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# Towards A Better Understanding of the Economic Value of Ships to Reef Scuba Diving in Southern California

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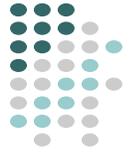
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## Executive Summary

The San Diego Oceans Foundation (SDOF) collected preliminary data on expenditures by divers visiting the Yukon ship to reef site in the waters off of coastal San Diego. Additionally, the SDOF collected residential zip code data from diver waiver forms from one “anonymous” dive operator running charters to the Yukon and other dive sites in the region. Using these expenditure and zip code data, we performed a preliminary analysis of the potential market and non-market value of diving to the Yukon. We find that, on average, divers that responded to the SDOF survey spent \$95 per dive trip on expenditures related directly to diving. Additionally, the average out of county diver spent an additional \$580 on lodging, food, beverage, and shopping during the previous day of their trip. We also find that the average diver to the Yukon enjoys approximately \$110 of additional non-market benefits from their dive. We perform a preliminary extrapolation of these numbers to the estimated 10,800 total dive trips and 6,000 dive trips made by out of county divers to the Yukon annually. Using these data we estimate that the potential market contribution of the Yukon may be on the order of \$4.5 million and the non-market value of the Yukon may be as large as \$1.2 million annually.

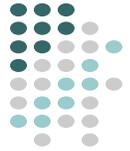
## Introduction

More and more, coastal communities are turning to artificial reefs as a means of protecting shoreline, creating habitat for fish and sea life, and providing new destinations for recreational fishing and scuba diving tourists. In Florida, over 380 existing vessels have been sunk to create artificial reefs. To date, over 700 ships serve as

artificial reefs in the waters off the continental U.S. coastline. The majority of these ships are found off the coast of Florida (380), New Jersey (129), South Carolina (100), and New York (65).

While the California Department of Fish and Game has an active artificial reef program, nearly all of the intentionally created artificial reef structures in California are intended to enhance sports fishing opportunities (Lewis and McKee, 1998). Most of these reefs are made from quarried rock materials, light poles, and pier pilings. California lags far behind many other coastal states in the creation of artificial “shipwrecks,” also known as ships to reefs, especially those intended for diving. The state has only ten ships currently in place as artificial reefs intended for recreational diving, only three are in Southern California.

Part of the slow pace of ships to reefs creation in California can be attributed to the high cost of acquiring, preparing, and sinking a ship for use as a dive site. Hess et al. (2001) report that the cost to prepare a ship for reefing can range from \$46,000 to \$2 million, depending on the size of the vessel. Recent discoveries of potentially polluting hazardous materials on board vessels that are candidates for ships to reefs (including polychlorinated biphenyls) have made ship preparation more costly than ever before. The San Diego Oceans Foundation (SDOF), recently paid \$238,000 to acquire the 366 foot, Canadian Destroyer Escort Yukon. The Foundation paid an additional \$97,000 to prepare the vessel and \$100,000 for towing, mooring, and sinking. Understandably, state agencies, local municipalities, and even non-profit diver organizations often want to have a better idea of the potential economic benefits of



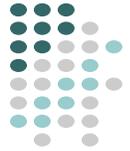
creating shipwrecks before proceeding with the costly process of finding, prepping, and sinking a ship in coastal waters.

To better understand the economic value of artificial shipwrecks in Southern California, the SDOF initiated two studies: 1) a 2002/2003 pilot expenditure survey for divers visiting the Yukon and 2) a sample of waiver data that provides information about the origins of divers visiting the Yukon and other reefs in southern California. The expenditure survey was intended as a first look at the potential economic impact of artificial reef diving in Southern California including benefits to local divers and the economic impacts that divers have on local businesses. The second sample of waiver data was intended to serve as the basis of an analysis of the potential non-market benefits of the Yukon; non-market benefits are those benefits that accrue to local and regional divers in excess of their expenditures. In the brief report that follows, we briefly describe the SDOF diver survey, present preliminary results from the survey, and discuss the limitations of the data. Pilot studies are always limited in the degree to which the data can be extrapolated. Nevertheless, the results from this pilot study demonstrate that the economic impacts of the Yukon are in keeping with estimates found for other ships to reef sites around the country. We also provide the results of a non-market analysis of diver waiver data from the years 2001 through 2003. The surveys demonstrate that the economic benefits generated by the Yukon, both market and non-market, are substantial and many times larger than the initial costs of “reefing” the vessel.

### **The Expenditure Survey**

A pilot survey was administered initially in 2002 to collect information about divers, their personal characteristics, and their spending associated with their dive trip to the Yukon. The goal of the survey was to quantify the contribution to the local economy of the Yukon artificial reef project; the premise being that the presence of the Yukon could have two primary impacts on the dive economy: 1) the Yukon would draw divers to the region that would not have visited in the absence of the wreck and 2) the Yukon would increase the economic wellbeing and spending of divers that would still have come to the region to dive, even in the absence of the Yukon.

Under ideal circumstances, the survey would have been administered to a random sample of divers to all dive sites in the region (including dive sites at Kelp Beds, the Coronado Islands, shipwrecks in Shipwreck Alley, and other artificial reef sites). Because the survey was essentially “unfunded” the SDOF was unable to conduct either a census of all divers or a random sample of divers. Instead, the SDOF distributed survey forms to dive operators and asked that the survey be given to all divers visiting the Yukon shipwreck; the placement and maintenance of the Yukon artificial reef dive site is a major component of the marine stewardship effort of the SDOF. Because of the way the survey was administered, there are two important limitations to our interpretation of the data: 1) we are unable to determine whether the results of the survey are representative of divers visiting the region over the course of the year and 2) we are unable to determine the additional impact on the local dive economy that



can be attributed directly to the Yukon.

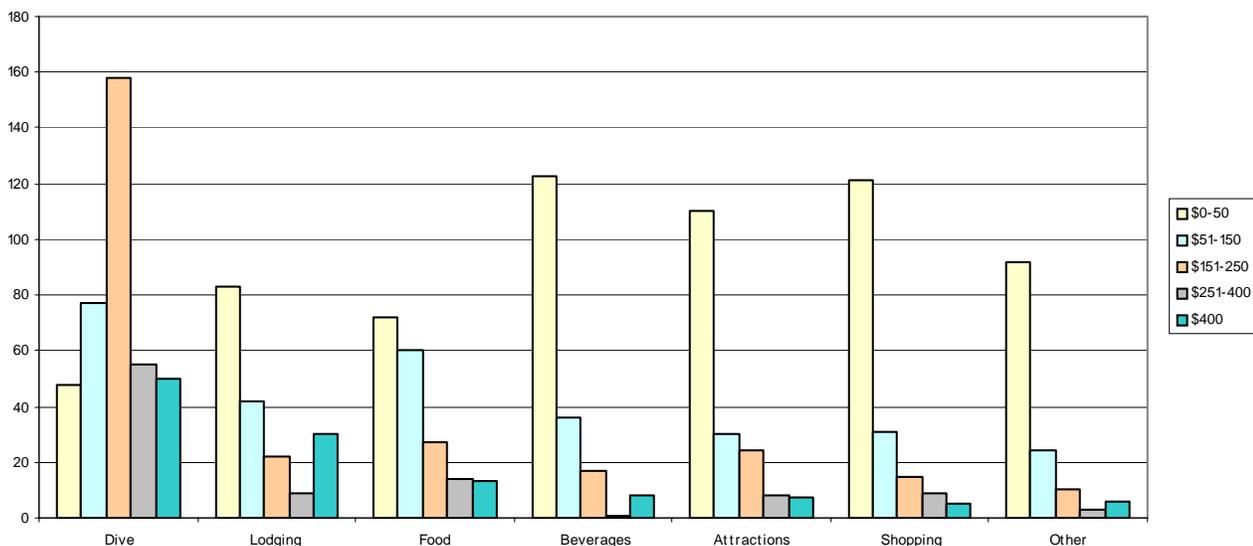
Despite the limitations in our ability to interpret and extrapolate the data, the SDOF pilot survey provides an insight into the personal characteristics of over 800 divers who visited the Yukon during 2002 (419 responses) and 2003 (395 responses). We present a summary of the most important elements of the survey below. It is important to note that two versions of the survey were administered. During 2002 and part of 2003, a preliminary survey was given to divers that provided open-ended questions regarding trip-related expenditures. This open-ended format resulted in a low response rate (54%) for expenditure questions, even among those completing the general part of the survey. To improve the response rate, the SDOF revised the survey so that respondents needed only to check a category of expenditures for each type of expenditure (see attachment A). The revision to the expenditure questionnaire substantially improved the response rate to expenditure questions among those completing the survey

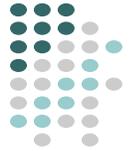
(86%). Below, we include the mean expenditures of the 2002 preliminary survey, only for reference.

**Expenditures Per Dive Trip**

Data were collected on seven principle categories of expenditures: diving, lodging, food, beverages, amusements, shopping, and other. All divers were asked to report expenditures related to their dive trip (e.g. charter fees, tanks fills, etc.), but only non-resident divers (those living outside of San Diego County) were asked to provide information on other types of expenditures (based on spending the previous day). For the 2003 revised pilot survey, survey respondents were asked to indicate if there expenditures fell within one of the following categories: \$0-\$50, \$51-\$150, \$151-\$250, \$251-\$400, and greater than \$400. The distribution of responses for the 2003 survey is given in Figure 1. Except for expenditures directly related to diving, the distribution of responses among these categories generally is

**Figure 1: Distribution of Expenditures Among Divers, by Category**





biased towards smaller categories.

In this preliminary analysis, we estimate expenditures per diver by using the mean value of the response category chosen as the “expected” expenditure of that respondent. Using this method, we find that, on average, divers that responded to the SDOF survey spent \$95 per dive trip on expenditures related directly to diving. Additionally, the average out of county diver spent an additional \$580 on lodging, food, beverage, and shopping during the previous day of their trip. A break down of spending, by category, is given in Table 1.

**Local Expenditures: The Yukon’s Contribution to the Recreational Dive Economy**

We cannot accurately extrapolate our expenditure estimates to the population of all divers since we are unable to determine whether the data gathered by the SDOF survey are representative of all divers. Nevertheless, we present a preliminary extrapolation working under the assumption that these expenditures provide an indication of the potential magnitude of expenditures by divers visiting the Yukon.

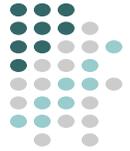
The San Diego Oceans Foundation estimates that 26,700 dives were made to the Yukon in 2003. From the SDOF survey of divers, divers visiting the Yukon make an average of 2.45 dives/day. From these two figures, we estimate that there were just over 10,800 dive trips made to the Yukon in 2003. Furthermore, just over

Table 1: Estimated Expenditures for Out of County Visitors to the Yukon Artificial Diving Reef

	Per Person Per Day Expenditures		Estimated Expenditure Totals (\$1,000s)	Wages to Sales Ratio <sup>1</sup>	Employment to Sales <sup>1</sup>	Wages (\$1,000s)	Employment (full time jobs)
	2002 <i>For reference only</i>	2003					
Diving	\$ 93	\$ 95	\$1,036	0.2079	15596	\$ 119	37
Lodging	\$ 212	\$ 133	\$ 797	0.1921	16265	\$ 153	49
Food	\$ 95	\$ 124	\$ 743	0.1760	11365	\$ 131	65
Beverages	\$ 42	\$ 74	\$ 445	0.1760	11365	\$ 78	39
Amusements	\$ 130	\$ 91	\$ 543	0.2915	14656	\$ 158	37
Shopping	\$ 136	\$ 77	\$ 463	0.2358	26214	\$ 109	18
Other	\$ 70	\$ 78	\$ 466	0.2358	26214	\$ 110	18
Observations	118	187					
Total Expenditures	\$777	\$673	\$4,027			\$858	262

<sup>1</sup>From the 1997 U.S. Economic Census.

<sup>1</sup>Following Leeworthy and Wiley (2002), we use sectoral data on revenues, wages, salaries, and employment from the most recent U.S. Economic Census (in this case 1997).



55% of all divers surveyed by SDOF were out of county divers. Therefore, we assume for this analysis, that just under 6,000 dive trips were made to the Yukon by out of town visitors in 2003. Of course, these estimates are approximate only and intended to illustrate the potential economic impact of the Yukon on the San Diego economy.

Expenditures by divers support the local economy; these expenditures create jobs, fund wages, and generate tax revenues. We estimate that just under \$4.5 million was spent by divers visiting the Yukon in 2003. Of these expenditures, spending by out of county residents represent a net influx of money into the local San Diego economy. We consider these expenditures here.

Diver operators are well aware of the value of the Yukon. We estimate that Yukon divers spent roughly \$1 million on dive charters and tank fills in 2003. Of these expenditures, just under \$600,000 (\$570,000) was spent by out of county divers. In turn, we estimate roughly that these expenditures supported 37 full-time jobs and \$119,000 in salaries and wages. (Overall, dive charter revenues for Yukon dives may have supported as many as 66 full time jobs and \$215,000 in wages and salaries.)

Not as obvious, but ultimately more important to the local economy, is the value of other ancillary spending by out of county divers during their visits to San Diego. Divers in the SDOF Yukon survey spent on average \$580/day for lodging, meals, and related expenditures. These expenditures may have contributed in excess of \$4 million to the local economy and supported 225 full time jobs and more than \$700,000 in

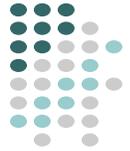
wages and salaries.

### **The Non-Market Analysis**

The creation of new recreational opportunities, like those embodied by the Yukon ship to reef, provide economic benefits to the region beyond what divers spend. These recreational opportunities also generate non-market benefits – the value that users place on a resource beyond what they pay to access that resource. These non-market benefits of artificial reefs can be substantial. Diving at artificial reefs in the Gulf of Mexico generated non-market benefits estimated at more than \$70 per diver day in Texas (Ditton) and as much as \$339 per diver per year at oil rigs in the Gulf of Mexico.

One common way to assess the non-market value of recreational resources is the travel cost method. The travel cost method uses travel expenditures by resource users, in this case divers, as a proxy for the price that the user pays to access the recreational resource. The idea is that a diver only makes a trip if the value of the trip is at least equal to or greater than the cost of the trip. The amount they value the resource beyond what they pay, their “consumer surplus,” represents a net benefit to society – the value added of the recreational resource. Divers that live closer to the reef tend to make more trips, but pay less in travel costs. As a result, the non-market value (i.e. consumer surplus) for local divers is greater than those for divers coming from greater distances.

As with the expenditure analysis, we ideally would like to estimate our travel cost model using a random sample of divers. Unfortunately, we lack these data. We do, however, have data



on the residential zip codes for divers filling out waivers to one “anonymous” dive operation in San Diego. We use these waiver data to demonstrate the potential non-market value (per diver day) for diving in southern California. We provide analysis for dives made to the Yukon specifically and dives made to all other sites in San Diego county.

We use Mapquest™ to estimate the round-trip miles from the harbor of San Diego to the zip code provided by divers in the waivers. We follow the Southern California Beach Valuation Project (Hanemann, Pendleton et al. 2004) and use the American Automobile Club’s estimate of the average variable costs per mile of \$.33/mile for year 2003 to convert miles driven to travel

costs (variable costs do not include depreciation and insurance costs). We follow the literature in the estimation of a basic travel cost model in which we estimate the per capita visitation to Southern California reefs by divers from regions with similar travel costs. For our purposes, we define our regions as counties and limit our analysis to divers traveling from California, Arizona, and Nevada since these divers are more likely to have driven than divers from outside the tri-state region. Specifically, we estimate the following model of per capita visitation.

$$\text{Visits/capita}_{\text{county } i} = \text{constant} + b_{1\text{travel}} \text{COST}_{\text{county } i} + b_{2\text{median household income}} \text{income}_{\text{county } i}$$

Separate models were estimated for the years 2001-2003 and for Yukon divers versus all other

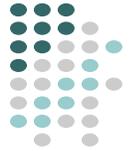
Table 2: Estimated Per Diver-Day Non-Market Values for Diving in Southern California

Dive Trips to the Yukon Ship to Reef Site

Year	Observations	Mean Consumer Surplus
2001	1699	\$ 116
2002	1325	\$ 101
2003	1232	\$ 114
	Mean	\$ 110

Dive Trips to All Other Southern California Sites

Year	Observations	Mean Consumer Surplus
2001	549	\$ 154
2002	343	\$ 105
2003	434	\$ 126
	Mean	\$ 128



divers (see Table 2). In all cases, the coefficient on travel cost was significant at the 99% confidence level for Yukon divers and greater than 90% confidence levels for all other divers (note the number of observations was significantly smaller for non-Yukon divers). Our preliminary estimates indicate that, on average, diver days for visits to the Yukon generate non-market values of approximately \$110 per diver day for the years 2001 through 2003. This value is marginally higher than per diver-day values found for other studies on artificial reefs. If we extrapolate this average non-market value to all 10,800 dive trips to the Yukon, we find that the non-market value of the Yukon may be on the order of \$1.2 million annually.

Like other studies that estimate the non-market values for both artificial reefs and natural sites, we find that the non-market value of trips to the Yukon is slightly lower than the estimated value of \$128 for all other reef sites considered (including other wrecks and natural sites). The gap between non-market values for trips to the Yukon and other sites diminished over the three years considered.

### **The Need for Future Research**

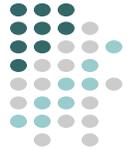
Preliminary evidence indicates that the economic contribution to the economy of San Diego of the “Yukon ship to reef” may be many times greater than the cost of acquiring, preparing, sinking, and maintaining the 366 foot vessel. More importantly, our initial findings suggest that creating additional, well-prepared, ships to reef sites in Southern California may also generate substantial economic benefits. Before new ships to reefs are considered, however, it would be prudent

to conduct a complete and detailed economic analysis of

the current economic impacts of the Yukon ships to reef project, the impact of the Yukon project on diving to natural and artificial reefs in Southern California, and the potential impacts of additional “new” artificial reefs in Southern California.

A more complete accounting of the economic impacts, including expenditures and non-market benefits, of current and future artificial reefs in Southern California will require a substantial survey effort. Ideally, a census of divers would be conducted over the course of a year at dive sites throughout the region. At the very least, a survey ought to be conducted in which the representativeness of the survey can be adequately assessed; this would require random sampling and a survey effort that substantially increases response rates over those currently available in the SDOF pilot study.

The value of the Yukon, or any new artificial reef site, lies in the degree to which it improves the quality and quantity of dive experiences available in the region. To best understand this “value added” component of artificial reefs, it is critical to understand how the creation of artificial reefs alters the overall demand and supply of reef opportunities. Artificial reefs offer dive opportunities that can provide novel characteristics or may simply substitute for existing dive sites. New reefs that enhance local dive offerings are likely to generate greater economic benefits than those that simply duplicate existing experiences.



Finally, it is important to remember that the value of artificial reefs extends well beyond divers and dive operators. The tourism industry specifically, and the local economy generally, often benefit more from new dive opportunities than do those involved directly in the dive industry. A more complete accounting of the economic impacts of diving, especially new diving to artificial reefs, will help to identify those in the community that are most likely to benefit, and thus most likely to support, the protection of existing reefs and the creation of new, environmentally sound artificial reefs.

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