

Socioeconomic Research & Monitoring Program for the
Florida Keys National Marine Sanctuary

Technical Appendix: The Economic Impact of the
USS Vandenberg on the Monroe County Economy

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Vernon R. Leeworthy

Office of National Marine Sanctuaries
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Introduction

This is the technical appendix to “The Economic Impact of the USS *Vandenberg* on the Monroe County Economy” (Leeworthy 2011). The USS *Vandenberg* is a 520’ decommissioned U.S. Air Force missile tracking ship and a WWII U.S. Army troop transport ship sunk off Key West Florida on May 27, 2009 as an artificial reef by Artificial Reefs of the Keys, Inc. (ARK). The permit for sinking of the USS *Vandenberg* required that pre and post sinking ecological and socioeconomic monitoring would be conducted. For the socioeconomic monitoring, advocates for artificial reefs hypothesized that sinking an artificial reef in a natural reef environment would reduce use (pressure) on the surrounding natural reefs; would increase business to local dive operators; and increase the economic impact measured as sales/output, income and employment in the Monroe County economy. In the case of the USS *Spiegel Grove* all three of these hypotheses were supported (Leeworthy et al. 2006). The same hypotheses were tested for the USS *Vandenberg* using the same methodologies as the USS *Spiegel Grove* study. Unlike the case of the USS *Spiegel Grove*, the hypothesis that introducing an artificial reef in a natural reef environment would reduce use on the surrounding natural reefs was not supported. The two hypotheses that dive operator business would increase and there would be a general increase in sales/output, income and employment in the Monroe County economy were supported. In the case of the USS *Vandenberg* the effect on total demand (use) dominated the substitution effect (switching from use of natural reefs to artificial reefs). A lower proportion of reef use is on natural reefs pre to post deployment of the USS *Vandenberg*, but the total use on both natural and artificial reefs increased. A lower proportion of reef use is on natural reefs pre to post deployment of the USS *Vandenberg*, but the total use on both natural and artificial reefs increased (Leeworthy 2011).

Here the methods used to estimate pre and post deployment use associated with the deployment of the USS *Vandenberg* and the associated economic impact is detailed.

Method Estimation of Reef Use: Pre and Post Deployment

The method of estimation followed the same general method used for the U.S. S. Spiegel Grove (Leeworthy and Stone (2005). The estimation follows a five step process (Figure 1):

- 1 Sum use from dive operator logbooks.
- 2 Derive extrapolation from on-water surveys to estimate to total dive operator use.
- 3 Extrapolate to total dive operator use.
- 4 Derive extrapolation factors to estimate total dive operator use, using on-water surveys, to the total for all use from all users.
- 5 Extrapolate to total use by all users.

The five steps are followed for both the pre and post deployment periods. The changes from pre to post are them calculated.

Estimates are made for each period by season (summer=June to November and winter=December to May), type of reef (artificial and natural), type of day (week day and weekend) and activity (SCUBA diving, snorkeling, fishing and other). For activity, “other” for dive operations is paying passengers that do not enter the water. When we present uses for all users “Others” become “other” from the dive operators plus those who fish.

Study Sites. As with the USS *Spiegel Grove* (Leeworthy and stone 2005), a set of study sites had to be selected that were near the site were the USS *Vandenberg* was planned to be sunk. All the dive operators were consulted to determine which natural and artificial reefs should be used as the study sites. Table 1 lists the sites included as the study sites. This is a key part of the design since we want to be able to determine the effect of reef use caused by introduction of the USS *Vandenberg*.

Figure 1. Use Estimation Method for USS *Vandenberg* Study Sites

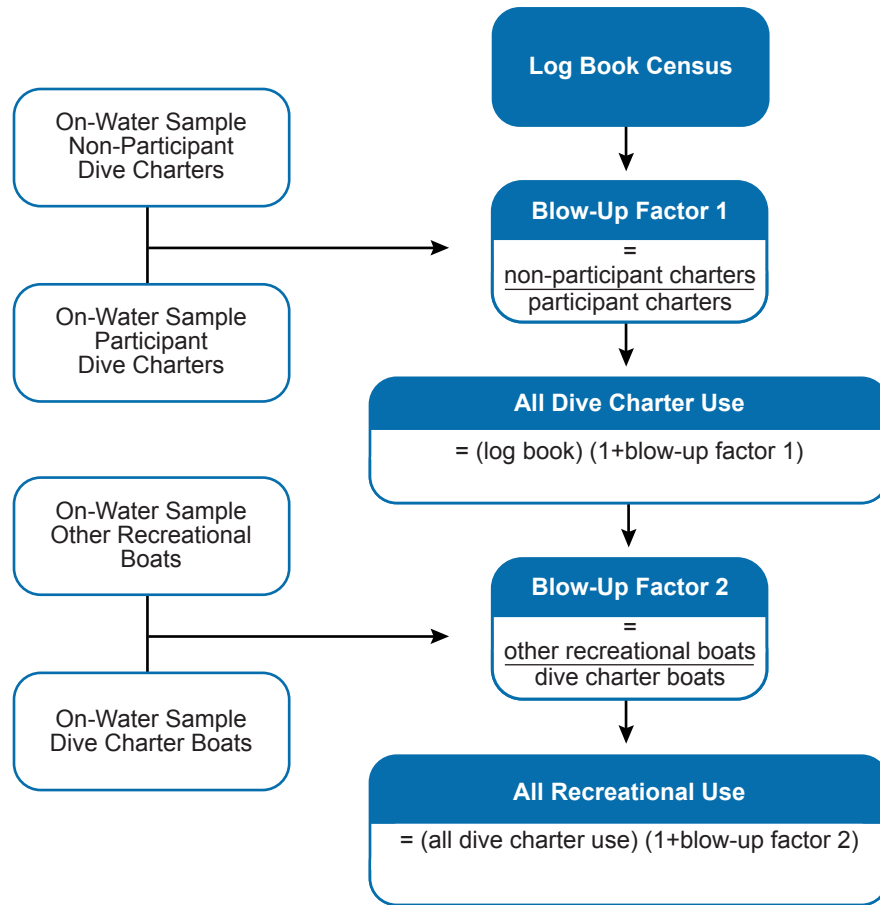


Table 1. Study Sites

Natural Reefs	Artificial Reefs
Pelican Shoals	Joe's Tug
Western Sambos	Toppino Buoy
Humps	Cayman Salvager
Eye of the Needle	USS <i>Vandenberg</i>
9 Foot Stake	
Eastern Dry Rocks	
Rock Key	
Sand Key	
Western Dry Rocks	

On-water Sampling Periods. The pre deployment period was the 12-month period from May 2007 through April 2008. Seventy-two days of on-water sampling were conducted over this period stratified by type of day (week day and weekend) and by type of reef (artificial and natural). The post deployment period was the 12-month period from July 2009 through June 2010. Again, seventy-two days of on-water sampling were conducted over the period stratified by type of day and type of reef. Since the USS *Vandenberg* was sunk on May 27, 2009, the post deployment monitoring was purposely delayed one month to avoid the “newness effect” or the demand by those who might have come only to be the first to dive the site. This is important because in interpreting results, the assumption is that the post deployment use estimated will be representative of future use.

Number of Dive Operators. The number of dive operators in the Key West District of the Florida Keys was eight (8) during the pre-deployment period, but doubled to 16 in the post deployment period. Five of the eight dive operators provided logbook data during the pre-deployment period, while 10 of the 16 dive operators provided logbook data for the post deployment period. As the on-water data revealed, the dive operators that provided logbook data accounted for the overwhelming amount of total dive operator use, so the logbook data is close to the census of dive operator use that was hoped for. Thus, the extrapolation factors for estimating total dive operator use are relatively small.

All the dive logbook data and on-water sampling was conducted under a grant from the Florida Fish and Wildlife Conservation Commission to Artificial Reefs Inc. and Florida Keys Community College.

Step 1: Sum use from Dive Operator logbooks.

In this step, the sums of the uses by dive operators that provided logbook data are done by season, type of reef, type of day, and type of activity are done for both the pre and post deployment periods. The estimates for the pre deployment period are presented in Table 2 and the post deployment estimates are in Table 3.

The estimates in Tables 2 and 3 are in number of dives. The logbooks record morning (am), afternoon (pm), and night dives and usually two dives at each of these times per day, but not always (occasionally only one dive is done). The number of SCUBA divers (Divers), snorkelers, and others (paying passengers that did not get in the water) are recorded for each reef site. The number of crew onboard is also recorded but not presented here.

Table 2. Pre Deployment Dive Operator Logbook - Without Adjustment for Missing Logbook Data
Study Sites Only

Season	Type of Day	Type of Reef	Divers	Snorkelers	DivSnork	Other	Total
Summer	Week Day	Natural	5,103	845	5,948	392	6,340
Summer	Weekend	Natural	2,001	401	2,402	83	2,485
Summer	Week Day	Artificial	2,022	89	2,111	120	2,231
Summer	Weekend	Artificial	946	54	1,000	74	1,074
Winter	Week Day	Natural	4,283	968	5,251	0	5,251
Winter	Weekend	Natural	1,866	422	2,288	0	2,288
Winter	Week Day	Artificial	1,595	43	1,638	459	2,097
Winter	Weekend	Artificial	834	9	843	28	871
Summer		Natural	7,104	1,246	8,350	475	8,825
Winter		Natural	6,149	1,390	7,539	0	7,539
Summer		Artificial	2,968	143	3,111	194	3,305
Winter		Artificial	2,429	52	2,481	487	2,968
Summer		All	10,072	1,389	11,461	668	12,129
Winter		All	8,578	1,442	10,020	487	10,507
Annual		Natural	13,253	2,636	15,889	475	16,364
Annual		Artificial	5,397	195	5,592	681	6,273
Annual		All	18,650	2,831	21,481	1,155	22,636
Summer	Percent	Natural	70.53	89.70	72.86	0.00	72.75
Winter	Percent	Natural	71.68	96.39	75.24	0.00	71.75
Annual	Percent	Natural	71.06	93.11	73.97	0.00	72.29

Table 3. Post Deployment Dive Operator Logbook - Without Adjustment for Missing Logbook Data Study Sites Only

Season	Type of Day	Type of Reef	Divers	Snorkelers	DivSnork	Other	Total
Summer	Week Day	Natural	8,047	1,537	9,584	565	10,149
Summer	Weekend	Natural	3,446	638	4,084	148	4,232
Summer	Week Day	Artificial	11,313	233	11,546	272	11,818
Summer	Weekend	Artificial	6,801	94	6,895	135	7,030
Winter	Week Day	Natural	5,910	1,228	7,138	390	7,528
Winter	Weekend	Natural	1,969	435	2,404	63	2,467
Winter	Week Day	Artificial	11,313	233	11,546	272	11,818
Winter	Weekend	Artificial	2,541	50	2,591	75	2,666
Summer		Natural	11,493	2,175	13,668	713	14,381
Winter		Natural	7,879	1,663	9,542	453	9,995
Summer		Artificial	18,114	327	18,441	407	18,848
Winter		Artificial	13,854	283	14,137	347	14,484
Summer		All	29,607	2,502	32,109	1,120	33,229
Winter		All	21,733	1,946	23,679	800	24,479
Annual		Natural	19,372	3,838	23,210	1,166	24,376
Annual		Artificial	31,968	610	32,578	754	33,332
Annual		All	51,340	4,448	55,788	1,920	57,708
Summer	Percent	Natural	38.82	86.93	42.57	63.66	43.28
Winter	Percent	Natural	36.25	85.46	40.30	56.63	40.83
Annual	Percent	Natural	37.73	86.29	41.60	60.73	42.24

Step 2: Derive extrapolation factors from on-water surveys to extrapolate to total Dive Operator use.

The on-water survey samples were used to derive the ratios of use of dive operators that did not supply logbook data to those that did provide logbook data. The blow-up factors for extrapolating to total dive operator use are then defined as 1+ (sum of dive operator use without logbook data/sum of dive operator use with logbook data). These blow-up factors were estimated for each deployment period by season, type of reef, type of day, and type of activity. Tables 4 presents the estimates for the pre-deployment period and Table 5 presents the estimates for the post deployment period.

During the pre-deployment period, the contractor failed to record “others” from the logbooks. To account for “others”, the on-water survey data was used to calculate the ratio of “others” to the sum of SCUBA divers and snorkelers. This is the last column of Table 4. It is used to derive the number of others in the logbook data.

Table 4. Pre Deployment Dive Operator Extrapolation Factors for Missing Logbook Data: All Study Sites

Season	Type of Day	Type of Reef	Sums Without			Sums With			Extrapolation Factor			
			Dive	Snork	Other	Dive	Snork	Other	Dive	Snork	Other	OtherWO
Summer	Week Day	Natural	29	44	7	239	95	22	1.121339	1.463158	1.318182	0.065868
Summer	Weekend	Natural	10	0	0	181	51	8	1.055249	1	1	0.034483
Summer	Week Day	Artificial	13	0	68	120	3	7	1.108333	1	10.71429	0.056911
Summer	Weekend	Artificial	3	0	37	204	13	16	1.014706	1	3.3125	0.073733
Winter	Week Day	Natural	0	0	0	68	11	0	1	1	1	0
Winter	Weekend	Natural	0	8	0	45	9	0	1	1.888889	1	0
Winter	Week Day	Artificial	0	0	0	25	0	7	1	1	1	0.28
Winter	Weekend	Artificial	15	0	1	85	5	3	1.176471	1	1.333333	0.033333

Table 5. Post Deployment Dive Operator Extrapolation Factors for Missing Logbook Data: All Study Sites

Season	Type of Day	Type of Reef	Sums Without			Sums With			Extrapolation Factor		
			Dive	Snork	Other	Dive	Snork	Other	Dive	Snork	Other
Summer	Week Day	Natural	12	0	0	41	4	1	1.292683	1	1
Summer	Weekend	Natural	17	16	0	181	51	8	1.093923	1.313725	1
Summer	Week Day	Artificial	20	0	0	409	2	0	1.0489	1	1
Summer	Weekend	Artificial	105	19	8	581	23	18	1.180723	1.826087	1.444444
Winter	Week Day	Natural	17	1	0	107	11	6	1.158879	1.090909	1
Winter	Weekend	Natural	0	0	0	102	7	4	1	1	1
Winter	Week Day	Artificial	18	0	0	231	9	9	1.077922	1	1
Winter	Weekend	Artificial	14	0	0	342	0	6	1.040936	1	1

Step 3: Extrapolate to total Dive Operator use.

In this step, the extrapolation factors from step 2 are multiplied by the logbook sums from step 1 to obtain estimates of “Total Dive Operator Use”. Tables 6 and 7 provide the estimates for the pre and post deployment periods, respectively.

Table 6. Pre Deployment Dive Operator Logbook - With Adjustment for Missing Logbook Data Study Sites Only

Season	Type of Day	Type of Reef	Divers	Snorkelers	DivSnork	Other	Total
Summer	Week Day	Natural	5,722	1,236	6,959	516	7,475
Summer	Weekend	Natural	2,112	401	2,513	83	2,595
Summer	Week Day	Artificial	2,241	89	2,330	1,287	3,617
Summer	Weekend	Artificial	960	54	1,014	244	1,258
Winter	Week Day	Natural	4,283	968	5,251	0	5,251
Winter	Weekend	Natural	1,866	797	2,663	0	2,663
Winter	Week Day	Artificial	1,595	43	1,638	459	2,097
Winter	Weekend	Artificial	981	9	990	37	1,028
Summer		Natural	7,834	1,637	9,471	599	10,070
Winter		Natural	6,149	1,765	7,914	0	7,914
Summer		Artificial	3,201	143	3,344	1,531	4,875
Winter		Artificial	2,576	52	2,628	496	3,124
Summer		All	11,035	1,780	12,815	2,131	14,946
Winter		All	8,725	1,817	10,542	496	11,038
Annual		Natural	13,983	3,402	17,385	599	17,984
Annual		Artificial	5,777	195	5,972	2,028	8,000
Annual		All	19,760	3,597	23,357	2,627	25,984
Summer	Percent	Natural	70.99	91.97	73.91	28.13	67.38
Winter	Percent	Natural	70.47	97.14	75.07	0.00	71.70
Annual	Percent	Natural	70.76	94.58	74.43	22.81	69.21

Table 7. Post Deployment Dive Operator Logbook - With Adjustment for Missing Logbook Data Study Sites Only

Season	Type of Day	Type of Reef	Divers	Snorkelers	DivSnork	Other	Total
Summer	Week Day	Natural	10,402	1,537	11,939	565	12,504
Summer	Weekend	Natural	3,770	838	4,608	148	4,756
Summer	Week Day	Artificial	11,866	233	12,099	272	12,371
Summer	Weekend	Artificial	8,030	172	8,202	195	8,397
Winter	Week Day	Natural	6,849	1,340	8,189	390	8,579
Winter	Weekend	Natural	1,969	435	2,404	63	2,467
Winter	Week Day	Artificial	12,195	233	12,428	272	12,700
Winter	Weekend	Artificial	2,645	50	2,695	75	2,770
Summer		Natural	14,172	2,375	16,547	713	17,260
Winter		Natural	8,818	1,775	10,593	453	11,046
Summer		Artificial	19,896	405	20,301	467	20,768
Winter		Artificial	14,840	283	15,123	347	15,470
Summer		All	34,068	2,780	36,848	1,180	38,028
Winter		All	23,658	2,058	25,715	800	26,515
Annual		Natural	22,990	4,150	27,140	1,166	28,306
Annual		Artificial	34,736	688	35,424	814	36,238
Annual		All	57,726	4,837	62,563	1,980	64,543
Summer	Percent	Natural	41.60	85.44	44.91	60.42	45.39
Winter	Percent	Natural	37.27	86.25	41.19	56.63	41.66
Annual	Percent	Natural	39.83	85.78	43.38	58.89	43.86

Step 4: Derive extrapolation factors to extrapolate from total Dive Operator use, using on-water surveys, to the total for all use from all users.

The on-water survey samples are used to derive the extrapolation factors or blow-up factors to extrapolate estimates of total dive operator use to uses by all users. Here it is important to note that research vessels, enforcement boats, and most importantly, snorkel boats were not counted. Use by each was recorded in the on-water data, but these uses were not counted because they would have nothing to do with the introduction of the USS *Vandenberg*. Although some people do snorkel on the U.S.S. *Vandenberg*, the large snorkel boats do not take their passengers to the USS *Vandenberg* and so would not have changed their patterns of use. The blow-up factors are defined as 1 plus the sum of all non-dive operator use/ the sum of all dive operator use. It is important to note the definition of “Other” in this and subsequent steps. Other here refers to all those who were fishing plus other passengers who did not get in the water. The results for the pre-deployment period are in Table 8, while the post deployment results are in Table 9.

Table 8. Pre Deployment Extrapolation Factors for Dive Operator Use to Total Use: All Study Sites

Season	Type of Day	Type of Reef	Sums Other Users				Sums Dive Operators			Extrapolation Factor			
			Dive	Snork	Other	Fish	Dive	Snork	Other	Dive	Snork	Other	Fish
Summer	Week Day	Natural	76	1325	171	102	268	139	29	1.283582	10.53237	6.896552	1.250614
Summer	Weekend	Natural	16	218	40	67	30	0	2	1.533333	1	21	3.233333
Summer	Week Day	Artificial	58	16	53	146	133	3	75	1.43609	6.333333	1.706667	2.073529
Summer	Weekend	Artificial	65	32	45	138	207	13	53	1.31401	3.461538	1.849057	1.627273
Winter	Week Day	Natural	59	708	109	145	68	58	9	1.867647	13.2069	13.11111	2.150794
Winter	Weekend	Natural	41	621	66	82	45	17	0	1.911111	37.52941	1	2.322581
Winter	Week Day	Artificial	7	1	9	144	25	0	7	1.28	1	2.285714	6.76
Winter	Weekend	Artificial	33	10	25	150	116	5	4	1.284483	3	7.25	2.239669

Table 9. Post Deployment Extrapolation Factors for Dive Operator to Total Use: All Study Sites

Season	Type of Day	Type of Reef	Sums Other Users				Sums Dive Operators			Extrapolation Factor			
			Dive	Snork	Other	Fish	Dive	Snork	Other	Dive	Snork	Other	Fish
Summer	Week Day	Natural	15	1046	116	69	53	4	1	1.283019	262.5	117	2.210526
Summer	Weekend	Natural	34	997	131	55	198	67	8	1.171717	15.8806	17.375	1.207547
Summer	Week Day	Artificial	75	6	23	114	437	2	1	1.171625	2.77	24	1.259681
Summer	Weekend	Artificial	129	58	70	164	686	42	26	1.188047	1.376	3.692308	1.225275
Winter	Week Day	Natural	11	543	42	115	124	12	6	1.08871	46.25	8	1.845588
Winter	Weekend	Natural	9	793	135	115	102	7	4	1.088235	114.2857	34.75	2.055046
Winter	Week Day	Artificial	70	26	40	238	249	9	9	1.281124	2.9125	5.444444	1.922481
Winter	Weekend	Artificial	66	2	37	267	375	1	6	1.176	2.1739	7.166667	1.710106

Step 5: Extrapolate to total use by all users.

In the final step, the blow-up factors are used to extrapolate to estimates of total use by all users. The results are summarized in Tables 10 for the pre-deployment period and Table 11 for the post deployment period.

Table 10. Pre Deployment - All Use Estimates for Study Sites

Season	Type of Day	Type of Reef	Divers	Snorkelers	DivSnork	Other	Fish	Total DivFish	Total All
Summer	Week Day	Natural	7,345	1,236	8,581	516	8,702	17,283	17,799
Summer	Weekend	Natural	3,238	401	3,639	83	8,124	11,763	11,846
Summer	Week Day	Artificial	3,218	89	3,307	1,287	4,831	8,139	9,426
Summer	Weekend	Artificial	1,261	54	1,315	244	1,650	2,965	3,209
Winter	Week Day	Natural	7,999	968	8,967	0	11,294	20,261	20,261
Winter	Weekend	Natural	3,566	797	4,363	0	6,185	10,548	10,548
Winter	Week Day	Artificial	2,042	43	2,085	459	11,073	13,157	13,616
Winter	Weekend	Artificial	1,260	9	1,269	37	2,218	3,487	3,524
Summer		Natural	10,583	1,637	12,220	599	16,826	29,046	29,645
Winter		Natural	11,565	1,765	13,330	0	17,479	30,809	30,809
Summer		Artificial	4,480	143	4,623	1,531	6,481	11,104	12,635
Winter		Artificial	3,302	52	3,354	496	13,291	16,644	17,140
Summer		All	15,062	1,780	16,842	2,130	23,308	40,150	42,280
Winter		All	14,867	1,817	16,684	496	30,770	47,454	47,950
Annual		Natural	22,148	3,402	25,550	599	34,306	59,855	60,454
Annual		Artificial	7,782	195	7,977	2,027	19,772	27,748	29,775
Annual		All	29,929	3,597	33,526	2,626	54,077	87,604	90,230
Summer	Percent	Natural	70.26	91.97	72.55	28.12	72.19	72.34	70.12
Winter	Percent	Natural	77.79	97.14	79.90	0.00	56.81	64.92	64.25
Annual	Percent	Natural	74.00	94.58	76.21	22.81	63.44	68.33	67.00

Table 11. Post Deployment - All Use Estimates for Study Sites

Season	Type of Day	Type of Reef	Divers	Snorkelers	DivSnork	Other	Fish	Total DivFish	Total All
Summer	Week Day	Natural	13,346	1,537	14,883	565	26,392	41,275	41,840
Summer	Weekend	Natural	4,417	838	5,255	148	5,564	10,819	10,967
Summer	Week Day	Artificial	13,903	233	14,136	272	15,241	29,377	29,649
Summer	Weekend	Artificial	9,540	172	9,712	195	10,049	19,762	19,957
Winter	Week Day	Natural	7,457	1,340	8,797	390	15,113	23,909	24,299
Winter	Weekend	Natural	2,143	435	2,578	63	4,940	7,518	7,581
Winter	Week Day	Artificial	15,623	233	15,856	272	23,892	39,747	40,019
Winter	Weekend	Artificial	3,111	50	3,161	75	4,609	7,769	7,844
Summer		Natural	17,763	2,375	20,138	713	31,956	52,094	52,807
Winter		Natural	9,599	1,775	11,374	453	20,053	31,427	31,880
Summer		Artificial	23,443	405	23,848	467	25,291	49,138	49,605
Winter		Artificial	18,733	283	19,016	347	28,500	47,517	47,864
Summer		All	41,206	2,780	43,986	1,180	57,247	101,233	102,413
Winter		All	28,333	2,058	30,391	800	48,554	78,944	79,744
Annual		Natural	27,362	4,150	31,512	1,166	52,009	83,522	84,688
Annual		Artificial	42,176	688	42,864	814	53,791	96,655	97,469
Annual		All	69,539	4,838	74,377	1,980	105,800	180,177	182,157
Summer	Percent	Natural	43.11	85.43	45.78	60.42	55.82	51.46	51.56
Winter	Percent	Natural	33.88	86.25	37.43	56.63	41.30	39.81	39.98
Annual	Percent	Natural	39.35	85.78	42.37	58.89	49.16	46.36	46.49

Estimation of Economic Impact

The general method for estimating economic impacts of the USS *Vandenberg* follows the method used for estimating the economic impacts of recreation-tourism for Monroe County found in Leeworthy and Ehler (2010) and Leeworthy and Morris (2010).

Expenditure Profiles. The expenditure profiles found in Leeworthy and Ehler (2010) for visitors and Leeworthy and Morris (2010) for residents were modified for visitors by customizing on an activity basis. For residents, the expenditure profile was for all those who did SCUBA diving, snorkeling and/or recreational fishing. For residents, sample sizes did not support separate profiles by activity. Expenditures per person per day for visitors are summarized in Table 12, while for residents in Table 13.

Table 12. Visitor Expenditure Profiles Per Person Per Day. By Activity, 2007-08

Expenditure Category	SCUBA Divers	Snorkelers	Fishers	Others
Lodging	\$31.29	\$73.07	\$103.65	\$73.07
<i>Publicly Owned</i>				
Hotel/motel/bed & breakfast/cabin, etc.	\$3.92	\$2.55	\$0.00	\$2.55
Camping site (RV/tent/camper)	\$0.00	\$0.13	\$0.00	\$0.13
<i>Privately Owned</i>				
Hotel/motel/bed & breakfast/cabin, etc.	\$27.37	\$64.48	\$93.44	\$64.48
Rental home, cottage, cabin, condo	\$0.00	\$5.91	\$10.21	\$5.91
Camping site (RV/tent/camper)	\$0.00	\$0.00	\$0.00	\$0.00
Food and Beverages	\$54.03	\$73.35	\$83.58	\$73.35
Food & Drinks consumed at restaurants & bars	\$39.07	\$60.70	\$60.21	\$60.70
Beverages purchased at a store for carry-out	\$4.32	\$5.12	\$6.76	\$5.12
Food purchased at a store for carry-out	\$10.64	\$7.53	\$16.61	\$7.53
Transportation	\$20.73	\$16.79	\$21.58	\$16.79
Rental automobile, motor home, trailer, motorcycle, or other recreation vehicle	\$4.07	\$3.11	\$4.99	\$3.11
Gas & Oil - auto or RV	\$12.08	\$6.65	\$10.76	\$6.65
Repair & Services - auto or RV	\$0.03	\$0.00	\$0.00	\$0.00
Parking fees & tolls	\$1.00	\$2.27	\$4.00	\$2.27
Taxi fare	\$0.02	\$0.77	\$0.50	\$0.77
Bus Fare				
a) Package tour	\$0.00	\$0.01	\$0.00	\$0.01
b) Any other bus fare	\$0.00	\$0.01	\$0.00	\$0.01
Airline Fares				
a) Package tours	\$0.05	\$3.16	\$1.33	\$3.16
b) Any other airline fares	\$2.82	\$0.21	\$0.00	\$0.21
Ferry Fare	\$0.66	\$0.60	\$0.00	\$0.60
Boating	\$1.80	\$4.83	\$5.72	\$4.83
Boat, jet ski, and wave runner rental	\$0.03	\$3.23	\$0.81	\$3.23
Boat fuel and oil	\$1.51	\$1.40	\$4.76	\$1.40
Boat repairs	\$0.00	\$0.00	\$0.00	\$0.00
Boat launch fees	\$0.00	\$0.03	\$0.05	\$0.03
Boat slip or marina fees (this trip only)	\$0.00	\$0.00	\$0.00	\$0.00
Sailing charters or sunset cruises	\$0.26	\$0.17	\$0.10	\$0.17
Fishing	\$0.00	\$0.00	\$48.52	\$0.00
Cut bait	\$0.00	\$0.00	\$3.29	\$0.00
Live bait	\$0.00	\$0.00	\$1.08	\$0.00
Daily or special fishing permits/licenses	\$0.00	\$0.00	\$0.93	\$0.00
Fishing lines, fly lines, fish nets, traps	\$0.00	\$0.00	\$1.08	\$0.00
Charter/party boat/guide fees	\$0.00	\$0.00	\$42.14	\$0.00

Table 12. Visitor Expenditure Profiles Per Person Per Day. By Activity, 2007-08 (continued)

Expenditure Category	SCUBA Divers	Snorkelers	Fishers	Others
Scuba Diving/Snorkeling	\$37.88	\$17.53	\$0.00	\$17.53
Rental fee for equipment	\$11.18	\$3.97	\$0.00	\$3.97
Charter/party boat/guide service	\$26.70	\$13.56	\$0.00	\$13.56
Sightseeing	\$0.00	\$0.00	\$0.00	\$0.00
Sightseeing tours	\$0.00	\$0.00	\$0.00	\$0.00
Glass-bottom boat rides	\$0.00	\$0.00	\$0.00	\$0.00
Backcountry excursions, kayak tours	\$0.00	\$0.00	\$0.00	\$0.00
Park entrance fees	\$0.00	\$0.00	\$0.00	\$0.00
Admission to tourist, amusement, festivals and other tourist attractions	\$0.00	\$0.00	\$0.00	\$0.00
Other Activity Expenditures	\$0.86	\$5.33	\$10.96	\$5.33
Rental fee for recreation equipment (bicycles, golf carts or others not listed above)	\$0.00	\$1.57	\$2.52	\$1.57
Guides service, tour, or outfitters (not listed above like parasailing)	\$0.00	\$0.59	\$1.10	\$0.59
Admission to motion pictures, museums, etc.	\$0.08	\$0.63	\$0.88	\$0.63
Admission to concerts or other musical	\$0.00	\$0.00	\$0.00	\$0.00
Spa treatments	\$0.78	\$2.54	\$6.44	\$2.54
Fitness activity fees	\$0.00	\$0.00	\$0.02	\$0.00
Miscellaneous Expenditures	\$9.26	\$12.33	\$18.58	\$12.33
Film purchases	\$0.11	\$0.28	\$0.05	\$0.28
Film development	\$0.00	\$0.01	\$0.00	\$0.01
Footware	\$1.92	\$1.35	\$2.66	\$1.35
Clothing	\$5.66	\$4.38	\$5.95	\$4.38
Souvenirs and gifts (not including clothing)	\$1.57	\$6.28	\$9.92	\$6.28
Other general merchandise	\$0.00	\$0.03	\$0.00	\$0.03
Services	\$0.03	\$1.46	\$0.08	\$1.46
Barber, laundry, and other personal services	\$0.03	\$0.13	\$0.07	\$0.13
Telephone, fax, other other business services	\$0.00	\$0.01	\$0.01	\$0.01
Physician, dentist and other medical services	\$0.00	\$1.32	\$0.00	\$1.32
Total Trip	\$155.88	\$204.69	\$292.67	\$204.69

Table 13. Resident Expenditure Profiles Per Person Per Day for SCUBA Divers, Snorkelers and Recreational Fishermen, 2008

Expenditure Category	Expenditure Per Person Per Day
Lodging	\$6.16
<i>Publicly Owned</i>	
Hotel/motel/bed & breakfast/cabin, etc.	\$1.03
Camping site (RV/tent/camper)	\$0.02
<i>Privately Owned</i>	
Hotel/motel/bed & breakfast/cabin, etc.	\$3.24
Rental home, cottage, cabin, condo	\$1.80
Camping site (RV/tent/camper)	\$0.07
Food and Beverages	\$29.05
Food & Drinks consumed at restaurants & bars	\$17.85
Food&Beverages purchased at a store for carry-out	\$11.20
Transportation	\$7.33
Rental automobile, motor home, trailer, motorcycle, or other recreation vehicle	\$0.44
Gas & Oil - auto or RV	\$3.77
Repair & Services - auto or RV	\$2.33
Parking fees & tolls	\$0.58
Taxi fare	\$0.21
Bus Fare	
a) Package tour	\$0.00
b) Any other bus fare	\$0.00
Airline Fares	
a) Package tours	\$0.00
b) Any other airline fares	\$0.00
Ferry Fare	\$0.00
Boating	\$23.45
Boat, jet ski, and wave runner rental	\$0.58
Boat fuel and oil	\$20.93
Boat repairs	\$0.00
Boat launch fees	\$0.21
Boat slip or marina fees (this trip only)	\$0.70
Sailing charters or sunset cruises	\$1.03
Fishing	\$22.24
Cut bait	\$4.70
Live bait	\$3.08
Daily or special fishing permits/licenses	\$0.00
Fishing lines, fly lines, fish nets, traps	\$2.16
Charter/party boat/guide fees	\$12.30

Table 13. Resident Expenditure Profiles Per Person Per Day for SCUBA Divers, Snorkelers and Recreational Fishermen, 2008 (continued)

Expenditure Category	Expenditure Per Person Per Day
Scuba Diving/Snorkeling	\$4.51
Rental fee for equipment	\$0.49
Charter/party boat/guide service	\$4.02
Sightseeing	\$0.00
Sightseeing tours	\$0.00
Glass-bottom boat rides	\$0.00
Backcountry excursions, kayak tours	\$0.00
Park entrance fees	\$0.00
Admission to tourist, amusement, festivals and other tourist attractions	\$0.00
Other Activity Expenditures	\$2.82
Rental fee for recreation equipment (bicycles, golf carts or others not listed above)	\$0.57
Guides service, tour, or outfitters (not listed above like parasailing)	\$0.00
Admission to motion pictures, museums, etc.	\$2.25
Admission to concerts or other musical	\$0.00
Spa treatments	\$0.00
Fitness activity fees	\$0.00
Miscellaneous Expenditures	\$3.98
Film purchases	\$0.69
Film development	\$1.12
Footware	\$0.74
Clothing	\$0.92
Souvenirs and gifts (not including clothing)	\$0.50
Other general merchandise	\$0.01
Services	\$0.65
Barber, laundry, and other personal services	\$0.26
Telephone, fax, other other business services	\$0.05
Physician, dentist and other medical services	\$0.34
Total Trip	\$100.19

Estimates of Person-day. The estimates of use in the first section of this report were measured in terms of number of dives. To estimate economic impacts number of dives has to be converted to person-days equivalents. The surveys of visitors and residents in 2007-08 found that the average number of dives per day was equal to two (2). So our estimates of person-days of use are simply the number of dives divided by two.

For economic impact, it is important to distinguish between residents and visitors to Monroe County. In this application, the difference is mostly due to differences in expenditures per person per day. After the conversion of dives to person-days, estimates of the proportion of use by residents and visitors is required. These proportions were derived for visitors from Leeworthy et al. 2010 and for residents from Leeworthy and Morris (2010). It is also important to note here the estimate of person-days by the resident export sector. Following Leeworthy and Morris (2010), which found that 44.15% of resident person-days of use in 2008 were by residents that do not derive their income from work in Monroe County? This is important for economic impact analysis to avoid double-counting of resident spending that would already be accounted for in the multiplier process of the tourism industry. Only the resident export sector person-days of use are used in estimating the economic impact of the U.S.S. Vandenberg, and this spending has multiplier impacts just as visitor spending since the source of incomes is not related to work in Monroe County. Table 14 summarizes the estimates of the proportion of person-days by visitors and residents and Table 15 the estimates of person-days pre and post deployment at the study sites.

Table 14. Proportion of Person-days for Visitors and Residents

Visitors/Residents	Activity	Percent
Visitors	SCUBA Diving	71.80
	Snorkeling	80.26
	Fishing	44.44
	Other	78.40
Residents	SCUBA Diving	28.20
	Snorkleing	19.74
	Fishing	55.56
	Other	21.60

Table 15. Pre and Post Deployment Person-days of Activity by Residents and Visitors

	Divers	Snork	Fishing	Other	Total
Pre Deployment	14,965	1,799	27,039	1,349	45,150
Resident	4,220	355	15,023	291	19,889
Resident Export ¹	1,863	157	6,632	129	8,781
Visitor	10,745	1,443	12,016	1,057	25,261
Post Deployment	34,770	2,419	52,900	990	91,078
Resident	9,805	477	29,391	214	39,887
Resident Export	4,329	211	12,976	94	17,610
Visitor	24,965	1,941	23,509	776	51,191

1. Resident export is 44.15% of total resident use. This use does not double-count resident use accounted for in the multiplier impacts of other export or basis industries such as tourism and has multiplier impacts because the source of income for these residents come from sources not related to work in Monroe County.

Estimates of Economic Impact. The estimates of economic impact were done for visitors by substituting total expenditures into the economic model found in Leeworthy and Ehler (2010). Total expenditures by expenditure category are equal to the total number of person-days of activity for each activity (Table 15) times the expenditures profiles of expenditure per person-day (Table 12). Similarly, the economic impact for the resident export sector was done by substituting total expenditures into the economic model found in Leeworthy and Morris (2010). Total expenditures by expenditure category are equal to the total number of person-days of resident export sector activity (Table 15) times the expenditures per person per day (Table 13).

Economic impacts and the changes pre and post for visitors is summarized in Table 16, while for residents results are summarized in Table 17.

Table 16. Pre and Post Deployment Economic Impacts:Visitors

Deployment	Activity	Expenditures	Sales/Output	Income	Employment
Pre	SCUBA Diving	\$1,674,931	\$1,875,922	\$812,153	27.20
Pre	Snorkeling	\$295,368	\$330,812	\$157,373	5.20
Pre	Fishing	\$3,516,723	\$3,938,729	\$1,810,869	58.62
Pre	Other	\$216,357	\$242,320	\$115,276	3.81
Pre	All	\$5,703,379	\$6,387,783	\$2,895,671	94.83
Post	SCUBA Diving	\$3,891,544	\$4,358,530	\$1,886,961	63.18
Post	Snorkeling	\$397,303	\$444,980	\$211,684	7.00
Post	Fishing	\$6,880,379	\$7,706,025	\$3,542,922	114.70
Post	Other	\$158,839	\$177,900	\$84,629	2.79
Post	All	\$11,328,065	\$12,687,435	\$5,726,196	187.67
Pre to Post	SCUBA Diving	\$2,216,613	\$2,482,608	\$1,074,808	35.98
Pre to Post	Snorkeling	\$101,935	\$114,168	\$54,311	1.80
Pre to Post	Fishing	\$3,363,656	\$3,767,296	\$1,732,053	56.08
Pre to Post	Other	-\$57,518	-\$64,420	-\$30,647	-1.02
Pre to Post	All	\$5,624,686	\$6,299,652	\$2,830,525	92.84
Pre to Post	SCUBA Diving	132.34%	132.34%	132.34%	132.28%
Pre to Post	Snorkeling	34.51%	34.51%	34.51%	34.62%
Pre to Post	Fishing	95.65%	95.65%	95.65%	95.67%
Pre to Post	Other	-26.58%	-26.58%	-26.59%	-26.77%
Pre to Post	All	98.62%	98.62%	97.75%	97.90%

Table 17. Pre and Post Deployment Economic Impacts:Residents (Export Sector Only)

Deployment	Expenditures	Sales/Output	Income	Employment
Pre	\$879,768	\$985,341	\$355,351	12.00
Post	\$1,764,346	\$1,976,067	\$712,733	24.00
Pre to Post	\$884,578	\$990,726	\$357,382	12.00
Pre to Post	100.55%	100.55%	100.57%	100.00%

Derivation of Estimates of State and Local Taxes Generated. Using the changes in pre- to post-deployment of the USS *Vandenberg* in sales, the changes in state and local sales taxes and the change in lodging tax revenues can be calculated. Because expenditures from surveys of visitors and residents include the tax revenues, the formula for estimating tax revenues has to take that into account. The simple formula can be stated in a general way and actual implementation simply requires inputting the appropriate tax rate and change in expenditure item.

Additional Tax Revenue Generated = (Change in expenditure * ((1 – tax rate) * tax rate)) * sales multiplier for Monroe County

The above general formula was used to calculate the portion of sales tax revenue received by the State of Florida and the portion received by local government. The State sales tax rate is 6%, however, one-half a percent (0.5%) is returned to local government making the net to the State of Florida 5.5%. The local government can add on 1.5% bring the total sales tax rate to 7.5%. Local government receives 1.5% plus the 0.5% returned to them by the State of Florida for a total of 2.0%. There is a local lodging tax rate of 5%. This is added to the sales tax bringing the total tax rate for lodging to 12.5% in Monroe County. The sales tax and lodging tax are broken out separately here.

To calculate the additional tax revenue generated by the USS *Vandenberg* requires going back to the expenditure profiles for visitors and residents and first breaking out separately the total expenditures for lodging to calculate the lodging tax. Sales tax rates are applied to the changes in total expenditures in Tables 16 and 17. The sales/output multiplier for Monroe county is 1.12. Table 18 shows the results of applying the formula for the amount of sales tax revenue and lodging tax revenues generated by level of government.

Table 18. Additional Annual State and Local Sales and Lodging Tax Revenues from the USS *Vandenberg*

State Sales Tax Revenue (5.5%)	\$378,920
Local Sales Tax Revenue (2.0%)	\$142,892
Local Lodging Tax Revenue (5%)	\$96,756
sub-total Local Tax Revenues	\$239,649
Total State & Local Revenue	\$618,569

1. State sales tax is 6%, but 0.5% is returned to local governments.
2. Local sales tax is 1.5%, but 0.5% of state sales tax is returned to local governments.
3. Local lodging tax is 5%, the 7.5% of sales tax on lodging is counted in the state and local sales taxes.

Additional Tax Revenues Generated to State & Local Governments. The USS *Vandenberg* generated an annual increase in state and local tax revenues of a little over \$618 thousand; about

\$379 thousand in state sales tax revenue and almost \$240 thousand in local sales and lodging tax revenues.

Net Present Value of Tax Revenues and Return on Investment. Using lower-bound conservative assumptions that the annual additional state and local tax revenues from the USS *Vandenberg* will remain constant (net of inflation); that the life of the USS *Vandenberg* will range from 20 to 40 years; and the real interest rate (net of inflation) used to discount future tax revenues to their net present values ranges from 3 to 5%, we can calculate the net present value of the future flow of the tax revenues and compare these to the net costs to the state and local governments that invested in the USS *Vandenberg* to support economic development and tourism.

Using the annual tax revenues and the above assumptions, the net present value of tax revenues to state and local governments ranged from a low of \$7.71 million assuming the USS *Vandenberg* has a useful life of only 20 years and the discount rate is 5% to a high of \$14.29 million assuming a useful life of 40 years and a discount rate of 3% (Table 19).

Table 19. Net Present Value of Additional State and Local Tax Revenue from the USS *Vandenberg*

Tax	3% Interest Rate (Millions \$) ¹			5% Interest Rate (Millions \$) ¹		
	20 years	30 years	40 years	20 years	30 years	40 years
State Sales Tax Revenue	\$5.64	\$7.43	\$8.75	\$4.72	\$5.82	\$6.50
Local Sales Tax Revenue	\$2.12	\$2.80	\$3.30	\$1.78	\$2.20	\$2.45
Local Lodging Tax Revenue	\$1.44	\$1.90	\$2.24	\$1.21	\$1.49	\$1.66
sub-total Local Tax Revenue	\$3.56	\$4.70	\$5.54	\$2.99	\$3.69	\$4.11
Total State & Local Tax Revenue	\$9.20	\$12.13	\$14.29	\$7.71	\$9.51	\$10.61

1. Interest rates are net of inflation, since tax revenues are also net of inflation. Assumption is that additional tax revenue is constant over time.

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Appendix Tables

Table A1. Post Deployment Dive Operator Logbook - Without Adjustment for Missing Logbook Data Vandenberg Only

Season	Type of Day	Divers	Snorkelers	DivSnork	Other	Total
Summer	Week Day	8,954	84	9,038	208	9,246
Summer	Weekend	5,672	53	5,725	119	5,844
Winter	Week Day	4,316	80	4,396	223	4,619
Winter	Weekend	1,892	23	1,915	62	1,977
Summer		14,626	137	14,763	327	15,090
Winter		6,208	103	6,311	285	6,596
Annual		20,834	240	21,074	612	21,686
Summer	Percent	70.20	57.08	70.05	53.43	69.58
Winter	Percent	29.80	42.92	29.95	46.57	30.42
Summer	% All Study	49.40	5.48	45.98	29.20	45.41
Winter	% All Study	28.56	5.29	26.65	35.63	26.95
Annual	% All Study	40.58	5.40	37.78	31.88	37.58

Table A2. Post Deployment Dive Operator Extrapolation Factors for Missing Logbook Data: Vandenberg Only

Season	Type of Day	Sums Without			Sums With			Extrapolation Factor		
		Dive	Snork	Other	Dive	Snork	Other	Dive	Snork	Other
Summer	Week Day	20	0	0	245	2	0	1.081633	1	1
Summer	Weekend	80	19	6	312	14	11	1.25641	2.357143	1.545455
Winter	Week Day	14	0	0	203	9	8	1.068966	1	1
Winter	Weekend	10	0	0	302	0	5	1.033113	1	1

Table A3. Post Deployment Dive Operator Logbook Adjustment for Missing Logbook Data Vandenberg Only

Season	Type of Day	Divers	Snorkelers	DivSnork	Other	Total
Summer	Week Day	9,685	84	9,769	208	9,977
Summer	Weekend	7,126	125	7,251	206	7,457
Winter	Week Day	4,614	80	4,694	223	4,917
Winter	Weekend	1,955	23	1,978	62	2,040
Summer		16,811	209	17,020	414	17,434
Winter		6,568	103	6,671	285	6,956
Annual		23,380	312	23,692	699	24,390
Summer	Percent	71.91	66.98	71.84	59.20	71.48
Winter	Percent	28.09	33.02	28.16	40.80	28.52
Summer	% All Study	49.35	7.52	46.19	35.05	45.84
Winter	% All Study	27.76	5.01	25.94	35.63	26.24
Annual	% All Study	40.50	6.45	37.87	35.28	37.79

Table A4. Post Deployment Extrapolation Factors for Dive Operator to Total Use: Vandenberg Only

Season	Type of Day	Type of Reef	Dive	Sums Other Users			Fish	Dive	Sums Dive Operators		Extrapolation Factor			Fish
				Snork	Other	Dive			Snork	Other	Dive	Snork	Other	
Summer	Week Day	Artificial	59	0	0	104	273	2	1	1.216117	1	1	1.378182	
Summer	Weekend	Artificial	105	9	0	135	496	33	20	1.211694	1.272727	1	1.255198	
Winter	Week Day	Artificial	66	17	0	203	217	9	8	1.304147	2.888889	1	1.89823	
Winter	Weekend	Artificial	49	1	0	225	318	1	5	1.154088	2	1	1.705329	

Table A5. Post Deployment - All Use Estimates for Study Sites:Vandenberg Only

Season	Type of Day	Divers	Snorkelers	DivSnork	Other	Fish	Total DivFish	Total All
Summer	Week Day	11,778	84	11,862	208	13,463	25,325	25,533
Summer	Weekend	8,635	159	8,794	184	9,102	17,896	18,080
Winter	Week Day	6,017	231	6,248	223	8,910	15,158	15,381
Winter	Weekend	2,256	46	2,302	62	3,373	5,674	5,736
Summer		20,413	243	20,656	392	22,565	43,221	43,613
Winter		8,273	277	8,550	285	12,282	20,832	21,117
Annual		28,686	520	29,206	677	34,847	64,053	64,730
Summer	Percent ¹	87.08	60.00	86.62	83.94	89.22	87.96	87.92
Winter	Percent ¹	44.16	97.92	44.96	82.13	43.09	43.84	42.57
Annual	Percent ¹	68.01	75.60	68.14	83.17	64.78	66.27	66.41
Summer	Percent ²	49.54	8.74	46.96	33.22	39.42	42.69	42.59
Winter	Percent ²	29.20	4.76	28.13	35.63	25.30	26.39	26.48
Annual	Percent ²	41.25	1.56	39.27	34.19	32.94	35.55	35.54

1. Vandneberg use as a percent of all artificial reef use at study sites.

2. Vandenberg use as a percent of all reef use (artificial and natural) at study sites.