Estimates of the Maximum Potential Economic Impacts of Marine Protected Area Networks in the Central California Coast

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Executive Summary

In this report we estimate the maximum potential economic impacts of various proposed marine protected area networks in the Central California Coast study region. We define economic impact according to accepted practice in cost benefit analysis, namely as changes in net economic value, or gross revenues less costs associated with prospective policy changes. Our definition of maximum potential impact assumes that fishermen cannot mitigate any impacts from closures. In addition, our computations embody conservative assumptions in the methods used to estimate and summarize impacts, and that generate results that are likely to err on the high side. We focus mostly on first-round effects on the commercial fishing sector, but also develop rough estimates of second- and subsequent-round effects on the processing sectors and supporting industries.

The estimates of maximum potential impact rely on the survey work and subsequent GIS data analysis done by Ecotrust and reported in various prior reports listed in the references. We combine Ecotrust's importance indices with cost share information from secondary sources to measure the maximum potential impacts of prospective closures on expected net economic values from commercial fishing. Our estimates of the maximum potential annual losses for the three BRTF options (in real 2005 dollars) are: $667,826 (Package 1); $1,260,175 (Package 2R); $1,117,642 (Package 3R). Our estimate for the CDFG Preferred Option is $989,692. These are relative to average annual real 1999-2004 baseline gross revenues of approximately $13,600,000 and net economic values of about $8,800,000. They represent percentage reductions in net pre-reserve economic values of: 7.5% (Package 1); 14.2% (Package 2R); 12.6% (Package 3R) and 11.2% (Package P). We also computed, for illustrative purposes, rough estimates of secondary impacts on the processing second and multiplier effects on the regional economy. These are proportional to the primary impacts by scale factors of approximately 0.38 and 1.73 respectively.

We are reasonably confident in the order of magnitude level of these estimates that range around $1,000,000 for primary sector harvester impacts. We are less confident that the differences between estimated effects are accurate enough to identify a best package based on direct potential economic impact comparisons alone. It should be re-emphasized that these are **maximum** estimated potential economic losses to the commercial sector. They are computed using assumptions that tilt the computations toward high estimates of impacts, and they also assume that fishermen do not adjust in response to closures, nor benefit from spillovers associated with closures.

Estimates of the Maximum Potential Economic Impacts of Marine Protected Area Networks in the Central California Coast

In this document, we provide estimates of the maximum potential economic impacts of four pending marine protected area (MPA) options for the Central California Coast. These four options are those examined by Scholz et. al. (2006b) in the 06/15/2006 draft document entitled “Summary of potential impacts of MPA packages P, 1, 2R, and 3R on commercial and recreational fisheries in the Central Coast Study Region”. Our analysis follows procedures outlined in our prior report, Wilen and Abbott (2006c). It also relies upon our previous reports Wilen and Abbott (2006a, 2006b) entitled “Discussion of Ecotrust Methodology in: ‘Commercial fishing grounds and their relative importance off the Central Coast of California” and “An Assessment of Ecotrust’s Relative Importance Indicators: Comparisons with Logbook Data for the Market Squid Fishery in the Central California Coast”

In the first section, we outline the general practices used by economists to provide economic assessments. The second section outlines and applies the methods we use and the impact estimates generated. The final section concludes.

I. Introduction

Economics has a body of formal and broadly accepted methods for assessing the economic impacts of prospective policy options. These methods were first developed in the 1930s for applications to development of water resources by the U.S. Army Corps of Engineers, particularly as to whether various water development projects (such as dam building) undertaken by governments generated benefits in excess of their costs. The methods have been refined over the past three decades and their use is now widespread throughout most government agencies in the planning and budgeting process, including everything from health policy to energy and environmental policy. Economic impact analysis is also used to analyze various fisheries policies at the local, state, and Fisheries Management Council levels.

How do economists determine the potential economic impacts of a prospective policy? There are basically several alternatives that may be used, depending upon the amount and quality of data available. All methods begin with the central notion that when a government entity implements a policy in an economic system, the policy essentially alters the inputs used by, and outputs produced by, the economy. For example, a dam built to produce hydroelectricity in a region will generate some new services of value (electricity, recreation), but at a cost of the construction inputs used as well as other values foregone (farming, forestry, ecological services). Economic impact analysis attempts to elucidate and summarize, usually in monetary measures, all of the positive and negative changes that are induced by a policy.

The so-called *with and without principle* frames the relevant scope for impact studies. The with and without principle focuses analysis on the task of hypothesizing what the relevant economy would look like *with* a prospective policy option, and comparing that with the economy *without* the policy. Generally, since impact analysis is directed at prospective policies, there is a need to forecast or provide a best judgment about how various inputs and outputs would change if the policy were adopted. For the task of this report, we are interested in knowing what the Central Coast economy would look like with a network of marine reserves compared to the economy without it. In principle, this involves forecasting the benefits and costs that would be incurred by current commercial and recreational users, some of whom would have areas closed to their current uses. We would also expect secondary effects on those industries and services that support the primary users, including processors, fishing gear and service suppliers, and sectors that support those industries, etc.

A. Cost-benefit analysis

There are several types of impact analyses that might be undertaken to examine potential impacts from marine reserves, and these are differentiated by the reach and scope of their coverage. The most comprehensive kind of economic impact analysis (but also the most data intensive) is a full *cost/benefit* analysis. A comprehensive cost/benefit analysis of economic impacts of an MPA system would attempt to monetize all of the benefits produced and all of the costs generated by all affected parties over all relevant time periods. These would include the costs (current and future) incurred by current commercial, recreational and other users that were removed from existing grounds as the MPA network was adopted. These policy costs would be stacked up against new benefits (current and future) associated with reserves, including any commercial and recreational spillover benefits from dispersal from the MPA. In addition, other benefits from MPA creation such as ecosystem services, tourism, dive, and educational benefits, insurance benefits, and existence values would be measured. Often, cost/benefit studies summarize results in a monetary metric called *net economic benefits*, represented by the sum of gross values of the goods and services that are produced by a system, less the costs of producing those goods and services. Net economic benefits are often confined to primary effects associated with the first round of impacts on existing users. But other analyses attempt to also include secondary and subsequent rounds of impacts (positive and negative) absorbed by processors, suppliers of goods and services to primary users, and other suppliers of goods and services. The focus on *net* economic benefits distinguishes economic cost/benefit analysis from what is commonly called “impact analysis”.

B. Impact analysis

Impact analysis is a step away from cost/benefit analysis in that it is a less comprehensive measure of change induced by policies and generally less demanding of data. Impact analysis focuses on various components of economic cost/benefit analysis such as gross sales changes, employment effects, and multipliers. These are clearly "impacts" of policies, but taken individually they fail to provide a complete picture of the full economic impact in two important ways. First, impact analysis is generally a gross rather than net measure of impacts. To take an example, suppose that a dam construction policy causes a number of farms to be displaced. Some measures of "impacts" on the agricultural sector would be the gross value of farm output lost, farm jobs lost, etc. But the gross value of farm output would be an overstatement of the economic impact to the sector because the costs of producing those outputs would actually be saved as a result of the policy. Similarly, a positive impact of the dam might be the new revenues generated by recreational businesses serving new users of a reservoir. But using gross revenues overstates the new recreation values because the input costs used to create these new values have not been accounted for. The idea in both of these examples is that while the sales values lost (or gained) are certainly impacts of a policy, the input costs must be netted out to get true economic impacts. Impact analysis also fails to provide a comprehensive picture of the full impacts of policies because it is generally directed at only one sector of an impacted system. For example, focusing on the agricultural sector losses from dam building exclusively would give a biased picture of the full project impact because it would ignore the offsetting benefits produced by new electricity production and recreational services. Similarly, an impact analysis that looked at commercial fishery impacts alone would miss other costs and benefits associated with other sectors and other goods and services associated with MPA creation.

C. Maximum potential economic impact

The work statement for this report asks for an economic impact analysis of four MPA plans for the Central Coast study region. More specifically, the scope of work asks for an analysis of *maximum potential economic impact* to the commercial fisheries for which spatial use data were collected and analyzed by Ecotrust. This places our task somewhere in between the above two kinds of impact analyses, a focus that is necessary in view of data limitations. On the one hand, it is not possible to do a full cost/benefit analysis of the MPA policy. First, there have been no projections of how MPA protection would enhance species within MPAs and, more importantly, result in spillover outside MPAs. Second, there is no information available to judge the potential for MPAs to generate non-consumptive values, including on-site use values like diving or tourism, or off-site non-use values such as existence values or posterity benefits. Hence while existing information might be useful to begin the cost side of MPA creation, there is less available to look at the benefit side. One the other hand, it is possible to create a rough estimate of the maximum potential economic impacts to the commercial sector by combining Ecotrust data and other information readily available from other sources.

II. Maximum potential economic impact to the commercial sector

In this section, we outline the methods we use to compute maximum potential economic impact to the commercial fishing sector and report our estimates. It is worth pointing out at the start that the task of estimating *maximum* potential impacts, if taken literally, does not provide much procedural discipline, since one could argue that any large number is an estimate of the maximum potential impact. We take an approach that imposes the kind of methodological discipline that a good cost/benefit analysis would impose in order to get close to an accurate estimate of the expected net economic impacts on the commercial sector. The accuracy of our estimates is limited and ultimately determined by the quality of our primary data inputs, namely the data gathered and compiled by Ecotrust. We take as a given that the data as reported by Ecotrust is accurate and representative. We augment that data by other sources available from other published reports, journal articles, and grey literature.

A. The Baseline Case

The first step in our methodology is to generate a baseline from which to estimate changes in the commercial fisheries that might be induced by a MPA policy. This initial step generates a *without* scenario for us to compare to a *with* scenario under which it is assumed that a MPA system is in place. We begin with a measure of the gross revenues generated by commercial fishing in the Central Coast region under current conditions without reserves. For gross fishing revenues, we use the 6 year average computed from Ecotrust data derived from PACFIN landings tickets reported in the Central Coast region. We then convert these values into real 2005 dollars, using a consumer price index for the San Francisco region.

To compute net economic benefits, we next need to scale gross base case revenues by factors that represent the share of costs in gross revenues, something for which we have no actual real data. Computing cost shares for each fishery would require detailed accounting data as well as myriad assumptions about how to impute costs for inputs that are not directly priced (eg. skipper/owner's labor time), how to treat capital and depreciation associated with vessels and gear, how to value vessel services (eg. using replacement or used vessel market prices), how to value labor time (actual share vs. opportunity costs) and other esoteric issues.

There are two methods that have been used to examine costs in commercial fisheries. The most common method is to survey fishermen and ask about various categories of expenditures. Costs obviously differ by vessel size and by type of operation and by the fishing strategies employed (eg. single species or multiple species). We found a small number of surveys conducted for fisheries that are similar, but not identical to, some of the fisheries in the Central Coast study region. One recently completed master's thesis surveyed California commercial salmon trollers and computed costs by operation size (Hansen 2003). The thesis does a reasonably good job of gathering costs, but it is difficult to summarize costs in ways that make computation of a representative cost share possible. It does report a simulation exercise for the year 2000 that suggests costs for salmon vessels over 36 feet are approximately 25% of revenues, but it does not include skipper/owner opportunity costs and is therefore an underestimate. Another more detailed and carefully done survey for the Alaskan drift gillnet fishery in Bristol Bay reports results of repeated annual surveys (Schelle et. al. 2004, Schelle and Muse 1983). This study has a very complete cost breakdown with careful imputations of skipper/owner time and the value of vessel capital services. Over a period with below-average revenue conditions, cost shares average about 35% for Alaska salmon.

The second method to determine cost shares involves examining lease prices and quota prices in fisheries that have been rationalized with individual transferable quota (ITQ) programs or with limited entry licensing programs. Lease prices, in particular, are an accurate measure of the profitability per unit of fish caught, because they are determined in competitive markets by buyers and sellers interested in trading quota. California has no fisheries that have been managed with quota systems, of course, but many fisheries around the world do. Of studies of ITQ prices, several report either annual lease prices or sale prices for quota. These vary over wide ranges that reflect whether the fisheries are conducted by operations with low or high capital requirements and whether the fishery has fully rationalized to its long run equilibrium. The most comprehensive study is one on New Zealand ITQ markets by Newell and Sanchirico (2005). It reports lease prices that average about 50% of pre-ITQ ex-vessel prices in a study of over 100 markets. A study of British Columbia fisheries done by Ecotrust Canada (Ecostrust, 2004) reports ratios of total capitalized value of either quota values or limited entry licenses to revenues. These ratios range from around 9.5 (groundfish trawl), to around 6-8 for halibut and sablefish longliners, to 5 for salmon and 3.3 for urchin. These represent ratios of asset values to revenues rather than ratios of lease prices to revenues. To put them on comparable footings with estimates derived from lease prices, it is appropriate to divide each of these by a capitalization factor of approximately 12 (Newell and Sanchirico), and subtract the result from one. The comparable implied cost shares would then be: groundfish trawl (21%), halibut longline (34%), sablefish longline (45%), salmon (60%), and urchin (70%).

As can be seen, the empirical evidence about cost shares varies widely, depending upon the fishery in question. For fisheries with moderate levels of vessel capital value such as salmon troll/gillnet or halibut/sablefish longline, cost shares in the range of 35-60% seem reasonable, implying net profit shares in the range of 40-65%. Fisheries with higher investments in vessel capital have comparatively lower variable costs per ton of landings and also spread vessel capital investment across multiple fisheries. This is the most likely reason why fisheries such as groundfish trawl have high implied net profit shares in the 70-80% range. Fisheries with lower catch rates and significant vessel investments such as salmon and urchin have implied net profit shares in the range of 30-40%. Overall, an upper-bound estimate for the Central Coast fishery that is also reasonable as an average or representative value is in the range of 65%. This is the value we employ to convert gross revenue estimates into estimates of net economic values from commercial fisheries.

Table 1 computes base case net economic values for each fishery in the third column. The first column gives 6-year average gross revenues in the study area by species, and the second column converts those individual-year averages to a 6-year average but expressed in real 2005 dollars. The third column converts gross revenues into net annual economic values for the no MPA base case, again expressed in 2005 real dollars.

Table 1: Base Scenario (No MPAs) Average Gross Revenues/Net Economic Value

Fishery	1999-2004 Average Gross Revenues	1999-2004 Average Gross Revenues (2005 $)	1999-2004 Avg. Net Economic Values (2005 $)
Anchovy	$327,953	$355,753	$231,239
Cabezon	$412,242	$451,011	$293,157
Dungeness crab	$251,097	$263,525	$171,291
Deep Nearshore Rockfish	$729,107	$788,621	$512,604
Halibut	$294,570	$322,307	$209,500
Kelp Greenling	$38,346	$41,779	$27,156
Lingcod	$49,240	$52,768	$34,299
Mackerel	$19,971	$21,348	$13,876
Rockfish Nearshore	$729,107	$788,621	$512,604
Rockfish Shelf	$131,091	$146,605	$95,293
Rockfish Slope	$246,623	$261,577	$170,025
Rock Crab	$117,697	$127,879	$83,121
Salmon	$1,898,419	$2,069,511	$1,345,182
Sardine	$1,086,653	$1,169,410	$760,117
Sablefish	$834,549	$901,729	$586,124
White seabass	$677,616	$730,213	$474,638
Surfperch	$29,719	$31,425	$20,427
Spot Prawn	$1,115,360	$1,213,335	$788,668
Squid	$3,698,783	$3,873,013	$2,517,459
Total	**$12,688,143**	**$13,610,432**	**$8,846,781**

B. Marine Protected Areas Impacts

The second step is to compute net economic values for the various MPA scenarios, and compare these with the net economic values associated with the base (no reserves) case. There are two ways to estimate post-MPA scenarios, given data available. The first is to simply assume that the reduction in net fishing revenues will be proportional to the reduction in fishing grounds area associated with each plan. This approach would be consistent with a situation in which net revenues are uniform over space. A second approach is to assume that reductions in net fishing revenues will be proportional to the reductions in Ecotrust's stated importance indices. This approach treats the importance indices as true indicators of the attractiveness of various sites and assumes they are roughly proportional to each site's expected net revenues. This approach preserves the weights identified by survey respondents rather than assuming a uniform spatial distribution of importance.

Our preferred method is to utilize Ecotrust's computations that weight various areas by importance. This is actually methodologically similar to what we would do if we had enough data to estimate a more formal discrete choice statistical model. In that case, we would simulate closures by reducing the attractiveness indicators of various sites; this would produce estimates of changes in trip proportions and trip totals to remaining open areas. These changes in effort would then be used to estimate new levels of landings and revenues after the closures. By assuming that the importance factors reflect fishermen's expectations about relative gross revenues expected from various sites, their computations of the total area-wide reductions in stated importance factors effectively scale down total expected fishery revenues and generate fishery-wide measures of impacts.

Table 2 shows, in the first column, estimates of the base scenario net economic values (*without* reserves); these are compared in the next 4 columns with the net economic values *with* reserves for each of the 3 BRTF scenarios and the CDFG preferred alternative. These are annual first round fishery impacts, expressed in real 2005 dollars.

Table 2: Total Net Economic Value for Alternative MPA Packages and Base Scenario

Fishery	Base Scenario	Package 1	Package 2R	Package 3R	Package P
Anchovy	$231,239	$218,012	$206,057	$212,601	$210,104
Cabezon	$293,157	$250,239	$211,923	$220,161	$236,666
Dungeness crab	$171,291	$163,583	$149,314	$148,869	$146,779
Deep Nearshore Rockfish	$512,604	$428,075	$395,730	$403,111	$409,468
Halibut	$209,500	$196,008	$188,508	$190,749	$194,499
Kelp Greenling	$27,156	$23,594	$20,661	$21,331	$22,480
Lingcod	$34,299	$29,803	$25,529	$26,328	$28,235
Mackerel	$13,876	$13,133	$12,450	$12,734	$12,543
Rockfish Nearshore	$512,604	$439,301	$381,172	$391,014	$413,620
Rockfish Shelf	$95,293	$88,184	$83,220	$83,629	$87,413
Rockfish Slope	$170,025	$145,661	$127,927	$133,198	$133,011
Rock Crab	$83,121	$73,155	$72,066	$72,174	$72,066
Salmon	$1,345,182	$1,299,177	$1,206,628	$1,255,727	$1,268,238
Sardine	$760,117	$720,286	$675,820	$701,512	$692,314
Sablefish	$586,124	$546,092	$449,557	$447,740	$444,341
White seabass	$474,638	$431,399	$435,908	$434,484	$436,620
Surfperch	$20,427	$19,869	$19,393	$19,301	$19,916
Spot Prawn	$788,668	$731,253	$666,582	$632,117	$691,819
Squid	$2,517,459	$2,362,132	$2,258,160	$2,322,356	$2,336,957
Total	**$8,846,781**	**$8,178,955**	**$7,586,606**	**$7,729,139**	**$7,857,088**

Table 3 reports the same information but is differenced to show primary impacts as changes in net economic value, measured from the base case without reserves. These are estimates of the maximum fishery-specific changes in net economic values that could be induced in the harvesting component of the commercial fishing sector as a result of specific MPA proposals. Recall that these are *upper bound* impacts, calculated under the assumptions that the fishing sector simply loses the net revenues in weighted proportion to the most important fishing grounds currently utilized, and that these losses are not compensated by either: 1) moving to other marginally less productive grounds elsewhere; or 2) increased harvests from spillover of adults and larvae to adjacent open areas as populations recover.

Table 3: Annual Maximum Potential Net Economic Value Losses Relative to Base Scenario

Fishery	Package 1	Package 2R	Package 3R	Package P
Anchovy	$13,227	$25,182	$18,638	$21,135
Cabezon	$42,918	$81,234	$72,996	$56,491
Dungeness crab	$7,708	$21,977	$22,422	$24,512
Deep Nearshore Rockfish	$84,528	$116,874	$109,492	$103,136
Halibut	$13,492	$20,992	$18,750	$15,000
Kelp Greenling	$3,563	$6,496	$5,825	$4,676
Lingcod	$4,497	$8,770	$7,971	$6,064
Mackerel	$744	$1,426	$1,142	$1,334
Rockfish Nearshore	$73,302	$131,432	$121,590	$98,984
Rockfish Shelf	$7,109	$12,074	$11,664	$7,881
Rockfish Slope	$24,365	$42,098	$36,827	$37,014
Rock Crab	$9,966	$11,055	$10,947	$11,055
Salmon	$46,005	$138,554	$89,455	$76,944
Sardine	$39,830	$84,297	$58,605	$67,802
Sablefish	$40,032	$136,567	$138,384	$141,783
White seabass	$43,240	$38,730	$40,154	$38,019
Surfperch	$558	$1,034	$1,126	$511
Spot Prawn	$57,415	$122,086	$156,551	$96,848
Squid	$155,327	$259,298	$195,103	$180,502
Total	**$667,826**	**$1,260,175**	**$1,117,642**	**$989,692**

These same impacts on net economic values are shown in Table 4, expressed as percentages of baseline net economic value. Table 4 columns are computed by dividing net economic value losses in Table 3 by baseline net economic values shown in the last column in Table 1.

Table 4: Annual Maximum Potential Net Value Losses in Percentage Terms

Fishery	Package 1	Package 2R	Package 3R	Package P
Anchovy	5.7%	10.9%	8.1%	9.1%
Cabezon	14.6%	27.7%	24.9%	19.3%
Dungeness crab	4.5%	12.8%	13.1%	14.3%
Deep Nearshore Rockfish	16.5%	22.8%	21.4%	20.1%
Halibut	6.4%	10.0%	9.0%	7.2%
Kelp Greenling	13.1%	23.9%	21.5%	17.2%
Lingcod	13.1%	25.6%	23.2%	17.7%
Mackerel	5.4%	10.3%	8.2%	9.6%
Rockfish Nearshore	14.3%	25.6%	23.7%	19.3%
Rockfish Shelf	7.5%	12.7%	12.2%	8.3%
Rockfish Slope	14.3%	24.8%	21.7%	21.8%
Rock Crab	12.0%	13.3%	13.2%	13.3%
Salmon	3.4%	10.3%	6.7%	5.7%
Sardine	5.2%	11.1%	7.7%	8.9%
Sablefish	6.8%	23.3%	23.6%	24.2%
White seabass	9.1%	8.2%	8.5%	8.0%
Surfperch	2.7%	5.1%	5.5%	2.5%
Spot Prawn	7.3%	15.5%	19.9%	12.3%
Squid	6.2%	10.3%	7.8%	7.2%
Total	**7.5%**	**14.2%**	**12.6%**	**11.2%**

C. Community Impacts

Many studies of economic impacts confine the analysis to first round or primary impacts. These impacts are associated with those first impacted by the policy in question. In this case, that would be the fishing sector, in particular the owners of vessels assumed to be removed from particular fishing grounds. But if, for example in the worst case scenario, harvests fall and net revenues fall permanently, then the net revenue losses themselves will set in motion second- and third-round effects that spread through community economies that host the fleets. Thus net primary-sector revenue reductions will translate into reductions in net benefits to supporting businesses (eg. fish processing, fishing supplies, fuel, boat repairs) and consumption service industries (eg. groceries, appliance sales, household services) associated with the first and subsequent rounds of expenditures. The sum of these additional economic impacts is commonly called the "multiplier effect", and it serves to scale up any changes in primary net benefit changes to arrive at total community impacts (Radke and Davis, 2000).

Generally, serious attempts to measure community impacts must rely on complicated and detailed information about the sources of inputs and payments for those inputs, paying particular attention to the source and destination of inputs and output payments (King and Shellhammer 1982, Pomeroy and Dalton, 2003). A question that must be addressed from the start is thus: what is the relevant region over which community impacts are to be measured? If the region is large (eg. the whole national or state economy), most of the values generated within the sector in question and so the impacts as a result of a policy change will be contained within the region. But if the region is small (eg. a small coastal community), then many of the total values associated with a sector will be contributed by, and accrue to individuals outside of the particular community. These effects are often described as "leakages". Regions that are large and self-sufficient have low leakages of payments to the outside in support of activities, but small trade-dependent regions have high leakages. The level of leakages determines by how much the impacts on the primary sector are multiplied to yield community impacts.

Without specific data or a regional input/output model, it is a somewhat speculative exercise to attempt to trace secondary impacts of policies like the MPA options proposed for the Central Coast study area. But we can sketch out an order of magnitude estimate as follows. First, the most important secondary impact of reserves is likely to be absorbed by the processing sector -- if indeed the first round impacts materialize (as we have assumed in this maximum impact analysis). To estimate maximum net economic value or net benefits (NB) associated with the processing sector, we again need to estimate processing sector costs as a share of gross revenues, just as we did with the harvesting sector. Assume for simplicity that the average "markup" of wholesale from ex-vessel prices is 2.0, so that $P_W = 2.0P_{EV}$ where P_W is the wholesale price and P_{EV} is the ex-vessel price. Assume also that average processing costs absorb 75% of the difference between wholesale revenues and fish purchasing expenses. Then net values or net benefits per unit weight from processing would be $NB = P_W - .75[P_W - P_{EV}] - P_{EV} = .25P_{EV}$.

This suggests that net values associated with processing are roughly 25% of ex-vessel gross revenues (compared with net values associated with the primary sector of 65%). The sum of primary sector harvesting and secondary processing sector net benefits would then be 65%+25%=90% of total landed values. These numbers are in the same ballpark as numbers generated from a carefully done recent study reported by Kirkley et. al. (2005) for the fishing sector in the state of Virginia. His numbers compute net benefits for the harvesting sector as 63% of landed value, and net benefits for the processing sector as 14% of the landed value.

A final step in community impact analysis is to compute subsequent rounds of benefits. These are associated with the spending of net benefits and input payments within the community, and the benefits that those generate by creating local business. For example, if the skipper/owner lives in the community, his local expenditures on groceries, together with his crew's expenditures on similar items generate new business and net benefits in the communities, the participants of which also generate new benefits in a cascade of effects. The sum of all of these "induced effects" is often estimated with a multiplier applied to the primary and secondary impacts. Multipliers are small for small economies with leakages and large for larger self-sufficient economies, but they range on the order of 1.0 to 2.0. Assume that we expect the local multiplier for the Central Coast economic region to be 1.25. Table 4 shows how we might compute the full economic impacts associated with the direct impacts reported in Table 3.

Table 5: Summary of Maximum Potential Economic Impacts (Annual real 2005 dollars)

	Primary Impacts	Secondary Impacts	Induced Impacts	Total Impacts
Package 1	$667,826	$256,856	$1,155,852	$2,080,534
Package 2R	$1,260,175	$484,683	$2,181,072	$3,925,929
Package 3R	$1,117,642	$429,862	$1,934,380	$3,481,884
Package P	$989,692	$380,651	$1,712,929	$3,083,272

III. Conclusion/Summary

Our best estimates of the maximum potential economic impact of the various MPA packages range around the $1,000,000 mark for primary harvester sector benefits, on an annual basis in real 2005 dollars. We are reasonably confident in the order of magnitude level of these estimates, but it is also important to reiterate that these are biased high in several ways. The most important is that they essentially assume that that the various MPA plans completely eliminate fishing opportunities in closed areas and that fishermen are unable to adjust or mitigate in any way. In addition, it is assumed that the reserves provide no spillover benefits. We also choose assumptions at various stages in the analysis that tip the analysis toward high estimates when choices must be made about alternative assumptions and interpretations of data, in order to get a maximum impact.

The various package differ in ways that reflect the manner in which various MPA options affect different portfolios of fisheries, the relative values associated with those species, and the manner in which survey respondents identified particular areas as coincident or not with prospective MPA plans. While we have done the best that we believe possible with existing data, we would be reluctant to recommend relying on the estimated differences to make policy decisions about which package is best. In the final analysis, there is not much quantitative difference between the estimated total maximum potential impacts of the various options and differences that do exist may be argued to be within the bounds of uncertainty in the analysis, assumptions, and data quality.

References

Ecotrust. 2004. Catch 22: conservation, communities, and the privatization of B.C. fisheries. November.

Hansen, Doreen. 2003. Estimating costs in the California commercial salmon fishery. M.S. Thesis, Dept. of Agric. & Resource Economics, UC Davis.

King, D.M. and K.L. Shellhammer. 1982. The California inter-industry fisheries model (CIF): an economic impact calculator for California's fisheries. Center for Marine Studies. San Diego State University.

Kirkley, J. T. Murray, and J. Duberg. 2005. Economic contributions of Virginia's commercial seafood and recreational fishing industries: a users' manual for assessing economic impacts. Virginia Institute for Marine Science.

Newell, R. and J. Sanchirico. 2005. Fishing Quota Prices. Journal of Environmental Economics and Management. 50(1).

Pomeroy, Caroline and M. Dalton. 2003. Socioeconomics of the Moss Landing commercial fishing industry. Report to the Monterey County Office of Economic Development.

Radtke, Hans and Shannon Davis. 2000. Description of the U.S. west coast commercial fishing fleet and seafood processors. Prepared for the Pacific States Marine Fishing Commission.

Schelle, K. K. Iverson, N. Free-Sloan, S. Carlson. 2004. Bristol Bay Salmon Drift Gillnet Fishery: Optimum Numbers Report. CFEC Report Number 04-34. Commercial Fisheries Entry Commission, Pouch KB, Juneau, Alaska 99811.

Schelle, K. and B. Muse. 1983. A suggested methodology for estimating the distribution of operating costs and net returns in Alaska's salmon fisheries. CFEC Report 93-9, Juneau, Alaska.

Scholz, Astrid, Charles Steinback and M. Mertens. 2006a. Commercial fishing grounds and their relative importance off the Central Coast of California. Report submitted to the California Marine Life Protection Act Initiative. May 4, 2006.

Scholz, Astrid, Charles Steinback and M. Mertens. 2006b. Summary of potential impacts of MPA packages P, 1, 2R, and 3R on commercial and recreational fisheries in the Central Coast Study Region. June 15, 2006.

Wilen, James and Joshua Abbott. 2006a. Discussion of Ecotrust Methodology in 'Commercial fishing grounds and their relative importance off the Central Coast of California'. Report submitted to the California Marine Life Protection Act Initiative. May 24, 2006.

Wilen, James and Joshua Abbott. 2006b. An Assessment of Ecotrust's Relative Importance Indicators: Comparisons with Logbook Data for the Market Squid Fishery. Report submitted to the California Marine Life Protection Act Initiative. June 13, 2006.

Wilen, James and Joshua Abbott. 2006c. Methods for Assessing the Maximum Economic Impacts of Potential Marine Reserve Networks. Report submitted to the California Marine Life Protection Act Initiative. June 18, 2006.