Charles University

Faculty of Social Sciences
Institute of Economic Studies

MASTER'S THESIS

Are Sharks Worth More Alive Than Dead? A Stated Preference Study on Shark Ecotourism in Costa Rica.

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Academic Year: **2016/2017**

Declaration of Authorship

The author hereby declares that he compiled this thesis independently; using only the listed resources and literature, and the thesis has not been used to obtain a different or the same degree.

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Prague, January 01st, 2017

Signature

Acknowledgments

With boundless appreciation, I would like to extend my gratitude to Mgr. Milan Ščasný PhD., for his incredible support in writing this research. He spent a countless number of hours on this thesis work, and ultimately, this research wouldn't have been possible without him. I would also like to express my gratitude to Carlos Avila, for his generosity in helping me conduct the in-person interviews.

I would also like to express my gratitude to Prof. Melville Saayman, who helped tremendously in the experimental design of this work. Thank you to Mgr. Martin Kryl for programming the survey instrument. Lastly, I would like to thank my family for their unconditional support.

This thesis was financially supported by research grant number 205 002 awarded by the Charles University Environment Center's PRVOUK Program "P02 - Environmentální výzkum" and from the European Union's Horizon 2020 Research and Innovation Staff Exchange programme under the Marie Sklodowska-Curie grant agreement No.6811228 (GEMCLIME).

Abstract

In this study, we aim at estimating the benefits for conserving shark populations in Costa Rica. In the first approach, we use a discrete choice experiment to elicit tourists' preferences for five tourism-related attributes when one of them is shark ecotourism. In the second apparoch, we estimate the willingness-to-pay for conserving three threatened-hammerhead shark species from a double-bounded dichotomous choice question. Preferences are elicited through the original survey that was carried out on a sample representative of the general tourist population (n=801). When tourism infrastructure and environmental-related attributes were valued within the discrete choice experiments, we found that tourists are willing to pay most for beach and city tourism infrastructure, \$0.86 and \$1.04, respectively, for each percentage point of improvement, while the same improvement in shark populations is worth about \$0.35 and the willingness to pay for conserving sea turtles and coral reefs is not different from zero. There is, however, a large heterogeneity in tourists' preferences even for conserving sea turtles or sharks. Our results imply that tourists are willing to pay about **\$35** to avoid the full extinction of shark populations. From three separate contingent valuation questions, we found that tourists were willing to pay **\$56** to conserve smooth hammerheads *(Sphyrna zygaena)*, **\$53** for scalloped hammerheads *(Sphyrna lewini)*, and **\$46** for great hammerhead sharks *(Sphyrna mokarran)*. Considering the annual tourist population, we found that the benefits of shark conservation, i.e. keeping a sharks alive, greatly exceed the revenues from selling shark products on the seafood market. Our study provides the first estimate of shark conservation benefits in Costa Rica, which is the key input for the ongoing conservation effort to recover and stabilize shark populations.

JEL Classification	Q25, Q26, Q51, Q55, Q57, Z32
Keywords	Marine conservation, willingness to pay, stated preferences, discrete choice experiments, contingent valuation, recreation infrastructure, shark excition; hammerhead sharks, coral reefs, sea turtles,

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Abstrakt

Cílem studie je odhadnout přínosy ze zachování populace žraloků v Kostarice. Pro odhad ochoty platit za zachování populace žraloků používáme metodu výběrového experimentu, v rámci něhož zjišťujeme preference turistů pro celkem pět atributů zkvalitnění turismu, včetně žraloky-zaměřené eko-turistiky. Prostřednictvím otázek diskrétní volby poté odhadujeme ochotu platit za zachování tří specifických ohrožených druhů žraloků z čeledi kladivounovitých. Preference jsou zjišťovány prostřednictvím šetření na reprezentativní vzorce turistů (n=801). Když byly oceňovány atributy spojené s turistickou infrastrukturou spolu s ekologickými atributy v rámci výběrového experiment, turisti jsou ochotni zaplatit nejvíce za zlepšení infrastrulkuty na plážích a ve městách, 0.86 USD a 1.04 USD, za každý procentní bod zlepšení, zaímco kvantitativně stejné zvýšení populace žraloků si cemili na 0.35 USD a ochota platit za zvýšení populace morských želv a koralových útesů se nelišila od nuly. Turisti jsou však ve svých preferencích heterogenní, a to včetně preference za zachování morských želv nebo koralových útesů. Naše výsledky implikují hodnotu ochoty platit za vyhnutí se vyhubení žraloků ve výši 35 USD na každého turistu. Ze tří nezávislých podmíněných otázek diskrétní volby odhadujeme ochotu platit za zachování populace kladivouna obecného *(Sphyrna zygaena)* ve výši 56 USD, za kladivouna bronzového *(Sphyrna lewini)* 53 USD a kladivouna velkého *(Sphyrna mokarran)* 46 USD. Jestliže vezmeme v úvahu celkový počet turistů přicházejících do Kostariky, hodnota přínosů ze zachování žraloků, tj. ponechání žraloků naživu, převyšuje hodnotu příjmů z prodeje výrobků ze zabitých žraloků. Odhad přínosů ze zachování populace žraloků v Kostarice, který předkládá naše studie, je tak užitečnou a jednou z klíčových informací pro probíhající diskuse o rozsahu zachování a miry stabilizace tohoto druhu.

Klasifikace Q25, Q26, Q51, Q55, Q57, Z32

Klíčová slova Multinomial logit, vyberova data, vyberovy experiment, stanovene preference, ochota platit, preference spotrebitelu

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Acronyms

CITES Convention on International Trade in Endangered Species of Wild Flora and Fauna

CLGT Conditional Logit

CV Contingent Valuation

DBDC Double-Bounded Dichotomous Choice

DCE Discrete Choice Experiment

MNLGT Multinomial Logit

SQ Status quo

WTP Willingness to pay

Master's Thesis Proposal

Author:	Bc. Alicia Berrios
Supervisor:	Mgr. Milan Ščasný PhD.
Defense Planned:	Febrary 2017

Proposed Topic:

Are sharks worth more alive than dead?: A stated preference study on shark ecotourism.

Motivation:

Sharks have played a prominent role in our oceans for millions of years, however, now many species are approaching extinction. During the last century, the practices of industrial and commercial fishing have drastically reduced shark populations- in some cases by 70-90% (Baum et al. 2003). Every year, commercial fisheries kill an estimated 100 million sharks, as demand for shark fin and meat continues to increase globally (perceived as a delicacy or wanted for its "medicinal properties").

The rate of fishing greatly exceeds the natural rate of reproduction, as sharks have a low fecundity rate (2-20 pups, with a maturation of 10-12 years). The ocean cannot simply keep up with the overexploitation of shark species, as they are slow to recover from such rapid depletion.

The elimination of shark species will have a much greater effect on the health of ocean ecosystems. One broad effect from the loss of apex predators being blooms of mesopredator populations, which in return has a negative effect on lower-level prey species (Myers et al. 2007).

Economically speaking, we can agree that, "money rules the world". The monetary incentive is what continues to drive fisheries away from conservation and towards exploitation. The fishing industry brings in a large amount of revenue for countries heavily active in this sector. However, environmentalists have argued that a transition to ecotourism may bring more economic benefits, while simultaneously conserving marine species.

A case study in Fiji proved that tourism can operate by collecting direct revenue from ecotourism activity, while the government benefits from additional taxes imposed via permits (i.e. tag or entry fees). These direct taxes from shark divers in Fiji brought in a total of USD 5.9 million in 2010 (Vianna et al. 2012).

A major universal barrier for shark conservation exists: the sensationalization of shark attacks on humans globally. Some people believe that sharks should be dead, rather than alive. This stigma may have an impact on conservation efforts. More specifically in areas like Daytona Beach, Florida- the shark attack capital of the world.

Economic literature on the value of sharks (dead and alive) is very limited globally. I believe that the lack of economic research relating to shark ecotourism is something that hinders policymaking in favor of shark conservation. My thesis will aim to put a price on a non-market good (an alive shark), while comparing it to the market price of shark meat. I will do this through stated preferences.

Hypotheses:

1. On average, tourists are willing to pay for avoiding shark extinction (i.e. the coefficient in the conditional logit for the shark attribute is positive and significant)
2. People who eat shark meat have larger preference (and hence the WTP) for the avoidance of shark extinction.
3. A tourist who visits the beach more often is willing to pay less for shark conservation. This difference disappears however, when controlling for the perceived risk related to shark attacks.
4. The value of a live shark is larger than the market value of shark meat/fin.

Methodology:

All of my hypotheses will be tested through a stated preference method, particularly discrete choice experiments (Carson and Louviere 2011). I will be selecting a beach in Florida where I will conduct my survey.

First, I will review literature to select attributes for the choice task. The attributes are framed on the ecological components of the marine system (e.g., water quality), as well as, the non-ecological components of the beach (e.g., infrastructure, parking fees, etc.). These attributes should represent why people might or might not choose to visit this beach. Ultimately, revealing whether or not shark populations in the area play a role in the responents' decision to visit that beach. One of the attributes will be the cost, presented through an accepted payment scenario and vehicle (e.g., a contribution to a fund as a part of parking or entrance fee).

The questionnaire will include these attributes in a choice set (choice experiment), in which the respondent will be asked to choose among the alternatives described by those attributes which levels will vary across the alternatives but also across the choice tasks. For instance, paying for parking might play a role in the decision making process to visit that particular beach. A respondent might prefer an option where they would be willing to accept free parking for an increased amount of shark populations in the area.

More specifically, the questionnaire is outlined as follows:

1. **General questions – elicit recreational behavior**
2. **Impact Appreciation: Describe the situation of shark population declination**
3. **Experience – things you can do with a shark**
4. **Elicit Attitudes towards: (1) the environment; (2) health ("risk aversion to death)**

5. **Core questions- choice experiment**
6. **Socio-demographic information**

I will test this instrument in a sort of pre-survey to see if the instrument works effectively, or if it needs to be altered. If it needs to be altered, I will conduct another pre-survey. This should be practiced on approximately 10-15 people, with the ultimate instrument being conducted on around 300-500 people. Ideally, I would have liked to collect this information in person, however due to my circumstances, I will be conducting my choice experiment online.

After I have my data, I will analyze data by conditional (only attribute model) and multinomial logit (the attributes interacted with socio-demographic variables and perception-specific regressors) (Louviere et al. 2000; Train 2009). Using the estimate coefficients, an implicit value of Willingness to Pay for shark conservation, and for other attributes, will be derived. Total economic benefit for shark conservation for the study site will be estimated.

At the end, I will research market prices for shark meat/fin, and will estimate the total annual revenue from selling sharks caught in the study site. These revenues will be compared with the economic benefits of shark conservation to test hypothesis no. 4.

Expected Contribution:

I hope to contribute to the amount of economic literature on the economic benefits of shark conservation. I also hope to ultimately apply my results (if hypothesis is proven) to active conservation efforts (of which I participate in voluntarily).

Outline:

1. Abstract
2. Introduction (includes background, review of relevant literature, and motivation)
3. Methodology: I will describe my methodology, including my choice experiment snapshots, and how I will derive my values.
4. Results: I will discuss my results from my questionnaire, and compare it to the market values for shark meat/fin.
5. Conclusion: I will summarize the findings of my work, potential implications, and suggestions for policymakers.

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Author **Supervisor**

1 Introduction

Sharks have played a pivotal role in our oceans for millions of years due to their contribution to global ecosystems. Presently, scientists are becoming increasingly alarmed by the rapid depletion of shark species due to global-industrial and commercial fishing practices. According to the Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES), various hammerhead & sawfish species, the basking shark, whale shark, and great white shark, have been red-listed as highly likely to become extinct.[1] Some species have even been reduced by up to 70-90% (Baum et al. 2003).

Every year, commercial fisheries kill an estimated 100 million sharks, as demand for shark meat and fin continues to increase internationally. The demand is primarily driven by the international market for shark fins, however, there is a large demand for all shark products. Sharks are exploited for their fins (used to produce shark fin soup), meat (frozen, fresh, brine, smoked, salted), skin (for sandpaper and leather), cartilage (considered to "anti-cancerous" properties), teeth, and liver-oil (pharmaceuticals and cosmetics), etc (Vannuccini, 1999). According to CITES, fins make-up only 2% of a shark's entire weight and the economic value of these fins greatly exceeds that of shark meat (40% of weight).[2] Shark meat is not always valued; therefore, it is often not retained while fishing. Thus, the practice of a term coined as "finning". In fact, shark fin is considered to be the most expensive item on the seafood market with market prices of over USD $400 per kilogram in Hong Kong – the world's largest shark fin market. However, shark fins are destined to be sold in other countries like China, Taiwan, Singapore, Vietnam, and Malaysia. The value of shark fin ranges from 20-250 times the value of shark meat by weight (Vannucinni, 1999). Fishermen consider it economically beneficial to to use limited vessel space when storing fins, a high priced commodity, rather than filling space

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[1] https://cites.org/eng/prog/shark/more.php

[2] Conservation and management of sharks: Trade-Related Threats to Sharks. Convention on International Trade in Endangered Species of Wild Fauna and Flora. Twenty-second meeting of the Animals Committee, Lima (Peru), 7-13 July 2006, p. 4.

with low-priced shark meat. Shark meat is also consumed largely in Europe and South America, with the biggest importers being Brazil, Italy, Spain, South Korea, and Uruguay.

Sharks, coupled with many other marine species, cannot recover from the rate of overfishing which exceeds their natural rate of reproduction- as sharks have a low fecundity rate (birth only 2-20 pups, and a maturation period of 10-12 years). The ocean simply cannot keep up with the overexploitation of shark species, because they are slow to recover from such rapid depletion.

Sharks are a valuable resource. The elimination of shark species will have a much greater effect on the environment by compromising the health of ocean ecosystems. As apex predators, sharks maintain the lower-level food chain by removing sick and weak species to ensure species diversity. Sharks also set spatial controls and abundance that indirectly maintain coral reef habitats and seagrass beds.[3] For instance, one observed effect from the loss of sharks are mesopredator blooms. A substantial increase in mesopredator populations negatively effects lower-level prey species and has ultimately led to the termination of many fisheries (Myers et al. 2007). Therefore, the removal of sharks has a cascading effect on small and large economies.

The only effective approach to conserve marine species is to implement a ban. Quotas, tradable or not, or pricing may also decrease overfishing considerably. It is also agreed that the monetary incentive is what may drive the fishing industry away from conservation and towards overexploitation. The fishing industry brings in a large amount of revenue for countries that are heavily active in this sector (i.e. Hong Kong).

On the other hand, marine scientists and environmental activists counter-argue that a transition towards an ecotourism-intensive economy may bring more economic benefits, especially to local residents, while simultaneously conserving many marine species enjoyed by the human population. In fact, there exists such cases in which marine-exploiting societies have successfully transitioned to ecotourism-based economies. A notable story is that of Donsol. The Donsol community in the Philippines once generated its revenues from whale shark-hunting, but now benefits from its booming whale shark tourism industry (Pine, 2007). The migration of whale sharks to Donsol has allowed the economy to grow. In 1998, the tourist

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[3] http://oceana.org/sites/default/files/reports/Predators_as_Prey_FINAL_FINAL1.pdf

population was around 800 people and generated USD $10,500 from boat rentals and registration fees. By 2005, the amount of tourists increased substantially to 7,200 visitors and generated USD $208,000. Since 2002, more than 200 fishermen have earned a steady seasonal employment, and over 300 jobs have been created as a result of its booming whale shark tourism industry. As a result, Donsol's poverty rank also increased substantially from rank 76 (one of the poorest) to 17 of the municipalities in the region (Arevalo, 2006).

In countries where shark fin importation is an issue, genetic analyses have proven that fins from threatened shark species are still emerging in these markets. Genetic evidence also proves that a main source of these sharks have come from Costa Rica (Gonzalez-Pestana et al, 2014).

Costa Rica has continued to lead the international system in the conservation and sustainability of natural resources, with a largely successful ecotourism industry. However, Costa Rica has a long history of shark fin exportation. In 2011, the Costa Rican government reported that a range of 350,000-450,000 sharks were killed, or "finned". This largely motivated the government to impose a decree that banned the practice of shark finning in 2013, and advocated for the listing of hammerhead sharks in Appendix II of CITES.

In 2015, Costa Rica took a step back in it's conservation efforts. The Ministry of Environment announced that the government would allow the exportation of hammerhead shark fins (one of the most endangered shark species). This new policy resulted in a substantial opposition movement (i.e. global movement to protect Cocos Island). A non-detriment finding (based on a technical analysis for the 2009-2014 period) published that an average of 81,877 kilograms of hammerhead shark fins were landed[4] by a national fleet, and 8,844 kilograms by an international fleet (a total of 60,320 sharks in a 6-year period), not including small-scale artisanal fleets.[5] The sharks are then exported to Taiwan and Hong Kong.

In consideration of these statistics, it is essential that the Costa Rican government passes an effective legislation that will infinitely ban the catch of sharks domestically, and the sale of

[4] Landing a shark: to bring a shark (whole, or pieces of shark) on shore. Many countries require that sharks be landed whole with fins attached. The goal is to reduce and discourage shark finning practices.

[5] http://mission-blue.org/2015/06/sharks-and-costa-rica/

shark products internationally. This policy must include such a scope that ensures that there are no loopholes[6] for fishermen.

In the past, the value of natural resources was unknown and was unable to be compared to their respective processed-forms for consumer use or consumption. Within the past decade, non-market valuation studies have provided policymakers with many economic benefit figures that stress the conservation of natural resources. Environmental and resource economists, in particular, are increasingly employing this valuation technique by eliciting public preferences, to derive a single value that can be assigned to both natural resource or resource characteristics. Still, for many species (both flora and fauna), non-market value is missing (Rogers et al, 2013).

The aim of this research is to provide empirical evidence for the economic benefits for keeping sharks alive in order to support legislation to reduce or stop shark fishing in Costa Rica. This will be done through analyses of preferences elicited from tourists visiting Costa Rica which will provide a framework for deriving the non-market benefits of Costa Rican tourists attributable to conserving sharks and other marine species (Rogers, 2013).

Based on existing literature we understand that tourists may be willing-to-pay (WTP) some dollar amount to avoid extinction of land or marine species (Saayman, 2014). To fulfill our goal, we use stated preference techniques to elicit individual preferences for shark conservation. Specifically, the method of discrete choice experiment (Carson & Czajkowski, 2012) is used to infer a trade-off between several attributes of a tourism-improving program that might be introduced by the Costa Rican government. These attributes include both tourism infrastructure improvement as well as protection of species such as sea turtles, sharks, and coral reefs – as well as the cost. Furthermore, to examine the WTP for three different hammerhead shark species (scalloped, smooth, and great hammerhead species), we conduct a contingent valuation study using the double-bounded dichotomous choice method. Using these two elicitation methods, we will empirically examine the following hypotheses:

[6] Loopholes: Fishermen do not report their entire catch, or hide fins detached from sharks discarded in the ocean. In some countries where fishermen much fish within a certain distance from shore, they may report to authorities that it was within this distance and not outside (there is no way to prove this).

1. Tourists are willing to pay a significant amount of money in order to reduce the rate of shark extinction.

2. Tourists would prefer a policy that improves city and beach infrastructure to environmental policies.

3. Tourists that visited a beach during their stay are more willing-to-pay to protect shark populations than tourists that did not.

4. Tourists would prefer policies that improve coral reefs or sea turtle populations to shark policies.

5. Do WTP figures vary across the three species of hammerhead sharks?

6. Are WTP values for shark conservation comparable when derived from discrete choice experiments vs. contingent valuation?

We would also like to empirically explore the following questions: How much are tourists willing-to-pay to protect coral reefs, and seas turtles in Costa Rica? Are specific tourists willing-to-pay more for shark conservation than others? Are older tourists willing-to-pay less than younger tourists? What is the WTP of those who dove with sharks?

Ultimately, we would like to compare the WTP for live sharks and annual revenues made from selling Costa Rican sharks on the seafood market. No doubt, there might be other benefits arising from keeping sharks alive than the ones to be addressed in our experiment. Hence, if the benefits as derived in our research exceed the lost profit, then we can certainly support the preservation of shark populations to be, on the best-cost analysis ground, socially desirable.

This work should contribute to current literature on shark valuation, because it offers a unique welfare analysis, providing the willingness to pay values derived from stated preference methods. In fact, nearly all existing literature have used a direct spending approach to derive an economic value of sharks based merely on expenditures made by dive tourists at particular diving areas. Such direct cost methods cannot serve as a benefit value, as for instance, the travel cost method would do. The travel costs may provide benefit estimates, however, such value would provide the user value only, keeping non-user values potentially attributed to recreation completely untouched. Moreover, existing literature does not provide a value of benefits that is representative of entire tourist populations. Perhaps, tourists in general are willing to pay some amount for conserving sharks, not only those who may directly benefit from diving with them. Furthermore, literature on shark valuation in Costa Rica is non-existent. Our research will cover all these gaps – we use the stated pereference method to derive both user as well as non-user values of both divers and of tourists in general in Costa Rica.

Using the discrete choice experiment, we find, on average, tourists are willing to pay **$17** as a lump sum payment to avoid the *50% extinction* of shark populations, and **$35** to avoid their *full extinction*. In a similar hypothetical scenario, based on contingent valuation, we elicited tourists' WTP for three endangered or red-listed hammerhead species and found that tourists are willing to pay **$55.88** for protecting smooth hammerheads, **$52.79** for scalloped hammerheads, and **$45.66** for great hammerhead sharks. With respect to other attributes for a public program presented in a discrete choice experiment, we found that tourists are indeed willing to pay the most for **beach and city tourist infrastructure**, about **$0.86** and **$1.04** (respectively) for each percentage point of improvement. Willingness to pay for the same improvement in **shark populations** is about **$0.35**, while WTP for conserving **sea turtles** and **coral reefs** is not statistically different from **zero**. There is, however, a large heterogeneity in tourists' preferences even for conserving sea turtles or sharks.

This research is structured as follows: Chapter 2 will elaborate on the existing literature of stated preference methods and the valuation of wildlife, marine attributes, and trade-offs between infrastructure and environmental improvement. The next chapter introduces the methodology, including the sampling strategy, experimental design and econometric model. Chapter 4 describes data estimation results and their interpretation are provided in Chapter 5, while Chapter 6 discusses them. The last chapter summarizes this work and its conclusion.

2 Literature Review

There exists substantial literature on the non-market valuation of tourism and the environment–including the valuation of marine resources. Alternatively, the economic value of sharks has been estimated using numerous methods such as Total Economic Value and values derived from direct spending (i.e. diving). Stated preference methods is rarely used to value shark species. The aim of this review is to briefly introduce valuation of ecotourism, recreation, and factors that affect preferences for marine and infrastructure attributes. This chapter will further justify the use of ecotourism to conserve biodiversity, but also its benefit as an economic driver.

2.1 Valuation of Ecotourism Using Stated Preference Methods

There is a significant amount of literature on the willingness-to-pay for ecotourism by using one of the stated preference methods. However, it should be kept in mind that it is difficult to determine the value that visitors place on viewing wildlife (Tonder, Krugell & Saayman, 2013).

According to Luzar et al (1995) and Tonder, Saayman, and Krugell (2013), ecotourism is defined as involving the use of the natural environment for non-consumptive purposes. Ecotourism is considered to be a major engine of growth and development in countries that have natural areas (marine and land) with unique flora and fauna. In fact, it is argued that *the* fastest growing tourism segment is nature-based tourism- growing at a rate of 10-30% every year (Kuenzi & Mcneely, 2008). Ecotourism is argued to contribute to development and economic growth, the development of infrastructure, involvement of local communities (employment and other opportunities), and the generation of income and foreign exchange earnings (Blamford et al., 1995; Dieke, 2001).

National parks (marine and land) attract tourism because of their focus on conservation and preservation of biodiversity (Tonder, Saayman & Krugell, 2013). Kuenzi and McNeely found that the amount of legally-protected natural areas has tripled over the last four decades, and thus, has increased competition between areas rich in biodiversity (Kuenzi & McNeely, 2008). In a study by Blamford et al (2009), it was found that ecotourism is equivalent to consumptive-industries such as farming, forestries, and fisheries *combined* in terms of revenue in South Africa. They supported Kuenzi & McNeely's argument that protected natural areas are one of the fastest growing segments in tourism.

The study by Tonder, Krugell & Saayman (2013), found that visitors to the Kruger National Park assigned a significant value (35.64%) on average spending for the opportunity to visit the Big Five species in South Africa. In another study conducted by Saayman (2014) on the "Big 7" ("Big Five" land species and two marine species), tourists were willing-to-pay to view land species more than marine species. However, they observed that visitors were not as familiar with the new Big Seven unlike the Big Five.

A study by Vianna et al. (2012), observed the effects of direct revenue collection on ecotourism activity in Fiji. They found that the government benefited from the collection of additional taxes on permits for shark diving (tag, entry fees). In total, these direct taxes paid by shark divers brought in USD $5.9 million in 2010.

Another notable study on reef sharks in Palau by Vianna et al. (2010), found that the value of an individual reef shark to the Paluan economy (at particular dive sites) was estimated to be USD $179,000 per year. The total business revenue generated by shark diving in Palau was estimated to be USD $17.4 million annually. This study proved that small island nation-economies can thrive from ecotourism, and particularly from diving. They also found that sharks are the principal reason for 21% of divers visiting Palau, and overall, the shark-diving industry makes up 8% of the country's GDP.

Overall, literature on the stated preferences of marine ecotourism and tourists' willingness-to-pay for marine conservation efforts in *Costa Rica* is relatively non-existent. Especially for specific species, such as sharks, as the existing literature is primarily framed around Costa Rica's national parks. Furthermore, some of the existing literature can be considered outdated. However, these studies may be useful in discussing the overall context of ecotourism in Costa Rica.

A contingent valuation study on the WTP of national park visitors in Costa Rica by Shultz, Pinazzo & Cifuentes (1998) found that both foreign and resident visitors were willing to pay more for entrance into the parks. In fact, the mean WTP was considerably higher than the current entrance fees. This supported the argument that contingent valuation methods are indeed an appropriate tool for measuring public preferences in developing countries.

A similar CV study in Monteverde, Costa Rica asked respondents about their willingness-to-pay to tolerate a cost in order to compensate for their carbon footprint. Laat (2015) found that there is no significant statistical difference in the origin of visitors and their willingness-to-pay. However, it was found that so-called "ecotourists" lacked knowledge about basic environmental concepts such as mitigation and compensation. Alternatively, we argue in this paper that the origin of tourists indeed has an impact on the WTP to protect shark species in Costa Rica.

2.2 Valuation of Recreation

2.2.1 Valuation of Wildlife

Wildlife tourism is a large component of the greater tourism industry – both global and domestic (Worboys et al., 2005). In some regions, wildlife tourism makes up for 20-40% of international tourism (Giongo et al., 1993). Wildlife tourism may refer to a spectrum of activities such as photographic and nature hikes, wildlife viewing, bird watching, snorkeling, scuba diving, whale watching, etc.

Valuing wildlife tourism is an important justification of the need to sustainably manage these industries. If species within these areas are conserved, tourists will continue to come to the site, bringing revenue in the form of income and opportunities for the local community and region. Valuation of wildlife tourism also provides policy makers and resource managers, with an important motivation for conserving ecological communities. If target species were no longer able to be observed by tourists, their time allocation, consequent expenditure at the site and services related (hotels, restaurants) would impact the local and regional community. Since national park resources (i.e. endangered species) are not bought or sold on the market, they require the use of non-market valuation. Both the travel cost (TCM) and the contingent valuation method (CVM) have been used to value wildlife services as a part of tourism activities.

There are several studies that use stated preference methods to value wildlife. Kruger and Saayman (2012), used the contingent valuation method to estimate the willingness-to-pay to see and conserve the Big Five species (african lion, leopard, rhino, elephant, and cape buffalo) at the Kruger National Park. They conducted questionnaires at the resting camps on the KNP property. They found that visitors to the Kruger National Park assigned a value of 34.64% of their total average spending to experience the Big Five species. The main determinants of visitors' WTP for viewing the Big Five in their natural habitat were age and marital status. The role of the Big Five also affected their decision to visit the Kruger National Park.

The Big Seven species is a relatively new "brand" to people in South Africa. The Big Seven refers to the original Big Five, and the addition of the great white shark and the southern right whale. The Addo Elephant National Park in the Eastern Cape Province, South Africa, is one of the only places where you can see all Big Seven species. Saayman and Saayman (2014) used the contingent valuation method to estimate the WTP for these species. They found that tourists were still focused on experiencing the Big Five, and that conservation authorities faced difficulties in establishing the Big Seven as a brand, since it was relatively new and unknown. Visitors were less willing to pay to see the marine species. They found that place of origin, spending, visitor's traveling with children, and those who were members of a conservation organization had a higher WTP. The most interesting finding, was that visitors' who specifically preferred to view the Big Five land species were more likely to pay to see the marine species. International visitors and males had a smaller WTP.

Studies that use contingent valuation to elicit tourists' preferences always find that visitors' characteristics and perceptions affect their WTP to view wildlife, such as the studies above. Visitors' characteristics and perceptions are of great interest to conservationists in developing countries such as India, Sri Lanka, Malaysia and the Philippines. Contingent Valuation studies on national parks in these countries have found that local visitors' lack resources to pay for entrance fees into these national parks, and subsequent conservation efforts.

A study on the Borivli National Park in India used the contingent valuation method to elicit resident visitors' WTP for the preservation and maintenance of the national park- including the park's wildlife (endangered mammals, birds, and reptiles). They found that households were willing to pay 7.5 Indian Rupees (~ $0.11 USD) per month for the preservation of the park's environmental amenities. Education level was found to increase the WTP. A one-year increase in a respondent's educational level increased the WTP by 5%. Aziz et al (2010) experienced results that supported Hadker and Saymaan's results. In a study on Taman Negara National Park in Malaysia, Aziz et al used the contingent valuation method to elicit tourists' WTP for entrance into the national park. They found that variables such as income, education, marital status, and nationality were important in determining respondents' WTP. International visitors were willing to pay more than local visitors. Malaysian visitors were less willing-to-pay, and this might be attributed to their income. Education was found to be the most important determinant of WTP, followed by income.

All of these studies may be considered to value wildlife as a part of "ecotourism" since they all include the practice of visiting natural habitats in a way that minimizes their ecological impact. For instance, visiting a national park to appreciate its natural state, and observe its wildlife- without exploiting its amenities. In Sri Lanka, about 14% of the land area comes under the Department of Wildlife conservation, and ranks among the highest in Asia. The Minneriya National Park attracts both local and foreign tourists for its bird watching, elephant viewing, and photography. Rathnayake (2016) employed the contingent valuation method to determine the optimum entrance fee that could be charged from visitors' viewing elephants at the park. They estimated a mean WTP of USD $1.30 per domestic visitor. If implemented as the park fee, the revenue of the national park would increase by 49% and visitor traffic would decrease by 48%.

2.2.2 Valuation of Marine Species

Wildlife-based tourism in marine environments is continuously developing, and generates billions of U.S. dollars in annual revenue (Pullis La Rouche, 2006; Cisneros-Montemayor et al., 2013., D'Lima et al, 2016). This industry subsequently supports regional and local livelihoods throughout the international system (Wilson and Tisdell, 2003; Blamford et al., 2009). According to Loomis et al. (2000), tourists commonly visit multiple sites within a region, and marine wildlife tourism is normally part of a larger circuit of tourism rather than the only attraction. Therefore, it is essential to estimate how much of total revenue generated from marine tourism (at a particular site site, or region) would be lost if a species were no longer existent, or available for tourists to view.

There is less literature on the use of stated preference methods for marine resources than non-marine wildlife. In the next sub-chapters, we review stated preference valuation literature on sea turtles, sharks, and coral reefs.

Sea Turtles

There are two notable studies that have used the contingent valuation method to estimate tourists' WTP to view sea turtles in their natural environment. Tisdell and Wilson (2001), used the CV method to estimate the willingness of tourists to pay for the protection of sea turtles. They found that tourists who had on-site experiences at Mon Repos beach in Australia, had a higher WTP than those that did not. These results implied that WTP is sensitive to whether or not a tourist sees wildlife.

In a similar, but very different study on sea turtles, Rathnayake (2016) employed the contingent valuation method to estimate an entrance fee that could be charged to local and foreign visitors for viewing sea turtles at the Rekawa sanctuary in Sri Lanka. Like Costa Rica, Sri Lanka experiences illegal sea turtle poaching as local Sri Lankans are dependent on the sale of turtle meat and eggs as a source of income. Considering this issue, Rathnayake used an interesting approach not seen in other literature: a scenario in which entry fees would be used to help compensate fishermen and reduce illegal poaching activities. He found that the mean WTP for local visitors was USD $0.73 and USD $15 for foreign visitors. Furthermore, results supported the re-design of entrance fees to secure the cooperation of low-income fishermen in turtle conservation.

Sharks

When reading literature on the valuation of sharks, we find that almost all studies estimate economic values using: (1) direct expenditures (particularly from diving); (2) the population of sharks present in a site area; (3) the lifespan of these shark species being studied (studies apply a discount rate according to species' lifespan). Studies based on direct expenditures are still useful for the purpose of this study, but we note that this studies don't measure welfare and hence can't provide benefit estimates. There is only one study, Pires et al. (2016), analyzing travel costs that can serve as benefit estimates associated however with the user values only, keeping the non-user untouched. We note that there is no study that elicits the stated preferences to value shark species.

Table 1: Literature on shark valuation using the direct cost method

Country	Shark Species	Value Per Yr in USD	Reference	Method
Bahamas	Sharks	$ 78 million	Cline (2008)	Direct spend
Belize	Whale Shark	$ 3.7 million	Graham (2004)	Direct spend
Canary Islands	Shark and ray	$ 22.8 million	De la cruz Modino et al. (2010)	Direct spend
French Polynesia	Lemon Shark	$ 5.4 million	Clua et al. (2011)	TEV
Maldives	Sharks	$ 38.6 million	Martin et al. (2006)	Direct spend
Palau	Sharks	$ 18 million	Vianna et al. (2010)	Direct spend
Fiji	Sharks	$41.6 million	Vianna et al. (2012)	Direct spend
Seychelles	Sharks	$ 4.5 million	Topelko and Dearden. (2005)	Direct spend
Seychelles	Whale Shark	$ 4.99 million	Rowat and Engelhardt. (2007)	Direct spend
South Africa	Tiger Shark	$1.7 million	Dicken and Hosking. (2009)	Direct spend
South Africa	White Shark	$ 4.2 million	Hara et al. (2003)	Direct spend
West Australia	Whale Shark	$ 12 million	Martin et al. (2006)	Direct spend
Fernando de Noronha Archipelago	Sharks	$2.64 million	Pires et al. (2016)	TCM

Live sharks are a very valuable resource to the tourism industry. Divers are particularly interested in seeing healthy sharks and are willing to pay big money to see them in their natural habitat. In fact, a study by Gallagher and Hammerschlag (2011) found that shark ecotourism industries operate in 29 countries and 83 locations. Dive ecotourism offers many benefits to local communities through the purchase of goods and services (i.e. dive operations; and indirect revenues including restaurants, hotels, transportation), employment in ecotourism-based companies, and diver tag permits or fees (Udelhoven et al, 2010). In fact, many studies included in this section have not included the tourism multiplier when deriving economic values of sharks. The establishment of well-managed-shark-based-ecotourism could mean significant economic effects for countries that implement them.

In one of the first studies on shark valuation, Anderson and Ahmed (1993) estimated the annual value of USD $33,500 for an individual grey reef shark in the Maldives in terms of direct diving revenue. They further estimated a total of USD $603,000 in direct diving revenue over the average lifespan of 18 years. At the time, a dead grey reef shark was estimated to be USD $32 to a local fisherman.[7] Therefore, grey reef sharks were valued at more than 100 times alive than dead.

The Bahamas have enjoyed recreational shark activites for over 25 years. In 2007, the country generated approximately USD $78 million in annual revenue and divers experienced over 73,000 interactions with sharks (Cline, 2008). For decades, the country has been a popular destination for shark interactions, generating about USD $800 million in gross revenue for the Bahamian economy. To protect its valuable shark-diving industry, the Bahamian government pass legislation in 2011 that banned the acts of fishing, possession, and trade of shark products (Lowe, 2011).

In a 2012 study by Vianna et al., divers were interviewed using a socio-economic survey which included questions about their direct expenditures of their current trip. They estimated the value of a single reef shark to be USD $179,000 to the tourism industry, and USD $1.2 million over its lifetime. Fisheries catching the same sharks that interacted with these divers would obtain and estimated USD $10,800 (0.00006% of its lifetime value). Using the same approach, Vianna

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[7]http://www.mrc.gov.mv/assets/Uploads/2001-The-Economics-of-Shark-and-Ray-watching-in-the-Maldives.pdf

et al. (2011) found that the total contribution of the shark-diving tourism to the whole economy in Fiji was estimated to be USD $42.2 million. Revenues were generated by the diving industry using departure taxes paid by shark-divers to the government.

Pires et al, 2016, took a different approach and employed the travel cost method (TCM) to estimate the total recreational value of the Fernando de Noronha Archipelago. Tourists were surveyed at the departure gate in order to capture their real expenditures for their trip. They found that the total recreational use of the archipelago was USD $92 million annually. Divers provided USD $36.4 million of the recreational value (all services produced for tourists), and sharks are responsible for 4% of the total economic benefit within the tourism industry. They found that the archipelago's shark diving industry earned more than other well-established industries in other countries. Another interesting observation was that 23% of tourists interviewed, became more interested in shark diving after they arrived.

A welfare study by Indab (2007) used the contingent valuation method and mutltivariate logit analyses to estimate the WTP whale shark conservation in Sorsogon, Philippines. Indab found that respondents were aware and concerned about current environmental issues, including the endangered status of whale sharks according to the IUCN. Respondents were not willing to pay for the implementation of a Conservaion Program due to poverty, unemployment and other economic concerns that prevail over environmental degradation. In fact, the entire contingent valuation exercise generated a zero welfare value. A whale conservation program could only survey on financial support from the international community.

Coral Reefs

Coral reefs are a source of recreation to divers and snorkelers, and is the recreational activity that is the most common source of monetary payments. There are two notable and recent studies that employ the contingent valuation method to estimate the recreational value of coral reefs. In 2002, Park et al. developed a travel cost-contingent valuation model to estimate the WTP of snorkelers to preserve the current water quality and health of coral reefs in the Florida Keys. The authors used a travel cost survey to examine both resident and visitor use of the Florida Keys. A subsample of the respondent that participate in natural-resource activities also received a contingent valuation survey. Respondents that received a CV survey, were informed that an increase in visitation would require infrastructure investment in the form of wastewater handling facilities. The average benefit estimates from the contingent responses, using Tobit model, was USD $735.

They found that years of experience in visiting the Florida Keys has a significant impact on willingness-to-pay, and a positive impact on the number of trips made. The variables for age and household income were not statistically different from zero, and WTP for coral reef trips decreased as recreationists made additional trips. Tourists that repeatedly visit the Florida Keys placed higher values on access to coral reefs. The average per person-trip user value for snorkeling was USD $481.

When respondents were confronted with an increased access cost for the snorkeling experience, results suggested that participants did not want to shift their expenditures to other sites or activities as a substitution. Results revealed that snorkelers engaged in a focused set of activities when visiting the Florida Keys.

A study by Trujillo et al. (2016), estimated the WTP of recreational divers to conserve the Corals of Rosario and San Bernardo National Natural Park, located in the Columbian Caribbean Sea. They used the single and double dichotomous choice models, and estimated divers' average WTP to be USD $89.56. They applied a discount rate of 3%, and estimated the present value of the reef to be USD $12.54 million.

Tourism Infrastructure vs. Conservation of Marine Species

The presented research aims to analyze the trade-off between species-conservation and tourism infrastructure development. Literature on a similar trade-off is relatively non-existent. Rathnayake's (2016) contingent scenarios are noteworthy, since one of his scenarios included a trade-off between beach infrastructure (tourism facilities) and sea turtle conservation. While in the first scenario, he focuses on improvements to tourism facilities (drinking water facilities, clean toilets, vistor centers, cafeteria souvenir shops, camp sites, museums), he proposes an improvement to visitor services and a sea turtle conservation initiative that would involve local communities in the second one. Rathnayake found that the mean WTP values of both local and foreign visitors were higher for the second scenario, with the sea turtle conservation (the mean is 93.08 LKR with s.e. = 8.69, and 15.33 USD with s.e. = 2.79, respectively), as compared to the program without this initiative (142.61 LKR with s.e. = 9.88, and 19.16 USD with s.e. = 1.53, respectively). This suggests that foreign visitors were more interested in conservation than enjoying recreational facilities (1 USD = 1.49 LKR). It also suggests that WTP for both segments of visitors (for sea turtle conservation) gets a significantly large positive value, as WTP for the scenario with this initiative was approximately 25% (foreign visitors) and 53% larger (local visitors) than the WTP for a program without this conservation initiative.

At the time of the survey, Rekawa foreign visitors already paid USD $10 and this study found that they would like to pay even more for improvements. Respondents' choices further suggested that their response may be influenced by their perception that the proposed initiatives in the second scenario would help solve the problem of turtle survival at the sanctuary.

3 Methodology

3.1 Analytical approach

In this study, I analyze the preferences of tourists visiting Costa Rica for conserving marine attributes (sharks, turtles, sharks), and the improvement of infrastructure. Data were collected through in-person surveys, using an online survey instrument programmed into tablets. A major aim of the survey was to estimate an average WTP among tourists to conserve shark populations present in Costa Rica.

The first exercise of the survey is focused on eliciting the preferences of tourists for improving tourism infrastructure (beach and city infrastructure) or improving environmental resources (shark populations, sea turtle populations, and coral reefs). This is done through a discrete choice experiment which allows the respondent to choose between several policy options characterized by randomly-varying attribute levels and costs.

The other component of the questionnaire was directed at eliciting the preferences of tourists for conserving three types of hammerhead shark species (scalloped, smooth, and great hammerhead) that are either declared as endangered or "red-listed" by CITES. I use the double-bounded dichotomous choice approach to derive a mean WTP of the representative tourist population for the conservation of these unconserved shark species for an undefined policy period.

The foundation of this study is based on the stated preference method to estimate the ultimate value of a live shark in Costa Rica. Unlike revealed preferences which relies on observed behavior for welfare analysis, the stated preference approach allows us to elicit an individual's preferences through survey instruments (Pearce, 2002).

We understand that market values are based on the supply and demand of that particular good or service. That is, that consumers and producers reveal their preference for that good or service everytime they engage in buying or selling. Therefore, one may argue that the market for deceased shark fin and meat is a functional market with prices set by the demand of consumers and producers trying to meet this supply. However, a functional market for conserving live shark populations in Costa Rica does not exist. Therefore, we employ contingent valuation and discrete choice methods to investigate the overall economic value of live sharks in Costa Rica.

With this considered, the stated preference method is used to elicit respondents' preferences by observing their choices in a survey comprised of hypothetical scenarios (hypothetical costs associated with a particular good or service). Thus, giving us an alternative when we do not have market data for a non-market good (i.e. shark diving).

3.2 Experiment design

In this study, we use the DBDC and DCE methods to simulate different hypothetical policy scenarios that will elicit tourists' preferences for shark conservation in Costa Rica. Both of these methods belong to the same class of elicitation approaches described by Carson and Louviere (2011). Both designs ask whether a respondent would be willing to make a one-time payment (in USD, as a local airport tax) when entering Costa Rica through the Juan Santamaria airport. This payment would go to a fund that would be allocated toward the different policy options listed in each method. It was noted that once the policy was live, the effects would take 10 years to see.

DCE design

The DCE exercise asks respondents to decide between different policy options that either improve infrastructure or the environment (at different attribute levels and costs which vary at random). A status quo option was always provided to the respondent.

Our discrete choice experiment focused on eliciting tourists' preferences towards tourism infrastructure or environmental improvement. More specifically, improving city infrastructure (i.e. power lines, wi-fi, cellphone towers, etc), beach infrastructure (i.e. hotels, public restrooms, restaurants, etc), coral reefs, shark populations, and sea turtle populations. For the discrete choice experiment, we used five qualitative attributes (each with 3-5 levels) and cost.

The exercise asked respondents to choose between several policy options, including their most preferred and least preferred option. Figure 1 gives an example of a choice card used in this experiment. For the shark and sea turtle conservation policies, the status quos (SQ) are the expected outcome if no policy is adopted (populations to be reduced by 50% in the future). For all other attributes, the SQ is that there is no policy adopted, and the consequence is that the attribute remains as it is today. All status quo options cost nothing, cost US $0.

Figure 1: Discrete Choice Experiment, Sample Choice Card

FIRST CHOICE

	Policy A	**Policy B**	**No policy**
Coral reefs	15% less	50% less	50% less (with "no policy")
City infrastructure	0% change (like today)	0% change (like today)	0% change (like today)
Beach infrastructure	15% more	15% more	0% change (like today)
Shark population	50% less	30% more	50% less (with "no policy")
Sea turtle population	15% less	15% less	0% change (as today)
Cost (one-time payment)	$5	$20	$0
Most preferred option?	Policy A	Policy B	No policy

Each of the policy options, A and B, offers to improve each attribute (by an increased percentage) at a certain cost. For all attributes, respondents were told that the effects would be seen in ten years from today. There are between three and five levels of quanity for each qualitative attribute, and always five levels for the cost, as shown in table 2.

Table 2: Attribute levels for Discrete Choice Experiment

Name of the attribute	Level 1	Level 2	Level 3	Level 4	Level 5
Coral reefs	0% change (like today)	5% less	15% less	50% less (with "no policy")	
City infrastructure	0% change (like today)	15% more	30% more		
Beach infrastructure	0% change (like today)	15% more	30% more		
Shark populations	30% less	10% less	0% change (like today)	10% more	30% more
Sea turtle populations	15% less	5% less	0% change (like today)	5% more	15% more

Due to a large amount of permutations, and the vast complexity of this experiment, a full factorial design was not feasible. Instead, we employed a D-efficient designed generated by using the NGENE software (Choicemetrics 2014)[8]. A design is built on the linear indirect utility additive in attributes using following priors of utility:

[8] The NGENE software is a program designed to build experimental designs for choice experiments. See http://www.choice-metrics.com/

U(alt1) = b1[0.7]*CORAL[0,35,45,50] + b2[0.6]*CITY[0,15,30] + b3[0.6]*BEACH[0,15,30] + b4[0.5]*SHARK[0,20,40,50,60,80] + b5[0.4]*TURTLE[-15,-5,0,5,15] + b6[-1]*COST[5,10,20,45,90] /
U(alt2) = b1*CORAL + b2*CITY + b3*BEACH + b4*SHARK + b5*TURTLE + b6*COST /
U(alt3) = bSQ[-1]

Prior coefficients (priors) for the five policies (attributes) were initially defined according our prior expectations. These expectations were framed around the guidelines found in Bliemer and Collins (2016). we hypothesized that city infrastructure would be the most preferred (1.0), followed by beach infrastructure (0.7), sea turtles (0.6), coral reefs (0.5) and sharks (0.4). On the contrary, our pilot data affirmed that coral reefs were actually the most preferred, and sea turtles the least preferred. We adjusted our priors to the ones seen in the above coding.

The design for the DCE encompassed 120 choice situations divided in 20 blocks, yielding 6 choice sets per respondent; refer to Annex II.

Double-bounded dichotomous choice design

The double-bounded dichotomous choice question asked respondents whether they were willing to pay to conserve one of three hammerhead shark species. The DBDC design is comprised of two attributes: the size that a given shark population will be increased (in percentage points), and costs. One hammerhead shark species was always valued in one contingent task and the species was selected at random from the following three: the scalloped, smooth, and great hammerhead shark species. Two hammerhead shark species were valued by each respondent, and the second shark species was selected from the remaining two.

These three shark species are either red-listed (vulnerable) or endangered according to the IUCN and CITES and are found in Costa Rican waters. Specifically,

- **the scalloped hammerhead shark (Sphryna lewini)** is listed as *endangered* on IUCN Red List of Threatened Species
- **the great hammerhead shark (Sphryna mokarran)** is endangered, approaching extinction, and

- **the smooth hammerhead shark (Sphryna zygaena)** is vulnerable, meaning that it's population is considered threatened. It is also listed on the IUCN Red List of Threatened Species.

Unlike the DCE, where respondents were given three alternatives (two policy options and one status quo option), the DBDC exercise presented one of the three species to respondents as one alternative option, along with the status quo option. The status quo keeps the current situation saying that "this shark species is endangered", meaning that it's population is approaching extinction, and cost nothing. Table 3 describes the levels of the shark population increase and cost as used in this exercise. Four levels of the population increase and five cost levels give 20 total combinations of the choice set. The same levels of the population increase were used for each of the three shark species. Both the population increase and cost were attributed to each of the two tasks independently and at random.

Table 3: Attribute levels for CV exercise

Increase in shark populations (form the status quo level)	5%, 10%, 15%, 20% (SQ=0% increase)
Cost	\$10, \$30, \$50, \$90, \$150 (SQ=\$0)

The respondents were given the first choice question (with one hammerhead species at random) and were asked if they accept or reject the policy option and bid presented. If rejected, the bid would halve. If accepted, the bid would double and the respondent would be asked again if they accept or reject the new bid. The exercise was repeated once more, but with two of the remaining hammerhead species presented (at random).

3.3 Econometric model

DCE analysis

In the first valuation section, the discrete choice experiment was used to elicit preferences towards improvement of infrastructure (development) and environment (conservation). Since the DCE is comprised of multiple alternatives and responses, the conditional logit model was employed for analysis.

We assume that the responses to the discrete choice questions are driven by a random utility model (McFadden, 1974), where the indirect utility $\overline{V}$ from an alternative depends on the attributes of that alternative. Formally, we assume that:

$$(1)\ V_{ij} = \beta_0 + x_{ij}\beta_{ij} + (y_i - c_{ij})\beta_2 + \varepsilon_{ij}$$

Where y and c are respondents' income and the costs of the alternative, error term (ε) is i.i.d. type I distributed.

$$(2)\ \overline{V}_{ij} = \alpha_1 \cdot \mathbf{GOAL}_{ij} + \Delta CO2_{ij} \cdot \left(\alpha_2 + \mathbf{INSTR}_{ij}\boldsymbol{\alpha}_3 + \mathbf{X}_i\boldsymbol{\alpha}_4\right) + \beta \cdot (y - COST_{ij})$$

$$(3)\ V_{ij} = \alpha_1 * CITY_{ij} + \alpha_2 * BEACH_{ij} + \alpha_3 * CORAL_{ij} + \alpha_4 * SHARK_{ij} + \alpha_5 * TURTLE_{ij} + \beta_1(y_i - c_{ij}) + \varepsilon_{ij}$$

where subscripts i and j denote the individual and the alternative, respectively. Terms BEACH and CITY describes the improvements in beach and city tourist infrastructure (in percentage points), while SHARK, TURTLE, and CORAL are the three variables describing the three marine species (again expressed in percentage-point- improvments from the status quo level). The last two terms, y and COST are the respondent's income and the cost of the program (in USD one-time payment). In equation (1), the α's are the marginal utilities and β is the marginal utility of income.

Adding the stochastic component of indirect utility, the error term error ε, that is i.i.d. standard type I extreme value distributed, the probability that alternative k is chosen is

$$P_{ij} = \frac{\exp(V_{ij})}{\sum_{k=1}^{J} \exp(V_{ik})}$$

Furthermore, the probabilities of both CDLGT and MNLGT contribute to the log-likelihood function:

$$log\, L = \sum_{i=1}^{n}\sum_{j=1}^{J} y_{ij}\, log\, Pr(ij)$$

where $\boldsymbol{y_{ij} = 1}$ if individual $\boldsymbol{i}$ chooses alternative $\boldsymbol{j}$ and equals zero otherwise.
Two classes of multinomal logit models may be used to describe discrete choice data: while generalized MNL logit models utilizes the characteristics of the individual as explanatory variables (i.e. income, nationality, age, education) to estimate the probability to choose an alternative. The conditional logit, as proposed by McFadden (1974), models expected utilities in terms of characteristics of the alternatives in discrete data. The former model does not conform to RUM, and therefore, we rely on the conditional logit in our analysis.

This model allows us to identify how the cost and levels of the infrastructure (development) and environmental conservation policies affected the respondents' choice. Additionally, interacting an attribute with an individual's characteristics allows us to analyze observed heterogeneity in preferences for the concerned program's attributes.

We derive mean WTP values by using the following equation:

$$\frac{-\alpha}{\beta}$$

We derive the mean WTP for conserving environmental and infrastructure attributes, as well as the marginal mean WTP to conserve one additional attribute, by dividing the coefficients of the variables by the coefficient on "cost". Where α represents the coefficients on "BEACH", "CITY", "CORAL", "SHARK", or "TURTLE", and β is the coefficient on "cost" in the conditional logit regression.

Standard errors of the mean WTP is computed by the delta method in STATA.

3.3.1 Dichotomous choice questions

Again, we assume that the responses to our second valuation questions are driven by an underlying and unobservable WTP for an increase in shark populations:

$$\text{(2a)} \qquad \mathrm{WTP}_i^{hs*} = \alpha + \beta \mathrm{SHARK}_i^{hs} + \varepsilon_i .$$

This model assumes that the WTP changes in proportion to a change in the increase of hammerhead shark populations, SHARK, where i denotes the respondent. Term ε is assumed to be normally distributed with a mean of zero and the variance σ^2. Coefficient β measures the marginal WTP for one percentage point of shark populations saved.

There are several possible strategies to estimate the WTP. The simple model, as described by equation (2a), is used to estimate the WTP for one particular hammerhead shark species, described by the upper subscript *hs*. It implies an estimation of three logit models separately, one for each shark species. This model, as well as other models described below, may be appended by a dummy in order to control for whether WTP depends on whether a particular shark species was valued in first or second place (as every shark species might appear in first or second place, given at random).

In order to examine preference differences among the three hammerhead shark species, we may estimate equation (2b):

$$\text{(2b)} \qquad \boldsymbol{WTP}_{ij}^{*} = \alpha + \beta \cdot \mathrm{SHARK}_{ij} + \boldsymbol{SPECIE}_{ij}\boldsymbol{\delta} + \varepsilon_{ij}$$

where **SPECIES** is a vector of dummies for each of the three hammerhead shark species equal to one of the respective species valued, or zero otherwise. The subscript *I* denotes a respondent, while *j* equals to 1 or 2, depending on whether the first or the second WTP question is concerned. Coefficient δ measures the marginal WTP for conserving the respective shark species, regardless of the size of the population.

In the case where the two WTP questions are merged, in equation (2a) we may assume that the two WTP responses are independent. It is, however, more likely that the two WTP responses (provided by the same respondent) are correlated, then, the appropriate statistical model is a random-effects probit where the dependent variable is whether someone said he or she would pay for improvement of each of the two shark populations.

Another strategy for estimating WTP, assuming responses provided by the same respondent are correlated, is to estimate the bivariate logit model, as described in equation (2c):

$$\text{(2c)} \qquad \text{WTP}_{\text{i}}^{(1)*} = \alpha + \beta \cdot \text{SHARK}_{\text{i}}^{(1)} + \textbf{SPECIE}_{\textbf{i}}^{\textbf{(1)}}\boldsymbol{\delta} + \varepsilon_i^{(1)}$$

$$\text{WTP}_{\text{i}}^{(2)*} = \alpha + \beta \cdot \text{SHARK}_{\text{i}}^{(2)} + \textbf{SPECIE}_{\textbf{i}}^{(2)}\boldsymbol{\delta} + \varepsilon_i^{(2)}$$

Unlike the discrete choice experiment used in this thesis, the dichotomous choice exercise focuses on eliciting respondents' preferences towards sharks, solely. The contingent question includes two attributes only: the percentage increase in shark populations and the cost. An individual's preferences are elicited for three different hammerhead shark species valued in two independent contingent valuation tasks.

The double-bounded dichotomous choice approach first asks a respondent whether they will accept or reject an option (including a level and cost) presented. If they accept, the respondent will receive a follow-up bid. However, the bid will either double or be reduced by half.

We will outline the basic model for the double-bounded dichotomous approach as described by Hanneman in 1991. Suppose we have ***N*** survey respondents. Respondent $\boldsymbol{i}$ is offered the initial bid amount $\boldsymbol{B}_i$ and one of the follow-up bids, "$\boldsymbol{B_i^d}, \boldsymbol{B_i^u}$", where $\boldsymbol{B_i^d} \leq \boldsymbol{B_i} \leq \boldsymbol{B_i^u}$. In other words, if a respondent answers "yes" to the initial bid, the follow-up bid $(\boldsymbol{B_i^u})$ will be greater than the intial $(\boldsymbol{B_i} < \boldsymbol{B_i^u})$**.** If the respondent answers "no", then the follow-up bid will be smaller than the intial bid $(\boldsymbol{B_i^d} < \boldsymbol{B_i})$. Therefore, the four binary outcomes of this model are simple, "yes yes", "no no", "yes no", or "no yes". Thus, the function form for the probabilities of these outcomes are:

$$\pi_i^{yy} = 1 - G(B_i^u; \theta)$$

$$\pi_i^{nn} = G(B_i^d; \theta)$$

$$\pi_i^{yn} = G(B_i^u; \theta) - G(B_i; \theta)$$

$$\pi_i^{ny} = G(B_i; \theta) - (B_i^d; \theta)$$

Where ***G*** will be represented by the cumulative logistic function:

$$G(B_i;\theta) = \frac{\exp(\theta)}{1+\exp(\theta)}$$

where $\theta = \alpha + \beta B$.

If $\boldsymbol{d_i}$, is a binary indicator variable for the ***yes/no*** responses given by the respondent to the two bid offers, and π denotes the response probabilities, then the log-likelihood function for the DBDC model (parameterized by θ), is as follows:

$$lnL^D(\theta) = \sum_{i=1}^{n}\{d_i^{yy} ln\pi^{yy}(B_{i,}B_i^u, \pi) + d_i^{nn} ln\pi^{nn}\left(B_i B_i^d, \theta\right) + d_i^{yn} ln\pi^{yn}(B_i B_i^u, \theta) + d_i^{yn} ln\pi^{yn}(B_i B_i^u, \theta)\}$$

The maximum likelihood estimator (MLE) for the DBDC model, $\hat{\theta}$, is the solution to $\frac{\partial lnL^D(\hat{\theta})}{\partial\theta} = 0$.[9] The asymptotic variance-covariance matrix for the MLE ($\hat{\theta}$) is estimated by:

$$V^D(\hat{\theta}) = \left[-E\frac{\partial^2 lnL^2(\theta)}{\partial\theta\partial\theta'}\right]^{-1} = I^D(\widehat{\theta^D})^{-1}$$

3.4 Survey instrument

The survey was programmed into an online format tailored to tablet devices, and was only available in English language. The computer assisted mode of the survey allowed us to use filter questions and more importantly to attribute the two choice designs at random. It is to be noted that each choice task (the DCE and DBDC) was designed in such a way that the alternatives, levels, and costs (including which of the two hammerhead shark species will be valued in the DBDC tasks) varied at random. This design allowed more information to be gathered, and controlled for possible ordering bias. We, however, presented the DCE task first, followed by the two DBDC tasks.

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[9] http://www.webmeets.com/files/papers/EAERE/2009/835/DBDC%20_EAERE2009%20_Prasenjit.pdf

The U.S. Dollar was the selected currency for this study, since the USD is accepted everywhere in the country, and is a major world currency (we also allowed respondents to provide their income and travel costs in the currencies of their choice).

The survey structure was as follows:

- Screening questions
- Demographic information
- Questions about respondents' trip to Costa Rica
- Choice task 1 (DCE)
- Questions to elicit respondents' attitudes towards ecotourism and environmental conservation
- Explanatory text about the plight of sharks, their importance, and lack of legislation in Costa Rica to protect sharks.
- Choice task 2 (DBDC), followed by protest questions.
- Socio-demographic information

The survey included socio-demographic questions (gender, age, country of residence, education, income). We also asked respondents about their purpose for visiting Costa Rica, and questions about what they planned to see or do during their trip. This information would allow us to see the different reasons why people choose to visit Costa Rica, and whether ecotourism played a big factor in their decision to visit the country.

4 Data description

4.1 Data collection

The Computer-Assisted-Personal-Interviewing (CAPI) technique (using tablets) was used to collect data. Paper handouts with longer texts describing shark species, attributes used in the DCE, and information about shark fishing practices were also at the hands of interviewers.

Data collection was primarily self-funded by the author, and other funding was obtained from the Charles University Environment Center. Funding from Charles University allowed the author to increase the sample size from 500 to 800. A Costa Rican firm, Infinet, was hired to conduct the in-person interviews, maintain quotas, hire interviewers, and handle necessary permits needed to interview at the Juan Santamaria Airport. The representativeness of the sample was controlled through quota selection based on gender, age, and country of residence. Quotas were selected based on statistics obtained from the Costa Rican Tourism Board.

Data were collected by conducting person-to-person surveys. Interviewers were local residents, and were selectively hired so age and gender bias would be controlled for (all ages and equal males to females). Furthermore, interviewers were proficient English speakers. The survey instrument was programmed and maintained by the Centrum pro otázky životního prostředí of Charles University, including the result database and output data matrices. Respondents were selected at random in the departure terminal. Furthermore, only one member of a family could complete a survey.

A 2-day pilot was carried out between July 26-28th, 2016 to collect initial data and test the survey instrument. Once ~50 surveys were collected, the data collection was interrupted and the survey designs were optimized. The prior coefficients of the indirect utility function for the NGENE software were adjusted to get a more efficient design as follows: a higher coefficient for coral reefs, and a smaller coefficient for sea turtles. Additionally, bids for the discrete choice experiment were found to be too high.

The main wave of data collection began August 17th, 2016 and concluded September 25th, 2016. Data were collected on weekends, as the airport would permit. Data was pulled weekly to allow for quota management.

4.2 Respondent characteristics

Screening questions removed Costa Rican residents and individuals under the age of 18. In total, 800 completed interviews were collected. The sample is representative of all tourists visiting Costa Rica, with respect to quota on gender, age, and country of residence, see Table 4. We performed a chisquare test, and found sample shares were not statistically different from quota shares (p-value=0.99087429).

Table 4: Sample description compared to quota variables

	Quota set	Sample, N=801
Male	54%	55%
North America	47%	46%
Central & South America	35%	35%
Europe	13%	17%
Africa & Asia	4%	3%
18 - 34	38%	39%
35 - 54	38%	40%
55 - 100	24%	21%

Note: Quotas were selected based on statistics obtained from the Costa Rican Tourism Board [10]

Central & South America, Europe, and Africa & Asia. The most respondents came from the United States (37%) and Central & South America (35%) with the least amount of respondents coming from Africa and Asia (3%). Respondents from each region were, *on average*, between 36-42 years old. Descriptive statistics of the sample indicate that our respondents were highly educated (see table 5).

[10] http://www.ict.go.cr/en/

Table 5: Respondents' level of education

	N	Percent
Tertiary with professional qualification (12- 14 years of education)	147	19%
Tertiary first degree (BA, Bsc, or equivalent); 15-16 years of education	188	24%
Tertiary higher degree (MA, MBA, MSc, Mphil or equivalent); 16-19 years of education	250	32%
Doctorate (more than 19 years of education)	152	19%

About 68% of respondents were employed full-time, 9% were students, and 9% were retired. Fifty percent of respondents were married and 41% declared themselves as single. Forty-six percent of respondents did not have children, 25% had one child, and 18% has two children.

Table 6: Descriptive statistics of income according to region

	Personal Income			Household Income		
Country	**N**	**Mean**	**Median**	**N**	**Mean**	**Median**
USA	78	**$65,737**	$60,000	63	**$80,556**	$80,000
Canada	18	**$43,333**	$45,000	11	**$87,727**	$60,000
Central & South America	71	**$34,381**	$25,000	55	**$34,483**	$17,500
Europe	46	**$52,376**	$40,000	35	**$70,123**	$45,000
Africa & Asia	6	**$55,833**	$52,500	5	**$47,000**	$25,000

Of the reported income, survey participants from the United States reported the highest personal income and respondents coming from Central & South America reported the lowest (see Table 6). In terms of household income, Canadian respondents reported the highest income. Overall, the average personal and household incomes were USD $50,550 and USD $62,172, respectively. About 70% of respondents did not provide information about their income, with the highest share being in North America and Central & South America.

About 50% of tourists were visiting Costa Rica for leisure purposes, and 33% for business purposes (Table 7). Sixty-two percent of respondents planned their trip to Costa Rica "several months ago", 20% answered "a month ago", and 11% said it was a spontaneous decision. The average group consisted of two people (including the respondent), and when asked how many people was the respondent paying for, the average was one person (i.e. the respondent).

Table 7: Tourists' purpose of visit

Purpose	N	Percent
Business	269	33%
Leisure	409	50%
Family	95	12%
Student	28	3%
Volunteer	17	2%

Fifty-six percent of respondents said that it was their first time visiting Costa Rica, and 19.5% said it was their second. The median length of stay was 9 nights. In a question asking respondents what was important when deciding on a destination to spend their vacation, most answered to experience a new destination, to relax, spend time with family and friends, and the value of a destination as being very or extremely important (table 8). The option "to see sharks" was one of the least important factors for respondents when choosing a new destination to visit, only 3.3 %.

In a similar ranking exercise, respondents were asked to rank reasons why they visited Costa Rica in order of importance to them. A ranking between four and five indicated that a factor was very (4) or extremely (5) important in their decision to visit Costa Rica. Respondents, on average, said that the most important reasons were Costa Rica's variety of flora and fauna, its status as one of the most biodiverse countries in the world, and how it is well-marketed as a great tourist destination. The least important reason was Costa Rica's large range of accommodation based on price and style. Ninety-three percent of respondents said that the planned to visit Costa Rica again in the future.

Table 8: Factors determining tourists' decision to visit Costa Rica

	N	Mean	Std Dev
To relax	781	4.72	0.64
To experience a new destination	781	4.75	0.56
To spend time with my family/friends	781	4.54	0.81
For educational purposes (learn something)	781	4.20	1.07
The variety of accommodation options	781	4.28	1.01
The value (money)	781	4.46	0.91
To take pictures of nature (plants and animals)	781	4.38	0.87
To see sharks	**781**	**3.30**	**1.44**
I like ecotourism	781	4.31	0.87
To see a marine habitats	781	4.03	1.00
Types of species	781	4.11	0.94
The ability to see a species in person, up close.	781	4.24	0.90
The ability to see a species you've never seen before.	781	4.35	0.90
Information about flora and fauna available at national parks.	781	4.06	0.97
Available route maps, with descriptive information	781	3.91	1.09
Diverse marine habitats	781	4.01	0.99
Fishing Charters	781	3.49	1.46

Most tourists visited Costa Rica's famous national parks, volcanoes, and beaches (see table 9). Only 14% respondents observed saw marine species such as turtles, coral reefs, and sharks in their natural habitat. An even smaller number of respondents (6%) went scuba diving.

Table 9: What did respondents see or do while in Costa Rica?

What did respondents see or do?	N=801
Visited national parks	57%
Visited the cloud forest	31%
Saw or hiked volcanoes	56%
Visited a beach	57%

Saw marine species like fish, turtles, or sharks in their natural environment	14%
Scuba Diving	6%

Fifty-eight percent of respondents visited a beach during their stay. The respondents who visited a beach were asked if they participated in any beach activities in a follow-up question. In table 10, we can observe that *most* respondents went swimming at the beach (51%), and did not engage in activities such as snorkeling (17%) or scuba diving (6%). In two additional follow-up questions, we asked respondents if they planned to see sharks *during their trip*, and if they ever went scuba diving or snorkeling with sharks or other marine species- 7.5% planned to see sharks and 22% dove with sharks or other marine species in the past.

Table 10: Beach activities

Beach activities that respondents participated in	N=801
Swimming	51%
Snorkeling	17%
Watersports	21%
Scuba Diving	6%

Another component of the survey instrument tests respondents' knowledge of ecotourism and shark fishing. Respondents were asked to select an option that best describes the definition of "ecotourism". Results indicated that respondents knew about ecotourism and its benefits- as 96% of respondents answered correctly.

In the contingent valuation component of the survey, we included a section that would elicit perceptions toward the risk of a shark attack. This included a ranking exercise which required respondents to rank five events according to their risk of death, including risk of dying due to shark attack. Interestingly, nearly all respondents ranked the events in their exact order, meaning that fatal shark risk was valued at the last place. When shown the actual risk ladder afterwards (table 11), respondents were asked whether they trust the information provided to them, of which 97% answered yes.

Table 11: Risk ladder

Disease and Accidental Causes of Deaths	Annual Deaths	Death Risk During One's Lifetime
Heart disease	652,486	1 in 5
Cancer	553,888	1 in 7
Stroke	150,074	1 in 24
Hospital Infections	99,000	1 in 38
Flu	59,664	1 in 63
Car accidents	44,757	1 in 84
Suicide	31,484	1 in 119
Accidental poisoning	19,456	1 in 193
MRSA (resistant bacteria)	19,000	1 in 197
Falls	17,229	1 in 218
Drowning	3,306	1 in 1,134
Bike accident	762	1 in 4,919
Air/space accident	742	1 in 5,051
Excessive cold	620	1 in 6,045
Sun/heat exposure	273	1 in 13,729
Lightning	47	1 in 79,746
Train crash	24	1 in 156,169
Fireworks	11	1 in 340,733
Shark attack	**1**	**1 in 3,748,067**

Source: https://www.flmnh.ufl.edu/fish/isaf/what-are-odds/risks-comparison/risk-death/

Following the risk section, respondents were provided with information regarding shark fishing, and the current status of red-listed three hammerhead species in Costa Rica. Respondents were asked whether they heard about this problem, and if they consider it a relatively serious problem. Forty-five percent of respondents indicated that they have heard about this problem, but however, did not think it was so serious. Forty-one percent of respondents never heard of the problem, and 13% heard of the problem and were aware of how serious it is. The fourth result revealed something interesting, 1% of respondents did not trust this information or thought this information was correct. This results implies that respondents may trust our information and the scenarios provided in each exercise. Furthermore, the 1% may be the "protestors".[11]

[11] Respondents that answer "no" because they do not trust the information, or do not take the survey seriously. Protestors may also not agree with the information provided, and perhaps suggest a different solution or answer.

5 Results

This chapter introduces the final results of the discrete choice experiment and contingent valuation exercise used in this research. A sub-chapter summarizing the main results are provided in the overview, followed by a more detailed description of the results for each experiment.

5.1 Discrete choice experiment

In the discrete choice experiment, we elicit tourists' preferences for environmental improvement and infrastructure development by providing tourists with a trade-off between environmental-specific attributes, infrastructure (city and beach) related attributes, and the cost. We analyze this data by using conditional logit. The results for the general tourist population are reported in tables 12 (model A) and 13, whilst the results for the conditional logit augmented with interaction terms (between the attributes and respondent-specific variables) are presented in tables 13 (model B), 14 to 15. We also estimate conditional logit to examine the differences for the cleaned sample (excluding speeders) and the full sample including speeders (tables 21-23). Data were analyzed using the SAS software package.

5.1.1 Conditional logit regression

Model (2) reported in Table 12 uses the alternative-specific constant only, without controlling for the qualitative attributes to get the willingness to pay for the proposed program. We find that tourists are willing to pay on average **$58.88**, as a local entrance (one-time payment) tax, if it would go into a fund to finance environmental improvement **or** tourism infrastructure development.

When we exclude speeders from the analysis, we find that the WTP for all attributes doesn't drastically change- there are only minor changes. Willingness to pay for the program slightly decreases from **$58.88 to $55.76**. In fact, when we isolate speeders and run the model, we find that all attributes increase and remain significant. Willingness to pay for the program almost doubles to $94.06. Robustness check of the analysis is displayed in detailed in Appendix.

Table 12: Conditional logit results of the whole program, model 2

	coeff	standard error	t-stat	approx pr > |t|	WTP
program	0.5505	0.0423	13	<.0001	**$58.88**
COST	-0.009349	0.000806	-11.6	<.0001	

In our basic model (Table 13, left panel) we found a positive WTP for both city and beach infrastructure development, as well as for conserving shark populations, as all coefficients are positive and significant at any convenient level. Coefficient on COST (used in USD) is always negative and significant, indicating that the higher cost, the lower probability to choose the program is. In contrast to our prior expectations, the coefficient for conserving coral reefs was not statistically different from zero, and the coefficient for conserving sea turtles was only significant at the 10% level.

All qualitative regressors CITY, BEACH, SHARK, CORAL, and TURTLE are expressed in perecentage points- improvement, and hence, the respective coefficients indicate marginal utility associated with this change.

Table 13 also reports the implicit willingness to pay values per percentage point, for instance, the marginal willingness to pay for avoiding the extinction of shark populations by one percentage point is $0.35. It also implies that the WTP for avoiding the 50% extinction of shark populations is $17 and WTP for conserving the whole shark population (that is avoiding shark population extinction entirely; is $35 (i.e. $0.35 * 100%).

Table 13: Conditional logit results for each attribute

	MODEL 1A				MODEL 1B			
	Coeff.		t-stat	WTP per %point	Coeff.		t-stat	WTP per %point
CITY	0.0123	***	7.24	$1.04	0.0124	***	7.31	$1.05
BEACH	0.0102	***	6.24	$0.86	0.0156	***	7.17	$1.32
BEACH x VISIT					-0.0100	***	-3.79	$0.85
CORAL	0.0000		-0.01	$-0.00	0.0000		0.03	$0.00
SHARK	0.0041	***	4.8	$0.35	0.0035	***	3.94	$0.30
SHARK X SEE					0.0036	**	1.97	$0.31
SHARK x DIVE					0.0012		0.43	$0.10
TURTLE	0.0029		1.37	$0.24	0.0043	*	1.89	$0.36
TURTLE x SEE					-0.0154	**	-2.32	$1.31
TURTLE x DIVE					0.0160		1.58	$1.36
COST	-0.0118	***	-10.01		-0.0118	***	-9.99	
NUMBER OF CASES.	14040				14040			
LOG LIKELIHOOD	-5063				-5072			
LOG LIKELIHOOD NULL (LOGL(0)).	-5142				-5181			

Note: Significance: *** (1%), ** (5%), * (10%)

Detailed investigation in model 1A suggests however that tourists are willing to pay 3-4 times more for development of tourism infrastructure **(~$1 per each percentage point**) than for conserving the environment. Tourists are willing to pay *more* for a shark conserving policy (**$0.30** per percentage point improvement) rather than for conserving sea turtles (**$0.36 per %point**), whereas they are not willing to pay anything for improving coral reefs.

Model 1B, right panel, aims at the effect of visiting the beach, seeing turtles and diving with sharks on WTP, interacting respective qualitative attributes with respective dummies VISIT, SEE, and DIVE. We apply both the qualitative attribute and the interaction in an additive form in the model. A positive coefficient on the interaction, hence, implies a positive (additional) WTP for the respective qualitative attribute. For instance, model 1B suggests that respondents who did not see the beach (VISIT=0) are willing to pay for beach infrastructure $1.32 per %point, while tourists who went to the beach (VISIT=1) are willing to pay in total $0.47, that is \$1.32 + \$0.85. Without controlling for the effect of visiting the beach, WTP for beach infrastructure is for the average tourist \$0.86 (model 1A).

Alternatively, we interact two dummies for diving or viewing with sharks and turtles individually. We observe that tourists who observed sharks (SEE=1) in their natural habitat (but did not scuba dive or snorkel, DIVE=0) had a WTP of **\$0.31** per percentage points larger than those who did not see nor dive with sharks. Those who dove with sharks (DIVES=1) but did not observe them (SEES=0) share a WTP with the reference group (DIVES=0, SEES=0), that is approximately **\$0.30** per percentage point. It implies that WTP for those who observed sharks is twice as large as the WTP for those who did not see or dive with sharks.

Furthermore, we are interested in knowing whether tourists coming from different parts of the world are willing to pay different amounts for conserving sharks. We are also interested to know whether WTP for other attributes vary across regions. Doing so, we introduce the interaction terms between all qualitative attributes and regional dummies, assuming the same marginal utility of income across the regions. We report the results for each of the three regions including the United States and Canada. Nevertheless, we note that there are very few respondents from Africa & Asia to conclude about their WTP values.

Interestingly enough, as reported in Table 14, we find that tourists from the United States and Canada had the highest WTP for conserving sharks (\$0.84 and \$0.58 per percentage point, respectively). Coefficients for the interactions with Europe, Central & South America, and Africa & Asia were not significant, indicating that WTP for these three regions is on average the same among them and is not statistically different from zero.

We further see that tourists from the United States and Canada have the highest average WTP for beach infrastructure development (**\$0.91** and **\$1.57** per percentage point, respectively) and for city infrastructure development (**\$1.39** and **\$1.27** per percentage point, respectively). WTP for BEACH and CITY infrastructure is positive and significant for visitors from all regions, but Africa & Asia (noting there are very few observations). When interacting region with coral reefs, we find a positive WTP for tourists from the United States **(\$0.36**) and especially from Canada (\$**0.47**), a negative WTP for tourists from Central & South America **(\$0.34**). Whilst, the coefficient for the interaction term with Europe and Africa & Asia is virtually not different from zero. All regional values for conserving sea turtles seems to not be different from zero, with weak a tendency of Europeans to pay something for sea turtle conservation.

Table 14: Conditional logit regression for attributes according to region

	Coeff.	Std.	t-stat	p-value	CI low	CI hight	WTP
SHARK x USA	0.008	0.001	5.1	0	0.005	0.010	0.58
SHARK x CANADA	0.011	0.003	3.64	0	0.005	0.017	0.84
SHARK x CS AMERICA	0.001	0.001	1.07	0.285	-0.001	0.004	0.11
SHARK x EUROPE	0.002	0.002	1.06	0.289	-0.002	0.007	0.19
SHARK x AFR ASIA	0.000	0.005	0.06	0.949	-0.009	0.009	0.02
BEACH x USA	0.012	0.003	4.24	0	0.006	0.017	0.91
BEACH x CANADA	0.021	0.006	3.59	0	0.009	0.032	1.57
BEACH x CS AMERICA	0.010	0.003	3.06	0.002	0.003	0.016	0.73
BEACH x EUROPE	0.009	0.004	2.29	0.022	0.001	0.017	0.71
BEACH x AFR ASIA	0.006	0.009	0.66	0.512	-0.012	0.024	0.46
CITY x USA	0.018	0.003	6.69	0	0.013	0.024	1.39
CITY x CANADA	0.010	0.005	1.82	0.069	-0.001	0.020	0.75
CITYx CS AMERICA	0.007	0.003	2.2	0.028	0.001	0.013	0.51
CITY x EUROPE	0.017	0.004	4.1	0	0.009	0.025	1.27
CITY x AFR ASIA	0.017	0.016	1.08	0.279	-0.014	0.047	1.29
CORAL x USA	0.005	0.002	2.37	0.018	0.001	0.009	0.36
CORAL x CANADA	0.006	0.003	1.76	0.078	-0.001	0.013	0.47
CORAL x CS AMERICA	-0.004	0.002	-2.24	0.025	-0.008	-0.001	0.34
CORAL x EUROPE	0.002	0.003	0.49	0.625	-0.005	0.008	0.12
CORAL x AFR ASIA	-0.006	0.007	-0.81	0.419	-0.019	0.008	0.43
TURTLE x USA	0.000	0.003	0.05	0.959	-0.006	0.007	0.01
TURTLE x CANADA	0.002	0.007	0.3	0.763	-0.012	0.016	0.16
TURTLE x CS AMERICA	0.003	0.004	0.96	0.335	-0.004	0.010	0.26
TURTLE x EUR	0.007	0.005	1.3	0.195	-0.003	0.016	0.50
TURTLE x AFR ASIA	0.016	0.011	1.43	0.153	-0.006	0.037	1.19
cost	-0.013	0.001	-9.39	0	-0.016	-0.010	-1.00

Wald chi2(26)=188.94	**Log pseudolikelihood = -4972.4632**
Prob>chi2=0	Pseudo R2 = 0.0329

Next, a model that includes the interaction terms between the qualitative attributes and sociodemographic variables is estimated. We find that the WTP for the conservation of sharks is positively correlated with household income, HINCOME (Table 15), both expressed in 10,000 USD a year (they are equal to 0, if income was not reported). In other words, WTP for shark conservation is increasing by $0.0160 for each 10,000 of respondent's (household) income. In order to control for the effect of those who did not report their income (71%), we introduce another interaction terms with dummy HINCOME missing, respectively. These coefficients are also positive and significant, and especially for the former term it gets a value that is more than ten times larger that coefficient for 10,000-high respondnet's income. This very strong effect on WTP may indicate that the respondents who did not report personal income might be quite rich as their WTP for conserving sharks corresponds to the WTP of respondnets with about 110,000 USD a year. WTP of those who did not report respondent's household income corresponds to WTP of respondents with only 13,000 USD. The preferences of males to protect sharks are the same as women.

Table 15: Conditional logit for household income and gender

	coeff.	s.e.	z-stat	p-stat
city	0.0126	0.0018	6.99	0.0000
beach	0.0103	0.0019	5.45	0.0000
coral	0.0002	0.0013	0.17	0.8661
shark	-0.0150	0.0034	-4.46	0.0000
turtle	0.0031	0.0021	1.45	0.1470
cost	-0.0122	0.0014	-8.87	0.0000
shark x male	0.0020	0.0019	1.04	0.2960
shark x hinc	0.0160	0.0043	3.71	0.0000
shark x hincmiss	0.0205	0.0034	6	0.0000
Number of observations = 14004				
LogLik= -4992.7452				
Pseudo R2= 0.0264				

Furthermore, we investigate whether WTP for the conservation of sharks is positive correlated with personal income, age, and education. We found that WTP for the conservation of sharks is positively correlated with personal income, and tertiary education with a professional qualification (12-14 years of education). The coefficient on age and higher education (bachelor, master, and doctorate) in neither case (these results are available upon request).

Tourists who are students, who have children, as well as who has a couple are willing to pay less for shark conservation (Table 16).

Table 16: Conditional logit results for occupation, group size, and children

	coeff.	s.e.	Z	P>|z|
city	0.0130	0.0018	7.16	0.0000
beach	0.0107	0.0019	5.66	0.0000
coral	0.0007	0.0014	0.52	0.6013
turtle	0.0029	0.0021	1.4	0.1634
cost	-0.0128	0.0014	-9.19	0.0000
shark	0.0014	0.0042	0.34	0.7352
shark x retired	0.0013	0.0037	0.37	0.7151
Shark x student	-0.0203	0.0042	-4.83	0.0000
shark x children	-0.0037	0.0010	-3.72	0.0000
shark x alone	-0.0002	0.0025	-0.08	0.9343
shark x couple	-0.0093	0.0034	-2.77	0.0061
shark x edu2	0.0043	0.0029	1.45	0.1472
shark x edu3	0.0032	0.0026	1.22	0.2214
Number of observations =14040				
Pseudo R2= 0.0361				
LogLik = -4955.8383				

In the survey instrument we provided respondents with exercises that would test their trust of the information provided to them and whether they thought the current situation with shark overfishing was serious or not (SERIOUS). We interacted this variable with the shark conservation attribute and found that the coefficient is not statistically different from zero (table 17), implying that the WTP of respondents who thought this problem is serious is just the same as the WTP of the others.

Furthermore, we incorporated a ranking exercise into the survey instrument that would elicit tourists' preferences for sharks (how much they like sharks) in comparison to other flora, fauna, and attractions like volcanoes, rivers, and waterfalls. For tourists' who ranked sharks as what they like most (RANK), counter to our expectation, we see that they have a negative WTP for shark conservation.

Table 17: Conditional logit results for specific survey exercises

	coeff.	s.e.	t-stat	p-value	**WTP**
city	0.012	0.002	6.92	0.000	**$1.04**
beach	0.010	0.002	5.44	0.000	**$0.86**
coral	0.000	0.002	0.01	0.992	**$0.00**
turtle	0.003	0.002	1.38	0.166	**$0.24**
shark	0.004	0.001	2.44	0.015	**$0.30**

shark x serious	-0.003	0.003	-0.93	0.351	**$0.23**
shark x rank	-0.006	0.004	-1.74	0.082	**$0.52**
cost	-0.012	0.001	-8.75	0.000	

5.1.2 Aggregate WTP results

In section 5.1.1., we estimated the marginal WTP for the five attributes used in the discrete choice experiment, as well as for the whole program. We found that tourists are willing to pay $17 to avoid the 50% extinction of shark populations – that is, as presented in the survey, expected size of shark population to be extinct in next 10 or more years, and $35 to avoid their full extinction.

According to the Costa Rica Tourism Board (ICT), 2.66 million tourists visited Costa Rica in 2015. If we use these estimates, we may calculate an aggregate WTP of **~$156,620,800** for the whole program. If we focus on shark prevention we get total WTP that corresponds to **~$45.22 million** to avoid the 50% extinction (in the coming decade), or **~$93.1 million** to avoid the full extinction of shark populations in Costa Rica.

5.2 Contingent valuation results

The contingent valuation exercise elicits preferences for the conservation of three endangered or red-listed hammerhead species found in Costa Rican waters. This experiment used a double-bounded dichotomous choice format. Both single-bounded (SBDC) and double-bounded choice data are analyzed. First, we present results of the basic models for all three analyzed hammerhead species. After, we present the extended WTP model in which we examine how WTP for protecting the hammerhead sharks is associated with respondent-sepcific characteristics.

We note that as we asked each of 780 respondents to value two out of the three hammerhead shark species, we have in total about 520 observations for each hammerhead specie (that is, 780*2/3). The two hammerhead species were attributed to each respondent at random and each hammerhead specie was valued either in the first or second place.

To sum up, WTP for all three hammerhead shark species (scalloped, smooth and great) is positive. The WTP estimates for smooth and scalloped hammerhead species were consistently larger than the estimates for the great hammerhead species for both SBDC and DBDC models. Simple investigation of yes responses seems to indicate, however, there might be an embedding problem, as the share of yes responses is not always increasing with the quantity, i.e. how many percent of the given hammerhead population might be protected (5%, 10%, 15%, or 20%). We note however, this might be due to the small size of subsamples that we analyzed (3 hammerhead species times 2 orders, gives the sample of about 260 only).

We focus our further attention to the results based on the DBDC data, since it provides us with more information than the SBDC model. Results based on the SBDC responses are reported at the beginning, as a part of our robustness check.

5.2.1 Single-bounded dichotomous choice responses

The probability to say yes is decreasing with the bid for both dichotomous questions and for all hammerhead species (reported in Annex II), that is also reflected by significant and negative coefficient in logit model using the SBDC responses. We do not observe such a linear trend for the quantities; probability to pay for the protection program does not always increase with the size of hammerhead population to be protected (Annex II).

We estimate logit with BID in USD and QUANTITY that is expressed in percentage points. Moreover, the order in which the valuation question is asked might affect the stated WTP (Bateman et al, 2004; Longo, 2015). n order to control for the effect of the order, we also introduce the third term that is a dummy that equals to one if the valuation question was asked at the first place.

In our first model, we pooled data from the two SBDC questions (N=1,566), controlling for every hammerhead species (dummies scalloped, great, smooth), bid and quantity, and whether the valuation question was placed at the first place. Coefficient on bid is significant and negative, as theory suggests. However, the coefficient on quantity is not significant and is even negative (although it's absolute value is very small). This indicates an embedding bias, that is, respondents are willing to pay for the conservation program, however, they do not pay attention for the size of population to be saved. WTP for the great hammerhead shark is lower (about $33.5), while WTP for the two remaining hammerhead species is the same, about $39, regardless what the size of population is. When data are pooled, it seems the order did not matter.

Table 18: Test for effect of order on WTP

Variable	Coefficient		t-stat	Implicit WTP
BID	-0.034	***	-16.94	
QUANTITY	-0.002		-0.18	0.06
Scalloped	1.315	***	6.51	38.79
Great	1.13	***	5.66	33.54
Smooth	1.307	***	6.25	38.54
first	0.117		0.95	(3.45)
No obs	1566			
Log Lik	-783.61			
Likelihood Ratio (R)	511.57			
McFadden's LRI	0.2461			

Note: Significance *** (1%), ** (5%), * (10%)

In the next three logit models, we analyze preferences for one hammerhead species, assuming the two responses are not correlated. Again, the coefficient on cost (BID) is significant and negative. Now, however, coefficient on QUANTITY is positive and always significant at any convenient level, implying that the WTP per one percent of hammerhead populations saved at $1.77 for great, $1.91 for smooth, and $2.20 for scalloped hammerhead sharks. For the largest population increase, by 20%, the corresponding WTP figures are $35, $38, and $44. Interestingly, asking the WTP question at the first place resulted in higher WTP when great ($13.70) or smooth hammerhead sharks ($16.50) were valued, both at the 5% level, but the order did not have an effect when scalloped hammerhead was valued (p=0.104).

Table 19: SBDC model for each hammerhead species

	Scalloped hammerhead			Smooth hammerhead			Great hammerhead		
	coeff		t-stat	coeff		t-stat	coeff		t-stat
BID	-0.0274	***	-9.54	-0.0272	***	-9.76	-0.0313	***	-9.53
QUANTITY	0.0602	***	4.90	0.0521	***	4.48	0.0552	***	4.31
first	0.3189		1.62	0.4498	**	2.23	0.4299	**	2.18

WTP per %point	2.20	1.91	1.77
No obs.	512	523	531
LogLik	-271.07	-268.65	-267.46
LL ratio	143.82	154.58	165.46
McFadden's LRI	0.2097	0.2234	0.2362

Note: Significance *** (1%), ** (5%), * (10%)

Assuming the two responses are correlated, the bivariate logit model may be estimated. Without controlling for the hammerhead species, the WTP for the conservation program is very similar for the first and second question - $39.40 and $40.70. The rho value indicates that the two responses are correlated

Table 20: The bivariate logit model

CV1	coeff	p-value	t-stat
Intercept	0.6335	***	5
bid	-0.0161	***	-13.76
quantity	0.0006		0.08
CV2			
Intercept	0.8762	***	6.52
bid	-0.0215	***	-15.13
quantity	-0.0034		-0.41
_Rho	0.7646	***	19.5
Number of Obs.	783		
Log Likelihood	-716.31		
AIC	1447		

Note: Significance *** (1%), ** (5%), * (10%)

5.2.2 Double-bounded dichotomous choice responses

To obtain estimates of the willingness to pay for the hammerhead species conservation program, we combine the responses to the initial (first) and follow-up (second) valuation question that allow us to form intervals around the respondent's unobserved WTP amount. Next we assume that WTP follows a certain distribution in the sample and specify an interval data model of the responses (Kaninen, 1993; Alberini 1995). This model is estimated by the maximum likelihood method.

Table 21 reports the simple interval-data model that includes the incercept only. Assuming normal distribution, this coefficient can be directly interpreted as the mean WTP estimate. Using DBDC responses, we find that mean WTP for is larger than in the SBDC model for all hammerhead shark species. Results indicate that tourists are willing to pay (for conservation) **$55.88** for smooth hammerheads, **$52.79** for scalloped hammerheads, and **$45.66** for great hammerhead sharks.

Table 21: SBDC model for each hammerhead species

	Great Hammerhead			Smooth Hammerhead			Scalloped Hammerhead		
	coeff		**s.e**	**coeff**		**s.e**	**coeff**		**s.e**
Intercept	3.8681	***	0.0578	4.0336	***	0.0543	4.0118	***	0.0587
Scale	1.0927		0.0582	1.0183		0.0539	1.0898		0.0603
Weibull Scale	47.8501		2.7665	56.4651		3.0676	55.2438		3.2424
Weibull Shape	0.9152		0.0487	0.982		0.052	0.9176		0.0508
No. Obs used	**531**			**523**			**512**		
LogLik	**-581.8514**			**-574.4021**			**-576.8953**		
(-2) LogLik	**1163.703**			**1148.804**			**1153.791**		
Mean WTP	**$45.66**			**$55.88**			**$52.79**		
Median WTP	**$32.06**			**$38.88**			**$37.05**		

Note: Significance *** (1%), ** (5%), * (10%)

Furthermore, we investigate whether WTP varies depending on which place the payment question was asked. Without controlling for the hammerhead species, we found that WTP for the program (based on the coefficient on intercept) is $35.10 for the first question and $40.70 for the second question, indicating that the order does not make a large difference. The coefficient on quantity is not significant in neither case (these results are available on request).

To test the internal validity of the responses, we run the regressions for each hammerhead species separately relating WTP and socio-demographic characteristics. These include: age,

region, gender (male=1), personal income (in $10,000), respondents who did not have any children (childless), education (edu2, edu3), retired respondents, and students. We refer to "edu2" as respondents with a tertiary education with professional qualification(s), and "edu3" as those with higher tertiary degrees (bachelor, master, and doctorate level). We also include variables that elicit preferences for sharks and marine wildlife. We do this by incorporating respondents who planned to view marine wildlife and sharks, as well as those who believed that the present problem of shark degradation was serious. Lastly, we include respondents who said that seeing sharks was a very or extremely important factor when deciding to visit Costa Rica (see Appendix I, question C3). We find that household income is not significant.
The Weibull distribution fits our data the best.

Table 22: Extended regression results for hammerhead species

	SCALLOPED HAMMERHEAD			SMOOTH HAMMERHEAD			GREAT HAMMERHEAD		
	Coeff.		s.e.	Coeff.		s.e.	Coeff.		s.e.
INTERCEPT	**2.454**	***	1.466	**3.334**	***	0.461	**4.131**	***	0.502
QUANTITY	**0.002**		-0.018	**0.011**		0.010	**-0.004**		0.010
MALE	**-0.072**		-0.300	**-0.116**		0.111	**-0.056**		0.113
AGE	**-0.559**		-1.633	**-0.320**		0.512	**-0.151**		0.510
PERSONAL INCOME	**0.039**	***	-0.001	**0.069**	***	0.024	**0.033**		0.022
MISSING PERS. INCOME	**0.143**		-0.196	**0.373**	**	0.182	**0.098**		0.174
USA	**1.804**	***	1.007	**0.524**	*	0.319	**-0.241**		0.370
CANADA	**1.508**	***	0.620	**0.550**		0.356	**-0.127**		0.414
CSAMERICA	**1.336**	***	0.552	**0.051**		0.317	**-0.553**		0.374
EUROPE	**1.509**	***	0.696	**0.504**		0.329	**0.023**		0.377
STUDENT	**-0.108**		-0.563	**0.217**		0.232	**0.126**		0.236
RETIRED	**0.229**		-0.242	**0.499**	**	0.225	**-0.003**		0.224
EDU2	**0.448**	**	0.101	**0.196**		0.168	**0.420**	***	0.158
EDU3	**0.084**		-0.223	**-0.248**	*	0.146	**0.219**		0.143
CHILDLESS	**-0.232**	*	-0.496	**-0.252**	**	0.124	**-0.240**	*	0.124
TOSEEMARINE	**-0.185**		-0.531	**-0.362**	**	0.156	**-0.271**		0.167
PLANVIEWSHARKS	**0.269**		-0.169	**0.168**		0.224	**0.122**		0.218
C3SHARK	**0.079**		-0.155	**0.083**		0.111	**0.191**	*	0.110
SHARKSERIOUS	**0.084**		-0.234	**0.171**		0.167	**0.264**		0.175
SCALE	**1.010**		0.903	**0.959**		0.053	**0.9629**		0.052

WEIBULL SHAPE	**0.991**	0.056		0.057	1.0385	0.057
NO OBS.	**504**		522		518	
LOGLIK	-540.01		-536.51		-547.32	
-2*LL	1080.24		1073.022		1094.637	

Note: Significance *** (1%), ** (5%), * (10%)

According to table 22, WTP for scalloped hammerhead sharks is positively correlated with personal income, region (all regions), and education (tertiary with professional qualification, or edu2). The variable "childless" had a negative coefficient, indicated that respondents who do not have children were *less* likely to accept the offered bid.

WTP for smooth hammerhead species (table 22) is positively correlated with personal income, missing income (tourists who did not provide their income), the United States (region), and "retired" tourists. WTP is negatively correlated with high education (tertiary with bachelor, master's, or doctorate degrees; edu3), and for tourists with no children. The variable "toseemarine" had a negative coefficient, indicating that respondents who planned to see marine wildlife during their trip in Costa Rica were *less* likely to accept the offered bid.

The results for great hammerhead sharks is different from scalloped and smooth hammerhead shark species (table 22). The variable "edu2" is positively correlated with WTP for great hammerhead sharks, indicating that respondents with professional qualifications are *more* likely to accept an offered bid. The variable "C3shark" becomes significant and positively correlated with WTP, revealing that respondents who said that seeing sharks was an important factor when deciding on a destination to visit were *more* likely to accept a bid for great hammerhead sharks. The variable "childless" is negatively correlated with the WTP for great hammerheads, following the same trend as the other two shark species. Personal income is no longer significant. The coefficients of males are not statistically different from females for all hammerhead shark species.

5.2.3 Aggregate WTP results

Aggregate willingness to pay for the conservation of three hammerhead shark species (scalloped, smooth, and great) may be calculated using the mean WTP values per person, per hammerhead species. Our estimates being, **$55.88**for smooth hammerheads, **$52.79** for scalloped hammerheads, and **$45.66** for great hammerhead sharks according to our DBDC model. These estimates were multiplied by statistical information of the representative tourist population for Costa Rica, obtained from the Costa Rican Tourism Board website (http://www.ict.go.cr/es/). The tourist population who visited Costa Rica last year was estimated to be approximately 2.66 million people.

Using these statistics, we calculate an aggregate WTP of **~$140,421,849** for scalloped hammerhead sharks, **~$148,653,737** for smooth hammerhead sharks, and **~$121,474,447** for great hammerhead sharks. Aggregate WTP estimates may encourage the implementation of an “airport” or “local tax” in which funds could be allocated to the conservation of one or all of these hammerhead shark species which are red-listed or endangered.

5.3 Comparing results to original hypotheses

In this section, we compare the results to our original hypotheses, and research questions.

Hypothesis #1: Tourists are willing to pay a significant amount of money in order to reduce the rate of shark extinction.

Indeed, we find that tourists are willing to pay a significant amount of money to conserve shark populations in Costa Rica. We found that tourists were willing to pay **$17** per individual to avoid the 50% extinction of shark populations, and **$35** to avoid their full extinction. In terms of aggregrate WTP, this amounts**~$45,220,000** to avoid the 50% extinction, and **~$93,100,000** to avoid the full extinction of shark populations in Costa Rica.

These estimates are *even larger* for red-listed or endangered hammerhead species in which we find that tourists are willing to pay **$55.88** for smooth hammerheads, **$52.79** for scalloped hammerheads, and **$45.66** for great hammerhead sharks according to our DBDC model. In aggregate terms this amounts to **~$140,421,849** for scalloped hammerhead sharks, **~$148,653,737** for smooth hammerhead sharks, and **~$121,474,447** for great hammerhead sharks. This implies that tourists may favor a policy that aims to focus on shark species that are in critical state.

Hypothesis #2: Tourists would prefer a policy that improves city and beach infrastructure to environmental policies.

Results confirm this hypothesis. Tourists are willing to pay 3-4 times more for tourism infrastructure **(~$1 per each percentage point**) than for conserving environmental attributes. More specifically, **$1.05** for city infrastructure, and **$1.32** for beach infrastructure. Tourists are willing to pay (per percentage point) $0.30 for a policy that conserves shark species, $0.00 for coral reefs, and $0.36 for turtles (however, only significant at the 10% level).

Hypothesis #3: Tourists that visited a beach during their stay are more willing-to-pay to protect shark populations than tourists that did not.

This study did not directly address whether tourists who visited the beach are willing to pay more than those that did not. Instead in an additive model, we analyzed "beachgoers" (tourists that visited the beach during their stay in Costa Rica) WTP to see the beach, view sharks or turtles in their natural habitats, or dive with sharks or turtles.

We find that tourists were willing to pay (per percentage point) *even more* to see sharks in their natural habit **($0.31**), but not dive with sharks (insignificant). When interacting these covariates, we find that beachgoers have a negative WTP to see turtles (**$-1.31**, **and significant at the 5% level**) in their natural habitat, and diving with turtles was not significant.

Hypothesis #4: Tourists would prefer policies that improve coral reefs or sea turtle populations to shark policies.

Our results suggest rather the opposite. Tourists are willing to pay *the most* for a shark conserving policy (**$.30**) rather than a sea turtle conserving policy (**$0.36, but only significant at the 10% level**), but not improving coral reefs (**$0 WTP**, **statistically significant from zero**). We believe that tourists may not place a significant value on coral reefs, since they may not understand all of the benefits that coral reefs provide.

6 Discussion

This chapter aims to discuss potential biases associated with the survey design and stated preference methods used in this thesis. Furthermore, we discuss the benefits of shark ecotourism as a solution to exhaustive shark fishing practices.

6.1 Potential biases

6.1.1 Survey instrument

The data used in this study were collected by conducting person-to-person, or face-to-face (F2F), surveys at the Juan Santamaria airport in San Jose, Costa Rica. Methods such as telephone interviews, the Computer-Assisted Self Interviewing (CASI) method, and mail questionnaires are also used for stated preference data collection. We chose in-person surveys because of its ability to deliver the most representative results, and excellent response rate. In fact, face-to-face surveys have several key strengths. They are based on personal interaction, which allows for personal interaction which can be controlled. The instrument is clearly structured, flexible, and adaptable (Szolnoki and Hoffman, 2013). Physical stimuli (i.e. image of sharks, or risk ladder) may be used in the survey environment, and and allows the interviewer to observe the respondent. Since our instrument was programmed online and used on tablets, an added benefit was that the data was automatically loaded into an online database. Furthermore, this streamlined the data collection process.

There are also some disadvantages associated with person-to-person surveys, such as high cost per respondent, interviewer bias, time pressure on respondents, and geographical limitations (Holbrook et al., 2003a, Holbrook et al, 2003b). Despite these biases, we considered the F2F approach to be best suited for our study.

6.1.2 SBDC vs. DBDC

In this study, we report mean WTP values for conserving three hammerhead species estimated by using the DBDC approach. We employ the DBDC approach because it is widely considered to have greater efficiency than the single bound estimator. However, biases such as an anchoring effect, starting-point bias and shift effect may be associated with the double-bounded dichotomous approach.

Anchoring bias arises when respondents "update" their WTP when presented with a second bid amount (Herriges and Shogren, 1996). The Herriges and Shogren model assumes that respondents' WTP is a weighted average of their true WTP and the first bid amount, when answering the second follow-up bid. Alternatively, the shift-effect, or shifting bias, occurs when a respondent "shifts" their answer for the second valuation question- exogenously changing from their true WTP (Alberini et al, 1997). For instance, if a shift parameter is negative, respondents devalure their second WTP following the first question. This is known as the incentive-incompatibility effect. Alternatively, a positive shift parameter indicates that a respondent may exhibit "accepting behavior" in which they overestimate their WTP for the second WTP valuation question. In this case, respondents tend to agree regardless of the bid level (Rust et al, 2010). According to Legget et al. (2003), shifting bias may be more prevalent in person-to-person surveys since respondents are more inclined to respond in a way that they think will please the interviewer.

Despite these potential sources of bias, we report the DBDC results since they allow us to report more information, that is more statistically efficient.

6.2 Protests and comments

Comments from respondents were generally very positive, stating that the study was interesting and important. Many respondents said that they didn't know that much about sharks, and that they wanted to know more about them.

Some respondents said that the bids were too high, or that they want to make sure that the money is actually going to shark conservation. Most comments said: (1) Tourists should not have to pay taxes, (2) Taxes should be voluntary, (3) taxes should be equalized (tourists and nationals pay the same), or (4) there must be another way to conserve shark species. Below, is are examples of the comments received:

1. "I think funds should cover more than sharks. More willing to cover more platforms for the amount of money requested. Smaller denominations just for sharks suggested."

2. "You should not impose more taxes, there should be another way."
3. "There are more ways to reach this goals. Tourists should not pay for this, at least not as a tax."
4. It would be well if volunteers with sharks on Cocos Island were more accessible and the Costa Rican government collaborated more with species conservation NGOs.
5. "The options are two expensive."
6. I would need to make sure that money is going to be for the sharks.
7. "We feel the rates paid by foreigners visiting parks and other should not be so exuberant compared to those paid by Nationals. Prices need to be equalised to make it affordable for visitors, also streets should be cleaned from garbage and maintained from pot holes."

We may take these comments into consideration to identify protesters in exclude them from the anlaysis. A one-time tax was presented in our scenario, since it is obligatory and could definitely be allocated towards shark conservation. On the other hand, a voluntary contributions need not be incentive compatible since many may behave strategically (to expect the others should contribute, as the donation is voluntary).

7 Conclusion

Sharks are tempting targets for fishermen since their fins have high monetary value. Both recreational and commercial shark fishing has had catastrophic effects on shark populations globally, since their slow growth and low reproductive rates simply cannot keep up with their rate of exhaustion. Some species have been reduced by 70-90%. Costa rica is a country that leads the world in sustainability intitiatives and community-based conservation, and is one of the top exporters of shark products to China and Hong Kong. Research on the economic value of shark ecotourism is not limited, but uses approaches based on the direct spending of divers.

For the first time, this study uses stated preference methods to estimate the value of shark conservation initiatives for the *representative* tourist population, not limited to divers. Furthermore, this research introduces a trade-off between tourism infrastructure development and environmental improvement. We derive a mean WTP of **$17** per individual to avoid the 50% extinction of shark populations, and **$35** to avoid their full extinction. These estimates are *even larger* for threatened species in which we find that tourists are willing to pay **$55.88** for smooth hammerheads, **$52.79** for scalloped hammerheads, and **$45.66** for great hammerhead sharks according to our DBDC model. With respect to other attributes for the public program presented in the discrete choice experiment, we found that tourists are indeed willing to pay the most for **beach and city tourist infrastructure**, about **$0.86** and **$1.04** (respectively) for each percentage point of improvement. Willingness to pay for the same improvement in **shark populations** is about **$0.35**, while WTP for conserving **sea turtles** and **coral reefs** is not statistically different from **zero**.

The results of this study demonstrate that tourists visiting Costa Rica place a significant value on the conservation of shark populations in the country. Results also identify important attudinal and sociodemographic factors that determine willingness-to-pay across the range of respondents who participated in this study. We found that respondents were willing to pay 3-4 times more for city and beach infrastructure development than attributes related to environmental conservation (coral reefs, sea turtles and shark conservation). WTP for the preservation of coral reefs was not significantly different from zero, and the WTP for a sea turtle conserving policy was only significant at the 10% level.

Additionally, our results permit a rough comparison to the benefits from shark fishing and the sale of sharks on the seafood market. We estimated an aggregate WTP of **~$45,220,000** to avoid the 50% extinction, and **~$93,100,000** to avoid the full extinction of shark populations in Costa Rica. For the three endangered or red-listed hammerhead species found in Costa Rican waters, we estimated an aggregate WTP of **~$140,421,849** for scalloped hammerhead sharks, **~$148,653,737** for smooth hammerhead sharks, and **~$121,474,447** for great hammerhead sharks.

In 2015, the Food and Agriculture Organization of the United Nations published their most recent technical paper: “State of the global market for shark products”.[12] According to the paper, the average annual value (from 2000 to 2011) of shark products exported by Costa Rica to China and Hong Kong SAR, was $7.7 million and included a mix of dried, unprocessed and frozen, unprocessed shark products. The average annual value of shark fin in Costa Rica (during the same period) was $1.9 million, and $8.9 million for the whole period. These results answer the main question of this thesis, are sharks worth more dead than alive? Our results indicate yes, and by a substantial amount. **Tourists are willing to pay > 10 times more than the value of sharks on the seafood market, in order to conserve shark populations in Costa Rica.**

In consideration of these values, and the WTP values calculated in this study, we find that it may be worthwhile for the Costa Rican government to eliminate the practice of shark fishing. However, this cannot be achieved without the full commitment to ensure that there are no loopholes for shark fishermen. The country has the potential increase its revenues up to ten times its current revenues from shark fishing. The transition to shark ecotourism not only brings economic benefits, but also also has much broader effects for the ocean ecosystems.

Costa Rica may learn from the story of the Rekawa sanctuary in Sri Lanka. Fishermen who depend on the sale of shark meat or fin as a source of income may be compensated by revenues

[12] http://www.fao.org/3/a-i4795e.pdf

from a shark-conserving policy and ultimately reduce shark fishing practices. The re-design of a policy which would conserve shark species would secure the cooperation of low income fishermen in shark conservation initiatives.

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Appendix I: Survey Design

This survey aims at visitors' preferences to travel in Costa Rica.
Participation in this survey is voluntary.

If there are any questions that you do not wish to answer you can leave it them unanswered. If you do not complete the survey, none of your answers will be used. Should you choose not to complete the survey you will not be penalized in any way. In addition, your answers will remain strictly confidential and anonymous and there are no risks involved in participating in this survey.

All information will be used solely for research and not commercial purposes. The research is not funded and has no connection to any marketing or tourism companies.

This survey is being conducted as part of a research project at Charles University in Prague, and has received financial support from an internal research grant from the Environment Center at Charles University.
This interview should take about 15-20 minutes to complete.

Your Consent to Participate.

If you choose to complete this survey, then by doing so you agree that:

• I have read this introduction
• I have been informed that my participation in this process is voluntary
• I have been informed of any risks involved in participating
• I voluntarily consent to take part in this survey

Section 0 – Screening Questions

Are you a tourist who has just visited Costa Rica?

Yes	1
No	2

Are you above the age of 18 years old?

Yes	1
No	2

CONTROL for ADULT TOURISM subsample: if for one or both answers are NO, then END AND WRITE
IF Q1=2 OR Q2=2 THEN
"Unfortunately you do not qualify for this survey. Thank you for your time."

Section A: Demographic Information

A1. What is your gender?

M	1
F	2

A2.

How old are you? (DROP DOWN MENU)	
	YEARS

A3. What is your native language?

English	1
Spanish	2
Other, Specify:	3

A4. What IS YOUR COUNTRY OF RESIDENCE?

Country of residence	Northern America United States □ Canada □ Central & South America Argentina □ Colombia Guatemala Honduras Mexico Nicaragua Panama Salvador Venezuela Europe Germany Spain France United Kingdom Italy Netherlands Switzerland Other Please name country of your residence: ____________

Section B: Tourism Information

B1. What is your purpose of visiting Costa Rica?
(Can select more than one)

Business	1
Leisure	2
Family Other, Specify:………………..	3 4

B2. When did you make your decision to visit the park?

Spontaneous decision	1
A month ago	2
Several months ago	3
I have been planning to visit Costa Rica for several years	4
other, specify	5

B3. Including yourself, how many people are traveling in your group?

Number	

B4. Including yourself, how many people are you paying for?
Write 1 if you pay for yourself only.

Number	

B5. What did you see/do in Costa Rica? Check all that apply to you.

National Parks	1
Cloud Forest	2
Volcanoes	3
Beaches	4
Watching marine species such as fish, turtles, corals, or sharks	5
Sea diving	6
Other, Specify	7

B6.

How many times have you been to Costa Rica, including your recent visit?	

B7.

How many nights did you stay?	

B8. Did you visit any beaches?

Yes	1

No	2

IF B8=1

B9a. If yes, what beach activities did you do? Check all that apply to you.

Swimming	1
Snorkeling	2
Watersports	3
Scuba Diving	4

END IF

B9b. Did you plan to view sharks on a glass bottom boat, or snorkel/scuba dive with sharks on this trip?

Yes [1]

No [2]

B14. DID YOU GO TO TORTUGA ISLAND OR COCOS ISLAND ON THIS TRIP?

Yes [1]

No [2]

B9c. Have you ever tried to snorkel scuba dive with sharks or other marine species?

Yes [1]

No [2]

B10. Were you here to see any particular animal (marine or land species)?

Yes, specify below.

Land species:
Marine species:

No

B11. Do you give money to environmental conservation organization?

Yes, specify	
No	

B12. Please select the option that best describes the definition of "ecotourism".

[1] When tourists consider everything based on economics, saving, and setting budgets.
[2] Tourism based on using other mediums of exchange instead of the local currency.
[3] Tourism primarily directed towards economic development.
[4] Tourism directed towards natural environments intended to support conservation efforts.

B13. How much did you spend on this trip to Costa Rica?
Please answer only for personal (money spent on yourself), or for group (money spent for your group as one total). Do not answer for both personal and group – provide information in one column only.

	Personally (money spent on myself)	Group (money spent for my group)
Entrances and Conservation Fees, tours tickets etc.	$	$
Accommodation	$	$
Airfare to/from Costa Rica per person (or cruise ticket)	$	$
Transportation in Costa Rica	$	$
Restaurants, food and drinks	$	$
Clothing, footwear, souvenirs and jewelry, other	$	$
Other expenses not listed above, please specify below		
__________	$	$
__________	$	$
__________	$	$

<u>Section C: Environmental & Tourism Preferences</u>

Consider the following scenario. The government of Costa Rica imposed a mandatory one-time payment to be paid by all tourists at a local airport when entering or leaving the country. These payments may improve city or beach infrastructure or conserve the environment.

In terms of improvement of the environment, coral reefs could be conserved, depletion of shark species population might be slowed down and population of sea turtles might be increased.

However, if more resources are used to improve infrastructure, more tourism and lack of resources for environmental protection might result in lower populations of sharks or sea turtles.

Imagine that it might take some time, say 10 years, *<u>to see all of these effects.</u>*

It is now up to you to decide which program you like the best and how the collected money might be allocated. When you will be choosing the best option, please, consider your available financial resources. Also consider that if you decide to pay, this payment would reduce the amount of money you could spend on other things, such as food, clothes or drinks.

You may of course prefer, not to pay anything at all or may not like the proposed improvements. In this case, just choose the "No policy" option. As a consequence of "No policy", however, quality of infrastructure will remain as exists today, population of sea turtles will not increase, and populations of coral reefs and sharks will significantly decline.

****** NEXT PAGE **********

The policy may have an effect on following five things:

Conservation of coral reefs

- The amount of coral reefs cannot be increased, but degradation may be slowed down. The fund will aim to reduce the speed of degradation of coral reefs by several percent.

- Degradation is caused by boat and other human activities (i.e. touching reefs, ocean acidification and increase of CO2 levels). If there is no action, coral reefs will be eliminated by 50% in the next decade.

- As a result of less coral colonies, there may be less fish biodiversity.

- The coral reefs will be conserved and the effects will be exclusive to Costa Rican coastlines.

City Infrastructure

- The fund will go towards increasing the amount and quality of city infrastructure available to you as a tourist.

- This includes better and safer roads, public toilets, and towers for better internet and telecommunications in remote areas.

- City infrastructure projects will be implemented throughout Costa Rica, and will be available for use in 10 years.

- Without this policy, city infrastructure will remain the same as today.

Infrastructure close to Costa Rican beaches

- The fund will go towards increasing public infrastructure close to Costa Rican beaches. This includes public toilets, restaurants, hotels and other facilities to be used by tourists. The infrastructure will be ready for use in 10 years.

- Without this policy, the amount and quality of infrastructure by the beach will remain the same, as exists today.

Conservation of Shark Species

- The fund will aim to combat shark fishing and *slow down the depletion of shark populations.*

- If there is no conservation policy, all shark population may be reduced by 50% in the future. Population of sharks may also be reduced as a consequence of lower budget for conservation of the environment when city or beach infrastructure will be significantly improved. Better infrastructure may also induce more tourism that may negatively affect shark population.

- As a consequence of less shark populations, there will be less seafood available to humans (i.e. scallops), an imbalance in marine ecosystems along the Costa Rican coastline (affecting fish biodiversity) and a negative effect on the health of coral reefs.

Sea Turtle Conservation

- The fund will go towards the protection of sea turtle nests on Costa Rican beaches.

- Population of sea turtles may be however reduced as a consequence of lower budget for conservation of the environment when city or beach infrastructure will be significantly improved. Better infrastructure may also induce more tourism that may negatively affect population of sea turtles.

- Increased sea turtle populations will prevent large jellyfish blooms, keep sea grass beds healthy with nutrients for the ecosystem, and will promote sand dune vegetation (and prevent beach erosion).

Costs

- Remaining attribute is how much this policy would cost.

- The cost would be paid once by each tourist at a local airport when entering or leaving the country.

****** NEXT PAGE **********

Example of the choice card.

	Policy A	Policy B	No policy
Coral reefs	5% less	5% less	50% less than today
City infrastructure	15% more	30% more	0% change (like today)
Beach infrastructure	30% more	15% more	0% change (like today)
Shark population	10% less	30% less	50% less than today
Sea turtle population	0% change (as today)	5% less	0% change (like today)
Cost (one-time payment)	$80	$40	$0

Most preferred option?	☐	☐	☐
Least preferred option?	☐	☐	☐

DCE design

Name of the attribute	SQ level	No. of levels (the policy)	Level 1	Level 2	Level 3	Level 4	Level 5	Level 6
Coral reefs	50% less than today	4	0% change (like today)	5% less	15% less	50% less (with "no policy")		
City infrastructure	0% change (like today)	2	0% change (like today)	15% more	30% more			
Beach infrastructure	0% change (like today)	2	0% change (like today)	15% more	30% more			
Shark populations	50% less than today	5	50% less (with "no policy")	30% less	10% less	0% change (like today)	10% more	30% more
Sea turtle populations	0% change (like today)	5	15% less	5% less	0% change (like today)	5% more	15% more	
Costs (one-time payment in USD)	0 USD	5	5 $	10 $	20 $	45 $	90 $	

C1. Please, consider now several policy options that will describe how collected money might be used to support tourism infrastructure or environmental protection.

We will show you two alternative policies and another option for “No policy”.
Assuming these are the only options available to you, which one would you like the most and which one is the least preferred by you? Please keep your financial circumstance in mind while answering.

Please choose the best option for you, and then the least preferred option for you.

Overall, we are going to ask you six times to choose the best and the least policy. Please always consider these policy options independently. For instance, answer each time as if you had not paid anything for the policies previously asked.

CHOICE ONE
Please choose the best option, and then the least preferred option for you.

MOST PREFERRED OPTION

LEAST PREFFERRED OPTION

CHOICE TWO
Please choose the best option, and then the least preferred option for you.

MOST PREFERRED OPTION

LEAST PREFFERRED OPTION

CHOICE THREE
Please choose the best option, and then the least preferred option for you.

MOST PREFERRED OPTION

LEAST PREFFERRED OPTION

CHOICE FOUR
Please choose the best option, and then the least preferred option for you.

MOST PREFERRED OPTION

LEAST PREFFERRED OPTION

CHOICE FIVE
Please choose the best option, and then the least preferred option for you.

MOST PREFERRED OPTION

LEAST PREFFERRED OPTION

CHOICE SIX
Please choose the best option, and then the least preferred option for you.

MOST PREFERRED OPTION

LEAST PREFFERRED OPTION

**************NEW SCREEN *************
IF SQ WAS SELECTED AT LEAST ONE TIME
MARTIN PLEASE COULD YOU ROTATE THE ORDER OF THE OPTIONS?

C2. When you were choosing between different policy options, and you chose "no policy" or "no change" at least once, could you please tell us why? Please choose up to two most important reasons

The choice was too difficult	1
I did not receive adequate information	2
I dislike the idea of increased beach infrastructure in Costa Rica	3
I don't trust the information I was given	4
There are more effective ways to attain the same goal	5
I am satisfied with current infrastructure and/or environmental conservation efforts.	6
I dislike the idea of tourists paying into an environmental conservation fund.	7
Residents of Costa Rica should have to bear the costs, not tourists.	8
I dislike the idea of tourists paying to the Costa Rican government.	9
Other:	10
Please Specify…………………………	

C3: What is important to you when deciding on a destination to spend your vacation? Please the following on a scale of importance to you. (please answer all possibilities)

	Not that Important	Slightly Important	Important	Very Important	Extremely Important
To relax	1	2	3	4	5
To experience a new destination	1	2	3	4	5
To spend time with my family/friends	1	2	3	4	5
For educational purposes (learn something)	1	2	3	4	5
The variety of accommodation options	1	2	3	4	5
The value (money)	1	2	3	4	5
To take pictures of nature (plants and animals)	1	2	3	4	5
To see sharks	1	2	3	4	5
I like ecotourism	1	2	3	4	5
To see a marine habitat	1	2	3	4	5
Types of species	1	2	3	4	5
The ability to see a species in person, up close.	1	2	3	4	5
The ability to see a species you've never seen before	1	2	3	4	5
Information about the flora and fauna at national parks	1	2	3	4	5
Available route maps, with descriptive information	1	2	3	4	5
Diverse marine habitats	1	2	3	4	5
Fishing charters	1	2	3	4	5

C4: Please rank the following according to your liking-where 1 is what you like the most, and 6 is what you like the least.

Birds	
Plants	
Sharks	
Rivers and Waterfalls	
Arenal Volcano	
Fish and Rays	

C5. Rate, on a scale of importance to you, why have you visited Costa Rica. (Please answer all possibilities)

	Strongly Disagree	Disagree	Neutral	Agree	Strongly agree
Costa Rica's variety of flora and fauna species (10,000 plants and trees; 30,000 insects; 160 amphibian; 220 reptiles; 850 birds; 205 mammals)	1	2	3	4	5
To see endangered species in their natural habitats such as various sea turtle, quetzal, viper, macaw, manatee, and frog species	1	2	3	4	5
One of the most biodiverse countries in the world	1	2	3	4	5
Costa Rica's world renowned reputation as a leader in sustainability and conservation	1	2	3	4	5
It is well-marketed as a good tourist destination	1	2	3	4	5
The variety of activities such as zip-lining, hiking tours, snorkeling, scuba diving, river rafting, etc.	1	2	3	4	5
The rainforest's well-designed trails	1	2	3	4	5
The different types of beaches (i.e. white, black, brown sand; swimming beaches; surfing beaches)	1	2	3	4	5
The large range of accommodations based on price and style (Basic to luxurious)	1	2	3	4	5
The implementation of green initiatives (solar panels, recycled furniture, reforested trees, etc)	1	2	3	4	5

C6. Do you plan to go to Costa Rica again in the future?

Yes	1
No	2

Section D: Shark Conservation and Reduction of Populations

D1. Please rank each event according to their risk of CAUSING death.
Use rank from 1 to 5, where 1 indicates the highest risk, and 5 denotes the smallest risk.

Drowning
Car accidents
Shark attack
Bike accident
Sun/heat exposure
************** new page *******
For decades, the media has given sharks a bad public image and has sensationalized shark attacks worldwide. News segments on shark attacks and movies like Jaws (directed by Steven Spielberg in 1975) create an increasingly larger misunderstanding of sharks by humans.

In a study about "All accidental death", the National Safety council found that shark attacks are an extremely rare phenomenon. For instance, there has only been 10 shark attacks in Costa Rica within the past 100 years (first recorded in 1919, and the last being 2011).

Annual Risk of Death During One's Lifetime

Disease and Accidental Causes of Deaths	Annual Deaths	Death Risk During One's Lifetime
Heart disease	652,486	1 in 5
Cancer	553,888	1 in 7
Stroke	150,074	1 in 24
Hospital Infections	99,000	1 in 38
Flu	59,664	1 in 63
Car accidents	44,757	1 in 84
Suicide	31,484	1 in 119
Accidental poisoning	19,456	1 in 193
MRSA (resistant bacteria)	19,000	1 in 197
Falls	17,229	1 in 218
Drowning	3,306	1 in 1,134
Bike accident	762	1 in 4,919
Air/space accident	742	1 in 5,051
Excessive cold	620	1 in 6,045
Sun/heat exposure	273	1 in 13,729
Lightning	47	1 in 79,746
Train crash	24	1 in 156,169
Fireworks	11	1 in 340,733
Shark attack	1	1 in 3,748,067

Source: https://www.flmnh.ufl.edu/fish/isaf/what-are-odds/risks-comparison/risk-death/

D2. Do you agree with the statistics above?
Yes

No

Sharks have played a prominent role in our oceans for millions of years, however, now many species are approaching extinction. During the last century, the practices of industrial and commercial fishing have drastically reduced shark populations - in some cases by 70-90%. According to the International Union for the Conservation of Nature (IUCN), almost 50% of shark species are threatened, or near-threatened with extinction.

Source: http://theconversation.com/shark-counting-divers-off-costa-rica-reveal-limits-of-marine-reserves-39461

This is of concern for scientists and conservationist, as the rate of fishing greatly exceeds the natural rate of reproduction, since sharks have a low fecundity rate (2-20 pups, with a maturation period of 10-12 years). The ocean simply cannot keep up with the overexploitation of shark species, as they are slow to recover from such rapid depletion. The elimination of shark species will have a much greater effect on the health of ocean ecosystems, with consequences effecting humans.

D3. How confident are you about information just provided?

Not Confident (strongly) Not Confident Neutral Confident Very Confident

Source: http://www.bestkeywestfishing.com/wp-content/uploads/2015/01/fishing61.png

Although Costa Rica has been praised for its sustainability and conservation initiatives, it has been one of the leading shark fin exporters for decades. Costa Rican waters once had abundant populations of many shark species, but now shark numbers are being rapidly depleted. Three particular hammerhead species are of concern for scientists: Scalloped hammerhead shark, Great hammerhead shark, and Smooth hammerhead shark.

Each of these three hammerhead shark specie have been either red-listed (populations considered threatened) or endangered (approaching extinction). Both scalloped and smooth hammerhead species are listed on CITES (Convention on International Trade in Endangered Species) Appendix II.

Hammerhead sharks (Sphyrna) are skilled predators that utilize their oddly shaped heads to improve their ability to hunt its prey; see the picture above. The position of their eyes provides hammerheads with a better visual range than most other shark species.

In 2013, the Costa Rican government signed Appendix II of CITES, a resolution that makes importing or exporting these species a violation without confirming that these species were being fished sustainably and with proper certificates of origin. As a consequence of legislative loopholes, Costa Rica's fishing industry is facing a collapse of fish stocks following a long history of overfishing. Fisherman are now catching and selling the smooth and scalloped hammerhead shark species to maintain their revenues.

D4. Have you heard about this problem?

[1] Yes, I have been aware how serious this problem is

[2] Yes, I have heard about that but have not thought it is so serious

[3] No, I have never heard about that

[4] I do not trust information being provided or think these information are not correct

Consider the following scenario. The government of Costa Rica is thinking about imposing a mandatory one-time payment (a local tax) to be paid by all tourists at a local airport when entering the country. These payments will go to a fund that will be directed towards protecting the endangered scalloped hammerhead, great hammerhead, and red-listed (threatened) smooth hammerhead shark species *to ensure that they do not go extinct.* The ultimate goal would be to increase populations and remove their endangered/red-listed status.

We are going to ask you to consider a payment for SHARK1 and SHARK2.

Consider the following options, assuming these are the only options available to you. In the case you prefer the current situation, the size of shark populations *will not be increased* and you will not be paying any payment.

In the case that the amounts of the payment are for any reason too high or not acceptable to pay, choose the current situation as well.

Please consider if you choose to pay, your budget will be smaller by this amount and you will have less money to spend on other goods, such food, clothes, or going to a restaurant.

SHARK1={scalloped hammerhead shark, great hammerhead shark, smooth hammerhead shark}

SHARK2={scalloped hammerhead shark, great hammerhead shark, smooth hammerhead shark}

and SHARK1≠ SHARK2

Please, consider now SHARK1; see its picture just below.

If SHARK1=Scalloped hammerhead shark, "This shark species is endangered meaning that its population is approaching extinction. Scalloped hammerhead shark is also listed on CITES (Convention on International Trade in Endangered Species) Appendix II."
If SHARK1=Great hammerhead shark, "This shark species is endangered, approaching extinction."
If SHARK1=Smooth hammerhead shark, "This shark species is red-listed, meaning that its population considered threatened. Smooth hammerhead shark is also listed on CITES (Convention on International Trade in Endangered Species) Appendix II."

***** PICTURE SHARK1 ****
D5-1. Would you pay BID1 USD for conserving SHARK1 if the size of their populations will be increased by POPUL1?
Yes 1
No 2

*IF yes, BID12=BID1*2*
IF no, BID12=BID1/2
D5-2. Consider now that the fee that would be imposed would be changed. Would you be willing to pay BID12 USD for conserving SHARK1 if the size of their populations will be increased by POPUL1?
Yes 1
No 2
*********************** NEW SCREEN ******************
IF D5.2=No
D6. When you were choosing between different options, and chose the "current situation" at least once, could you please tell us why? Please choose up to two most important reasons

The choice was too difficult	1
I did not receive adequate information	2
I cannot tell the difference between shark species	3
I don't want to pay into a fund or to Government of Costa Rica at least once.	4
I don't trust the information I was given	5
There are more effective ways to attain the same goal	6
I believe there is nothing we can do to reverse their status	7
I dislike the idea of tourists paying to conserve shark species.	8
Residents of Costa Rica should have to bear the costs, not tourists.	9
This does not effect me, therefore I should not pay.	10
I am satisfied with the current situation.	11
Other:	12

Please Specify…………………………
*********************** NEW SCREEN ******************
Let us now concentrate on another shark species, that is SHARK2. Please look below to see a picture of SHARK2.

If SHARK2= Scalloped hammerhead shark, "This shark species is endangered meaning that its population is approaching extinction. Scalloped hammerhead shark

is also listed on CITES (Convention on International Trade in Endangered Species) Appendix II."
If SHARK2=Great hammerhead shark, "This shark species is endangered, approaching extinction."
If SHARK2=Smooth hammerhead shark, "This shark species is red-listed, meaning that its population considered threatened. Smooth hammerhead shark is also listed on CITES (Convention on International Trade in Endangered Species) Appendix II."

***** PICTURE SHARK2 ****

D7-1. Would you pay BID2 USD for conserving SHARK2 if the size of their populations will be increased by POPUL2?

Yes 1
No 2

*IF yes, BID22=BID2*2*
IF no, BID22=BID2/2

D7-2. Consider now that the fee that would be imposed would be changed. Would you be willing to pay BID22 USD for conserving SHARK2 if the size of their populations will be increased by POPUL2?

Yes 1
No 2

*********************** NEW SCREEN ******************

Scalloped Hammerhead Shark

Great Hammerhead Shark

Smooth Hammerhead Shark

Section E: Socio-demographic information

At the end, we would like to ask some information about yourself.

E1. What is your highest level of education?

No School (0 years of school attendance)	1
Elementary school (up to 8 years of attendance)	2
Lower secondary with no diploma (8 to 12 years)	3
Upper secondary with a diploma (8 to 12 years)	4
Tertiary with professional qualification (12 to 14 years)	5
Tertiary first degree (BA or BSc, or equivalent) (15-16 years)	6
Tertiary higher degree (MA, MBA, MSc, Mphil or equivalent) (16 to 19 years)	7
Doctorate (more than 19 years)	8

E2. How would you describe your current employment status?
Multiple choices
[1] Employed full-time
[2] Employed part-time
[3] Self-employed
[4] Student
[5] Looking after the home full-time
[6] On maternity/paternity or parental leave
[7] Retired
[8] Unemployed, looking for work
[9] Unable to work due to sickness or disability
[10] Other
Please specify: ....………………

E3. What is your Marital Status?

Single	1
Married	2
Living Together	3
Divorced	4
Widow/er	5

E4. How many children do you have?

I don't have any children	0
1 child	1
2 children	2
3 children	3
4 children	4
5 and more children	5

E5. **What is <u>your personal</u> gross (before tax) <u>annual</u> income?**

No Income	1
< $5,000	2
$5,001-$10,000	3
$10,001-$15,000	4
$15,001-$20,000	5
$20,001-$30,000	6
$30,001-$40,000	7
$40,001-$50,000	8
$50,001-$70,000	9
$70,001-$90,000	10
$100,001-$120,000	11
$120,001-$150,000	12
$150,001-$200,000	13
>$200,000	14
I would not like to answer	888
I prefer to write my income in my currency (specify currency)	E5Amount: _____ Currency: CURRENCY

E6. What is the total gross annual income of your household, from all sources after tax and compulsory deductions?

(Please include all sources of income such as child support and other state support, interest, and other revenues ...)

No Income	1
< $5,000	2
$5,001-$10,000	3
$10,001-$15,000	4
$15,001-$20,000	5
$20,001-$30,000	6
$30,001-$40,000	7
$40,001-$50,000	8
$50,001-$70,000	9
$70,001-$90,000	10
$100,001-$120,000	11
$120,001-$150,000	12
$150,001-$200,000	13
>$200,000	14
I would not like to answer	888
I don't know	999
I prefer to write my income in my currency (specify currency)	E6Amount: ______ Currency: CURRENCY

This is the end of the questionnaire. Thank you very much for your time and participation.

We note that all scenarios that suggested to paying for nature or sharks conservation were fully hypothetical and they were not proposed, discussed or consulted with the government or any other authority in Costa Rica.

If you have any comments about this questionnaire, please write down your comments. If you would like to learn more about this research, you can contact **MILAN SCASNY OR ALICIA BERRIOS VIA EMAIL AT SHARKS@CZP.CUNI.CZ.**

Appendix II: Conditional logit, basic model for various samples.

Table 23: Conditional logit results for all observations, including speeders

	Coeff	s.e.	t-stat	p-value	CI Low	CI High
city	0.0123	0.0018	6.9	0	0.0088	0.0158
beach	0.0102	0.0019	5.42	0	0.0065	0.0138
coral	0.0000	0.0013	-0.01	0.996	-0.0026	0.0026
shark	0.0041	0.0010	4.21	0	0.0022	0.0060
turtle	0.0029	0.0021	1.38	0.168	-0.0012	0.0070
cost	-0.0118	0.0014	-8.71	0	-0.0145	-0.0092
WTP in USD	**Coeff**	**s.e.**	**t-stat**	**p-value**	**CI Low**	**CI High**
beach	**0.860**	0.14005	6.14	0	0.5853	1.1343
city	**1.041**	0.15197	6.85	0	0.7433	1.3390
coral	**-0.001**	0.11235	-0.01	0.996	-0.2208	0.2196
shark	**0.347**	0.06984	4.97	0	0.2099	0.4837
turtle	**0.244**	0.17256	1.41	0.157	-0.0942	0.5822

Number of observations = 14040
LogLik = -5062.7814
Pseudo R2 = 0.0153

	Coeff	s.e.	t-stat	p-value	CI Low	CI High
program	0.5505	0.0779	7.07	0	0.3979	0.7032
cost	-0.0093	0.0010	-9.71	0	-0.0112	-0.0075
WTP for program	**58.89**	7.74837	7.6	0	43.6988	74.0719

Number of observations = 14040
LogLik = -5044.9574
Pseudo R2 = 0.0188

Table 24: Conditional logit results for all observations, excluding speeders

Observations excluding speeders

	Coeff	s.e.	t-stat	p-value	CI Low	CI High
city	0.0123	0.0019	6.61	0	0.0087	0.0160
beach	0.0096	0.0020	4.87	0	0.0057	0.0134
coral	0.0003	0.0014	0.22	0.825	-0.0024	0.0030
shark	0.0037	0.0010	3.67	0	0.0017	0.0058
turtle	0.0035	0.0022	1.6	0.109	-0.0008	0.0078
cost	-0.0119	0.0014	-8.35	0	-0.0147	-0.0091

WTP in USD	**Coeff**	**s.e.**	**t-stat**	**p-value**	**CI Low**	**CI High**
beach	**0.800**	0.1452	5.51	0	0.5155	1.0849
city	**1.032**	0.1589	6.49	0	0.7203	1.3433
coral	**0.026**	0.1149	0.22	0.823	-0.1995	0.2510
shark	**0.314**	0.0724	4.33	0	0.1719	0.4557
turtle	**0.294**	0.1791	1.64	0.101	-0.0569	0.6451

Number of observations =12780
LogLik = -4610.2561
Pseudo R2 = 0.0149

	Coeff	s.e.	t-stat	p-value	CI Low	CI High
program	**0.5239**	0.0811	6.46	0	0.3650	0.6829
cost	**-0.0094**	0.0010	-9.11	0	-0.0114	-0.0074
WTP for program	**55.76**	7.944583	7.02	0	40.1924	71.3346

Number of observations = 12780
LogLik = -4610.2561
Pseudo R2 = 0.0177

Table 25: Conditional logit results for speeders only (n=70)

Observations only speeders (n=70)						
	Coeff	**s.e.**	**t-stat**	**p-value**	**CI Low**	**CI High**
city	0.0126	0.0062	2.02	0.043	0.0004	0.0247
beach	0.0162	0.0065	2.5	0.012	0.0035	0.0289
coral	-0.0033	0.0043	-0.77	0.443	-0.0118	0.0052
shark	0.0075	0.0033	2.28	0.023	0.0010	0.0139
turtle	-0.0040	0.0070	-0.57	0.571	-0.0177	0.0097
cost	-0.0104	0.0043	-2.41	0.016	-0.0188	-0.0019
WTP in USD	**Coeff**	**s.e.**	**t-stat**	**p-value**	**CI Low**	**CI High**
beach	**1.565**	0.5677	2.76	0.006	0.4520	2.6771
city	**1.213**	0.5327	2.28	0.023	0.1694	2.2575
coral	**-0.321**	0.5042	-0.64	0.524	-1.3094	0.6672
shark	**0.719**	0.3168	2.27	0.023	0.0985	1.3403
turtle	**-0.383**	0.7351	-0.52	0.602	-1.8235	1.0578
Number of observations =1260						
LogLik = -4610.2561						
Pseudo R2 = 0.0288						
	Coeff	**s.e.**	**t-stat**	**p-value**	**CI Low**	**CI High**
program	**0.846**	0.2862	2.96	0.003	0.2851	1.4071
cost	**-0.009**	0.0025	-3.59	0	-0.0139	-0.0041
WTP for program	**94.06**	31.72018	2.97	0.003	31.8905	156.2313
Number of observations = 1260						
LogLik = Log pseudolikelihood = -4610.2561						
Pseudo R2 = 0.0379						

Appendix III: Descriptive Statistics

Table 24: Descriptive Statistics

The MEANS Procedure

Variable	N	Mean	Std Dev	Minimum	Maximum
edu1	801	0.202247	0.401927	0	1
edu2	801	0.234707	0.42408	0	1
edu3	801	0.540574	0.498662	0	1
USA	801	0.359551	0.480169	0	1
CANADA	801	0.076155	0.265411	0	1
CSAMERICA	801	0.342072	0.4747	0	1
EUROPE	801	0.162297	0.368954	0	1
AFRASIA	801	0.024969	0.156127	0	1
PURPbus	801	0.33583	0.472575	0	1
PURPleis	801	0.510612	0.5002	0	1
PURPfam	801	0.118602	0.323521	0	1
PURPstud	801	0.034956	0.183784	0	1
PURPvol	801	0.021223	0.144219	0	1
SWIM	801	0.494382	0.500281	0	1
scubsnork	801	0.183521	0.387335	0	1
retired	801	0.089888	0.286199	0	1
student	801	0.093633	0.291499	0	1
children	783	1.003831	1.180071	0	5
childless	801	0.445693	0.497353	0	1
alone	801	0.626717	0.483979	0	1
couple	801	0.169788	0.375681	0	1
sharkserious	801	0.127341	0.333563	0	1
TOSEEMARINE	801	0.138577	0.34572	0	1
PLANVIEWSHARKS	801	0.072409	0.259327	0	1
C3shark	801	0.453184	0.498114	0	1
hinc	785	13701.75675	41799.73896	0	300000
hincd	173	62172.71125	70235.12534	0	300000
pinc	783	14396.94936	35354.45289	0	300000
pincd	223	50550.72355	50666.56248	0	300000

hincmiss	801	0.764045	0.42486	0	1
pincmiss	801	0.699126	0.458925	0	1

Appendix IV: NGENE Design

MNL efficiency measures

				Wed	after 4"
D error	0.000367	**time**		Wed 11:18	11:22
A error	0.018843	**D value**		0.004311	0.000392
B estimate	4.91924	**no. eval**		20	2,549
S estimate	0.168398			Wed	after 4"

Prior	b1	b2	b3	b4	b5	b6
Fixed prior value	0.7	0.6	0.6	0.5	0.4	-1
Sp estimates	0.163535	0.167405	0.168398	0.166454	0.165804	0.165156
Sp t-ratios	4.846746	4.790404	4.776252	4.804062	4.813473	4.822905

Choice situation	**alt1.coral**	**alt1.city**	**alt1.beach**	**alt1.shark**	**alt1.turtle**	**alt1.cost**	**alt2.coral**	**alt2.city**	**alt2.beach**	**alt2.shark**	**alt2.turtle**	**alt2.cost**	**Block**
1	50	30	15	20	-5	10	35	15	0	50	15	5	16
2	35	15	30	60	0	45	50	30	15	0	-15	20	8
3	45	0	30	80	5	45	50	30	0	0	5	10	20
4	35	30	15	50	5	10	50	30	30	20	0	10	15
5	50	30	30	40	-5	45	35	0	30	50	-15	20	14
6	50	0	0	20	-5	90	50	15	0	40	-5	90	11
7	45	0	15	40	-15	45	50	15	0	50	5	90	9
8	45	0	0	20	5	10	50	30	15	20	15	45	3
9	50	15	0	40	15	5	45	0	15	60	15	20	13
10	0	30	30	60	15	10	35	0	0	20	0	90	6
11	50	0	30	60	15	90	45	30	30	60	-15	90	2
12	35	0	0	50	0	90	35	15	30	60	-5	90	11
13	0	15	0	0	-5	90	45	30	15	50	5	90	16
14	45	0	15	60	0	20	45	15	0	50	15	20	1
15	45	15	15	40	-15	5	50	0	30	20	5	5	5
16	35	0	0	60	5	45	45	0	0	0	5	20	18
17	35	30	0	50	5	90	35	30	30	60	-5	90	6
18	50	0	0	0	15	45	0	30	0	60	-15	45	14
19	0	15	15	60	0	10	35	30	15	0	-15	10	16

20	0	0	0	0	-5	45	50	0	15	80	15	5	12
21	50	30	30	50	0	45	35	30	15	40	5	20	10
22	50	30	0	80	-15	10	50	15	30	60	-15	10	8
23	50	0	15	20	-15	45	50	30	30	40	5	90	2
24	35	30	0	80	-15	5	45	15	30	80	-15	20	5
25	0	30	0	20	-5	5	45	0	15	60	-15	45	8
26	35	30	30	50	-15	20	45	30	0	50	15	20	18
27	0	15	0	80	15	10	45	15	30	0	-5	10	5
28	0	15	15	0	0	20	50	15	15	20	5	20	3
29	45	15	30	20	5	10	50	15	30	40	0	20	18
30	45	15	0	60	0	5	50	0	15	80	5	20	1
31	45	30	30	40	5	20	35	15	0	80	5	5	4
32	35	30	30	40	5	45	0	15	15	80	0	20	9
33	45	15	15	50	-15	20	45	15	30	80	-5	45	17
34	0	15	0	20	0	20	0	0	30	50	5	45	4
35	0	15	30	0	15	10	35	0	0	40	-5	20	4
36	50	0	0	60	-5	20	45	0	30	80	0	45	19
37	50	30	30	0	15	20	35	30	15	40	-15	10	20
38	45	0	30	80	0	90	50	30	0	60	15	90	13
39	0	15	30	20	0	10	0	30	15	20	15	45	2
40	0	0	15	20	15	10	0	30	0	40	15	45	19
41	50	15	15	40	0	20	45	30	15	80	0	45	7
42	45	15	0	50	-15	5	35	0	30	20	5	10	20
43	45	0	15	80	15	90	35	0	15	20	5	45	2
44	0	30	15	60	-5	45	35	30	0	60	0	90	17
45	35	30	15	20	-5	20	45	15	15	0	-15	5	4
46	50	30	0	0	-15	45	45	30	0	40	15	5	12
47	45	30	15	20	15	5	0	30	30	80	5	10	11
48	45	0	0	50	5	5	45	0	0	20	-15	45	7
49	0	15	30	40	-5	20	45	0	30	40	0	45	16
50	50	30	15	80	15	45	45	0	30	40	5	5	14
51	35	15	0	80	0	90	45	15	0	80	-15	20	6
52	45	0	30	80	15	90	0	30	15	0	-5	20	16
53	35	0	0	60	-5	10	50	15	0	40	5	20	10
54	50	30	15	50	5	90	0	30	0	40	15	45	12
55	35	15	15	60	-5	10	50	30	15	20	5	90	5
56	50	0	30	40	-5	10	0	0	15	50	-5	45	13
57	50	15	15	0	0	90	35	15	15	80	15	90	11
58	0	0	30	20	15	5	0	15	30	0	15	5	9
59	45	15	30	60	5	90	0	0	0	20	0	10	15
60	35	30	0	80	5	10	50	0	30	60	5	10	17
61	0	0	30	0	5	20	35	30	30	50	15	90	13

62	50	30	15	0	5	5	0	30	0	80	15	5	6
63	0	15	30	60	15	90	35	15	0	0	15	10	12
64	35	0	0	0	15	90	45	15	15	80	-5	90	8
65	0	15	15	80	5	10	50	15	0	40	-5	10	17
66	50	30	15	40	5	90	50	15	15	20	15	90	4
67	50	30	15	50	5	5	0	30	15	50	-15	45	9
68	50	15	30	40	0	20	45	0	15	80	0	20	18
69	35	15	15	80	5	10	45	30	15	50	-5	10	18
70	35	15	30	60	15	90	35	15	0	20	0	45	11
71	45	0	0	40	15	5	50	15	30	20	0	20	3
72	45	15	30	20	-5	5	45	0	0	60	15	5	10
73	35	0	30	0	-15	5	45	15	0	60	0	10	20
74	0	0	15	80	15	5	0	30	15	60	0	5	1
75	50	15	15	20	15	90	35	0	15	20	5	45	20
76	0	0	15	60	15	20	35	30	15	50	-15	45	15
77	45	0	0	80	-5	45	0	0	15	50	-15	5	12
78	35	15	0	60	-5	45	0	30	30	60	-15	45	7
79	0	0	15	80	-5	5	0	15	15	60	0	5	6
80	45	30	30	80	5	90	45	0	0	0	-15	5	1
81	0	15	0	50	15	20	45	15	15	40	-15	45	15
82	0	15	0	0	0	20	45	0	30	80	5	90	3
83	35	15	0	50	-5	20	0	0	30	80	-5	20	19
84	35	15	15	50	-15	10	0	30	15	60	5	5	7
85	50	15	0	0	5	45	50	0	30	60	15	90	14
86	50	15	15	40	-5	45	50	0	15	50	-5	45	3
87	35	30	15	80	-5	90	35	30	30	60	-5	90	9
88	45	0	30	60	0	5	35	30	30	60	0	20	3
89	50	0	30	20	0	20	50	15	0	0	0	10	13
90	35	0	30	80	-15	20	35	0	0	80	-5	5	4
91	45	0	30	80	-15	45	0	0	30	50	15	10	1
92	0	30	15	0	15	20	35	0	0	0	-5	10	8
93	50	0	0	50	-15	5	50	15	30	0	15	20	10
94	50	30	0	0	-5	5	35	15	30	20	5	20	7
95	45	30	15	60	5	90	50	15	0	20	-15	45	5
96	50	15	30	50	0	90	50	0	15	0	-15	45	15
97	35	15	0	60	-15	20	45	0	0	20	0	5	5
98	45	30	15	50	-15	90	0	0	0	50	-15	10	17
99	45	0	30	0	-15	45	50	15	30	60	-15	90	11
100	35	30	30	60	15	45	35	15	15	40	-5	10	19
101	45	30	15	0	0	90	35	30	0	20	-5	10	9
102	45	15	15	50	-15	45	0	15	0	50	-5	10	14
103	35	30	15	20	-15	20	50	15	30	40	0	90	6

104	35	30	30	20	0	90	0	0	0	20	-5	10	2
105	0	15	30	40	-5	45	35	15	30	40	-15	90	17
106	0	30	0	50	0	10	0	30	30	0	5	5	14
107	50	0	30	40	5	10	50	15	15	80	-5	5	1
108	45	0	15	80	-15	20	0	30	30	40	0	90	20
109	50	15	0	20	0	5	50	30	30	0	-5	20	8
110	35	0	0	20	5	5	0	15	0	80	5	20	10
111	0	30	30	40	-5	10	45	0	30	0	0	5	12
112	0	30	0	50	5	5	45	0	30	0	0	10	19
113	0	15	0	0	0	10	35	30	15	50	15	90	10
114	45	30	30	40	-15	10	45	30	0	40	15	5	18
115	35	30	0	40	15	5	35	0	15	80	-5	5	16
116	0	0	30	0	0	20	0	0	0	0	0	90	19
117	35	30	0	20	-15	45	0	15	30	50	-15	45	15
118	35	0	30	40	-15	10	35	15	15	0	15	5	7
119	45	0	15	50	-5	45	0	0	15	40	0	10	13
120	0	30	15	40	-15	5	0	30	0	50	-5	5	2