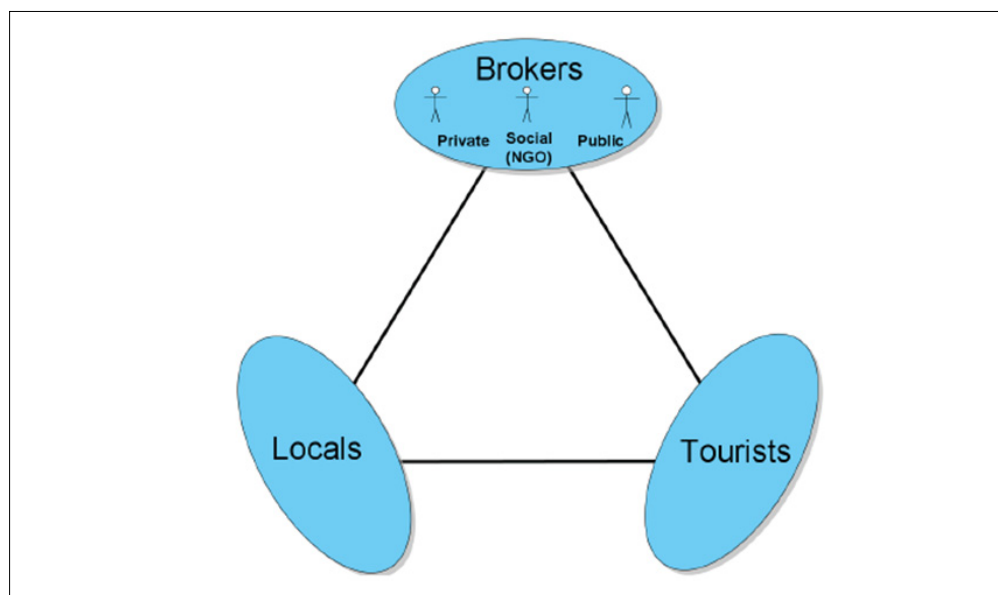
2.1 Beach pollution

Beach pollution as defined here as any item that appears on beaches as the result of man's activity (following Sommerville, 2003). Beach pollution is largely derived from three sources, litter deposited on the beach, litter deposited on land that makes its way to the beach, and marine debris that washes onto the beach (*e.g.* Willoughby *et al.*, 1997; Somerville, 2003). Here, litter is defined as solid waste that is discarded by humans, including material that has been discarded illegally. Marine debris is defined as "any man-made object discarded, disposed of, or abandoned that enters the coastal or marine environment" (NOAA, 2007). For the purposes of this model, the term marine debris will be used to refer to all persistent solid waste in coastal or marine ecosystems, beach litter will be used to refer to solid waste, both organic and non-organic, on beaches, and litter will be used to refer to illegally dropped waste, generally in urban areas.

It should be understood that all three terms are referring to essentially the same waste materials, just in different locations. These include plastics of all shapes and sizes, glass, metal, Styrofoam, pieces of wood products, rubber, derelict fishing gear, and derelict vessels, along with items found in storm water discharge such as syringes and cigarette butts (Cho, 2005; Shiomoto and Kameda, 2005; NOAA, 2007; Willoughby, 1997; Santos *et al.*, 2005).

2.2 Broker-Local-Tourist model

Miller and Auyong's Broker-Local-Tourist model (Figure 1) classifies the components of a tourism system into three groups. *Brokers* are those who are professionally involved in the tourism industry, and consist of *private sector brokers*, those who belong to the tourism industry, *public sector brokers* who regulate, legislate, and plan for tourism, and *social movement brokers* (or NGO brokers), who address tourism issues from outside the government and industry (Miller *et al.*, 1999). Brokers are neither uniformly for or against tourism, and broker-broker conflicts are very common (Miller *et al.*, 1999).



Source: Miller *et al.* (1999)

Figure 1. The Broker-Local-Tourist model

Locals are those who reside in the same community or district where tourism occurs, however their income does not come from the tourism industry (Miller *et al.*, 1999). This group may consist, for example, of teachers, fishermen, or store clerks. Different local groups may be affected by tourism in different ways, and may hold different opinions concerning tourism.

Tourists are those who travel to a location for a relatively short period of time, either for business, recreation, or education (Miller *et al.*, 1999). The tourists of a beach environment are involved in activities on the beach itself, and activities in the near-shore waters such as swimming, wading, recreational fishing, and recreational boating. Tourist subgroups include recreational boaters and fishermen and beach users. Here, anyone who is involved in recreational activities on the beach or marine environments is considered tourists, even if they would otherwise be considered locals. Although generally locals participating in beach recreation would still be considered locals, the pollution impacts that this group has on the beach and marine environment while recreating are fundamentally different than in the normal course of their life. Therefore, it is thought necessary that recreating locals be considered tourists for the purposes of this study.

3. Literature review

The conceptual model developed here is based on the available literature. Issues identified in the literature addressed four different questions: first, how do people contribute to marine debris and beach litter, and second, how does marine debris and beach litter affect people? This pattern emerged quickly and created the framework of two-way interactions for the model. Further, it became apparent from the literature that each of the local and tourist groups would need to be subdivided based on the different ways these groups contributed to and were affected by marine debris. Third, the literature identifies a number of factors unique to a specific beach that influence the degree of beach pollution. Finally, some of the literature was focused on mitigating people's contribution to marine debris and beach litter or reducing the impact that this pollution had on people. These three main discussions in the literature are summarized here and provide the framework for the conceptual place based tourism model developed.

3.1 How do beach brokers, locals, and tourists contribute to marine debris and beach litter?

Marine debris comes from four major sources: recreation and tourism litter, sewage related debris, fishing debris, and shipping waste (Somerville, 2003). The majority of marine debris originates from land-based sources. One study found that in 7 of 9 locations surveyed the major source of pollution was land based (Topping, 2000). A brief overview of the contributions of brokers, locals, and tourists to marine debris and beach litter can be found in Table 1.

Table 1. The contributions to beach litter and marine debris by brokers, locals, and tourists found in the literature

BLT model component	Contribution to beach litter and marine debris
Brokers	
Private brokers	Sewage waste and construction debris from land based private brokers (Green, 2005; Hall, 2001; Martinez-Ribes <i>et al.</i> , 2007)
	Garbage and discarded fishing gear from broker led recreational boating and fishing and the cruise ship industry (Klein 2003)
Public brokers	Poor legislation, enforcement, urban planning, and sewer maintenance (de Araujo and da Costa, 2007; Green, 2005; Ofiara and Brown, 1999)
NGO brokers	Unknown
Locals	
Local residents	Garbage can become storm water discharge, sewage overflow, or landfill runoff (Allsopp, 2006)
Local industry	Construction materials from development sites, hand cleaning and air-blasting media particles, other manufacturing materials (Martinez-Ribes <i>et al.</i> , 2007; Derraik, 2002)
Local fishermen	Fisheries: Abandoned or lost fishing gear, garbage (Oigman-Pszczol and Creed, 2007)
	Aquaculture: Styrofoam used for buoyancy and other materials (Cho, 2005)
Local boaters	Solid waste lost overboard
Tourists	
Beach tourists	Disposal of food containers, cigarettes, and other materials on the beach (Allsopp <i>et al.</i> , 2006)
Recreational boaters	Garbage discarded or lost overboard (Backhurst and Cole, 2000; Gregory, 1999)
Recreational fishermen	Garbage and fishing gear discarded or lost overboard (Allsopp <i>et al.</i> , 2006)

3.1.1 Contributions from brokers

Land-based private sector brokers, such as those running hotels, restaurants, and other beach-side attractions are a major source of beach litter and marine debris. For example, in Thailand hotels have caused local rivers to become excessively polluted with waste due to an artificial lagoon constructed for the benefit of tourists (Green, 2005). Additionally, some hotels have in-house sewage systems which can back up and discharge into nearby bodies of water during heavy rain (Hall, 2001; Green, 2005). The construction of hotels and other development can also create marine debris (Martinez-Ribes *et al.*, 2007).

Private sector brokers can also run recreational boating, fishing, and other water-based experiences. These activities can contribute significantly to marine debris and beach litter through accidental or purposeful loss of waste and fishing equipment. Additionally, cruise ships release large quantities of solid waste every day, including some particles of incinerated plastics and larger items of marine debris lost overboard (Klein, 2003). This is a large source of marine debris, and greatly contributes to beach litter when cruise ships are in ports or shallow water.

Public sector brokers can contribute to marine debris and beach litter indirectly through poor legislation and enforcement. The lack of urban planning in sea-side urban centers has been blamed for the creation of beach litter and marine debris (De Araujo and da Costa, 2007; Green, 2005). Landfill runoff may be more likely because of improper siting which places the landfill near a body of water. Through poor maintenance and planning, public brokers can increase the amount of sewage and wastewater that overflow into local bodies of water. In New Jersey, as in many other locales around the world, waste water from sewage treatment plants contaminates beaches due to old or faulty equipment or poor management practices (Ofiara and Brown, 1999).

NGO brokers are not generally thought of as sources of marine debris and beach litter. However it is possible that their outreach activities could contribute to pollution. In a case examined later, it was found that distributing pamphlets describing the effects of marine debris and beach litter and plastic bags for tourists to place their trash in only exacerbated the beach litter problem.

3.1.2 Contributions from locals

Locals, or those not directly connected to beach tourism but who live in the beach community, contribute to marine debris in two major ways. The first is through litter thrown away in the street that is washed into the ocean, and the second is through sewer waste.

Some municipalities have storm drain systems designed to carry rain water to the nearest body of water. Heavy rains wash litter from the streets into the ocean these systems (Allsopp, 2006). Locals' garbage can also be washed from landfills into oceans during heavy rain events (Allsopp, 2006). Other municipalities have combined sewer systems designed to carry sewage and storm water. In heavy rain events, these systems can be pushed beyond capacity, leading to untreated sewage waste as well as street litter being discharged. This is a major source of land-based marine debris (Allsopp, 2006).

Local industry can also contribute to marine debris. Construction material, such as bricks or plastic tubes, is a frequent component of marine debris in areas that are being developed, and in these areas it can be a major input (Martinez-Ribes *et al.*, 2007). Some local industries may use cleaning media that consists of very small particles which always pass through sewage treatment and into the oceans (Derraik, 2002). Additionally, local production facilities can release various plastics and other manufacturing materials.

Local fishermen contribute to beach litter and marine debris through abandoned or lost fishing gear and waste that is lost overboard (Oigman-Pszczol and Creed, 2007). Although MARPOL Annex V prohibits dumping, the ease of this disposal method leads some to think that it will persist far into the foreseeable future (Gregory, 1999). Local aquaculture operations can contribute Styrofoam, which is used for buoyancy, as well as other materials (Cho, 2005).

3.1.3 Contributions from tourists

Tourists, both local and from out of town, are a major source of beach litter (Topping, 2000). While the exact percentage depends on the beach, one study found that approximately 70% of beach litter could be attributed to beach users (Ivar do Sul and Costa, 2007). Tourists themselves realize this; individual beach users attribute beach litter to beach users as a group, although individuals are unlikely to admit littering (Santos, 2005; Hillery *et al.*, 2001; Priskin, 2003). Beachgoers often leave food and drink packaging, as well as plastic beach toys and cigarette butts on the beach (Allsopp, 2006). Recreational fishing gear is also commonly left as litter.

Tourists participating in recreational boating or aboard cruise ships also contribute significantly to beach litter and marine debris. Items such as food packaging, plastic bags, and fishing gear are often 'lost' overboard, either purposefully or inadvertently (Allsopp, 2006). In New Zealand, recreational boaters were found to be the major source of marine debris in some areas (Backhurst and Cole, 2000). Further, recreational boaters are notorious for being unaware of the MARPOL Annex 5 regulations regulating marine disposal of waste (Gregory, 1999).

Tourists can also contribute to marine debris through street litter and sewer waste as discussed in the previous section.

3.2 How does beach litter and marine debris affect components of the BLT model?

As beach tourism is so closely tied to beach aesthetics "the greatest impact associated with visual pollution, such as beach litter, is ... the economic loss associated with the reduction of amenities" (Tudor and Williams, 2006). Obviously, these amenity reductions affect the bottom line of private brokers and the enjoyment of the tourist. However, these negative effects also affect public brokers and locals through reduced community income and depleted fish stocks.

It is possible that marine debris and beach litter could have positive effects as well. Unfortunately, very few examples of positive impacts occur in the literature. It is unknown if this is because there are no documented cases, or if no researcher has made this a field of inquiry. A brief overview of the effects of beach litter and marine debris on brokers, locals, and tourists can be found in Table 2.

Table 2. The effects on brokers, locals, and tourists attributed to beach litter and marine debris in the literature

BLT model component	Effect of beach litter and marine debris
Brokers	
Private brokers	Reduced tourist visits, reduced revenue, damage to resort image, costs incurred from beach clean-ups (Tudor and Williams, 2006; Ballance <i>et al.</i> , 2000)
	Damage to propellers, shafts and engine failure, and maritime accidents caused by marine debris (Gregory, 1999; Cho, 2005)
Public brokers	Costs incurred from beach clean-ups of municipal beaches and marine areas, damage to public broker boats such as ferries, accidents caused by marine debris (Topping, 2000; de Araujo and de Costa, 2007; Somerville <i>et al.</i> , 2003; Gregory, 1999; Cho, 2005)
NGO brokers	Unknown
Locals	
Local residents	Depressed economy from reduced tourism revenue, reduced fish consumption, possible intangible costs, health and safety hazards (Ofiara and Brown, 1999; Tunstall and Penning-Rowsell, 1998; Gregory, 1999; Ivar do Sul and Costa, 2007)
Local industry	Unknown
Local fishermen	Fisheries: Reduced catches, vessel and equipment damage, lost hours from marine debris buildup (Gregory, 1999; Ofiara and Brown, 1999; Ivar do Sul and Costa, 2007; Cho, 2005; Somerville <i>et al.</i> , 2003)
	Aquaculture: Unknown
Local boaters	Vessel damage (Gregory, 1999)
Tourists	
Beach tourists	Reduction in beach enjoyment, health and safety hazards (Gregory, 1999; Ivar do Sul and Costa, 2007; Ofiara and Brown, 1999; Backhurst and Cole, 2000; Santos <i>et al.</i> , 2005)
Recreational boaters	Vessel damage (Gregory, 1999; Topping, 2000)
Recreational fishermen	Lower catch per hour or trip, reduced enjoyment, increased travel costs, lower quality or safety (Ofiara and Brown, 1999; Gregory, 1999)

3.2.1 Impacts on brokers

Many studies have found that clean beaches are one of, if not the, most important factor to tourist beach selection and enjoyment. “Tourists associate the presence of wastes along the coasts with polluted beaches and poor water quality, and hence littered beaches are a major deterrent to tourism” (Martinez-Ribes *et al.*, 2007). In Wales, for all 19 beaches studied, ‘clean litter-free sand’ and ‘clean water’ were the first and second most important factors in beach selection (Tudor, 2006). These results have been mirrored for beaches with a wide variety of characteristics in England (Tunstall, 1998), South Africa (Balance *et al.*, 2000), and Brazil (Santos *et al.*, 2005), among others.

In South Africa, 85% of both out of town tourists and local tourists would avoid visiting beaches with more than 2 items of litter per square meter, and 97% of visitors would avoid visiting if the beach had more than 10 large items per square meter (Ballance *et al.*, 2000). As a result, areas that are dependent on tourism can face serious hardship due to beach litter pollution (Oigman-Pszczol and Creed, 2007). It should also be noted that local tourists, even more so than out of town tourists, are very sensitive to information about beach degradation (Tunstall, 1998).

The effects of these aesthetic preferences include “a loss of tourist days producing damage to the leisure and tourism infrastructure; damage to commercial activities, *e.g.* fisheries, dependent on tourism; and damage to the resort image” (Tudor and Williams, 2006). Furthermore, if the media reports on a marine debris wash-up event, beaches that are not affected by the event will also see reduced visitation numbers and lost revenue (Ofiara and Brown, 1999).

Public and private brokers, such as municipal beaches or beach resorts, are often required to clean beaches of beach litter frequently to continue attracting tourists. This results in much higher maintenance costs, as beach cleaning is quite expensive. In South Africa, cleaning costs for the Cape Metropolitan area for 1994-5 was R3.5 million, which is very expensive when compared to the value of these beaches (Ballance *et al.*, 2000). These efforts have since increased in scope and cost (Ballance *et al.*, 2000). Publicly owned community beaches and local and national parks – all the responsibility of public brokers – are also subject to increased maintenance costs which the community must pay for (Topping, 2000; de Arajo and de Costa, 2007; Somerville *et al.*, 2003).

Boating accidents have also been caused by marine debris, impacting public and private brokers who are boating operators, as well as local commercial boaters and trade fishermen and boating tourists (Gregory, 1999). Fishing gear discarded by local fishermen can become entangled in a boat’s propellers or shafts, causing engine failure (Cho, 2005). In Korea, 204 maritime accidents occurred between 1996 and 1998 as a direct result of marine debris, and England reported 180 cases of marine debris fouling propellers during 1998 (Cho, 2005). In one particularly dramatic example, marine debris entangled both shafts and the right side propeller of an overloaded ferry, contributing to the vessel capsizing and sinking, resulting in 292 deaths (Cho, 2005). One harbor, trying to avoid accidents such as these, spent 15,000 GBP per year clearing the harbor of floating debris (Cho, 2005).

3.2.2 Impacts on locals

When marine debris and beach litter cause tourists to avoid private brokers, as mentioned above, it negatively impacts the economy of tourism dependent communities. As a result, local businesses are often harmed, even if they are not directly involved in the tourism industry (Ofiara and Brown, 1999). This phenomenon is known as ‘multiplier effects’ (Ofiara and Brown, 1999).

Local fishermen who rely on populations of near-shore fish for their livelihood are very vulnerable to events which harm their fish stocks (Gregory, 1999; Ofiara and Brown, 1999; Ivar do Sul and Costa, 2007). Fisheries can be harmed through “outright mortality, loss of fish habitat and spawning grounds, and decreases in recruitment and gain in weight” (Ofiara and Brown, 1999). Ghost fishing caused by local fishermen’s discarded nets can also cause high mortality of commercially valuable species. In Korea, 200 kg of king crab was found in derelict nets in one harbor (Cho, 2005). Fish stocks harmed in this way will result in fishermen catching fewer fish, resulting in decreased incomes and possibly economic hardship.

Catches can also be contaminated with marine debris, resulting in persistent difficulty with debris accumulation in nets, catches contaminated with debris, and nets snagging on debris (Cho, 2005). Additionally, the fishing industry can suffer financial losses due to fishing vessel damage and equipment damage, as well as the lost fishing time that results (Somerville *et al.*, 2003). Shellfish fisheries may need to be completely shut down if a health hazard is suspected. Furthermore, locals who own boats, even if they are not fishermen, are subject to the hazards of marine debris as described in the brokers section (Gregory, 1999).

Similarly, locals who enjoy dining on locally caught fish, and especially shellfish, are faced with safety issues if, sewage contaminates local waters or the marine debris contains medical waste (Ofiara and Brown, 1999). This can in turn reduce the prices that locals are willing to pay for local seafood, further depressing local economies (Ofiara and Brown, 1999).

It is also possible that locals, and possibly tourists as well, will find that the devaluation of the beach goes beyond any lost community income or reduced enjoyment of beach facilities. The existence value – the pleasure derived from knowing something exists – along with the other intangible benefits of a clean beach is something that no study has yet examined.

3.2.3 Impacts on tourists

When marine debris and beach litter make beaches unpalatable, tourists are harmed because their beach experiences are less enjoyable (Ofaria and Brown, 1999; Backhurst and Cole, 2000). This is especially true when beach litter is sewage derived, or is perceived to be sewage-derived even if it is not (Tunstall, 1998). Even at urbanized beaches, the illusion of being in and interacting with a ‘natural’ litter free environment is very important (Tunstall, 1998). The reactions people have to high levels of beach litter can be very strong. Some of the comments taken from a logbook in New Zealand, for example, read “...feel sickened by the sight of so much plastic and glass pollution on the beach...” and “pollution disturbing” (Gregory, 1999).

This loss of enjoyment derived from the beach experience can be approximated using willingness to pay studies. These studies determine the amount a consumer, or in this case tourist, would be willing to spend to increase the quality of the beach they are visiting. Estimates of this range quite a bit, and are often tied to tourist's incomes and other complex factors, but one estimate put the value of a linear foot of clean beach at 14\$/year (Cho, 2005).

The impacts on tourist beachgoers can also be more physical – 30% of beach users surveyed had suffered problems caused by beach litter, mostly from cutting themselves on glass and other sharp materials (Santos *et al.*, 2005). The incidence of human diseases, along with general public health, has also been tied to beach litter and marine debris (Gregory, 1999; Ivar do Sul and Costa, 2007). These matters affect both tourists and locals.

Recreational boaters, like local fishermen, are affected by marine debris when it clogs boat's water intakes, blocks pumping systems, or fouls boat propellers (Topping, 2000).

Recreational fishers, also like local fishermen, are affected when fish stocks suffer due to marine debris (Ofiara and Brown, 1999). Fewer fish in the water means fewer fish caught per hour or per trip, greatly reducing the pleasure of fishing (Ofiara and Brown, 1999). Faced with this situation, some recreational fishermen either reduce the number of trips they take, or stop fishing in the affected location (Ofiara and Brown, 1999). If they choose to fish in alternate locations, they may face increased travel costs (Ofiara and Brown, 1999). Recreational fishermen will also reduce the number of fishing trips they take if the quality and safety of fish are negatively impacted (Ofiara and Brown, 1999).

3.3 *What characteristics of a specific beach affect beach pollution?*

A number of factors modify the amount of litter found on a beach. As mentioned earlier, the distance to urban centers is a major factor in beach litter amount. The distance of a beach from a population center is a major factor influencing the quantity of litter on a beach (Willoughby *et al.*, 1997; Cho, 2005; Oigman-Pszczol, 2007; Martinez Ribes *et al.*, 2007). The distance to a tourist center is also a major factor (Santos, 2005). In Brazil as well as the UK, most beach litter derives from beachgoer activities and recreational boats (Willoughby *et al.*, 1997; Oigman-Pszczol and Creed, 2007). Which of these factors influences a particular beach more is generally dependent on the specific properties of the beach in question.

The relative abundance and origin of beach litter can change seasonally. In fact, in Brazil, beach litter in the summer is entirely tourist derived, whereas in the winter, when there are no tourists, beach litter is fishing derived (Santos, 2005).

The volume of people using beach resources and the intensity of this use is often a key determinant of litter volume (Backhurst and Cole, 2000; Sun and Walsh, 1998).

In Brazil, it was found that the amount of litter generated in all areas increased with the number of tourists and litter generation was highest on the weekends (Santos, 2005; Oigman-Pszczol and Creed, 2007). In the Balearic Islands, beach litter abundance was shown to parallel hotel occupation, a measure of tourist activity and beach usage (Martinez-Ribes *et al.*, 2007).

Beach litter composition depends greatly on the habits of locals and tourists. Social attitudes and behaviors of beach users are a predominant influence on the composition of beach litter (Oigman-Pszczol and Creed, 2007). The level of education also influences beach litter generation. In the UK, litter generation per person was much lower than in Indonesia because of local knowledge of the effects of litter (Willoughby *et al.*, 1997). There is also a socioeconomic component to the type of beach litter (Oigman-Pszczol and Creed, 2007; Santos *et al.*, 2005). Between two adjacent beaches studied, litter generation was higher at the beach with lower income and education for any density of people (Santos *et al.*, 2005).

Beach litter is also a function of physical factors such as “beach dynamics, oceanic circulation patterns, weather, and debris characteristics” (Oigman-Pszczol and Creed, 2007). Currents strongly affect the deposition of marine debris on beaches. In Japan, marine debris is more dense in southern Japan than in the north, due to differences in the current patterns (Shiomoto and Kameda, 2005). The windward shores of beaches generally have higher levels of marine debris pollution than the leeward side (Gregory, 1999). The effects of El Nino have been found to also greatly increase marine debris accumulation patterns (Morishige, 2007). Additionally, larger beach widths and dense vegetation retain beach litter more effectively, which results in higher densities (de Araujo and da Costa, 2007). Beaches that are composed of pebbles as opposed to sand are more likely to accumulate small litter as it can easily fall deep into the substrate, and these beaches are also impossible to clean mechanically (Martinez-Ribes *et al.*, 2007).

3.4 What actions have been proposed to mediate the relationship between brokers, tourists, and locals and the environment?

The consequences of beach litter on brokers, locals, and tourists alike will provoke action on behalf of each of the groups which will impact the others. Beach litter and marine debris reduction requires three steps: “first to identify the sources of waste, second to identify practical alternatives, then third to implement them” (Topping, 2000). However, because there are so many possible courses of action, only a few of the most commonly recommended ones are described here, along with the ‘typical’ relationship between brokers, locals, and tourists that the method represents. It is important to remember that there is no panacea; although each planning or policy process has been found to work in some locations, the specific conditions and institutions of a region will determine the end result (Hall, 2001).

3.4.1 Clean-up initiatives (often broker or local organized, all can participate)

Beach clean-up programs are often used to improve the aesthetic appearance of beaches. However, although necessary, simply collecting litter is not only expensive, but ineffective and only a stop-gap reactive measure (Santos *et al.*, 2005; Oigman-Pszczol and Clark, 2007). Community led beach clean ups focus only on larger more visible debris and do not always produce statistically significant declines in beach litter (Oigman-Pszczol and Clark, 2007). Repeated intensive beach cleanings are necessary to maintain acceptable aesthetic standards, and even these measures will not remove small litter particles (Somerville *et al.*, 2003). Furthermore, cleared beaches regain beach litter at an alarming rate, even if the only source is from ocean transport. A beach in Panama took only three months to regain 50% of the original beach litter load (Derraik, 2002). The disposal on land of litter removed from beaches is also a consideration, as it can be hard to incinerate and quite heavy (Cho, 2005).

3.4.2 Educational mitigation (brokers → locals and tourists)

Because of the inefficiency and the high cost of beach cleaning, measures that prevent litter are likely to be more effective in the long run. Locals, in conjunction with private and public brokers as well as tourists, should instead work to reduce the amount of litter entering the beach ecosystem (Oigman_Pszczol and Clark, 2007). That is not to say that beach and marine debris removal programs are not necessary. These measures are useful in removing waste that has already accumulated, or that accumulates as a result of outside forces.

To progress beach litter and marine debris control policy it is necessary to identify the main sources of pollution (Williams *et al.*, 2002). With the source of pollution identified, those actors contributing to beach litter and marine debris can be identified and targeted with education (Williams *et al.*, 2002). Beach and port authorities could also use this information to create legislation and action plans to prevent pollution in their jurisdictions (Williams *et al.*, 2002).

Tourist education has been proposed by many researchers as a method to reduce litter generation, and some even suggest that it should form the basis of a beach litter and marine debris management program (Priskin, 2003; Santos *et al.*, 2005). It is argued that education will have long-term effects, especially if children are targeted in volunteer beach clean-ups to encourage life-long litter responsibility through education (Santos *et al.*, 2005; Derraik, 2002). Most importantly, education needs to address the 'throw away' mentality of today's society (Ballance, 2000).

Tourists, especially those who feel that they are part of the problem, or have lower levels of environmental education, are often very receptive to beach litter and marine debris education (Priskin, 2003). Education should also be targeted at socio-economic groups that

are more likely to pollute, such as those with lower incomes and education levels (Santos *et al.*, 2005). Those tourists who are most interested in learning about beach litter and marine debris problems likely are already knowledgeable about environmental problems (Priskin, 201, 2003). However, they may not know exactly how their actions are impacting the environment they are visiting and improvements to their behavior could certainly be made (Priskin, 2003).

Littering is acceptable behavior in many communities, and since these activities are a major source of marine debris, these attitudes need to be changed (Topping, 2000). Communities could develop programs that work with people's natural tendencies in order to manipulate and change them for the better (Topping, 2000). Most locals and tourists will resist solutions that require extra effort; therefore it is imperative that solutions be tailored with convenience in mind. Incentives, financial or otherwise, will also influence people to act in a manner that reduces marine debris (Topping, 2000). Beachgoers may contribute to marine litter mainly because there are poor disposal practices, and recommend that communities act to enforce environmental protection and management policies (Oigman-Pszczol and Creed, 2007). These actions would require public brokers, in conjunction with locals and private brokers, to institute guidelines suggesting the placement of garbage cans, signs or programs explaining the importance of preventing litter to tourists.

Distributing plastic bags for waste collection or pamphlets that describe the detrimental effects of littering, however, have been found to be counterproductive. These items which are meant to prevent litter often become litter themselves, only increasing litter generation by beachgoers (Santos *et al.*, 2005).

3.4.3 Grading systems (public brokers/NGOs → private brokers)

In the UK, the National Aquatic Litter Group (NALG) has proposed a beach grading system, which they believe would help with public awareness and beach management (Somerville *et al.*, 2003). This system would require regular surveys of beach litter, the result of which is an A-D letter grade for the beach (Somerville *et al.*, 2003). The hope is that this system will be easier for the general public to understand, and therefore have more meaning and educational value (Somerville *et al.*, 2003). It is also thought that having a grade posted at a beach will lead to more responsible beachgoers and less beach litter generation (Somerville *et al.*, 2003). Furthermore, because of the specifics of the grading protocol, this system also has the potential to aid management in identifying the sources of beach litter and therefore targeting problem groups specifically, as well as evaluate the progress of management plans (Somerville *et al.*, 2003).

3.4.4 Economic methods (public broker → brokers, locals, and tourists)

Local governments within a region will need to work with each other in order to reduce marine debris. For example, marine debris can originate on land, and wash into

the marine system. In Korea, local governments have set up a program in which marine debris generating inland communities help pay the clean-up costs for coastal communities to remove and dispose of marine debris (Cho, 2005).

Additionally, it is necessary to remove derelict fishing gear because it can entangle local fishermen's nets and compound the problem (Cho, 2005). To this end, Incheon City in Korea has implemented a program that financially rewards local fishermen who retrieve and turn in marine debris collected during fishing (Cho, 2005). Although somewhat slow to catch on, this program has resulted in reduced marine debris and cost savings for the local government, who pay the fishermen a fraction of what it would cost the government to collect the debris (Cho, 2005). Governments will also need to make sure that their waste disposal policies account for the disposal of marine debris collected by local governments and fishermen (Cho, 2005).

3.4.5 Other methods (various)

Non-Governmental Organizations (NGOs) have been found to be of varying importance in the control and amelioration of beach litter and marine debris. In Goa, India, it was found that the involvement of NGOs was crucial in guiding the socioeconomic development, and keeping the harmful effects of coastal tourism development in check (Hall, 2001). In many other locations, however, NGOs have made only a minimal contribution (Hall, 2001).

Storm water runoff, sewage overflow, and landfill run-off is another vector by which beaches are polluted. There are a few factors at work in these situations, controlled mainly by the actions of locals and public brokers. Locals (and to some extent tourists) are responsible for littering in municipal streets – in these cases, tactics similar to those used to educate tourists about beach litter should be used. Public brokers are responsible for faults in sewage systems as well as poor landfill placement, which cause waste to runoff into coastal environments. In these cases public brokers must regulate themselves to create and enforce legislation regulating the construction and maintenance of sewer systems and landfill placement.

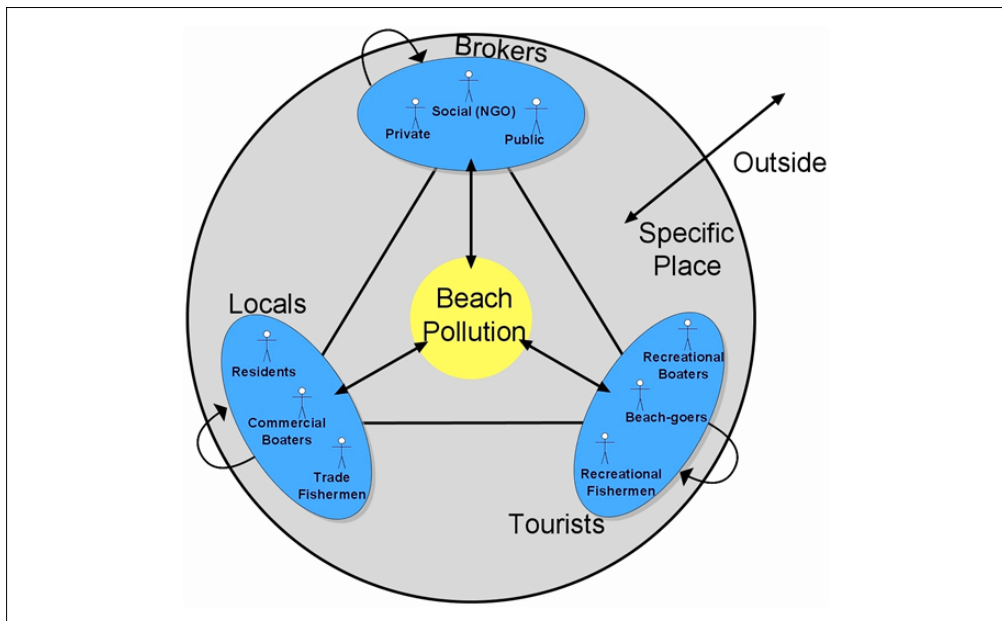
Locals and public brokers will also need to regulate or otherwise encourage private brokers to reduce their litter generation. Using marine debris source information, specific legislation could be created to attempt to address the specific actors contributing to pollution (Williams *et al.*, 2002). For example, a local government may implement standards that hotels will have to abide by to reduce the amount of sewage waste they contribute, or implement fines and enforcement for tourists found discarding waste on beaches.

Because of ocean currents, there is often an international component to marine debris and beach litter (Cho, 2005). In Japan, for example, 38% of litter found on one beach originated in Korea (Cho, 2005). Although international concerns are really outside the scope of this study, they are worth mention as public brokers will have to work with

their counterparts across county and country borders to effectively target beach litter and marine debris. MARPOL Annex V, a treaty which seeks to control and reduce marine debris generated by ships, is such an example of international cooperation.

4. The conceptual model

There are three main components to the conceptual model (Figure 2). First, Miller and Auyong’s Broker-Local-Tourist model provides the underlying framework of human interactions (Miller *et al.*, 1999).



Notes: The place-based tourism model, which depicts the interactions between brokers, locals, tourists and the central element, here beach pollution, in the context of a specific place, in this case a beach.

Figure 2. The place-based tourism model

The broker, local, and tourist groups are shown in the blue ovals. Within each of these groups, sub-groups have been identified based upon the patterns found in the literature review. These sub-groups are represented by the labeled stick figures located within each of the blue group ovals. The broker group has been broken down into Miller and Auyong’s categories of public, private, and social or NGO brokers (Miller *et al.*, 1999). These sub-groups are closely tied to different aspects and interactions with beach litter and marine debris. The local group has been divided into residents, commercial boaters,

and trade fishermen (those who derive significant portions of their income from fishing) according to their different interactions with beach litter and marine debris found in the literature review. The tourist group has similarly been divided into beach-goers, recreational boaters, and recreational fishermen, again according to their different interactions with beach litter and marine debris.

The broker, local, and tourist groups interact both with each other and within the group (Miller *et al.*, 1999). This is indicated by the triangular connections between each of these groups, and the u-shaped self-loops associated with each group. These interactions can take many forms. For example, within the broker category, a public sector broker (local legislature) may regulate private sector brokers (beachfront hotel owners). An example of between group interactions includes private sector brokers (hotel owners) acting to educate tourists (beach-goers). Many of these are discussed in the literature review.

The second component of the model is the central element, beach litter and marine debris, which is shown in the yellow circle. The double-headed arrows connecting the groups of the broker-local-tourist model with the central element represent both the contributions to beach litter and marine debris and the impacts that this pollution has on each of the three groups. These arrows should be seen to connect both the group as a whole and each subgroup to the central element in this way. The double-headed arrow connecting the local group is indicative of how all groups of locals contribute to beach litter and marine debris and are also affected by it.

Third, the interactions described above take place in the context of a specific place. The large grey circle represents a specific place, and encompasses all of the interactions between the components of the BLT model and the central element that happen in this specific place. Here the specific place is a beach, or a series of adjacent beaches, however other places could also be explored through this model. Factors unique to a place that affect beach pollution are described in the literature review.

Anything outside of the specific place is here referred to as the 'outside.' This is represented by the white space outside of the grey specific place circle. However, this outside region still influences the interactions between elements of the BLT model and the central element in the specific place, as indicated by the double-headed arrow. As an example, the state or federal government could pass laws that limit the ways in which public brokers can regulate private brokers.

This model could easily be extended to describe many other interactions types between the tourism BLT components and a place. By simply changing the specific place of study, large shifts in the pattern of interactions between components of the BLT model and the central element can occur along with shifts in the division of sub-groups in the BLT model. Furthermore, by changing the central element— perhaps instead of using beach pollution, another form of pollution or a management action such as zoning could be used – the entire context of the model changes.

5. Conclusion and future directions

Interactions between the various factors of the nature-based tourism paradox are complex. The model developed here from the literature attempts to describe the interactions in terms of the links between components of the Broker-Local-Tourist model and beach litter and marine debris.

Brokers, locals, and tourists all make significant contributions to beach litter and marine debris, either directly or indirectly. Each broker, local, and tourist type contributes in different ways and degrees. Typically private brokers contribute through construction debris, hotel sewage waste, and recreational boating waste. Public brokers are often ultimately responsible for contributions from storm water and sewage overflows, as well as waste resulting from poor planning and legislation. The effects of NGO brokers have not been adequately studied. Locals contribute to beach litter and marine debris in two main ways, first through garbage and sewage waste that washes into nearby water bodies, and second through the solid waste and fishing gear discards of local fishermen. Tourists are often a major contributor to beach litter, both through littering directly on the beaches and because of the waste that results from recreational boating and fishing. The effects of these groups on beach pollution are often mediated by beach usage, socio-economic factors, geographic proximity to urban and tourist areas, and the physical properties of the beach.

In turn, beach litter and marine debris have various effects on brokers, locals, and tourists. Although it is possible that some of these effects could be positive, the literature thus far has only detailed the negative effects on brokers, locals, and tourists. Private brokers often see reduced tourism revenue resulting from polluted beaches and marine areas, and are often forced to conduct expensive beach clean-up efforts. Public brokers also have to pay for these clean-up efforts on municipal beaches and in local waters. Again, the effect on NGO brokers has not been adequately studied. Locals are harmed by beach litter and marine debris in many ways. In locations where local economies are highly dependent on tourism revenue, depressions can occur if tourism numbers fall off due to polluted beaches. Local fishermen can be harmed when marine debris negatively impacts important fish stocks. Local fishermen and boaters are also harmed if marine debris causes damage to boat propellers or engines. Beach litter and marine debris has also been shown to negatively impact human health. Tourists who visit polluted beaches are likely to have a poor experience and reduced enjoyment, and recreational boaters and fishers face problems similar to local boaters and fishermen.

Brokers, locals, and tourists have made some attempts to ameliorate the negative impacts of beach litter and marine debris. Beach clean-ups have often been used to reduce the visibility of beach litter; however these measures are expensive, of questionable value,

and reactionary. They are, however, necessary to reduce the amount of beach litter and marine debris already present in the environment. More proactive measures that have been proposed include education and economic incentives.

This study is not exhaustive, as it does not explore all the aspects of interaction between people and place, but only those presented in the literature. However, this is the first step to understanding the linkages between beach tourists and beach pollution, and subsequently the nature-based tourism paradox. Although imperfect, the proposed model has attempted to bring together the forms of interaction described in the literature, building on Miller and Auyong's Broker-Local-Tourist model (Miller *et al.*, 1999) in a straightforward and adaptive manner.

Further research into the issue of a tourism paradox should be directed at first at examining areas where interactions are largely unknown, such as with NGO brokers. This information will allow for a more complete assessment of "how the various factors [of the nature-based tourism paradox] interact with each other" (Hillery *et al.*, 2001). In addition, the causality of these interactions will need to be examined. This is likely to be a difficult and elusive task.

In order to address beach litter and marine debris, studies and monitoring programs need to be implemented to determine the sources of pollution. Alongside these beach litter and marine debris studies and monitoring programs, the interaction framework detailed in this paper can be used to create effective preventative measures. For example, if it is found that private brokers are the main contributor to pollution, it will be understood that private brokers can implement enforcement measures to control this source of pollution, and can work with NGO brokers to educate private brokers about the consequences of their actions. This framework can also be used to allow for the mitigation of harmful impacts of beach litter and marine debris on brokers, locals, and tourists. If, for example, local fishermen are suffering significant harm from the pollution caused by private brokers, they could be required by public brokers to pay for the damages caused to local fishermen. It is in drawing these connections between brokers, locals, tourists, and their contributions to and detriments caused by beach litter and marine debris that the framework developed here is most valuable.

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