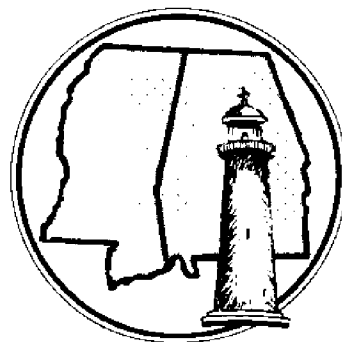


**Empirical and Theoretical Observations  
on the Potential Economic Benefits  
and Costs  
Associated with Mississippi-Alabama  
Liberty Ship Reef Program**

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**EMPIRICAL AND THEORETICAL OBSERVATIONS ON THE POTENTIAL  
ECONOMIC BENEFITS AND COSTS ASSOCIATED WITH  
MISSISSIPPI-ALABAMA LIBERTY SHIP REEF PROGRAM**

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## PREFACE

This study is part of a larger study designed to provide information needed to plan and manage efficiently a program of artificial fishing reef development within the coastal waters bordering the states of Mississippi and Alabama. This particular aspect of the study focuses on economic considerations of artificial reef developments now underway in the area. The nature of costs and benefits arising out of artificial fishing reef developments are analyzed. Particular attention is paid to the questions of who bears the costs and who receives the benefits. Some of the implications of the study coincide with popular beliefs; others contradict some of them. Large portions of the results are based on theoretical rather than empirical considerations. Complete quantification of all costs and benefits is not possible in a small study such as this one. Nevertheless, the study breaks new ground in that it is the first systematic analysis of the general costs and benefits of an artificial reef program. Previous work has focused only on particular aspects of benefits and costs. Hopefully, the study results will prompt further work along some of the lines developed herein.

The assistance of several individuals was most helpful.

Special appreciation is expressed to Mr. Wayne Swingle of the Alabama Department of Conservation and Natural Resources, and to Dr. George Crozier of the Alabama Marine Science Program.

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# ECONOMIC ANALYSIS OF MISSISSIPPI-ALABAMA LIBERTY SHIP FISHING REEFS

## INTRODUCTION

The development of artificial fishing reefs in coastal waters has become common practice. A variety of materials has been used ranging from tires to streetcars, but none appears more significant than the Liberty Ship hulls which have recently been released to the states for this purpose. These cut-down hulls are being sunk all along our coasts. Ten ships are being placed in eight locations off the Mississippi and Alabama coasts.

It has been the experience of fishermen that these reefs accumulate significant populations of reef-dwelling species that are desirable to commercial fishermen and sportfishermen. Thus, these artificial reefs become a resource of great potential.

No hard information is available as to the total cost of these efforts, the immediate economic benefits, the potential long-run benefits, and the distribution of these costs and benefits. However, the charter boat industry and the sportfishing community are convinced of a favorable cost-benefit ratio--at least, from their standpoint. Since public funds are involved in the development and placement of these



reefs, it is only prudent to try to establish their economic feasibility prior to the expenditure of additional public funds. While biological data can provide answers to questions relating to the technical feasibility of the reefs in terms of their ability to attract fish and increase the fish population in the waters surrounding the reef, ultimately, the feasibility of a reef depends upon the economic benefits and costs involved. Benefits are, in the first place, dependent upon biological effects, and knowledge of these effects is necessary to achieve maximum benefits. However, the knowledge is not sufficient to determine whether or not the development is justified. This report is part of a larger attempt to provide data needed to evaluate and properly manage the Liberty Ship reef developments in Mississippi and Alabama.

If it can be shown that the public or private benefits which are attributable to an artificial reef program exceed the public or private costs of that program, a more justifiable case for additional artificial reef construction is possible.\* On the other hand, if the general benefits do not exceed the costs, then the development of additional reefs becomes a matter of whether or not the public wishes to subsidize the commercial and sportfishing interests.

This study sought to identify properly both the long and short term economic benefits of the Mississippi-Alabama Liberty Ship reef program and, where possible, to quantify these economic costs and benefits.

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\*This would be a necessary, but not sufficient, condition for the economic justification of the reef.

For the most part, reasonably accurate quantification of costs is possible, at least from the local area's standpoint. This is not the case with respect to benefits, and quantification of benefits was not possible.

In Alabama, the Marine Resources Division of the Alabama Department of Conservation and Natural Resources is the state agency in charge of taking title to the Liberty Ship hulls and converting these into artificial fishing reefs. In Mississippi, a state chartered non-profit corporation named the Mississippi Gulf Fishing Banks Inc. or MGFBI is in charge of reef development. The procedures followed by both states are similar. After taking title to the Liberty Ships, the states must obtain a permit to sink the ship at an approved location. The ships must be cut-down so that all superstructure and possible pollutants are removed. This process generates valuable salvage. After the salvage process is completed, the ships are towed to the approved locations and sunk. Buoys are attached and maintained so that fishermen can locate the hulls. This artificially imposed irregularity in the bottom becomes the basis for a large chain of marine life.

While there is a rapidly developing body of literature on the biological and engineering aspects of artificial reefs, almost no research exists on the economic aspects of these reefs.\* Buchanan did investigate

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\*See, for example, Laura Colunga and Richard Stone Eds. Proceeding: Artificial Reef Conference sponsored by the Center for Marine Resources, Texas A & M University, The National Marine Fisheries Service, and the Texas Coastal and Marine Council 1974.

the influence of the Paridine Artificial Reef on the economy of Murrells Inlet, S.C. \* Swingle estimated some of the potential benefits from the Liberty Ship reefs to the State of Alabama. \*\* A complete analysis of the economic effects of an artificial reef program has not yet been done.

#### Definition of Relevant Benefits

The determination of the relevant benefits resulting from the Liberty Ship reefs is very complex compared to the determination of costs. A crucial and complex issue which must be settled initially is the identification of relevant benefits. The term benefits as used in this section refers strictly to realized economic benefits to people-- that is, products or services of value to someone in the sense that they actually give up (through direct or indirect private or collective action) something else of value in order to obtain those products or services. In short, benefits are confined to what economists refer to as "economic goods" as opposed to free goods which may be useful but the consumption of which has no opportunity cost. Note, however, that all economic goods and, hence, benefits as defined here, need not be sold for money in the market place.

It is important to stress several aspects of this definition of benefits. For one thing, for a product of a reef to be a benefit, it must be utilized. For example, a new artificial reef may result in the

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\*Buchanan, C.C., "Effects of an Artificial Habitat on the Marine Sportfishing and Economy of Murrells Inlet, S.C." Marine Fisheries Review, Vol. 25 No. 9 (1973), 15-22.

\*\*Swingle, Wayne E., "Report on the Potential Value to the State of Alabama of the Proposal to Utilize Liberty Ships as Off-Shore Reefs." Mimeographed Report by Alabama Department of Conservation.

attraction of large numbers of desirable sportfish to a concentrated location, but if no one takes advantage of this by fishing on the reef, no benefit is realized even though there are positive biological results, and, hence, the creation of potentially useful products attributable to the reef. Second, the realizer or consumer of the benefit must actually give up something of value (it need not be money) in order to realize the benefit of the reef. If the tangible or intangible output of the reef is so commonly available that it is free for the taking, additional production of that commodity has no value no matter how useful and desirable it may be.\* Assuming reasonably efficient markets, the approximate valuation of the benefit is what the consumer of that benefit actually gives up even if he would be willing to pay or give up more than he actually does. The implication of this is that the price of goods (services) purchased by sportfishermen in order to engage in fishing at the reef is the cost and, therefore, the value of the reef to the sportfishermen.

Many people benefit potentially from an artificial reef. The sportfisherman, the commercial fisherman, the charter boat operator, the bait and tackle dealer, the gasoline dealer, the ice dealer, the motel industry, retail food and drink establishments, and restaurants to name a few. Through responding, it is possible for people throughout all segments of the economy to share in the benefits or value of the output of an artificial reef. In short, the fishing reef may contribute to some extent to the overall economic development of a local area.

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\*This is referred to in the economics literature as the paradox of value.

For any benefit generating project, the amounts of benefits generated and costs incurred are not absolute constants but are relative to the makeup, identity, and objectives of the particular person or group of people involved in the project. This is true with respect to almost any benefit-generating project and clearly so with respect to the case of artificial fishing reefs constructed from the Liberty Ship hulls. Cost and benefits vary depending on the identities of the groups considered because of wealth-transfer effects which are created. For example, the federal government's gift of Liberty Ships to the states of Mississippi and Alabama is clearly a benefit when looked at from the standpoint of the two states and, particularly so when looked at from the viewpoint of the coastal areas of the two states. When viewed from the standpoint of the taxpayers in the remaining forty-eight states, the gift is a cost since these taxpayers give up the salvage value of the vessels to the citizens of Alabama and Mississippi. Thus, what is viewed as a benefit in Jackson and Montgomery (and Biloxi and Mobile) should be properly viewed as a transfer-payment in Washington. Any time one deals with wealth-transfer effects, one man's costs are another man's benefits and vice-versa. Much of what is beneficial to particular groups due to the Liberty Ship reefs is of the nature of a wealth-transfer and many of these effects are quite complex. Hence, it is necessary to understand clearly the viewpoint from which benefits and costs are being calculated.

Benefits are considered from several standpoints throughout this report, and the reader is cautioned against assuming that benefits to any group or area are absolute with respect to society as a whole. In general, the proper view of benefits for various groups is as follows. From the standpoint of a particular business or group of businesses in a given area, the relevant benefits may be considered as the value of additional business income gained (or lost) as a result of the reef. For example, charter boat operators as a group in the Mississippi-Alabama coastal areas will increase their annual earnings as a result of the reefs. Thus, the benefits to this group of businesses would be these increased earnings that are attributable to the reefs. On the other hand, consider another group of businesses-the Florida charter boat operators. Quite likely, they will lose some business to Alabama and Mississippi as a result of the reefs. Thus, the reefs will impose costs upon this group. From the standpoint of the economy of the local coastal area in whose waters the hulls are sunk, the relevant benefits would be the value of additional business brought into the area from nonlocal areas as a result of the reef. From the standpoint of the sportfishermen as a group, the relevant benefits are the value of the increased average fish catch per unit of effort which is attributable to the reef. The proper measure of these benefits, as discussed below, is the increased expenditure by sportfishermen that can be attributed to the reef. From the standpoint of the U.S. economy or society in general, the net dollar benefits would be much smaller than the sum of the positive benefits

to various groups in the economy since a large portion of these benefits are offset by negative effects on other groups.

#### Cost of the Liberty Ship Reefs\*

There were no acquisition costs to the States of Alabama and Mississippi for acquiring, preparing, and towing the hulls to the sites at which they have been or will be sunk. Obviously, some economic costs of the above functions were borne by someone since resources were used. The reason that the two states were able to escape a cost burden is that they acquired "surplus" ships from the Federal Maritime Administrator out of the mothball fleet at Mobile. These "surplus" ships had no value as ships. However, they did have some salvage value. In effect, the federal government gave these ships and their salvage value to the States of Alabama and Mississippi. Thus, there is an implicit acquisition cost - the salvage value of the ships - but this acquisition cost is borne by the federal government and U.S. taxpayers rather than the treasuries of Alabama and Mississippi and the taxpayers of these states.

The hulls had to be prepared for sinking -- that is, the superstructure had to be removed so that they would not constitute a hazard to other ships. Also possible sources of pollution had to be removed.

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\*Cost data for the Alabama Reef are from interviews with Mr. Wayne Swingle of the Alabama Department of Conservation and Natural Resources. The Mississippi cost data were obtained from Mr. Bill Demoran of the Gulf Coast Research Laboratory

Bids were taken for the salvage rights to ships with the provision that the salvaged hulls were to be towed to the respective reef locations. Thus, in effect, the cost of preparing each hull and towing it to its ultimate location was paid out of the salvage value of the ships which was a gift of the federal government to the states.

Competitive bidding for the salvage rights resulted in a \$25,000 total (\$5,000 per ship) return to the State of Alabama and a \$50,000 (\$10,000 per ship) return per ship to Mississippi plus the services of salvaging and towing the ships to their respective locations. Additional revenue of \$15,000 was collected by Alabama since salvage operations exceeded a contract time limit and a penalty resulted.

In Alabama, the State was also responsible for the cost of sinking the hull. This was done by a team of Navy personnel at a cost of about \$125 per ship. The State paid the per diem of the personnel involved. There will be no charge for sinking the last hull as the Navy is using this as a training exercise. In Mississippi, the cost of sinking the hulls was part of the salvage contract. There were some other miscellaneous administrative costs which were borne by the States-- phone calls letters, trips, etc. in connection with acquiring the ships, obtaining permission to sink them, and getting EPA approval. These costs ran to less than \$1,000 dollars for both Alabama and Mississippi. Precise figures were not available. The largest initial cost item was the cost of providing a twenty-four hour guard over the ships from the time that the States acquired title until the ships went to the salvage yard. This



guard was necessary for over two years and the total cost to the State of Alabama was \$17,202, and the cost to Mississippi was \$16,000.

The other major cost item is marking the reefs. This is done with buoys. For the Alabama reefs, cost of initial buoys will run about \$945 per ship or \$4,722 total. This includes chain, anchors, hauling, and preparing the buoys (sandblasting, painting and filling partially with styrofoam). The initial buoys were surplus and were acquired at a token cost of \$25 each. If the State had paid full cost for these buoys, this would have added several thousand dollars to the cost. Installation of the buoys on the Mississippi reefs is part of the salvage contract.

The only long-term costs associated with the ship reefs are the costs of maintaining the buoys marking the sites of the reefs. The estimated present value of these costs is \$15,381 in the case of the Alabama reefs. In the case of the Mississippi reefs, the estimated present value of the maintenance cost of buoys was estimated at \$16,618. A summary of costs from the standpoint of the States of Mississippi and Alabama is presented in Table 1.

It should be stressed that the cost figures shown in Table 1 are from the viewpoint of the States of Mississippi and Alabama. A significant cost was borne by the federal government. The total cost figure for Mississippi was somewhat lower due primarily to better terms of the salvage contract in that state.

TABLE 1

SUMMARY OF COSTS AND INITIAL BENEFITS ASSOCIATED  
WITH THE MISSISSIPPI-ALABAMA LIBERTY SHIP  
REEF DEVELOPMENTS

	Alabama	Mississippi
Costs		
Acquisition Costs	0 <sup>b</sup>	0 <sup>b</sup>
Hull Preparation Costs	0 <sup>b</sup>	0 <sup>b</sup>
Sinking Costs	500	0 <sup>b</sup>
Guard Costs	17,202	16,000
Marking Buoys	4,722	0 <sup>b</sup>
Miscellaneous Costs	<u>1,000</u>	<u>1,000</u>
Total Initial Costs	\$23,424	\$17,000
Present Value of Operating & Maintenance Costs (Buoy Replace- ment, etc.) <sup>c</sup>	<u>\$15,381</u>	<u>\$16,618</u>
Total Present Cost	\$38,805	\$33,618
Initial Benefits		
Revenues from Salvage Sales	25,000	\$50,000
Late Penalty Paid by Salvage Company	15,000	
Total Initial Benefits	40,000	\$50,000

<sup>a</sup>Gift from Federal Government.

<sup>b</sup>This cost was borne by the salvage company under terms of the salvage contract.

<sup>c</sup>Based on a 100 year life and a 6 percent rate of discounting.

### Benefits of The Liberty Ship Reefs

It is the general opinion that most of the benefits of the Liberty Ship reefs will accrue to the sportfishermen. To a lesser extent there will be a small number of scuba diving fans in the area who will also share directly in the benefits of the reef, and there are likely to be some commercial fishing benefits from the reef. In order to receive the benefits of the reef, these groups will often have to purchase the products and services of others such as charter boat operators, boat, motor, tackle, gas, bait, and ice dealers, etc. Thus, other businesses and individuals at the local level will indirectly receive benefits from the reefs through increased sales of some of their outputs.\*

Due to the very small number of people involved, the benefits to scuba diving fans were not treated in this study. Contact with some of these fans indicates that area divers will receive some benefits from the reef. The benefits to sportfishermen are discussed separately below

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\*Normally a useful product or service is owned or controlled by someone or a group of people, and the owner(s) captures(capture) the value of the benefits of the product or service to users by charging the users directly. In the case of the artificial reef, as with many other non-privately owned assets, there is no resource owner to directly levy charges on the resource users. Nevertheless, the reef fisherman must pay for the use of the resource. In this case he pays indirectly to nonowners of the resource who have some control over the user's ability to capture the direct benefits of the resource (in this case, the artificial reef). The use of the reef, which is in essence a free good, is effectively tied to the consumption of certain other goods and services--charter boat services, boat, motor, and gas purchases, etc. The owners of these nonfree goods and services find that sales of their product are tied to the use of the reef. The increased benefits of the reef to the sportfishermen push up the demand curve for these tied nonfree products and services. The increase in the sales of these tied nonfree products reflect the economic value of the benefits of the reef to the sportfishermen.

along with the indirect benefits to the general economy of the coastal area of the two states.

It is clear that there are positive benefits to particular local businesses as a result of the reef. To quantify these benefits would require specifying the increase in their income which is attributable to the reef. As noted below, however, the resulting estimate of benefits would not apply to any other set of economic units and would probably overstate the net local area benefits.

#### Benefits To Sportfishermen

The value created by an artificial fishing reef as far as sportfishermen are concerned can be viewed as an increase in the average expected catch per unit of fishing effort.\* In terms of economic theory, this is operationally equivalent to a product improvement which increases the user's satisfaction or "utility" derived from consumption of the good. The effect of this is to increase the demand for the good. Development of the Liberty Ship reefs increases the demand for fishing effort in the waters around the reef. The effect of the reef is conceptualized in Figure 1.

A demand curve such as that shown in Figure 1 depicts the quantities of an item that will be consumed at alternative prices for given levels of income, tastes, and prices of other goods. In this sense the demand

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\*An original goal of this project was to quantify the differences in catch which could be generated by the reefs. This would have required estimates of per-effort catches at reefs versus control points. Sources which were to have provided this data were unable to do so in a suitable form. Hence, the per-effort catch differences due to the reef could not be quantified.

Price of Fishing Effort  
in Waters Surrounding  
The Reef

$$= P_R = \sum_{i=1}^n S_i$$

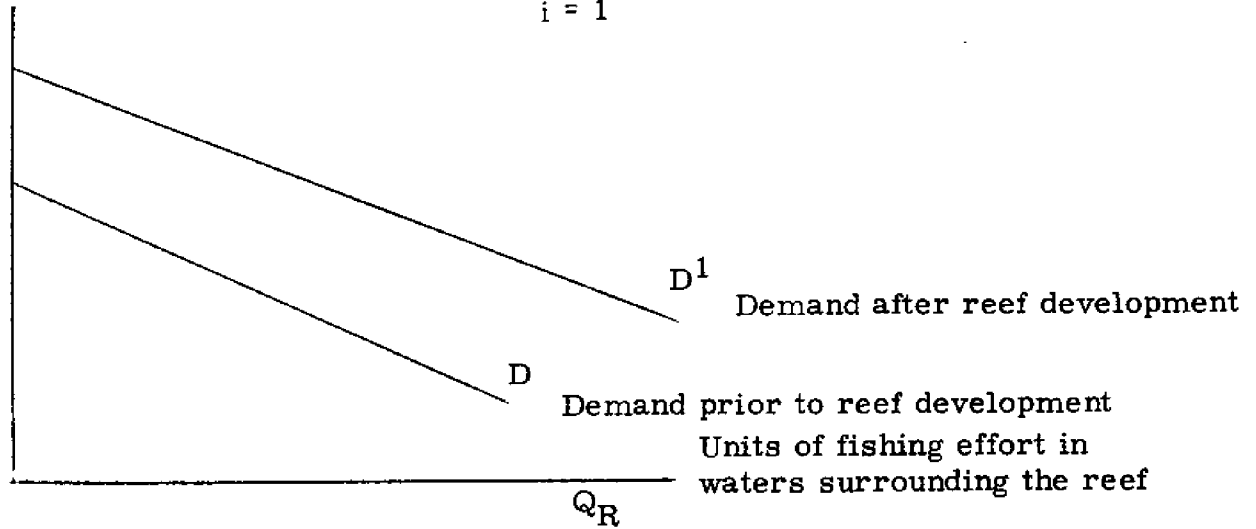


Figure 1

Illustration of Potential Effect of Artificial  
Fishing Reef Development On Demand For Fishing Effort

function for fishing effort at artificial fishing reefs is no different than any other demand function. However, there is a somewhat unique aspect of this demand function. The price of artificial reef fishing effort is a composite of costs (prices) of items which must be consumed in order to fish at the reef--charter fees, tackle, bait, ice, gas, boats, motors, and (for nonlocal fishermen) meals, lodging, and transportation ( $S_i$ ). Some of the costs included in the price of artificial reef fishing effort may be imputed costs in the sense that they are not dollar transactions occurring in the market place. An example would be the lost wages of a fisherman who leaves his job four hours early on Friday to get in a long weekend of fishing. Part of the cost of his fishing effort is four hours of foregone wages.

The value of benefits to the sportfishermen is conceptualized in Figure 2.

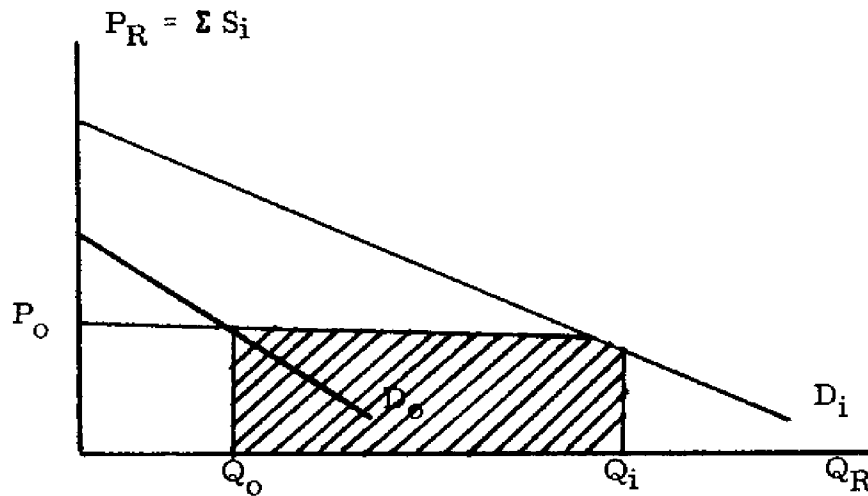


Figure 2

#### Value of Sportfishing Benefits of Artificial Reef

Remembering that  $P_R$ , the price of reef fishing efforts, is a composite of costs of other goods and services, then, unless the reef development is on a large scale, it is realistic to treat these costs as unaltered at both the individual and market level by the increased demand due to the artificial reef. The improvement in fishing prospects due to the Liberty Ship reef shifts the demand curves from  $D_0$  to  $D_i$ . At the given price,  $P_0$ , the value of the benefits of the increased fishing efforts

due to the reef development is given by  $P_o (Q_1 - Q_o)^*$ . In short, we may measure the benefits of the reef by the increase in fishing expenditures by sportfishermen who increase their fishing efforts due to the reef.

While fishermen benefit directly from the reefs in the sense that they utilize the reefs, other individuals and groups receive positive economic benefits from the reef. Those that benefit most directly are the local sellers of fishing related services and equipment. In short, positive benefits of the reefs will accrue to sportfishermen and those businesses serving area sportfishermen. In quantifying these positive benefits, it would be necessary to identify the increase in sales at various businesses that can be attributed to additional fishing effort generated by the reef. The impact of the reef is, at present, in its infancy stage, but there is every reason to expect effects to occur through time.

It must be noted that dollars needed to make the monetary purchase stimulated by the reefs are not created by the reef. Rather, they must

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\*Note that the Price,  $P_o$ , of fishing effort at the reef as conceptualized here is really an average of composite prices of alternative combinations of products and services which may be purchased to fish the reef weighted by the relative use of each alternative. For example, one approach chosen by some sportfishermen may be the use of charter boats. Another approach is the purchase or use of his own boat, motor, and gas. Different fishermen will choose different alternatives and the price of each alternative is different. The price  $P_o$  is, then,

$$P_o = W_1 P_1 + W_2 P_2 \dots W_n P_n$$

where  $n$  = the number of alternative combinations of purchases which leads to fishing at reef

$W_i$  = the proportion of fishermen at the reef who use the  $i$  th alternative

$P_i$  = the composite price of goods and services leading to the  $i$  th alternative method of fishing the reef.

be transferred from their present use. Sportfishermen making reef-related fishing expenditures make these purchases by transferring dollars from other uses. Thus, while they cannot be identified or specified a priori, there are equal negative effects for each dollar of positive benefits generated by increased sportfishing due to the reefs. This does not mean that there is an absence of net benefits to society as a whole from the reef. Assuming the marginal utility of money is the same for businesses affected positively as for those affected negatively, the dollar effects do cancel out, but the sportfisherman receives a positive net benefit or he would not permanently change his expenditure pattern. However, throughout society as a whole, there would be a zero net dollar benefit to economic units in terms of sales and incomes.

Due to the presence of wealth-transfer effects, particular groups or areas may receive positive measurable dollar benefits to sales and incomes. For example, sales and income of local charter boat operators, bait, tackle, boat, and motor dealers would be positively affected. If all of the increased reef-related fishing expenditures are attracted from outside the local area by the reef, then the local economy benefits by this dollar amount. But, it should be clearly understood that this is really a transfer of income from nonlocal areas which experience a negative economic effect from the reef. More realistically, at least some of the reef-related increase in fishing expenditures are by local residents who reorganize their local spending patterns. This creates



at least some negative transfer effects within the local area. This situation has important implications for attempts to quantify the local area economic benefits from the fishing reefs. The net local area benefits from the reefs are not as great as the sum of the benefits to local charter boat operators and other sellers of fishing related products and services. In fact, if there is no increase in sales to nonlocal fishermen, it is unlikely that there are any net benefits to the local area. There will be, of course, nonmeasurable benefits to sportfishermen. Net local area benefits (measured in terms of income) are always equal to the sum of the income generated by additional nonlocal expenditures attracted to the area by the reefs. Again, however, these are always offset by negative effects in nonlocal areas.

#### Net Benefits To Local Areas

With respect to the local area in general, before there will be any net economic benefits from an artificial reef program, the program must attract nonlocal fishing related expenditures into the area. More specifically: (1) the program must be large enough to result in a noticeable improvement in fishing results in the area, (2) this increase in fishing results must be communicated to sportfishermen who are not currently fishing within the local area, (3) the improvement in fishing must be great enough to induce at least some of these sportfishermen to switch from their nonlocal fishing locations to the reef location, and (4) this switch must result in increased local area expenditures. In short, the reef development must be of sufficient

size and fish producing capability and sufficiently well publicized to cause a net increase in the number of nonlocal fishermen attracted to, and spending money in, the local area, and/or it should be of sufficient size and fish producing capability to cause the present nonlocal fishing populace to increase their expenditures for fishing in the reef area. There will also be economic development benefits if some local residents are induced to reduce their nonlocal fishing expenditures as a result of increased fishing effort at the reefs.

Assuming that these conditions are met, the present value of local area economic benefits of an artificial fishing reef development, measured in terms of local area income, may be stated as\*

$$(1) \quad \sum_{t=1}^T \sum_{i=1}^n \frac{R_{it}S_{it}}{(1+d)^t} \quad \frac{1}{1 - \sum_{i=1}^n R_{it}C_{it}}$$

where: T = the number of years during which the fishing reef will generate additional fishing related expenditures in the local area,  
 i = the i th sector of the local economy,  
 t = the current year,  
 n = the total number of sectors in the local area economy,  
 R = the proportion of sales in the i th sector which is retained as local income in that sector,  
 S = sales to nonlocal residents occurring due to the artificial fishing reef + fishing related sales to local area residents that would have been made outside the area in the absence of the reefs,

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\*For a more detailed discussion of this particular approach to economic base modeling and the rationale behind equation (1), see: Donnie L. Daniel and D.C. Williams, Jr., The Economic Impact of a Small Recreation-Oriented Reservoir, Water Resources Research Institute, Mississippi State University, July, 1975, Chapter II.

- C = the local area's collective marginal propensity to consume the products or services of the  $i$ th sector,  
 d = the rate of time discount

This framework (equation 1) outlines the total (direct and indirect) local income effects of the reef program. Direct effects are given by the term  $\sum_{t=1}^T \sum_{i=1}^n \frac{R_{it}S_{it}}{(1+d)^t}$ . The remainder of the equation is the local

multiplier, and it captures the indirect effects.

There are several characteristics of the local area economic development benefits of the Liberty Ship reef program which make it extremely difficult to obtain the data needed to quantify these benefits. Chief among these are: (1) the long life of the project and the likelihood that the values of some parameters of the model are volative over time, (2) the need to distinguish and measure the amount of reef related spending, and (3) the lack of data on local versus import consumption in each sector. While these difficulties present problems, they are not prohibitive ones. However, any effort to measure the economic development benefits will require as a minimum a multiyear project with repeated surveying of reef fishermen and their spending habits. Since the ability of the reefs to attract nonlocal fishermen will gradually increase over time, data on the first year or two of the project would not be representative. The cost of quantifying the economic development benefits of a reef program and the need to have these estimates prior to development of the reefs make an a priori approach to estimating reef benefits highly desirable.

## CONCLUSIONS

The Liberty Ship fishing reef program as it is now being carried out is economically feasible from the standpoint of the states of Mississippi and Alabama and the coastal areas thereof. The present value of the economic benefits will exceed the present costs of the project in both states even when the dollar value of some known benefits is not quantified and included in the total.

The story does not end here. The reason for the favorable benefit-cost ratio to the states may stem from the fact that there is a large transfer-payment from the federal government involved. The gift of the ships and, thus, their salvage value, greatly reduced the cost to the states of the reef development. The salvage value of these ships yields the states a substantial cash revenue sufficient to pay for preparation, placement, and marking of the hulls. In the absence of this federal subsidy, it is possible that costs would have exceeded benefits. Certainly initial costs would have exceeded initial benefits. Long-run benefits to the states, which could not be quantified here, might be sufficient to justify the project even without the federal subsidy. A much more detailed study would be necessary to ascertain this.

Likewise, there are positive net benefits to particular groups of businesses and individuals within the coastal areas of the states. Charter boat operators, bait, tackle, and fishing equipment dealers

will all receive positive benefits from the project. Many other businesses and individuals will receive benefits indirectly as incomes are respent and dealers make purchases from suppliers. To the extent that outside dollars are attracted into the area, the general economy of the area will be enhanced. However, it is not possible at this time to make any quantitative estimates of the amounts involved. It must be stressed that these local area benefits are ultimately only wealth transfers. Somewhere, they are offset by negative effects, and this has significant implications. It means that even though the reef developments may be beneficial to particular states, locales, or businesses, from the standpoint of all the states there may well be no net benefits. If this is the case, reef development may become economically rational for an individual state, but not for the federal government unless the government has wealth transfer objectives in mind.