Beauty and the Beasts: Beaches, Litter, Debris, and People

(Beach Valuation and Public Perceptions of Marine Debris)

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Abstract

Marine debris and beach litter pose serious threats to the environment and coastal economies. This project examined the economic ramifications of marine debris and the public's willingness to participate in mitigation. The specific objectives were to analyze the economic value of having a clean beach and to ask: why do people litter? This was accomplished first by collecting and summarizing existing research regarding the state of marine debris and the value of beaches in California. This information shaped a case study, which employed a survey tool to: (1) perform a contingent valuation to quantify the willingness of beach-goers to take part in cleaning the beach as measured by their willingness to financially contribute to this goal and (2) ask questions meant to uncover some of the social issues associated with marine debris, such as why people litter at all. Armed with the knowledge of the value of a clean beach to the public, one can identify an efficient level of cleanup and maximize the net value of beaches to society. This information can also be used to identify whether litter is best managed at the source, or once it has made it into the environment. Of the 76 people surveyed, 60.5% were willing to pay a fee of at least $1 to go toward a cleanup effort. In addition, survey responses indicated that the top reason people litter is a lack of caring/respect. Improving the efficiency of marine debris management, whether economically or socially, can save money and more importantly help protect the ocean.

Preface

I have always passionately believed in conservation and the protection of marine life. Through my work at a large aquarium over the past several years I have worked to educate the public about many pressing ocean issues. My desire to broaden my knowledge base and gain a better understanding of the many tools available for marine conservation brought me to the Center for Marine Biodiversity and Conservation. For this Capstone, I chose a topic of interest and concern – marine debris – and examined the issue through the new lenses of economics, policy/law and judgment/decision-making.

Broadly, this project examined the economic ramifications of marine debris and the public's accountability and willingness to participate in mitigation. The specific objectives were to analyze the economic value of having a clean beach and to ask: why do people litter? This was accomplished first, through collecting and summarizing existing research regarding the state of marine debris and the value of beaches in California. Second, I conducted in-person surveys at a local beach and used this as a case study for how marine debris might affect beach economies. The survey assessment included: (1) a contingent valuation study to quantify the willingness of beach-goers to take part in cleaning the beach as measured by their willingness to financially contribute to this goal and (2) questions to examine some of the social issues associated with marine debris such as why people litter at all. Ultimately, increased knowledge of the economics of marine debris and the public's motivations as they relate to marine debris may lead to improved and diversified strategies to limit and stop the flow of trash into the ocean.

Problem Statement

Beaches are an iconic symbol of California. The sand, waves and great weather make for a classic California day. Unfortunately, pollution, and in particular marine debris, taints this pretty picture. Marine debris and beach litter are not only ugly and visible reminders of humanity's impact on the marine environment, but they pose serious threats to both this environment and coastal economies (CA OPC, 2007).

There are many programs and laws designed to manage trash, but there is great potential for improvement. Coastal areas are visited frequently and thus are extremely valuable to local, state

and national economies. It is this value that motivates coastal cities to maintain their beaches, however, despite costly efforts to mitigate marine debris, trash still ends up on beaches. This begs one to ask: is cleanup sufficient? Is cleanup efficient?

One way to answer these questions is to take a look at the value the public places on having a clean beach. Armed with this knowledge, one can identify an efficient level of cleanup to maximize the net value of beaches to society. This information can also be used to identify whether litter is best managed at the source, or once it has made it into the environment.

Ultimately, debris is a result of human activity. While debris can enter the environment via wind and storms, the source is an individual who mishandled the debris either intentionally or unintentionally causing it to end up on beaches or in the ocean. For this reason, it is important to explore beach-goers' motivations for and perceptions of littering. Improving the efficiency of marine debris management, whether economically or socially, can save money and more importantly help protect the ocean.

Background

The laws

There are many laws and programs in place to manage marine debris. In 1987, the US ratified Annex V of the International Convention for the Prevention of Pollution from Ships (MARPOL). This law prohibits at-sea disposal of plastic waste and mandates that ships be a certain distance from shore when dumping solid wastes. In 1998, Congress extended the dumping regulations in Annex V to all navigable waterways in the nation with the Marine Plastic Pollution Research and Control Act (MPPRCA).

The U.S. Environmental Protection Agency (US EPA) Office of Water monitors and manages land-based pollution found on beaches and waterways. In 1990 Congress authorized the EPA to assess the effectiveness of marine debris legislation and other methods to control debris. This eventually led to the creation of the National Marine Debris Monitoring Program (NMDMP), a collaboration of the US EPA, the Ocean Conservancy and the National Oceanic and Atmospheric Administration (NOAA). Despite all these efforts and more, marine debris persists.

The trash

Marine debris is defined as "any manufactured or processed waste material that enters the ocean environment from any source" (Coe & Rodgers, 1997). In 1975, the National Academy of Sciences estimated 6.4 million tons of debris were discarded into the world's oceans annually, a figure believed to have increased in the subsequent years (Gordon & CACC, 2006). While some of this debris comes from ocean-based sources such as cargo or fishing boats, a staggering 80% of marine debris is estimated to come from land-based sources (UNEP, 1995; Ocean Conservancy, 2007).

This threat to marine life is found in every ocean of the world. Ingestion of or entrapment and entanglement in marine debris kills and harms great numbers of sea birds, marine mammals, and other sea life annually, including many of which are threatened or endangered (UNEP, 1995). In addition to threatening wildlife, marine debris, or the pollution associated with it, destroys habitats, impairs vessels, threatens human health and is a strain on the economy (Ocean Conservancy, 2007).

As the oft-seen slogan "all drains lead to the ocean" suggests, large amounts of trash can reach the ocean via stormwater drainage. Much of the litter that is intentionally or unintentionally discarded into watershed drainage areas ends up on beaches and in the water (LA, 2001). The shoreline acts as an interface between land and sea. Beaches thus become for marine debris both a source – in the form of discarded trash, which is transported into the ocean via runoff and wind – and a sink, in the form of marine debris that washes ashore. To confound the issue further, in addition to what washes up on shore and what is introduced from the surrounding watershed, a large percentage of beach debris can come from beach-goers themselves.

The NMDMP conducted a 5-year study from 2001-2006 to identify the type and quantity of marine debris on beaches. This study, funded by the US EPA, monitored debris in 21 coastal states, islands and territories and found that 48.8% of the debris found on coastlines came from land-based sources, followed by 33.4% general source debris and 17.7% ocean based-debris (Ocean Conservancy, 2007). Table 1, adapted from the NMDMP Report, only shows the top three items per source although many more items were counted. Notably, the top three items

found overall were plastic straws, plastic beverage bottles and plastic bags, all of which have the potential to be recycled.

Table 1: Most common marine debris items found on beached by source and type, adapted from the National Marine Debris Monitoring Program Report, 2007

DEBRIS ITEM	PERCENT OF TOTAL
Ocean Based Sources	
Rope > 1 meter	5.50%
Fishing Line	3.40%
Floats/Buoys	1.50%
Land Based Sources	
Plastic Straws	27.50%
Balloons	7.80%
Metal Beverage Cans	7.40%
General Sources	
Plastic Beverage Bottles	13.00%
Plastic Bags < 1 meter	9.00%
Plastic food bottles	3.50%

Plastic and other synthetic materials have gained attention in recent years because they can persist in the ocean for a long time (Gordon & CACC, 2006). It is feared that small pieces of plastic suspended in the water column may be creating a flux of harmful chemicals to the ocean that can bioaccumulate in food webs, but a strong understanding of these impacts is lacking (Derraik, 2002).

The numbers

Annually, Americans make nearly 2 billion visits to beaches in the U.S. according to the Clean Beaches Council (as cited by Houston, 2002). In 2005, the National Ocean Economics program (NOEP) released a study that ranked California's ocean economy number one in the nation (Kildow & Colgan, 2005). At $1.15 trillion per year, California's ocean economy makes up 19% of the total US coastal economy (Kildow & Colgan, 2005). This estimate includes a wide range of economic activity including employment and gross state product (GSP). Yet, marine debris

and terrestrial trash still litter the beaches up and down the coast of California, beaches that have an estimated value of $5 billon for market and nonmarket values combined (Kildow & Colgan, 2005).

For an economy that benefits so greatly from beach visitation, littered beaches are becoming an increasing threat. Current beach cleanup activities are costly, revealed by the fact that enough waste was collected from six miles of beach to fill 10 garbage trucks every week for a summer, all at a cost of $350,000 (CACC, 2008, ¶3). As it stands, a conservative estimate of the cleanup costs associated with illegally dumped terrestrial trash in the state of California is $200 million/year (KCB, n.d.). What would a loss of beach visitation, due to litter, cost a beach community per day, per season or even annually?

Case Study: Moonlight Beach

I used Moonlight Beach in Encinitas, CA as a case study for an economic assessment of the value of a clean beach. The goal was to gain insights into how marine debris might affect a local beach economy. Moonlight is a popular and well-maintained beach with a variety of amenities including bathroom facilities, free parking, volleyball courts, a children's playground and a lifeguard station. The beach, one of 6 in the city, is state-owned but managed and maintained by the City of Encinitas. In 2006 the city's beaches were estimated to have an economic value of $59 million for market and nonmarket values combined* (City of Encinitas, 2008). Moonlight draws large crowds and had an estimated 639,744 visitors in 2007 ** (City of Encinitas, 2008; Appendix A). According to the City of Encinitas, Moonlight Beach has an approximate value of $58,000 per summer day. Presumably, this value is a potential loss if the beach is closed or visitation drops as a result of litter.

Like all cities in the state of California, the City of Encinitas must ensure that water run-off into the ocean has been cleaned of trash and harmful pollutants. In 1999, San Diego Coastkeeper sued

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* The city hired economist Dr. Philip King from SFSU to estimate the value of beaches in the City of Encinitas in 2006. His evaluation coupled with information from the Army Corps of Engineers was used to value a typical day at the beach for a typical beach-goer.

** In 2003, the City of Encinitas began a program to count beach attendance using laser counters across beach access points in the city. This was to supplement the more standard but less accurate counting technique by lifeguards in the city. Total visitation to all beaches in Encinitas was estimated to be 2.9 million visitors.

the city because of its lack of a clean water plan (San Diego Coastkeeper, 2008, ¶1). According to the State Regional Water Quality Control Board, cities in California can be fined up to $10,000 per day per violation if they do not comply with Clean Water Act regulations (as cited by Encinitas Clean Water Program Clean Water Q&A, 2008). Statewide, laws mandate bathing water and public notification standards as well as protocols for identifying sources of fecal indicator bacteria at high-use beaches impacted by flowing stormdrains, such as Moonlight Beach (Heal the Bay, 2008, ¶1).

Cottonwood Creek collects run-off from the watershed of Encinitas and empties into the ocean at Moonlight Beach. As a result of the pollution collected from the watershed, the water at the beach was receiving failing grades from Heal the Bay (Appendix B), a leader in water quality monitoring. In 2000, the city had to post warning signs 93 times because of poor water quality. Thus, in 2002, the city installed an $815,000 UV water treatment plant at Moonlight Beach, which has an annual operating cost of $30,000. The treatment facility has been successful at cleaning 99.9% of the pathogenic bacteria and viruses from the water that were previously shown to cause a variety of ailments from eye and respiratory infections to rashes (Encinitas Clean Water Program UV treatment presentation, n.d.).

In addition to the UV Treatment Plant, the City of Encinitas employs other methods to keep the run-off clean, including stormdrain and beach maintenance. They have a large vacuum that flushes and cleans sewer and stormdrain lines, cameras that capture moving pictures of debris in pipes and they pick up trash on the beaches and streets. In one year, city crews collected a total of 355 tons of trash from both the underground and aboveground stormdrain system and an additional 11,575 bags of trash from around the city (Encinitas Clean Water Program Clean Water Q&A, n.d.). All of these methods are part of the city's Clean Water Program, which is currently funded by the city's general fund. According to the City of Encinitas' Jurisdictional Urban Runoff Management Program's (JURMP) 2006-2007 Annual Report, maintenance and cleanup costs associated with the Clean Water Program are estimated to be $1.2 million per year (City of Encinitas, 2008).

Focus of Study

While it is clear that the estimated value of the beaches in the City of Encinitas outweighs the cost of maintaining them, I still wanted to know: (1) how much the beach visitors value having a clean beach and (2) their level of concern as evidenced by their willingness to participate in the cleanup effort.

Survey Creation and Questions

I created a contingent valuation survey to assess the value of a clean beach and included questions aimed at identifying beach-goers perceptions of marine debris (Appendix C). In general, I wanted to ask of Moonlight beach-goers: is beach litter a serious issue? Who should pay for the cleanup? The survey I conducted was a proof-of-concepts study designed to evaluate the feasibility and need for a larger contingent valuation study to measure the public's value of clean beaches.

Prior to conducting the surveys permission was granted by UCSD's Institutional Review Board (IRB), which was required because the study involved human subjects (Appendix C).

Survey – Contingent Valuation (CV)

Various economic methods are used to place value on commodities. For a commodity such as a clean beach, there is no direct market value to associate with it and so survey techniques, including contingent valuation (CV) have been created to get at these values. According to Carson (1999) "CV is usually the only feasible method for including passive use considerations in an economic analysis." In this study, CV was used to assess beach-goers willingness to pay for beach cleanup as it can be used to calculate the overall value that visitors place on having a clean beach. An additional benefit is that willingness to pay can generally indicate the public's willingness to participate in cleanup.

The CV question in this study presented respondents with a couple of options. They were shown a picture of a clean beach and a picture of a dirty beach (Appendix D). Both photos were staged so that the main difference between them was the presence or absence of trash. When presented with the scenario that described beaches in Encinitas as looking like the dirty picture, they were asked their willingness to pay a $2 fee for each beach visit knowing that the funds would go

toward a cleanup effort that would get the beach to the level of cleanliness shown in the clean picture. If they were willing to pay $2, respondents were asked if they would be willing to pay $3. If they were not willing to pay $2, respondents were asked if they would be willing to pay $1. Finally, if the respondent was not willing to pay $1, they were asked if they would visit another beach with no fee or do another activity.

Survey – Why Litter

The final question on the survey was designed to explore the motivations behind littering. Behavioral research and the science behind why people make certain decisions is not a new field, however, it was not until recently that the field has expanded to include environmental decision-making.

Respondents were asked why they believe some people continue to make choices, such as littering on a beach, that cause harm to the environment. Their answers were coded and categorized to get a sense of the frequency of certain answers, which might unveil some of the personal motivations behind the choice to litter or not and ultimately the choice to protect the environment.

Survey Methods

The survey involved in-person surveys conducted at Moonlight Beach in Encinitas, CA. Surveys were conducted from the same spot at Moonlight Beach – at the end of a path to the beach from the main parking lot. It was assumed that soliciting every 5th person passing the survey spot would provide a sample population representative of (in terms of age, ethnicity, size of group) the population of beach-goers at Moonlight Beach.

Due to time constraints, three other students assisted in conducting surveys. Each student was given a script to follow for approaching respondents in order to reduce biases (Appendix C). Surveyors solicited subjects as they were arriving at or leaving Moonlight Beach and asked if they would be willing to participate in a short survey regarding beaches. Upon receiving consent, surveyors provided the respondent with the survey, which was filled out by the respondent. All subjects asked to participate were 18 or older and the survey took no more than 5 minutes of the participant's time to complete.

Surveys were conducted on a random sample of weekends and weekdays at a random sample of times over a period of about 3 weeks. The randomness was directly tied to my (or my student assistant's) ability to get to the beach. Ideally, I would have generated a random sample of days and times. Additionally, it would be important to control for differing weather*, beach conditions**, times of day, days of the week, etc. as these factors could influence survey responses.

Results

76 surveys were collected from 4/20/08 – 5/12/08 on 5 weekdays and 4 weekend days. Survey times on both weekdays and weekends included AM periods (9AM – noon) and PM periods (noon – 6PM).

Demographics and Perceptions

The majority of those surveyed live in Encinitas or within 20-miles of the city. Most of them visit the beach 2-3x/week or more in both winter and summer months and nearly all agreed that beach litter is a serious issue. (Figures 1-3)

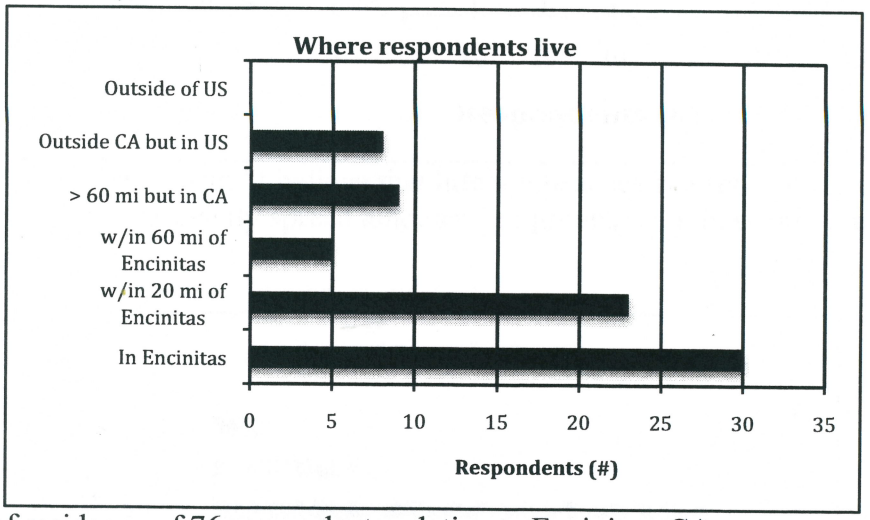

Figure 1: City of residence of 76 respondents relative to Encinitas, CA.

* Weather was recorded using information provided by NOAA's NCDC.

** Beach condition was chosen from a preset number of categories created from prior observations of beach conditions at Moonlight Beach in Encinitas:

- Extremely dirty (trashcans overflowing, many large pieces of trash on ground)
- Dirty (trashcans full, a few large pieces of trash on ground)
- Clean (trashcans not full, a few small pieces of trash on ground)
- Extremely Clean (trashcans mostly empty, no visible pieces of trash on ground)

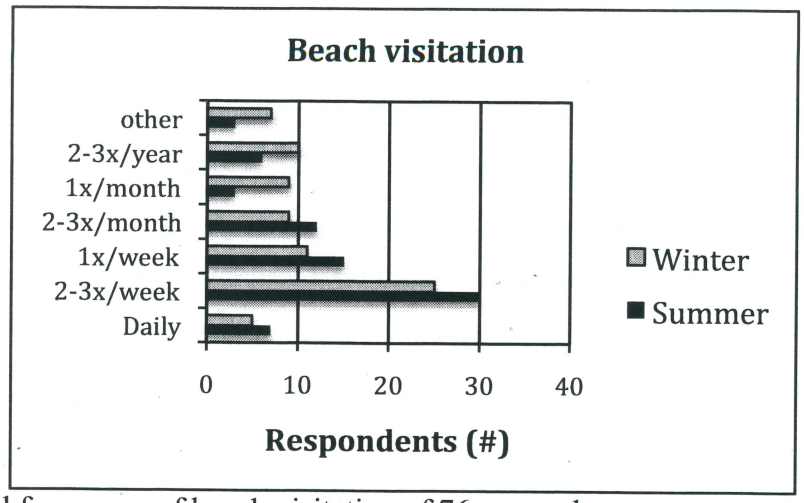

Figure 2: Seasonal frequency of beach visitation of 76 respondents.

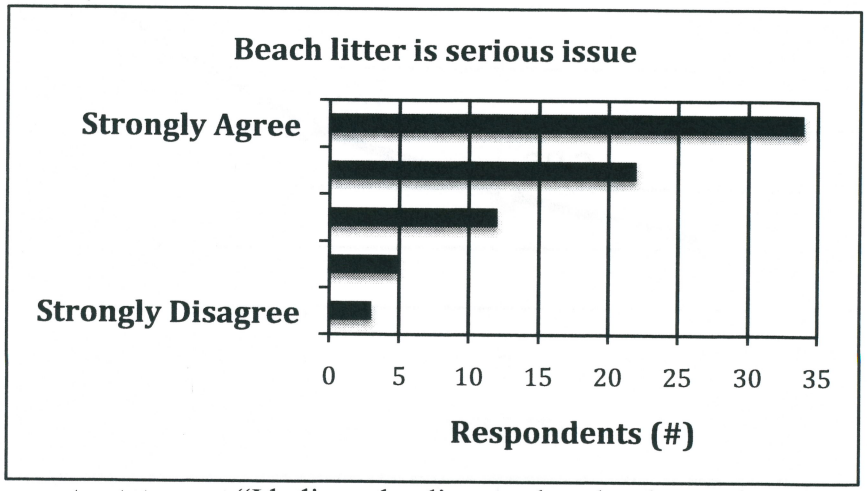

Figure 3: Responses to statement "I believe that litter on beaches is a serious problem."

The age of respondents was evenly spread amongst age groups with those 60+ represented the least. (Figure 4)

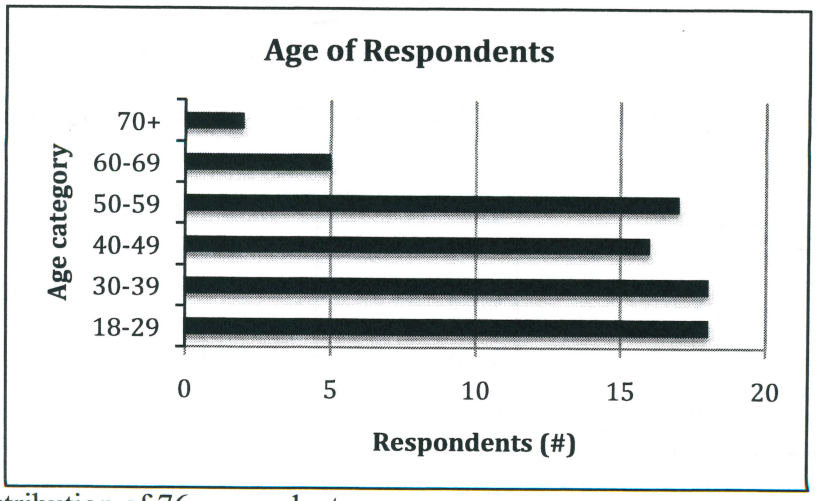

Figure 4: Age distribution of 76 respondents.

Willingness to Pay

Overall, less than half of the respondents, 38.2%, were willing to pay the $2 dollar fee as presented. 60.5% of all respondents were willing to pay at least a $1 fee. Of those willing to pay a $2 fee, 58% were willing to pay $3 and these respondents represented 22.4% of the total number of individuals surveyed (Figure 5). Of those respondents not willing to pay $1 to go to Moonlight Beach, 66.7% responded that they would go to another beach, 13.3% would do another activity, 6.7% would do either and 13.3% did not respond.

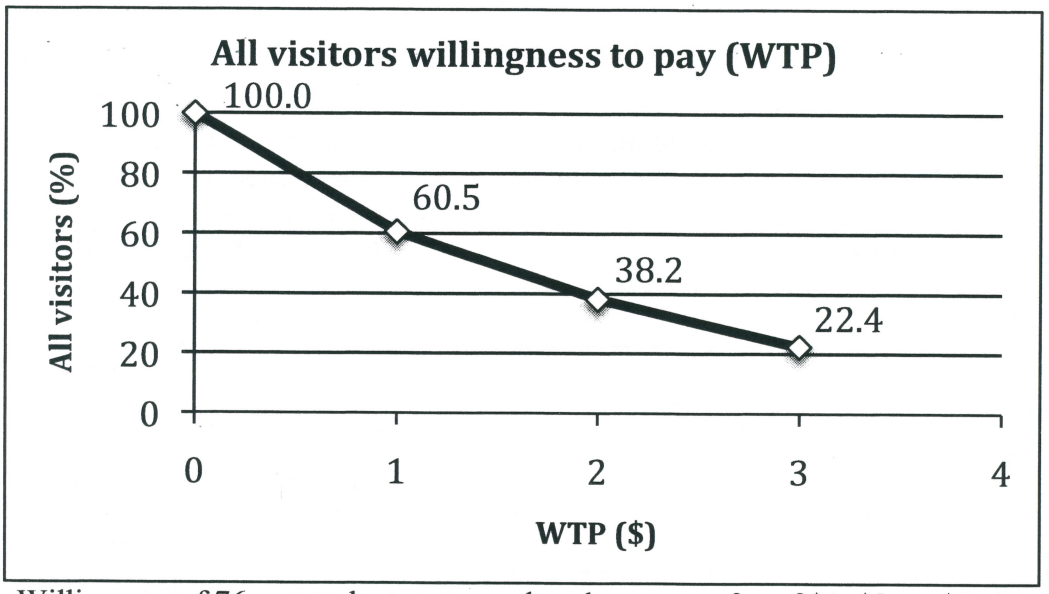

Figure 5: Willingness of 76 respondents to pay a beach entrance fee of $1, $2, or $3. (Note: At $0 it is assumed that 100% of respondents are willing to pay $0 or more since currently there is no fee. At $1, 60.5% of respondents are willing to pay at least $1 or more. At $2, 38.2% of respondents are willing to pay $2 or more. At $3, 22.4% of respondents are willing to pay $3.)

I compared the demographic data with the WTP data and found that those who visit the beach frequently and those who live in Encinitas are less likely to pay the fee (Table 2 and Table 3).

Table 2: Beach visitation frequency and WTP

%	wtp $1	wtp $2	wtp $3
visit 2-3x/week	45.9	18.9	10.8
visit 2-3x/month	66.7	44.4	25.9
visit 2-3x/year	100.0	88.9	44.4

Table 3: Encinitas vs. non-Encinitas residents and WTP.

%	wtp $1	wtp $2	wtp $3
Encinitas Residents	56.7	20	6.67
Non-Encinitas Residents	63.0	50	32.6

Why Litter?

I coded the open-ended responses and identified the categories in Table 4. The reasons most frequently referenced in the responses were a lack of caring/respect, lack of effort and lack of education/knowledge. Other reasons referenced less often in the responses were attention/mindlessness, cultural, not enough trashcans and maturity.

Table 4: Coded open-ended responses to question: "Assuming people care about the environment, why do you believe some people continue to make choices, such as littering on a beach, that cause harm to the environment?"

WHY PEOPLE LITTER	% OF ANSWERS
Lack Caring/Respect	34.2
Lack Effort	32.9
Lack Education/Knowledge	26.3
Lack Attention/Mindlessness	9.2
Cultural	7.9
Not enough trash cans	6.6
Lack of Maturity	5.3

Discussion

WTP Findings

Initially, I believed that those who visit the beach frequently and those that live in Encinitas would "value" a clean beach more and thus be more likely to pay an entrance fee. However, upon examination of the frequency of visitation and respondents' hometown, the opposite appears to be true. It may be the case that for those that visit the beach frequently the thought of having to pay a fee each time they visit can be cost prohibitive and therefore they may be less willing to pay. Since Encinitas residents make up many of the frequent visitors, this may apply to

them as well. In addition, Encinitas residents could additionally believe that their city taxes already support cleanup and thus do not feel they should pay an additional fee.

The WTP responses did show that some respondents were at least interested in participating in the cleanup effort. Since 60.5% of respondents were willing to pay at least $1, it suggests that over half of respondents would financially contribute to mitigating marine debris.

Overall, the information provided by respondents' willingness to pay for cleanup could be used to calculate the value beach-goers at Moonlight Beach get from having a clean beach. Since there is currently no fee, the entire area under the WTP curve represents the surplus value for a clean beach. Further, this value can be used to calculate an efficient level of cleanup so as to maximize the net value of beaches to society.

The calculation for the net surplus value of having a clean beach at Moonlight is not provided in the main section of this paper. Please refer to Appendix F, which provides more detail on using the WTP curve in this survey to calculate the net surplus value of a clean beach.

Survey Limitations

Most of the visitors that were approached were willing to take the survey and the few who declined did so due to time constraints or language limitations. Respondents did show visible relief when it was made clear that I was a student and I believe that I was successful in attaining a high level of participation because of this.

The sample is potentially lacking proportionate representation from the mothers and fathers with young children who use the playground at Moonlight Beach. The station for collection of surveys was just next to the playground and while many of these parents passed by; they were less likely to participate in the survey due to the constraints of having very young children to attend to at that time.

Moonlight Beach was very clean during the time period of the survey and on most days the weather was beautiful. This may have affected the responses. It might be interesting to see how answers would change on crowded summer days with a bit more trash on the sand.

The exercise of using this survey has helped to identify improvements for future surveys. For instance, in the analysis of this survey data, it was recognized that an important question was missing from the questionnaire. In order to determine whether or not trash on a beach would cause visitation to drop, respondents should have been asked if they would stop visiting Moonlight Beach if it began to look like the dirty beach picture. Responses to a question like this might indicate the potential value to be lost if visitation to the beach declines.

Since the fee is hypothetical, there are no consequences for respondents' answers. The initial entrance fee was set at $2 in order to be reasonable and not cost prohibitive. However, it could have been started at $3 and this may have changed the outcome of answers. This is referred to as starting point bias. Also, there may be a belief among respondents that other respondents may be willing to pay and therefore, they do not have to provide a payment – a phenomena called free riding (Goodstein, 2007). If respondents believed their answers would have an effect on a given outcome, they may have strategically answered to control for this. Finally, the survey itself could lead to biases depending on the context in which the questions were provided (Goodstein, 2007). I attempted to reduce these biases by applying methods that have been used in other similar studies.

It is important to note that the choice to visit a beach depends on a variety of factors for beach-goers. The visitors themselves differ from one another by age, ethnicity, income and interests. Timing, weather, cleanliness, amenity options, proximity to home and more play a role in decisions to visit particular beaches on particular days.

Additional Thoughts

Survey responses shed some light on the public's value of clean beaches, their willingness to participate in cleanup and the motivations behind littering. This information can be used to create more effective programs and policies to limit the flow of trash into the ocean.

More often than not, laws and programs meant to reduce marine debris treat the symptoms as opposed to the causes. This leads to the question: what is the more efficient course of action? The answer depends on the context. From an economic perspective, it may be that treating the symptoms is more cost efficient. However, in the case of marine debris, which can be traced

back to individual choices, it is important to consider the options for treating the source. These choices range from the individual who chooses to litter or pick up trash, to the local, state and national governments that choose to enact laws and programs meant to reduce and cleanup waste.

Regarding choices, the City of Encinitas has made a few of interest. First, in the fiscal year 2007-08 the city chose to reduce street sweeping "to meet the minimum requirements of the National Pollutant Discharge Elimination System (NPDES) permit" (City of Encinitas, 2007). This expenditure cut was made to offset other increasing operating costs in the city, despite the fact that it could potentially allow more trash to stay on the streets that could eventually get washed into the ocean. Second, the City of Encinitas contracts with an outside company to clean their beaches. This cleanup occurs in the morning rather than at the end of the day. According to lifeguards, on busy summer and weekend days, cleanup in the evening would be more valuable. This is because the combination of birds and high tides move the litter left by beach-goers on the sand or even in trashcans up and down the beach as well as into the ocean.

In order to treat the cause of marine debris stakeholders at all levels must be responsible for their actions. At the individual level this could be done by instilling a sense of stewardship for the environment that leads to responsible behavior. My survey responses indicated that the number one reason why people litter is a lack of caring/respect. Programs focused on connecting people with the environment, such as outdoor education and neighborhood cleanups, may result in an increase of caring and respect and ultimately lead to conservation-minded behavior. As for tools specifically related to beach litter, encouraging the public to participate in maintaining their environment by providing disposable bags to beach-goers for removing trash during a visit could be beneficial.

For industry, responsibility could be a reduction in waste and programs for recycling. One approach that is gaining popularity in the U.S. is extended producer responsibility programs (EPR). Based on the Polluter Pays Principle (Principle 16 Rio Declaration), EPR programs make the producers responsible for their products from their creation to their disposal (Kibert, 2004). This approach was first introduced in Germany in 1991 when the government passed the Ordinance on Avoidance of Packaging Waste (Kibert, 2004). Germany was experiencing a

severe landfill shortage and packaging was responsible for 30% of the waste by weight and 50% by volume (Motavalli, n.d.). This ordinance made industry responsible for handling the packaging waste to help reduce per capita consumption of packaging.

Kibert (2004) noted that although EPR is criticized for its possible lack of environmental and economic effectiveness, it has triggered industry to enact good environmental practices. Both Xerox and Kodak have implemented EPR programs that take back office machines and single use cameras, respectively. One of the most impressive EPR programs has been adopted by the U.S. carpet industry. Companies such as Interface, Inc. have begun carpet-recycling programs to turn disposed carpets – comprised primarily of non-renewable petroleum based products – into new carpets for resale (Kibert, 2004).

In 2002, a voluntary agreement, the Memorandum of Understanding for Carpet Stewardship (MOU) was signed by the carpet industry, state governments, EPA and non-governmental organizations (NGOs) with the goal of keeping 40% of carpets from ending up in landfills by 2012 (Kibert, 2004). While EPR practices are mandatory in some countries, they are currently voluntary in the U.S. and are often referred to as extended "product" responsibility so as to imply the responsibility lies with whoever engages with the product from the producer to the retailer to the consumer (US EPA website, 2008, ¶1). According to Kibert (2004), as more EPR programs are implemented and as more U.S. companies operate in countries, which require them to comply with these programs, more of these practices may be fostered in the U.S.

Alternative practices to reduce waste could come in the form of bans or fees for objects such as plastic bags. This practice is used in many other countries, either through charging for plastic bags or by not providing them at all. Ireland requires stores to charge for plastic bags while China has banned them altogether. The Swedish furniture company IKEA voluntarily began a plastic bag reduction program by charging for plastic bags, which reduced plastic bag use at their stores by 95% (IKEA, 2008). Giving monetary value to items previously seen as waste can motivate litter-reducing behavior.

There is no silver bullet for solving the marine debris issue. Education to change hearts and minds is good, but it seems that incentives are needed to drive behavioral changes. While it is

hopeful to see some industries making voluntary strides towards sustainability, we need to strengthen and diversify our tools to manage waste. Overall, combinations of personal, public and governmental interventions will be necessary to reduce marine debris.

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Appendix A: Moonlight Beach Attendance (2007 Beach Attendance Report)

Month	Counts	Average	Days Down	Estimated Attendance	Attendance Change	Percent Change
January	NA	NA	31.0	NA	NA	NA
February	369.5	52.8	21.0	1478.0	NA	NA
March	6128.5	306.4	11.0	9499.2	8021.2	542.7
April	199.0	46.0	29.0	1533.0	-7966.2	-83.9
May	9777.0	465.6	10.0	14432.7	12899.7	841.5
June	25682.5	951.2	3.0	28536.1	14103.4	97.7
July	58799.5	1068.3	2.0	60936.1	32400.0	113.5
August	33920.5	1094.2	0.0	33920.5	-27015.6	-44.3
September	7298.0	561.4	17.0	16841.5	-17079.0	-50.3
October	5800.0	214.8	4.0	6659.3	-10182.3	-60.5
November	4101.5	205.1	10.0	6152.3	-507.0	-7.6
December	2927.5	209.1	17.0	6482.3	330.1	5.4

Appendix B: Heal the Bay Grades for Moonlight Beach Water Quality (2000-2005)

Period	AB411 Dry Weather	Overall Dry Weather
2000-01	F	F
2001-02	D	D
2002-03	B	No samples
2003-04	B	A
2004-05	B	B

Appendix C: Moonlight Beach Script, Survey and UCSD's Institutional Review Board (IRB) Consent Forms

2008 Encinitas Beach Survey
Script for Surveyor

"Hello, I am a graduate student at UCSD working on a school project. Would you be willing to help us by answering questions on a short survey? It should only take about 5 minutes."

If no…
"Thank you".

If yes…
Hand the respondent a copy of the *Consent Document* to read/keep and the *Encinitas Beach Survey* on a clipboard to fill out with a pen. Also hand them a copy of Picture X and Picture Y.

If asked what the project is about…
"I am trying to learn about people's attitudes toward and perceptions of beaches."

2008 Encinitas Beach Survey
Questions

For Office Use Only
Study Number:
Date:
Time surveyed:
Survey Location:
Weather Condition:
Beach Condition:

Directions: Hello and thank you for participating in this short beach survey. Please attempt to answer every question below. There are 15 questions total. Circle one answer for each question, unless otherwise indicated. If you have any questions, please let us know.

1. How often do you visit any beach in the winter?
   a. Daily
   b. 2-3 times a week
   c. Once a week
   d. 2-3 times each month
   e. Once a month
   f. 2-3 times each year
   g. Other :_____

2. How often do you visit any beach in the summer?
   a. Daily
   b. 2-3 times a week
   c. Once a week
   d. 2-3 times each month
   e. Once a month
   f. 2-3 times each year
   g. Other :_____

3. I believe that litter on beaches is a serious problem.

Strongly Disagree				Strongly Agree
1	2	3	4	5

4. Please indicate what percentage you believe the following parties are responsible to pay for beach litter or trash programs in the City of Encinitas. Note, the total percentage must equal 100%.

Beach-goers/Visitors	_____%
City of Encinitas	_____%
State of California	_____%
Other: _____	_____%

5. How clean would you say Moonlight Beach is today?

Extremely Dirty				Extremely Clean
1	2	3	4	5

6. Have you visited other beaches in San Diego that are not in the City of Encinitas?

____ YES ____ NO

If the answer to the above question is YES, then how clean would you say other beaches that are not in the City of Encinitas are in general?

Extremely Dirty				Extremely Clean
1	2	3	4	5

7. I would be more likely to visit a beach that looks like Picture X versus a beach that looks like Picture Y.

Strongly Disagree				Strongly Agree
1	2	3	4	5

8. What if all of the beaches in the City of Encinitas began to look like Picture Y. The City of Encinitas could increase its beach cleanup efforts in order to keep beach cleanliness to the level shown in Picture X, if it were able to raise the funds to support beach cleanup. Would you be willing to pay a $2.00 fee each time you visited a beach in Encinitas, knowing that all the money from this fee was going toward the cleanup effort?

____ YES **____ NO**

If YES, would you be willing to pay $3.00?

____ YES ____ NO

If NO, would you be willing to pay $1.00?

____ YES ____ NO

If NO to $1.00, please answer the following:

a. If you did not go to a beach in Encinitas because of the fee would you:
   i. Go to another beach outside the City of Encinitas or
   ii. Do some other activity

9. Please rank the following 1-6 in terms of importance to your visit to a beach (6 being Most Important and 1 being Least Important).

_____ Beach not too crowded
_____ Has bathroom facilities
_____ Has fire pits
_____ Clean beach
_____ Easy parking
_____ Has children's playground

10. Assuming people care about the environment, why do you believe some people continue to make choices, such as littering on a beach, that cause harm to the environment?

_____

_____

11. How many people are with you today, beside yourself? _____

12. Who is with you today? (circle all that apply)
    a. I am alone
    b. Family (including young children under the age of 12)
    c. Family (not including young children under the age of 12)
    d. Friends

13. What is your age?
    a. 18-29
    b. 30-39
    c. 40-49
    d. 50-59
    e. 60-69
    f. 70+

14. What is your ethnicity?
    a. Asian
    b. Black (African American)
    c. Hispanic
    d. White (Caucasian)
    e. Other: _____

15. How far from Moonlight Beach (in Encinitas) do you live?
    a. In Encinitas
    b. Outside Encinitas, but within about 20 miles
    c. Outside Encinitas, but within about 60 miles
    d. Greater than 60 miles, but in California
    e. In the US, but not in California
    f. Outside of the US

080407S

UNIVERSITY OF CALIFORNIA, SAN DIEGO
HUMAN RESEARCH PROTECTIONS PROGRAM

TO: Ms. Elizabeth Keenan Mailcode: 0170X

RE: Project #080407S California's Coastal Economy: Marine Debris, Beach Litter and Social Attitudes

Dear Ms. Keenan:

The above-referenced project was reviewed and approved by one of this institution's Institutional Review Boards in accordance with the requirements of the Code of Federal Regulations on the Protection of Human Subjects (45 CFR 46 and 21 CFR 50 and 56), including its relevant Subparts. This approval, based on the degree of risk, is for 365 days from the date of **IRB review and approval** unless otherwise stated in this letter. The regulations require that continuing review be conducted on or before the 1-year anniversary date of the IRB approval, even though the research activity may not begin until some time after the IRB has given approval.

This study was reviewed by the IRB through the expedited review procedure as authorized by 45 CFR 46.110 and 21 CFR 56.110 and falls under research category (7): Research on individual or group characteristics or behavior (including, but not limited to, research on perception, cognition, motivation, identity, language, communication, cultural beliefs or practices, and social behavior) or research employing survey, interview, oral history, focus group, program evaluation, human factors evaluation, or quality assurance methodologies.

Waiver of written consent has been granted for this study under CFR 46.117(2) the research presents no more than minimal risk of harm to subjects and involves no procedures for which written consent is required outside the research.

Date of IRB review and approval: **3/14/2008**

/la

Michael Caligiuri, Ph.D.
Director, Clinical Research Protections Program
Mailcode: 0052 Phone: 858-455-5050
E-mail: hrpp@ucsd.edu

Note: All Human Subject research conducted at the VA facility and/or utilizing VA/VMRF funds MUST BE APPROVED by the VA Research and Development Committee prior to commencing any research.

Approval release date: 3/20/2008

2008 Beach Litter Survey
Consent Document

I, Elizabeth Keenan, am a graduate student at the University of California, San Diego and am interested in beach litter issues in California. I am undertaking a study that will last from March 2008 through May 2008. There will be approximately 200 participants in this study.

You have been asked to take part because I would like to learn about perceptions of beach cleanliness as well as how much beach goers, like yourself, value beaches in California. If you agree to participate in this study, I will ask you a series of questions related to your beach visit today and possibly to your past and/or future beach experiences. The entire survey will take approximately 5 minutes. You will be free to skip any question you do not wish to answer and may terminate this survey at any time.

The only risk involved in this study is a minimal chance of loss of confidentiality. These risks are minimal as I will not record any data which can identify you personally as a participant in this study. All data will be kept on a password protected computer and only researchers involved in this project will be able to view this data.

You will not receive any compensation for participating in this study.

You may call the UCSD Human Research Protections Program at 858-455-5050 to ask about your rights as a research subject or to report research-related problems.

There will be no direct benefits to you from these procedures however, the investigators may learn more about the public's perceptions of beach litter and how much they value beaches in California.

I have explained this study but if you have any more questions or research related problems you may contact Elizabeth Keenan at the Center for Marine Biodiversity and Conservation at UCSD at 858-822-2886.

Your participation is entirely voluntary, and the records of your interview will be kept confidential. As I previously stated, no personally identifying information will be recorded and all data will be available only to the investigators of this study.

Do you agree to participate as a subject in this study?

Appendix D: Moonlight Beach Survey Pictures

Picture X – Clean Beach Photo (E. Keenan)

Picture Y – Dirty Beach Photo (E. Keenan)

Appendix F: Calculation for net surplus of a clean beach

For the following calculation, I used a modification of the WTP curve (Figure 5). The data used were from the same 76 respondents, however, the x- and y-axes were switched and the respondents were represented in actual number rather than percentage (Figure A). In order to estimate the net surplus for a clean beach, represented by the area under the curve, a linear trend line was applied to the data. Next, I divided the area under the curve into sections in order to make the calculation (Figure B).

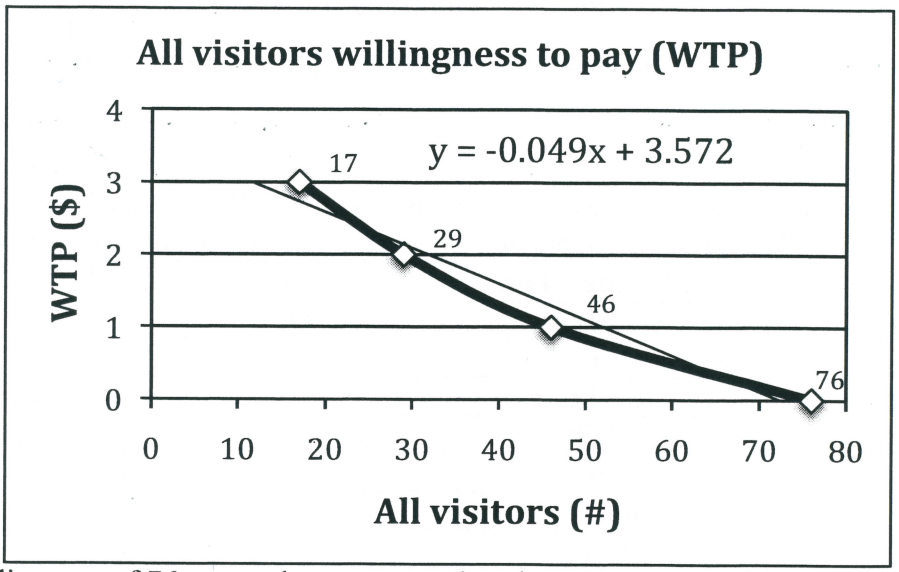

Figure A: Willingness of 76 respondents to pay a beach entrance fee of $1, $2, or $3 with linear trend line overlaid.

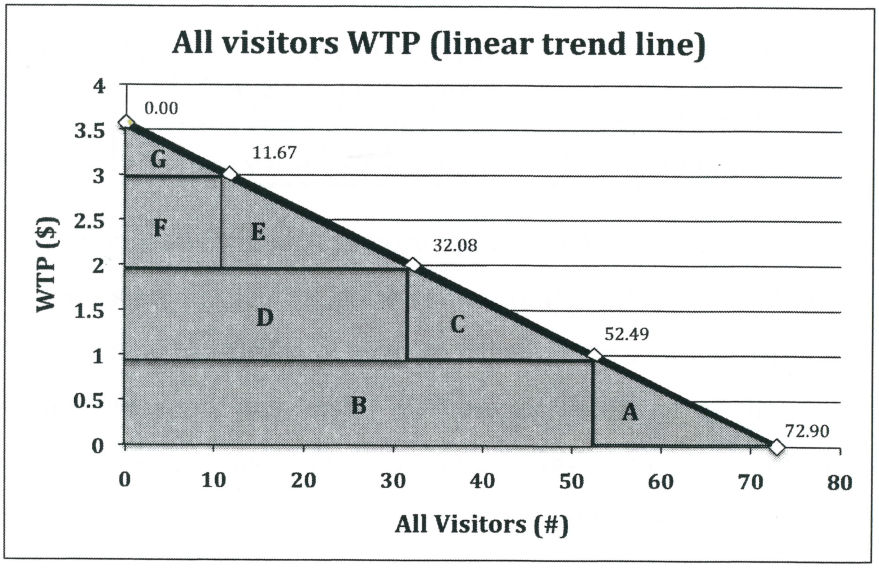

Figure B: Willingness of 72.9 respondents to pay a beach entrance fee of $1, $2, or $3 based on linear trend line. The area under the curve is broken up into sections for the calculation.

Since there is currently no fee, the entire area under the curve can be used to represent the surplus value of a clean beach for the respondents. For a single day at the beach, the value was $130.18 for all 76 respondents (Table A). This is an average of $1.79 per respondent. Using these values as well as the annual visitation of 639,744 to Moonlight Beach in 2007 an estimate of the overall value of the clean beach to all visitors for one day and one year can be calculated (Table B). Based on the attendance for 2007, average daily attendance at Moonlight Beach was 1752.72 people and therefore, the estimated surplus value for a clean beach for one day based on that average attendance was $3,129.92. Further, the estimated surplus value for a clean beach for one year was $1,142,420.87.

Table A: Calculated value (for 72.9 respondents) for one day at Moonlight Beach. Calculated by summing the values for total areas A-G under linear WTP curve in Figure B.

Area	Total Value of Area
A	$10.21
B	$52.49
C	$10.21
D	$32.08
E	$10.21
F	$11.67
G	$3.33
Total	**$130.18**
Average/respondent	**$1.79**

Table B: Estimated surplus value for a clean beach at Moonlight using reported 2007 attendance (639,744 visitors/year; 1,752.72 average visitors/day).*

Surplus value one day	**$3,129.92**
Surplus value one year	**$1,142,420.87**

*This surplus value is only an estimate based on the values provided in this particular survey. As mentioned in the discussion, the starting point values for the CV questions in the survey could have been different, leading to a different average value per person. Furthermore, this calculation assumes that the 76 respondents' answers to WTP are representative of all visitors to Moonlight Beach. Additionally, it assumes respondents from Encinitas are not already contributing to a clean beach (i.e. via taxes). At best, this calculation is meant to only represent a way to use WTP to get surplus value for a nonmarket good.