TECHNICAL BULLETIN 78 SEPTEMBER 1964

An Economic Evaluation of the Oregon Salmon and Steelhead Sport Fishery

Agricultural Experiment Station
Oregon State University
Corvallis

Contents

AUTHORS: William G. Brown is Associate Professor of Agricultural Economics, Oregon State University; Ajmer Singh, a former graduate research assistant, is now with the Board of Economic Development, Springfield, Illinois; and Emery N. Castle is Professor of Agricultural Economics, Oregon State University.

The authors appreciate the assistance of their colleagues on this research project. Darwin Nielsen made substantial contributions during the first research year and Lyle D. Calvin gave invaluable help in the survey design and the related statistical analysis. The contributions of others, including Albert N. Halter, John A. Edwards, and Robert G. Mason are also acknowledged.

An Economic Evaluation of the Oregon Salmon and Steelhead Sport Fishery

WILLIAM G. BROWN, AJMER SINGH, and EMERY N. CASTLE

Summary and Conclusions

Gross and net economic value of the Oregon salmon-steelhead sport fishery were estimated from angler expenditure data obtained from a mail survey during 1962. Schedules were mailed during each month of 1962 in an effort to minimize errors from faulty recollection or memory bias. Out of 5,515 questionnaires supposedly delivered, almost 80% were returned and at least partially completed.

In 1962 it was estimated that salmon-steelhead sport anglers were spending over $9 million annually on durable equipment items primarily for salmon-steelhead fishing. It was also estimated that over $8 million was spent by salmon-steelhead sport anglers during 1962 on "current" expenses associated with salmon-steelhead fishing trips. Total expenditures (except for angling licenses) by salmon-steelhead sport anglers were estimated to be $17.5 million. Counting expenditures for angling licenses connected with salmon and steelhead, total expenditures by sport anglers were estimated to be in the neighborhood of $18 million, plus or minus $3 million. The gross economic value of the salmon-steelhead sport fishery was, therefore, approximately $18 million.

Net economic value of the salmon-steelhead sport fishery in 1962 was also estimated. Net economic value was defined as the estimated value of the sport fishery resource to a single owner who could charge for the opportunity of fishing for salmon and steelhead. Net economic value was estimated to be in the range of from $2.5 to $3.1 million per year, as of 1962.

Projections of the estimated net economic value indicated that the salmon-steelhead sport fishery should increase in value with increasing population and higher family incomes. A 50% increase in net economic value to $4.7 million annually within 10 years is predicted if income and population trends of the past 10 years continue.

Methodological conclusions are as follows:

1. The Clawson method, generalized by the use of appropriate statistical tools, offers a promising method for the estimation of demand schedules for recreation.

2. Future work should concentrate on measuring carefully some of the variables affecting demand that this study has shown to be important, such as family income and travel distance.
3. Additional thought needs to be given to the conceptual framework underlying the interpretations of demand schedules for outdoor recreation. Some important theoretical relationships remain to be established.

Introduction

The objective of this study was to develop information on the economic importance of the salmon-steelhead sport fishery in Oregon. In achieving this objective, estimates have been made of (1) annual expenditures by salmon-steelhead sport anglers, and (2) the "net" economic value of this salmon-steelhead sport fishery resource.[1] These estimates are based on conditions which existed during the 1962 calendar year and do not pertain to returns which might be obtained under modified harvesting regulations. Although such estimates have relevance to management problems, this investigation should not be viewed as a management study. A complete analysis of the management problem would include information on fishery biology, conservation implications, and other economic considerations. It is hoped that the findings reported herein will be used with these limitations in mind.

Increasing demand for the utilization of rivers and streams for hydroelectric power, irrigation, flood control, navigation, pollution disposal, and other purposes sometimes presents severe hazards to migratory fishes in these rivers and streams. Procedures have been developed for estimating monetary benefits resulting from most of the water uses mentioned above. However, administrators face a more difficult task when trying to place a monetary value on the fishery resource. Such estimates, however, are of use both when the economic feasibility of fish-protective facilities are being considered or when the value of the fishery to be foregone is compared with benefits resulting from alternative use of the streams. While economic considerations are not the only (or most important) justification for the preservation of anadromous fishes for future generations, better knowledge about their economic value would be helpful in making decisions affecting the future of the fishery resource.

Where fish are caught and processed commercially, an economic evaluation is conceptually straightforward, and benefits can be estimated empirically. Important considerations in an economic evalua-

[1] A detailed explanation of the net economic value concept is presented beginning on page 29.

tion of fishery resources have been pointed out by Crutchfield.[2] The problems involved will not be discussed further here, except to note that Crutchfield and his colleagues appear able to make valid empirical estimates of the potential value of the commercial fishery resource. However, the conceptual problems involved in estimating the value of the sport fishery are complex and are similar to the problems encountered in general when trying to estimate the demand for outdoor recreation. Consequently, a brief evaluation of various procedures for measuring the value of outdoor recreation will be presented.

Evaluation of Methods for Estimating Outdoor Recreation Benefits

Many illogical schemes have been suggested for evaluating recreation benefits. One rather interesting method was the "cost" method employed by the National Park Service from 1950 to 1957.[3] It was contended as follows: ". . . A reasonable estimate of the benefits arising from a reservoir itself may be normally considered as an amount equal to the specific costs of developing, operating, and maintaining the recommended facilities. . . ." Such a statement is a good example of "circular reasoning."

Another method involves using gross national product. It has been contended that the value of a day spent in recreation can be assumed to be, on the average, as equal to GNP divided by the total population multiplied by the number of days in the year. It is clear that the problem is assumed away when this procedure is followed.

Perhaps the most commonly employed fallacious method of inferring net value has been the gross expenditures method. The rationalization for using this method is that recreation is worth at least as much to the recreationist as he is willing to pay for it. While it is true that a particular recreation is valued at least as high as other things which could have been purchased with the same money, it is also true that if this recreation were abolished, most of the money might simply be directed toward other goods and services. Loss from this shift, where the recreationist would be forced to some second choice would not be total expenditures but some other amount which total expenditures by themselves do not measure. If such a method were to be used, it would be difficult to compare recreational benefits with the benefits which might be received from alternative uses of nat-

[2] James A. Crutchfield, "Valuation of Fishery Resources," *Land Economics,* Vol. XXXVIII, No. 2 (May 1962), pp. 145-154, and "Valuation of a Fishery," *Transactions of the 27th North American Wildlife and Natural Resources Conference* (Wildlife Management Institute, Washington, D. C., 1962), pp. 335-346.

[3] National Park Service, United States Department of the Interior, *A Method of Evaluating Recreation Benefits of Water Control Projects,* 1950.

ural resources. Using the gross expenditure method would be analogous to using total farm expenses of the farmer as the value of water used in irrigation. Obviously, such a procedure applied to every water use would lead to difficulty.

It should be clear from the above that recreational use of natural resources is considered to be fully equivalent to any other use of natural resources from an economic point of view. It is sometimes alleged that recreational use is "nonproductive," while an alternative use such as irrigation or power is "productive" and adds "new wealth." Such a position cannot be defended with the logic of economics if one accepts the concept of consumer sovereignty. If those who possess purchasing power in an economy use their funds to bring them the greatest satisfaction, then the way they use their income provides a measure of the way they value different goods. Should they choose to allocate some of their income to outdoor recreation and away from (say) food or power, we cannot say the nation is poorer as a result. In fact, any artificial barrier which would prevent people from spending their money on outdoor recreation would make the nation less wealthy from an economic viewpoint.

The preceding remarks focus attention on the fact that what is wanted is not some gross value but rather the net economic value of the particular recreational activity.[4] It is this net value which has engaged the attention of the more rigorous investigators. These investigators may have been influenced by an ingenious suggestion by Professor Harold Hotelling of the University of North Carolina. In a letter to the Director of the National Park Service, Hotelling stated that it should be possible to set up approximate measures for evaluating, with a reasonable degree of accuracy, the service of national parks to the public.[5] One approach, which Hotelling thought should be pursued, was as follows:

> Let concentric zones be defined around each park so that the cost of travel to the park from all points in one of these zones is approximately constant. The persons entering the park in a year, or a suitably chosen sample of them, are to be listed according to the zone from which they come. The fact that they come means that the service of the park is at least worth the cost, and this cost can probably be estimated with fair accuracy. If we assume that the benefits are the same no matter what the distance, we have, for those living near the park, a consumers' surplus consisting of the differences in transportation costs. The comparison

[4] Throughout this bulletin direct or primary benefits (either on a gross or net basis) are treated. Indirect or secondary benefits are neither discussed nor treated, except insofar as gross expenditures may give some indication of secondary benefits induced by the fishery resource.

[5] Land and Recreational Planning Division, National Park Service, *The Economics of Public Recreation* (The "Prewit Report," Washington, D. C., 1949), unpaged reproduction of letter.

of the cost of coming from a zone with the number of people who do come from it, together with a count of the population of the zone, enables us to plot one point for each zone on a demand curve for the service of the park. By a judicious process of fitting, it should be possible to get a good enough approximation to this demand curve to provide, through integration, a measure of the consumers' surplus resulting from the availability of the park. It is this consumers' surplus (calculated by the above process with deduction for the cost of operating the park) which measures the benefits to the public in the particular year. This, of course, might be capitalized to give a capital value for the park, or the annual measure of benefit might be compared directly with the estimated annual benefits on the hypothesis that the park area was used for some alternate purpose.

The problem of relations between different parks can be treated along the same lines, though in a slightly more complicated manner, provided people entering the park will be asked which other national parks they have visited that year. In place of a demand curve, we have as a result of such an inquiry, a set of demand functions. The consumer surplus still has a definite meaning, as I have shown in various published articles, and may be used to evaluate the benefits from the park system.

This approach through travel costs is one of several possible modes of attack on this problem. There are also others, which should be examined, though I think the method outlined above looks the most promising.

An interesting application of Hotelling's concentric travel cost zones was presented by Trice and Wood.[6] They used data obtained from visitors to three similar areas in the Sierras. The data contained information regarding (1) number of persons in each recreational party, (2) the city or county of origin of each party, (3) the number of days spent by each party in the area of recreation, and (4) the number of days the party spent on its entire recreation trip. By using these four items of information from each recreational party, an average cost of travel per visitor day was computed. Travel costs were estimated to be 6.5 cents per mile; however, other rates were also used for the sake of comparison.

Analysis of the data was made to obtain the cost of a recreational value per visitor day for the 90th percentile level and for the median level. The median level was then subtracted from the 90th percentile level to obtain what Trice and Wood called "free value received," and which, supposedly, approximated a consumer surplus value.

Hines has suggested that the Trice-Wood analysis requires the additional, and unrealistic, assumption that individual preference scales are identical.[7] Some such assumption does seem necessary if

---

[6] Andrew H. Trice and Samuel E. Wood, "Measurement of Recreation Benefits," *Land Economics,* Vol. XXXIV, No. 3 (August 1958), pp. 196-207.

[7] Lawrence G. Hines, "Measurement of Recreation Benefits: A Reply." *Land Economics,* Vol. XXXIV, No. 4 (November 1958), pp. 365-367.

90% of the visitors living nearest to the recreational area are to receive a "consumer's surplus" or "free value received" equal to the travel cost of the 90th percentile minus the median travel cost. Lessinger also questions whether it is generally true that those who are "able to enjoy the parks without incurring the full travel expense of the most distant travelers" obtain a consumer's surplus.[8]

It does appear that there are two important limitations to the Trice-Wood analysis. The first and most crucial relates to the "travel cost per visitor day—number of visitors days" relationship.[9] If this relationship were a good approximation to the actual price-quantity relationship or demand for visitor days, then the Trice-Wood procedure would merit greater confidence. A second and related limitation concerns the logic of subtracting the median level of travel cost per visitor day from the 90th percentile level. Why should the 90th percentile be selected as the "bulk-line" market value rather than some other percentile, such as the 80th or 60th?

Despite the aforementioned limitations to the Trice-Wood analysis, it has been applied to other problems. More importantly perhaps, the pioneering efforts of Trice and Wood have stimulated interest in improving quantitative analysis in an important but neglected field of research.

Probably the most important approach to the problem of measuring the demand for and value of outdoor recreation has resulted from the imaginative and extensive research of Marion Clawson.[10] In his research, Clawson first computed what he called an approximation to the demand curve for the recreation experience as a whole. This demand schedule or curve was measured by plotting the estimated costs per visit as a function of the number of visits per 100,000 population in a zone in a given distance range. Clawson assumed that the visit to the recreational site was the main purpose of the trip and, therefore, had to bear all costs of the trip, allocating to other activities on the trip only those costs additional to the main trip.

Clawson states that the correspondence between cost per visit and number of visits per 100,000 base population may include some variables, such as the cost of distance in time, and to this extent may not represent a pure demand curve showing the net relation between price and volume. However, disregarding this possible complication, Clawson assumes that the experience of users from one location zone pro-

[8] Jack Lessinger, "Measurement of Recreation Benefits: A Reply." *Land Economics,* Vol. XXXIV, No. 4 (November 1958), pp. 369-370.

[9] *Trice and Wood, loc. cit.,* p. 205.

[10] Marion Clawson, *Methods of Measuring the Demand for and Value of Outdoor Recreation,* Reprint No. 10 (Resources for the Future, Inc., Washington, D. C., February 1959).

vides a measure of what people in other location zones would do if costs in money were the same.[11]

Clawson is able to estimate the number of visitors at each level of increased fees by his assumption that the differences in the rates of use between various distance zones is caused by differences in the money costs between zones of visiting the park. He is thus able to project attendance figures for various hypothesized entrance fees to derive a new demand curve that supposedly measures the relation between number of visits and entrance fees. The fee structure that would maximize net revenue to the owner of the area can then readily be computed. This measure of the value or benefit of the recreational area would then provide one basis of comparison with other possible uses of the water and other resources of the area.

Clawson's procedure is simple and direct and has greatly influenced research in resource economics.[12] Nevertheless, certain limitations of Clawson's approach should be noted if further advances in methodology are to be made. A crucial limitation is connected with Clawson's method of estimating the demand for the total recreational experience. It would seem that more than the monetary cost of the visit is involved in determining the number of visits per 100,000 population of various distance zones. One would expect the effect of distance to act as a demand "shifter." The cost of the trip in time would be one effect that could shift the demand curve to the right or to the left, depending upon whether the visitor regards the travel time as pleasant or onerous.[13] However, in addition to the complication of travel time, distance can be expected to shift the demand curve to the left for another reason. The greater the distance a zone is from a particular recreational site, the greater are the number and appeal of available substitutes for that particular site, because other sites become relatively cheaper in time and money. Certainly if a prospective visitor lives one thousand miles from Yosemite National Park, the visitor very likely has many alternatives to Yosemite, especially in-

[11] Clawson states that "we assume that the experience of users from one location zone provides a measure of what people in other location zones would do if cost in money *and time* were the same." Clawson, *op. cit.*, p. 24. Italics have been added because it is difficult to see how the cost of time has been explicitly taken into account. Complications concerning travel time will be discussed later.

[12] For example, Milstein uses Clawson's approach to estimate the effect of increasing fees on attendance figures for a lake. Cf. David W. Milstein, "An Economic Approach to Leisure Analysis," *Social Problems*, Vol. 9, No. 1 (Summer 1961), pp. 17-31. Also cf. Lionel J. Lerner, *Quantitative Indices of Recreational Values*, Conference Proceedings of the Committee on the Economics of Water Resources Development, Report No. 11, Economics in Outdoor Recreational Policy (University of Nevada, Reno, August 6-8, 1962), pp. 55-80.

[13] Clawson points out this fact, *op. cit.*, pp. 19-20.

sofar as time and costs of travel are concerned. Hence, it would seem desirable to take account of distance explicitly, rather than indirectly, if more accurate projections are sought.

Knetsch makes the significant observation that while the Clawson relationship between money costs and number of visits is distorted because of the effect of the time constraint, the Clawson demand curve should be consistently biased to the left of the true demand curve.[14] That is, the Clawson demand curve is an underestimate of actual demand for given resources. The assumption is, of course, that the greater the travel time required, the fewer will be the visits, even if money costs were to remain the same. Knetsch's prediction is borne out by our empirical work presented later in this bulletin.

Knetsch suggests that other demographic factors, such as age and income, should be helpful in improving demand projections for outdoor recreation. Others have also discussed the use of travel cost for isolating the demand function.[15]

The Clawson approach is a special case of the more general phenomenon of transfer costs.[16] Transfer costs are those costs incurred by the buyer or the seller of goods, but which are not normally included in prices. In the case of outdoor recreation (when publicly owned) resources are used with little or no admission charge; most of the costs involved are of a transfer nature. The cost of travel is certainly an important but by no means the only transfer cost involved in salmon-steelhead fishing. The approach used in this study was to utilize these transfer costs in an attempt to estimate the net economic value of the sport fishery resource. For the reasons outlined above, the total of these transfer costs is not equivalent to the net economic value.

To utilize such data effectively, one must have some decision-making model for the fisherman in mind. This aspect of research in this area has been neglected. For purposes of this study it was postulated that fishermen would tend to move toward an equilibrium condition characterized by equating the marginal cost of obtaining an additional unit of recreational experience with the marginal utility or

---

[14] An excellent review and appraisal of possible methods for measuring the demand for outdoor recreation has been made by Jack L. Knetsch, "Outdoor Recreation Demands and Benefits," *Land Economics*, Vol. XXXIX, No. 4 (November 1963), pp. 387-396. Also, Jack L. Knetsch, *Marketing Research and Recreational Use of Resources*, Paper prepared for the Convention of the Association of Southern Agricultural Workers, Marketing Section (Atlanta, Georgia, February 3, 1964), 18 pp.

[15] Emery N. Castle, "Activity Analysis in Water Planning," Chapter X in *Economics and Public Policy in Water Resources*, Stephen Smith and Emery Castle, eds., (Iowa State University Press, 1964).

[16] Clifford Hildreth first suggested this terminology to the authors.

satisfaction from the experience. It seems reasonable to expect that such a marginal cost curve would rise in a positive manner and that the marginal utility would decline as additional units of the recreation experience were obtained, and that at some point an intersection of the two functions would result in an equilibrium.

The above model suggests an important distinction between fixed and variable transfer costs. The marginal cost curve mentioned above will be influenced only by variable costs. To obtain the empirical counterpart of the above model, questionnaires were taken from sport fishermen. The sample and questionnaire used are described in the next section. However, the distinction between fixed and variable cost categories in the questionnaire stemmed from the reasoning outlined above.

Sampling Procedure Used for the Main Questionnaire

Before presenting the numerical results and economic implications of this study, some factors considered in constructing the questionnaire and the procedure followed in obtaining the sample should first be outlined. An important factor influencing the selection of the sample was the decision to reduce error from memory bias by mailing questionnaires to anglers at the end of each month during the year 1962. Questions regarding expenditures made on fishing trips were thereby confined to one month. (For more detail see page 2 of the questionnaire in the Appendix.)

It was also decided that angler expenditures should be solicited on a "per angler-family" rather than a "per angler" basis.[17] The "per angler-family" basis was preferred because many angler expenditures are made by the family as a unit, rather than by each family member separately. It would be complicated, if not impossible, to try to have the respondent partition his own particular expenditures from those of the family as a whole. Since the number of anglers in the family was determined from question number 1, page 1 of the questionnaire, (see Appendix) it was possible to estimate the number of anglers per family. These figures, along with other data, provided a basis for "blowing up" the sample estimate of expenditures to an estimate of total expenditures made by salmon-steelhead anglers in the state.

A preliminary step before selecting the sample was to decide the approximate number of questionnaires to be mailed during the year.

[17] The questionnaire was mailed to the individual angler who happened to be selected, but it applied to the family as a whole.

Based upon cost per respondent and an estimated 50% return, this figure was set at 6,000. (However, because the anglers returned more than the expected 50%, the total number of questionnaires actually mailed during the year was reduced slightly to 5,751.)

The next step was to compute a basis for distributing the approximately 5,800 questionnaires among the various types of licenses.[18] Of the types and combinations of angling licenses, only a few categories need to be considered for this report. First, the salmon-steelhead angler's license ($1 fee) is required to fish for salmon and steelhead, as well as the general angling license. The salmon-steelhead license is usually purchased at the same time the general angling license is bought, but sometimes it is purchased later. There are also various types of general angling licenses. Both residents of Oregon and nonresidents can buy daily general angling licenses for $1 which are good for one day only. Nonresidents can also buy the special vacation angler's license for $5—to angle for a period of seven consecutive days. For residents, the most common general angling license is the resident angler's license which costs $6 and is good for the calendar year. Any type of general angling license which holds for the calendar year will hereafter be referred to as an "annual" license as contrasted with the "daily" or "vacation" license.

Special provision was needed for drawing sufficient daily and vacation licenses. Anglers holding daily and vacation licenses tend to be underrepresented if given only one month's weight[19] because the daily angler is almost sure to fish one day for salmon or steelhead during the month that he bought the daily license (assuming that he bought a salmon-steelhead card).[20] On the other hand, the holders of annual angling licenses with S-S cards usually do not fish for salmon and steelhead every month that they are eligible to fish. For this reason, the daily-vacation licenses were assigned a weight greater than that of one month for the ordinary annual licenses with S-S cards. Therefore, this weighting provided the basis for allocating the sample between daily and vacation licenses versus annual licenses. It was also decided that approximately two-thirds of the annual licenses should be those licenses where the S-S tag was purchased for $1.00 at the same time that the annual license was purchased.

A basis was also needed for scheduling the sample of names of license holders among the 12 months of the year. Because fishing for salmon and steelhead was of primary interest, it was decided that total

---

[18] The various kinds of licenses in 1962 are described in *Synopsis of Oregon Angling Regulations 1962* (Oregon State Game Commission, 1634 S. W. Alder Street, Portland, Oregon), 47 pages.

[19] The meaning of the weights is explained on page 14.

[20] Salmon-steelhead will often be abbreviated to S-S in this report.

eligible months of S-S fishing would be given the greatest consideration in distributing the mailings during the 12 months of 1962. That is, anglers who purchased annual angling licenses in January would have a greater chance of being selected than anglers who bought in later months. Also, it was decided that the months of July, August, September, and October should have a weight twice that of all other months because these four months represent the heavy salmon-steelhead fishing season.

From previous years' license sales, 1962 sales patterns were projected. Monthly weights were assigned on the basis of the number of months that the annual license holder with salmon-steelhead card would be eligible to fish. Anglers who purchased their annual license with S-S tag in January had a greater chance of being selected than did anglers who purchased their licenses later. This information is summarized in Table 1. It must be remembered that the projected figures in Table 1 for 1962 were estimated in 1961. Hence, they were used only as a guide for determining the percentage of names to draw in each month.

For an annual license purchased in January with S-S card, there are 12 months of fishing possible. All months were arbitrarily given a weight of 0.5 except for July, August, September, and October, as shown in Table 1. Therefore, each annual license with S-S tag which was purchased in January would have a weight of 8.0. Those annual

Table 1. PROJECTED 1962 SALES OF ANNUAL LICENSES WITH S-S CARDS AND ASSIGNED WEIGHTS FOR EACH MONTH WITH PROJECTED ELIGIBLE MONTH-EQUIVALENTS OF S-S ANGLING.

Month	Monthly weights	Cumulative weights	Projected 1962 annual licenses with S-S cards	Month-equivalents for annual licenses with S-S cards
January	0.5	8.0	16,300	130,400
February	0.5	7.5	27,600	207,000
March	0.5	7.0	9,600	67,020
April	0.5	6.5	13,900	90,350
May	0.5	6.0	20,600	123,600
June	0.5	5.5	9,200	50,600
July	1.0	5.0	10,000	50,000
August	1.0	4.0	14,000	56,000
September	1.0	3.0	10,000	30,000
October	1.0	2.0	5,000	10,000
November	0.5	1.0	2,400	2,400
December	0.5	0.5	....	....
TOTALS	8.0	.....	138,600	817,370

Table 2. NUMBER OF NAMES DRAWN PER MONTH AND DISTRIBUTION OF MAIL SURVEY FOR THE TWELVE MONTHS OF 1962

Names drawn and month of mailing	Months												
	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
Total names drawn	587	1,280	686	912	1,565	594	478	783	734	313	52	....	7,984
Total names actually used for mailing in various months	492	1,067	560	741	780	396	330	540	480	313	52	....	5,751
January	42	....	....	....	....	....	....	....	....	....	....	....	42
February	30	73	....	....	....	....	....	....	....	....	....	....	103
March	30	71	40	....	....	....	....	....	....	....	....	....	141
April	30	71	40	57	....	....	....	....	....	....	....	....	198
May	30	71	40	57	65	....	....	....	....	....	....	....	263
June	30	71	40	57	65	36	....	....	....	....	....	....	299
July	60	142	80	114	130	72	34	....	....	....	....	....	632
August	60	142	80	114	130	72	74	360	....	....	....	....	1,032
September	60	142	80	114	130	72	74	60	360	....	....	....	1,092
October	60	142	80	114	130	72	74	60	60	257	....	....	1,049
November	30	71	40	57	65	36	37	30	30	28	33	....	457
December	30	71	40	57	65	36	37	30	30	28	19	....	443

licenses purchased in February with S-S tags would have a weight of 7.5; the March licenses a weight of 7.0, etc. This system of weights is referred to as the cumulative weights in Table 1. These cumulative weights times the number of annual licenses with S-S tags purchased in the corresponding months give the month-equivalents for annual licenses in Table 1.

The sum of the month-equivalents in Table 1 was 817,370 total month equivalents. These figures, plus estimated daily and vacation licenses, provided a rough guide as to the appropriate sampling rate for each month.

Distribution of mailings during the year

The mailing pattern corresponded approximately to the weighting system used in selecting names for each month's license purchasers. For example, in Table 2, of the 587 names drawn in January, 492 were mailed questionnaires during 1962. These questionnaires to January license buyers were sent out at the rate of about 30 per month, except for July, August, September, and October when the rate was doubled to 60. Similarly, the 1,067 February license buyers averaged about 71 questionnaires per month, except for July, August, September, and October.

In Table 2, of the 540 August names which were mailed questionnaires, there were 360 questionnaires which were mailed in August. This upsurge in numbers of questionnaires sent to August purchasers of licenses reflects the fact that 300 daily license holders who bought in August were sent questionnaires for August. Similarly, 300 daily license purchasers in September were mailed questionnaires for September. In October about 200 daily license holders were sent questionnaires. These special mailings to daily license holders were an attempt to get information from them which otherwise would have been unavailable.

Almost 80% of the questionnaires which were delivered were returned by respondents, as shown in Table 3. The post office returned 236 questionnaires unopened, as shown in the last column of Table 3. There probably were additional questionnaires which were delivered but not to the proper person because of discrepancies in names and addresses. Considering the problem of incorrect names and/or addresses, the return of 4,392 questionnaires as indicated in Table 3 shows remarkably good cooperation by angler-families with the survey.

In Table 3 the returned questionnaires are subdivided between "usable" and "unusable." It should be pointed out that the usable group consisted of questionnaires which were at least partially complete. Many of these questionnaires were complete enough to use for

Table 3. TOTAL QUESTIONNAIRES MAILED, RETURNED, AND NONRESPONSE DURING EACH MONTH OF 1962

Month	Total questionnaires mailed	Questionnaires returned			Nonresponse including post office nondelivery	Post office nondelivery returned
		Total	*Usable*[1]	*Unusable*[2]		
January	42	37	30	7	5	....
February	103	90	78	12	13	3
March	141	120	108	12	21	3
April	198	163	141	22	35	3
May	263	188	170	18	75	3
June	299	239	204	35	60	12
July	632	485	417	68	147	21
August	1,032	762	626	136	270	60
September	1,092	798	649	149	294	61
October	1,049	808	695	113	241	38
November	457	344	293	51	113	16
December	443	358	315	43	85	16
TOTAL	5,751	4,392	3,726	666	1,359	236
Percent of total questionnaires mailed:		76.37	64.79	11.58	23.63	
Adjusted[3] percent of total questionnaires mailed:		79.64	67.57	12.08	20.36	

[1] The number of questionnaires classified as usable varies with the purpose of the analysis and hence is not constant throughout the report.
[2] Unusable questionnaires either had discrepancies or were too incomplete to use and therefore had to be considered in the analysis as nonresponse.
[3] 236 post office nondelivery returns were deducted from both the total questionnaires mailed and the total nonresponse leaving the totals equal to 5,515 (5,751 minus 236) and 1,123 (1,359 minus 236), respectively.

one purpose but not for other purposes. Hence, the proportion of usable versus unusable questionnaires will vary in later tables, depending on how the questionnaires are being utilized.

As mentioned earlier, approximately two-thirds of the names drawn were names of anglers who had purchased a salmon-steelhead card along with their angling license. One-third of the names drawn were from people who did not buy the S-S card when they bought their angling license. Of course, some of this latter one-third group bought the S-S card later in the year when they decided to go salmon or steelhead fishing. Also, one member of a family might buy the S-S card, whereas another member or more of that family might not buy the S-S card.

The relative distribution of completed questionnaires between families with one or more S-S cards versus families with no S-S cards is shown in Table 4. The bulk of the questionnaires, an estimated 3,872, was distributed to angler-families with one or more S-S cards and one or more annual angling licenses. It can be seen from Table 4 that nonresponse was much higher from daily angler respondents, with an estimated nonresponse of 227 plus 212 equal to 439, or over one-half. Part of this nonresponse may have been because there was an inevitable delay of at least one or two months from the time these people fished before we could obtain their names and addresses and mail them a questionnaire. This timing problem was much less acute for the holders of annual licenses, since most of the questionnaires to annual license holders were sent to names which had been drawn in previous months and could, therefore, be sent out promptly in the latter part of the month for which expenditures were requested.

Table 4. Distribution of the Mail Sample Among Angler-Families With Salmon-Steelhead Licenses and Angler-Families Without Salmon-Steelhead Licenses

Description of the questionnaire	Angler-families with S-S licenses				Angler-families without S-S licenses				Total	
	With all daily angling licenses		With other than all daily angling licenses		With all daily angling licenses		With other than all daily angling licenses			
		%		%		%		%		%
Usable	155[1]	38	2,738	71	77[2]	25	756	81	3,726	68
Unusable	28	7	489	12	14	5	135	15	666	12
Nonresponse	227	55	645	17	212	70	39	4	1,123	20
TOTAL	410	100	3,872	100	303	100	930	100	5,515	100

[1] Out of 255 usable questionnaires from salmon-steelhead angler-families with daily angling licenses, 100 turned out to be families with one or more annual licenses so that these 100 families were classified as other than all daily license families, leaving only 155 salmon-steelhead families with all daily angling licenses.

[2] Out of 105 usable questionnaires from daily anglers without salmon-steelhead licenses, 28 happened to be from angler families where other family members held licenses other than all daily angling licenses, leaving only 77 families with all daily angling licenses.

Estimated Expenditures by Salmon-Steelhead Anglers in Oregon

As indicated earlier, in constructing the mail survey questionnaire (reproduced in the Appendix), a careful distinction was made between expenditures on fixed or "durable" equipment versus variable or "current" expenses. "Durable" expenditures were defined to include tackle, boating equipment, special clothing, and camping equipment. These expenditures were for the type of equipment that could be used for many camping trips, perhaps over a number of years. "Current" expenses, on the other hand, were defined to be only those costs associated with fishing trips made during a particular month. Such current expenses would include items such as transportation costs or mileage on the private car, lodging, charter boats and guide service, bait and lures, and rental of boats, motors, tackle, or gear. All of these current expenditures would be those associated with fishing trips taken in a given month. These items were listed on page 2 of the mail questionnaire, shown in the Appendix.

Estimation of either current or durable expenditures involves certain peculiar problems. Consequently, a separate discussion of each category will be made.

Estimation of durable expenses

Several ways of estimating durable expenditures could be employed. One way would be to ask each angler-family respondent to estimate the cost or value of all their durable equipment purchased over the years. One disadvantage of this method would be inaccuracies introduced because of faulty recall or memory bias. Another serious problem associated with this approach would be the necessity to determine the amount of depreciation involved in order to get the cost of the durable equipment on an annual basis. To get away from this last problem of depreciation, the respondents in this mail survey were asked to estimate expenditures made for durable equipment only during the preceding 12 months (item number 2, page 1 of questionnaire, Appendix). This procedure made it unnecessary to ask for total value or cost of equipment which would then have required another estimate of annual cost or depreciation.

One consequence of asking for durable equipment costs for the preceding 12 months only is that it does lead to a high variance of estimate, simply because people tend to be "uneven" in the way they purchase expensive durable items from year to year.[21] For example,

[21] Certain words used in this report (such as variance, confidence interval, and correlation coefficient) are statistical terms and have technical meanings. A reference is George W. Snedecor, *Statistical Methods* (Iowa State University Press, 5th ed., 1956).

one angler-family may list a durable expenditure running into hundreds or thousands of dollars for boating equipment, whereas another family may have just as much or more durable equipment but may have purchased none of this equipment during the preceding 12 months and would, therefore, enter zero as their durable expenditure. This feature simply results in more spread or dispersion in durable equipment expenditures than for "current" expenditures which were requested on page 2 of the questionnaire.

Another problem encountered was that of allocating the cost of durable items among the various uses of these items. The problem arises since durable items, such as boats, may be used for purposes other than salmon-steelhead angling. For example, boats are used to fish for other kinds of fish and even for nonangling purposes, such as water skiing. Our approach to this problem was, in effect, to ask the anglers to allocate costs between salmon-steelhead fishing, all fishing, and nonfishing purposes. (This approach can be seen in more detail on page 1 of the questionnaire, Appendix.)

Because of the complicated nature of cost allocation, many respondents failed to complete the cost allocation section, even though they filled in the rest of the questionnaire properly. The number of angler-families who completely allocated their costs of durable equipment was 1,079, or slightly less than half of the angler-families who actually spent money on durable equipment. These data are shown in Table 5. There were 1,114 angler-families who furnished incomplete allocations. An estimated 606 angler-families spent nothing in the preceding 12 months on durable equipment. Ninety-four angler respondents indicated the percent of durable equipment cost allocated to salmon-steelhead angling but then failed to indicate what percent of cost was allocated to all angling. That is, they completed the first and third columns but failed to fill in the second column of page 1 of the questionnaire.

Table 5. Classification of Usable Questionnaires From Salmon-Steelhead Angler-Families According to Their Allocation of Durable Equipment Expenditures

Description of the questionnaires	Number of salmon-steelhead angler-families
Complete allocation of durable angling expenses	1,079
Incomplete allocation of durable angling expenses	1,114
Nothing spent on durable angling equipment	606
Allocation of durable angling expenses to salmon-steelhead angling only	94
TOTAL	2,893

Despite the complicated nature of the cost allocation, enough respondents did make the allocation so as to provide a basis for estimating durable expenditures by all salmon-steelhead anglers. Although this projection can be criticized, it seemed to be the most plausible assumption to make regarding the division of durable equipment expenditures.

It should be mentioned that the average total expenditure for durable equipment items was almost the same for angler-families who allocated their costs as for angler-families who did not allocate their costs. In fact, anglers not allocating costs averaged $204.42 per family for all durable equipment, whereas those who did allocate costs averaged only $199.48 per family. Thus, it would seem that our procedure would not overestimate durable expenditures for salmon-steelhead angling, unless, of course, the angler-families who did not allocate were spending a significantly smaller proportion of their total durable expenditures for salmon and steelhead fishing.[22]

In order to estimate the total expenditure for durable equipment made by salmon-steelhead anglers, an assumption first had to be made about what the anglers who did not respond would have spent. Although there is no single completely satisfactory answer to this problem, some assumptions seem more reasonable than others. In classifying responding anglers according to how quickly they sent in their questionnaires, the following pattern was observed:

	Average expenditures for S-S durable equipment
Respondents answering 1st letter	$112.59
Respondents answering 1st reminder	68.31
Respondents answering 2nd reminder	67.64

From this pattern it would appear that average expenditure per angler-family might have continued to decline had further efforts been made to follow up on nonresponding angler-families. Therefore, to have taken the average of the above respondents could have biased upward the estimate for the total population of anglers.[23] Consequently, a simple least-squares regression was used to extrapolate a

[22] Additional detail with regard to sampling procedure and estimation of expenditures is given by Ajmer Singh, *An Economic Evaluation of the Salmon-Steelhead Sport Fishery in Oregon,* Ph.D. Thesis, August 1964, Oregon State University Library, 166 pp.

[23] A discussion of this problem is given by W. G. Cochran, *Sampling Techniques,* 2nd ed. (John Wiley & Sons, Inc., New York, 1963), pp. 355-393. Also, Alfred Politz and Willard Simmons, "An Attempt to get the 'Not at Homes' into the Sample Without Call Backs," *American Statistical Association Journal,* Vol. 44 (March 1949), pp. 9-31, and Vol. 45 (March 1950), (a note), pp. 136-137.

value of $56.74 as the projected average salmon-steelhead durable expenditure for nonrespondents. A similar method was followed for extrapolating an estimate of $5.50 as the projected amount that nonresponding daily angler-families might have spent.

Another problem involved in making a final estimate of durable equipment expenditures concerned the division of total salmon-steelhead cards between angling families with only daily licenses and families with other than daily angling licenses. Only incomplete information was available concerning which types of anglers held the salmon-steelhead cards. The best information available on this matter was from figures compiled under the direction of Dr. Lyle Calvin.[24] These figures pertained to 1961 but were projected to 1962. The main deficiency of these data arises because approximately 30% of the anglers buy their salmon-steelhead licenses sometime after they have purchased their general angling license, rather than at the same time. Nevertheless, using 70% of the anglers of 1961 as a base, an estimate of the distribution of the salmon-steelhead cards among daily and nondaily general angling licenses was made and is presented in Table 6.

The preceding average and projected amounts provided the basis for estimating the total durable expenditures made in Oregon which

Table 6. ESTIMATED DISTRIBUTION OF TOTAL 1962 OREGON SALMON-STEELHEAD ANGLING LICENSE SALES AMONG DAILY AND OTHER THAN DAILY ANGLING LICENSES[1]

	Salmon-steelhead angling licenses		
Allocated to:	With daily angling licenses[2]	With other than daily angling licenses[2]	Total
Usable	12,503	133,145	145,648
Unusable	2,259	23,779	26,038
Nonresponse	18,312	31,366	49,678
TOTAL	33,074	188,290	221,364

[1] All expenditures were on a per family basis and these families were divided into two groups: (1) Families with only daily angling licenses, and (2) families with other than daily angling licenses. Therefore, the total number of salmon-steelhead anglers in 1962 had to be converted into one or the other of these two types of families.

[2] The original estimate of 54,412 and 166,952 total 1962 daily and other than daily salmon-steelhead angling licenses sold respectively were adjusted for the shift made when daily angling license holders are found to be members of families with other than all daily angling licenses. Nearly 39 percent of the daily angling license holders with S-S cards are members of families who have angling licenses other than daily angling licenses. Therefore, the total daily salmon-steelhead angling licenses were reduced by 21,338 and this figure (21,338) was added to the other than daily salmon-steelhead angling license total.

[24] L. D. Calvin and R. H. Hicks, *An Evaluation of the Punch Card Method of Estimating Salmon-Steelhead Sport Catch,* Oregon Agricultural Experiment Station Technical Bulletin 81 (in process).

were allocated to salmon-steelhead angling. These estimated expenditures can be summarized as follows:

Total expenditures for durable equipment allocated to S-S angling:

Annual license family respondents	= (95,736)	(84.92)	=	$8,129,900
Annual license nonresponse	= (19,136)	(56.74)	=	1,085,800
Daily license family respondents	= (9,006)	(7.70)	=	69,300
Daily license nonresponse	= (11,172)	(5.50)	=	61,500
	TOTAL			$9,346,500

From these figures, it is estimated that over nine million dollars were spent in 1962 for durable items such as tackle, boating equipment, special clothing, and camping equipment because of the Oregon salmon-steelhead sport fishery. However, the limitations of the above estimate should be pointed out. One obvious limitation is involved in the way that nonresponse was handled. Probably a better procedure would have been to have followed up nonresponse by personal interviews to see if nonresponse differed significantly from responses by the anglers. However, higher costs would have been involved in obtaining these data.

Another factor that needs to be kept in mind is the high variance associated with durable item expenditures. Since large expenditures for items such as boats or campers are not made every year, a fairly high variance of estimate results. The estimate of variance from the responding angler-families was 99.20. Assuming that the variance of nonresponding families was also 99.20, the 95% confidence interval about the mean of durable expenditures allocated to S-S angling for all families was as follows:

Mean = $9,346,500 ÷ 135,050 = $69.21
Standard error = 9.96
95% confidence interval = $69.21 ± 19.52

Using the above confidence limits, the estimated total expenditures figure for durable equipment allocated to S-S angling in Oregon during 1962 was somewhere between 6.7 and 12 million dollars.

Amount spent for various durable items

The breakdown of total durable expenditures into various items is as follows:

Item	Total durable expenses allocated to S-S angling	Percent
Tackle and gear	$1,904,800	20.38
Boat equipment	5,493,900	58.78
Special clothing	362,600	3.88
Camp equipment	1,434,700	15.35
Other equipment	150,500	1.61
Total	$9,346,500	100.00

Expenditures for boat equipment associated with S-S angling accounted for over half the total durable expenditures allocated to S-S angling. The other equipment which composed only 1.61% of the total S-S durable expenses included items not enumerated in the questionnaire. These items included ropes, auto-pickups, life jackets, and so forth bought solely for angling and camping related to angling.

Estimation of current expenses

Although some of the same problems are involved in the estimation of current salmon-steelhead expenditures as for durable equipment, estimates of current expenditures merit considerably more confidence. For one thing, the allocation problem was less troublesome. If an angler-family fished only for salmon and/or steelhead on a given trip, current expenses of the trip would be recorded on page 2 of the questionnaire (Appendix), and all costs of that trip would be counted as having been spent on salmon and steelhead. On the other hand, if the angler-family fished for "other" fish (i.e., other than salmon or steelhead), then all current costs of the trip would be counted as spent for "other" fish. The only borderline cases were occasional trips where the anglers fished for both salmon-steelhead and "other" fish. In such cases, for lack of anything better, the cost was split evenly between salmon-steelhead fishing and "other" fishing. However, these borderline cases were relatively few, as can be seen from the right side of Table 7 where 215 angler-families are listed as having fished for both salmon-steelhead and "other" fish. Even here, most of these 215 families did not fish for both on the same fishing trip. Therefore, the problem of allocating current expenses between salmon-steelhead and "other" fish was not an important difficulty.

Probably the most troublesome problem related to current expenditures was that of projecting a figure for the nonresponding angler-families. There were minor problems in determining what constituted nonresponse. For example, in the left half of Table 7 there were 313 angler-families who returned questionnaires which were not complete on page 2. Some of these families failed to indicate whether they had fished or not. Since the information from these angler-families was not complete enough to use for estimating current expenses, these 313 questionnaires were finally classed as unusable. This left 3,413 total usable questionnaires, both with and without S-S angling licenses. Of these 3,413 angler-families, 2,650 (2,893 minus 243) had S-S angling licenses. The return response of these 2,650 S-S

Table 7. Number of Responding Angler-Families With Usable Questionnaires Who Fished for Salmon-Steelhead, "Other," or for Both Salmon-Steelhead and "Other" Fish During Each Month of 1962

	Total responding angler-families:			Total fishing angler-families:			
Month	Who fished	Who did not	Who did not complete page 2 of the mail questionnaire	Who fished for salmon-steelhead only	Who fished both for salmon-steelhead and "other" fish	Who fished for "other" fish only	Total
January	13	14	3	13	0	0	13
February	24	47	7	16	2	6	24
March	43	50	15	26	6	11	43
April	68	62	11	24	13	31	68
May	94	66	10	15	11	68	94
June	107	79	18	16	17	74	107
July	224	146	47	52	45	127	224
August	264	305	57	111	57	96	264
September	206	388	53	100	36	70	206
October	133	532	30	79	23	31	133
November	40	229	24	33	1	6	40
December	55	224	36	46	4	5	55
TOTAL	1,271	2,142	313	531	215	525	1,271

angler-families and the average S-S current expenditures for each return were as follows:

	Number of respondents	Average S-S current expenditures
1st return	1,031	$10.62
2nd return	1,155	7.50
3rd return	464	6.50
	2,650	

From the return averages, it appears that average S-S current expenditures, like durable expenditures per angler-family, might have continued to decline had further efforts been made to follow up on nonresponding angler-families in the sample. For reasons similar to those explained in the estimation of S-S durable expenditures, a simple least-squares regression equation was estimated for each month to extrapolate the monthly average S-S current expenditures for nonrespondents. These extrapolated averages appear in Table 8.

Another problem involved in the estimation of current expenditures concerned the conversion of total miles traveled for S-S fishing into dollars. In various studies automobile transportation costs have been based on a figure between 7 and 10 cents per mile.[25]

In this study, expenditures on automobile transportation were computed at 4.5 cents per mile. This figure was based on the cost per mile observed by the Oregon State Motor Pool. The Pool, for the biennial 1959-61, calculated $.04490 ($.02586 for operating plus $.02404 for overhead cost) as an average total cost per mile for all the vehicles in the Pool.[26]

Mileage cost was computed only when the respondent used his automobile to go fishing. In case the respondent was paid by the riders in his car, the amount was deducted from his transportation expenses so as to avoid any double counting. This was necessary because if any of the riders happened to be a respondent, then the amount he paid (for transportation) to the driver or owner of the automobile would be counted as his transportation expense.

From the figures in Table 7 and preceding tables, it can be seen that nonresponse was much higher for daily angler-families than for

[25] D. E. Pelgen, "Economic values of striped bass, salmon and steelhead sport fishing in California," *California Fish and Game*, Vol. 41, pp. 5-17, 1955.

W. W. Armstrong, *The economic value of hunting and fishing in Arizona*, (Phoenix, Arizona Department of Game and Fish, 1956), p. 7.

W. C. Davis, *Values of hunting and fishing in Arizona*, Bureau of Business and Public Research. Special Studies No. 21 (Tucson, University of Arizona, 1962).

[26] Oregon Dept. of Finance and Administration. *Fourth biennial report 1961-63, the state motor pool and state passenger transportation system and policies* (Salem, Oregon, 1963).

Table 8. ESTIMATED AVERAGE AND TOTAL CURRENT EXPENSES FOR SALMON AND STEELHEAD ANGLING IN OREGON DURING 1962

	Angler-families with other than all daily licenses			
	Average S-S current expenses		Total S-S current expenses	
Month	Per respondent family	Projected per nonresident family	For all respondent families	Projected for all nonrespondent families
January	$ 7.73	$ 5.52	$ 243,565	$ 34,765
Feb.	6.77	4.83	254,951	36,355
March	8.27	5.90	381,338	54,374
April	8.28	5.91	499,582	71,275
May	4.59	3.28	302,467	43,204
June	7.05	5.03	495,347	70,646
July	13.48	9.62	1,058,220	150,957
August	16.60	11.85	1,458,061	208,050
Sept.	9.66	6.89	893,676	127,410
Oct.	5.94	4.24	559,720	79,860
Nov.	3.46	2.47	327,956	46,797
Dec.	5.67	4.03	542,823	77,501
Total for families with other than all daily licenses	....	....	7,017,706	1,001,194
	Angler-families with only daily licenses			
	Average S-S current expenses		Total S-S current expenses	
	Per respondent family	Projected per nonrespondent family	For all respondent families	Projected for all nonrespondent families
Average of Jan. to Dec.	$ 7.81	$ 5.84	$ 70,337	$ 65,244

the other angler-families. Nonresponse from angler-families with one or more annual licenses amounted to only about one-sixth, whereas nonresponse from daily angler-family respondents was over half (approximately 55%). Fortunately, angler-families with all daily licenses accounted for only a small proportion of the total days of salmon-steelhead fishing. Similarly, they accounted for less than 2% of the estimated total current expenses. Therefore, projected current expenses for all nonresponse (both daily and annual license holders) came to only approximately 13% of total current expenses.

These current expenses are shown in Table 8 by month for angler-families with one or more annual licenses. Estimated current expenses from Table 8 total around $8,150,000.

Compared with durable equipment expenditures, the variance of average monthly current expenditures was lower, being slightly less than \$0.30. Consequently, 95% confidence limits, about the average monthly current expenditures from all angler-families, would be approximately \$7.80 ± 1.07. This confidence interval is relatively narrower than for durable expenditures. Using the above confidence interval, 1962 S-S current expenditures in Oregon ranged between 7.0 and 9.3 million dollars.

Amount spent for various current items

The breakdown of the total S-S current expenditures amount into various current expenditure items is given as follows:

Item	Total current expense allocated to S-S angling	Percent
Transportation	\$2,391,000	29.32
Lodging	511,300	6.27
Food and beverages, including liquor	2,847,700	34.92
Charter boats and guide service	912,600	11.19
Bait, lures and other tackle	796,700	9.77
Boat and motor rental	260,200	3.19
Tackle and gear rental	105,200	1.29
Other	330,300	4.05
Total	\$8,155,000	100.00

It is seen from the above figures that expenditures for food and beverages including liquor on fishing trips account for over one-third of the total S-S current expenditures. The inclusion of food expenditures may be criticized, since one may argue that money spent for food on fishing trips would be spent regardless of whether one goes fishing or not. However, a sample of the questionnaires indicated that most of the food expense listed was for restaurant meals. Therefore, money spent for food and beverages represents, for the most part, expenditures that would not have been made had the angler stayed at home.[27]

Estimation of durable plus current expenses

The estimate of total expenditures related to Oregon S-S sport fishery was obtained simply by adding the S-S durable and current expenditures as shown below:

Total S-S durable expenditures =	\$ 9,346,500
Total S-S current expenditures =	8,155,000
Total	\$17,501,500

Of course, the same limitations that applied to the durable and current expenditure estimates would also apply to the above total expenditure estimate. The most important of these limitations are again

[27] Ajmer Singh, *op. cit.*, pp. 79-80.

the extrapolations required to estimate the durable portion of total angler-expenditures.

Disregarding the complication of nonresponse, an approximation of the variance of total expenditures was calculated.[28] Using these estimates, the 95% confidence intervals per family were as follows:

Mean = \$17,501,500 ÷ 135,050 = \$129.59
Standard error = 11.63
Confidence interval = \$129.59 ± 22.80.

Using the above confidence limits, it is estimated that total expenditures by S-S anglers in Oregon in 1962 were between \$14.4 and \$20.6 million. These figures do not include angling license fees which would add approximately \$500,000 to the above figures.

Estimation of Net Economic Value of the Oregon Salmon-Steelhead Sport Fishery

In the preceding section, estimated total expenditures by salmon-steelhead anglers provide an estimate of the gross economic value of the Oregon salmon-steelhead sport fishery. Including expenditures allocated to licenses, total expenditures by salmon-steelhead sport anglers in 1962 were probably between \$15 and \$21 million. Therefore, the 1962 gross economic value of the Oregon salmon-steelhead sport fishery is estimated to be within the range of \$15 to \$21 million.

Estimating the net economic value of the Oregon salmon-steelhead sport fishery is more complicated and difficult. "Net economic value" will be our best estimate of the monetary value of the sport fishery resource which might exist if the resource were owned by a single individual, and a market existed for the opportunity to fish for salmon and steelhead. This net economic value would approximate the value of the resource to a single owner who could charge sport anglers for his permission to fish for salmon and steelhead.

The advantage of the above definition of net economic value is that it comes closest to imputing a value to the fishery resource comparable to what its value might be if it were privately owned.[29] The concept is not without its limitations, however. To bring some of these limitations into the open, it is necessary to state the reasoning underlying the empirical measurement. The measurement procedure involves estimating a demand function for salmon-steelhead sport fishing. This function is a schedule of the amount of fishing (measured in

[28] Details of the computations and assumptions required are given by Ajmer Singh, *op. cit.*, esp. pp. 80-84.

[29] Important factors involved in an economic evaluation of fishery resources have been discussed by James A. Crutchfield, "Valuation of a Fishery Resource," *Land Economics*, Vol. XXXVIII (No. 2), May 1962.

days of fishing) that would be done at all possible prices for fishing. Different estimates of such a function are presented and described subsequently. Even if such a function were known with certainty, however, problems of interpretation would still remain. What point on the demand curve should be selected as a measurement of "net economic value?" Crutchfield[30] has suggested that a point should be selected which would "maximize net yield from leasing or selling rights to fish." This would be the price which a monopolist would charge and is the concept used in this study.

Care should be exercised, however, when this net economic value is compared with the net economic value from an alternative use of the resource. The assumption is usually made in benefit-cost analysis that competition rather than monopoly prevails. Recognition exists, however, that competition may not always prevail and that adjustment may have to be made for the lack of competition.[31] It seems important that the same kind of qualification should apply to outdoor recreation. In general, only two procedures for adjustment appear possible. One would be to use a similar technique and estimate monopoly returns for all of the alternative uses of the resources. This is obviously impractical for many uses. The other possibility is to interpret the demand curve differently than is done herein. An appropriate alternative has not yet been identified; however, efforts should continue to uncover more appropriate interpretations if demand functions estimates such as those reported here and in similar studies are to be of the most value.[32]

---

[30] *Ibid.*, p. 146.

[31] Otto Eckstein, *Water Resource Development* (Harvard University Press, Cambridge, Massachusetts, 1958). *Policies, Standards and Procedures in the Formulation, Evaluation and Review of Plans for Use and Development of Water and Related Land Resources,* Senate Document 97, 87th Congress, 2nd Session. E. N. Castle, Maurice Kelso, and Delworth Gardner, "A Review of the New Federal Evaluation Procedures." *Journal of Farm Economics,* Vol. XLV (No. 4), November 1963.

[32] The problem of interpretation of demand schedules has always been of interest in economics. Alfred Marshall (*Principles of Economics,* 8th ed., Macmillan, Chapter VI, p. 124), has said "The excess of the price which he would be willing to pay rather than go without the thing, over that which he actually does pay, is the economic measure of this surplus satisfaction. It is called consumer's surplus." Knetsch (*op. cit.,* p. 397) argues that the total area under the demand curve should be used as a measure of the economic value of the resource. The difficulty associated with such a procedure is to obtain comparable values for other uses. The approach adopted here, as mentioned above, is to use a monopoly return. Knetsch would use the return to a perfectly discriminating monopolist. It is possible to estimate the total consumer's surplus or what a perfectly discriminating monopolist would obtain from the demand curves presented herein. This involves summing the values under the demand curve or integrating the demand function. This is done later in this bulletin for one of the estimated demand functions.

Estimation of net economic value by the Clawson method

Clawson's method of estimating the value or benefit of a recreational area was discussed earlier in this report.[33] Clawson's method can be adapted to the expenditure data of this study. There is a complication, however, resulting from the fact that salmon-steelhead fishing is not confined to any one location in Oregon. All reported applications of Clawson's method have been concerned with estimation of outdoor recreational demand for a particular site or area. Then, distance zones were established with respect to the recreational area of interest.

Despite the fact that salmon and steelhead angling is not confined to any one area of the state, it is still possible to establish distance zones based upon the average distance that most anglers of an area drive when they go salmon-steelhead fishing. In Figure 1, Oregon is divided into five main zones, based primarily on average distance traveled for S-S (salmon-steelhead) angling. The zone closest to S-S fishing is the coastal zone. Families in this zone averaged only 37 miles per S-S fishing trip since these families lived close to the ocean and coastal rivers where most of the S-S fishing was done.

Families in zone 2 of Figure 1 averaged about 105 miles per S-S fishing trip. Families of zone 3 averaged 140 miles, while families in the Portland zone were intermediate between zones 2 and 3 with 120 miles per S-S fishing trip. As might be expected, families of zone 4 in eastern Oregon traveled farthest, 220 miles per S-S fishing trip. These statistics are summarized in Table 9.

Table 9. Average Miles Per S-S Fishing Trip, Variable Cost Per S-S Fishing Day, Population, Total S-S Fishing Days in Survey Sample, and S-S Days • 10^4 ÷ Population for Each Distance Zone

Distance zone	Average miles per S-S fishing trip	Average variable cost per S-S fishing day	Zone population	Sample S-S fishing days	S-S days • 10^4 / Population
		Dollars			
1	37	4.02	184,147	455	24.71
2	105	6.14	455,923	721	15.81
3	140	6.00	473,861	704	14.86
4	220	12.00	229,786	144	6.27
5	120	6.71	481,421	808	16.78

[33] Marion Clawson, *Methods of Measuring the Demand for and Value of Outdoor Recreation,* Reprint No. 10, (Resources for the Future, Inc., Washington, D. C.), February 1959.

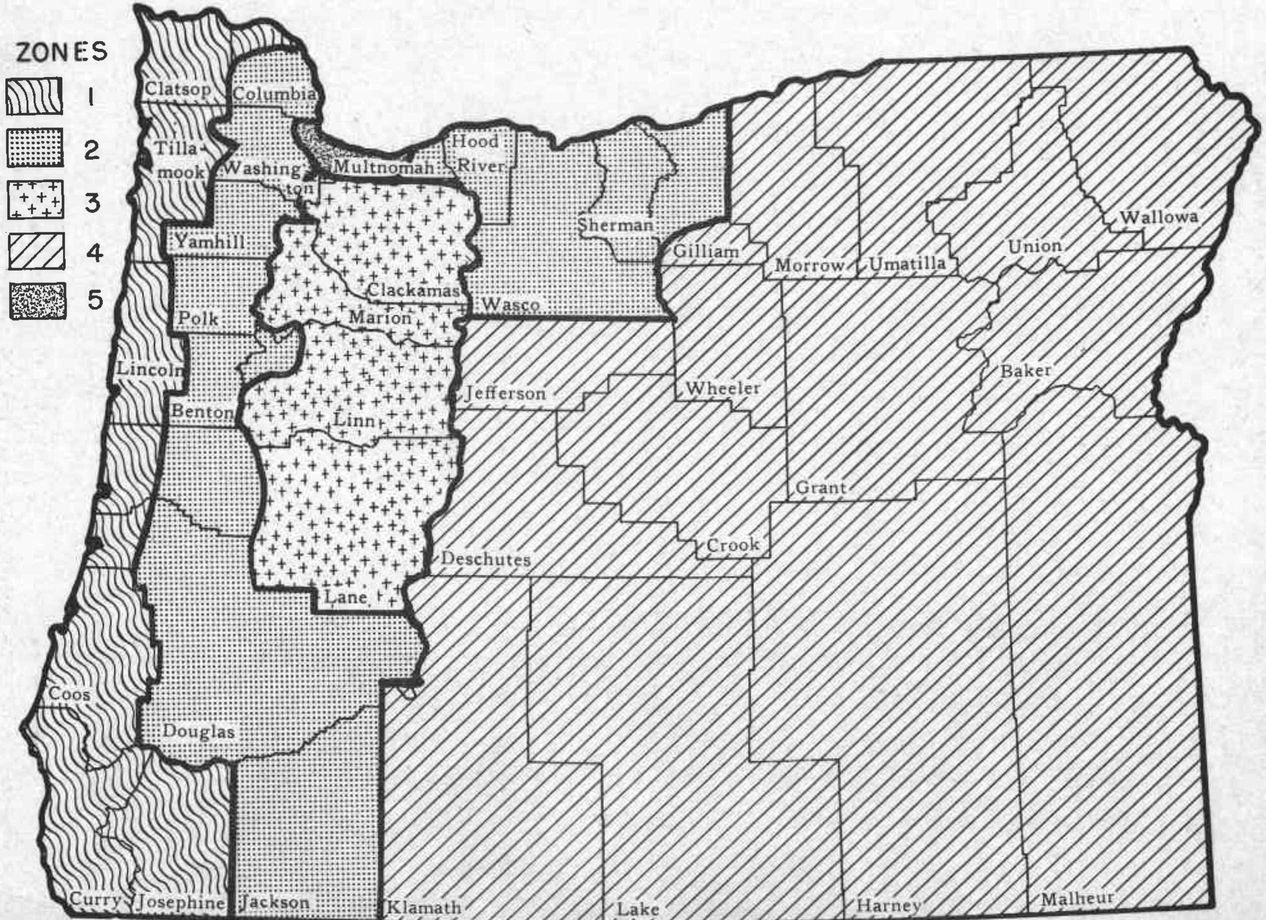

Figure 1. Geographic location of the five distance zones in Oregon.

A strong relationship exists between average miles per S-S trip and average S-S variable cost, as shown by the figures in Table 9. Some correlation would be expected since slightly over one-fourth of S-S variable cost resulted from miles driven on S-S fishing trips. However, nontravel costs per S-S day of fishing were also correlated with number of miles driven per S-S day.

Variable costs per S-S day have been plotted against S-S days taken per unit of population in Figure 2. The function graphed in Figure 2 corresponds to what Clawson calls the demand curve for the

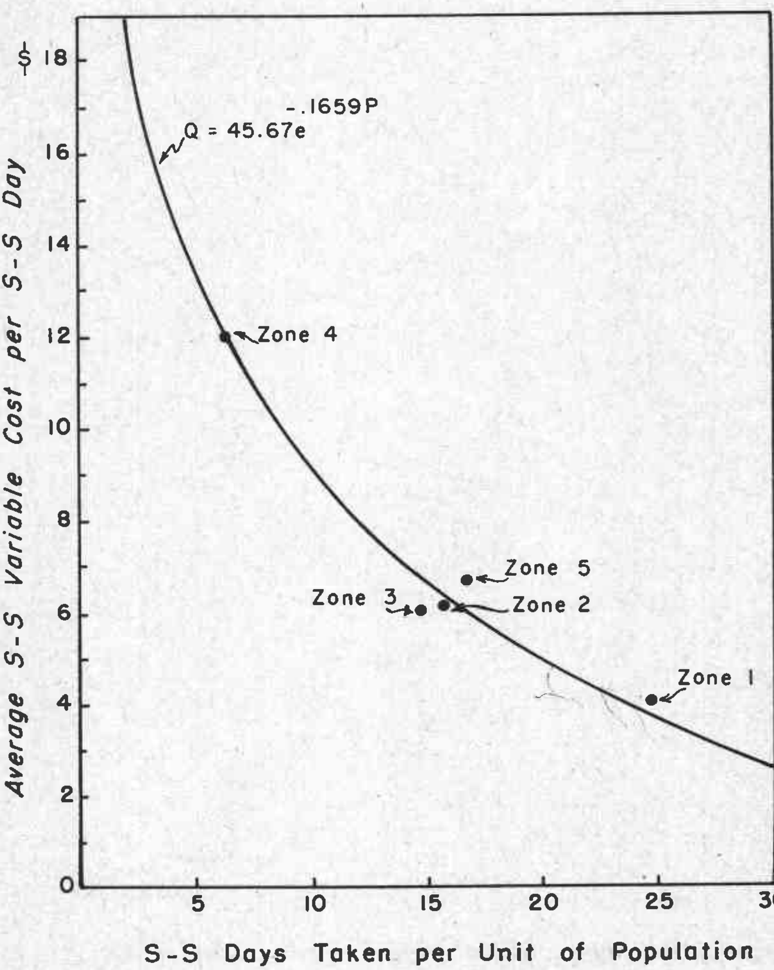

Figure 2. Relationship between average cost per fishing day and the number of S-S days taken per unit of population by the five main distance zones in Oregon.

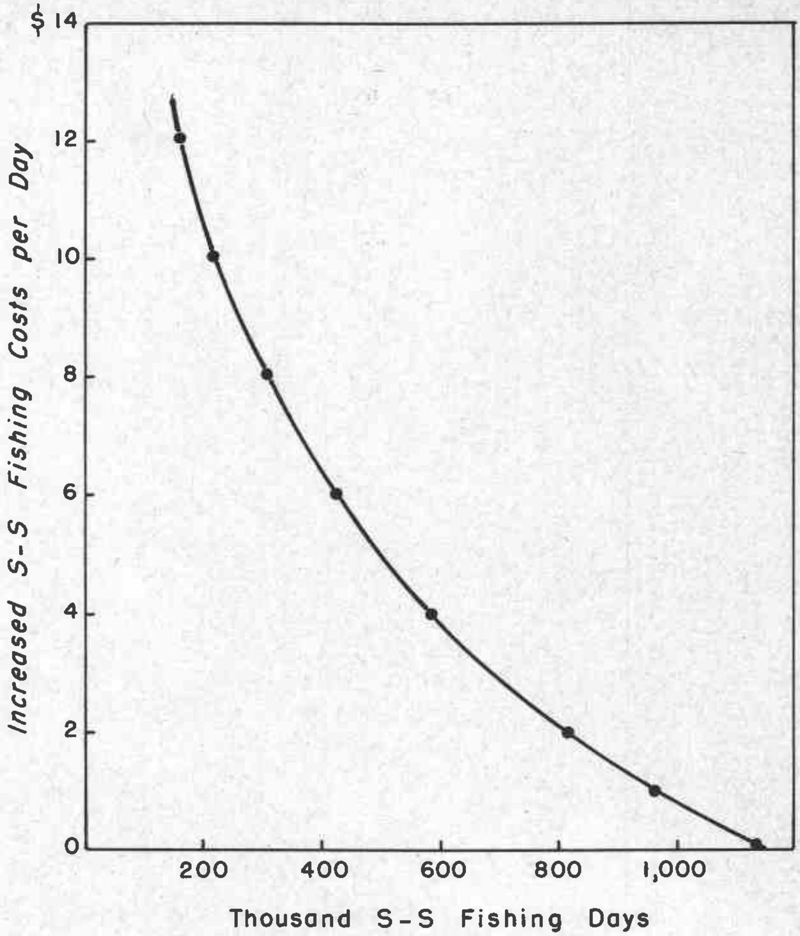

Figure 3. Projected effect of increased cost per S-S day on number of S-S fishing days taken by anglers (projection by Clawson model).

recreation experience as a whole. As mentioned earlier, the approximated demand relationship between cost of S-S fishing per day and number of S-S days taken per unit of population is an oversimplification. There may be many factors operating other than cost to reduce the number of per capita S-S days in the more distant zones as compared to the closer zones. Nevertheless, Clawson's procedure can be used to predict estimated number of S-S fishing days taken per zone as S-S variable costs per day are increased for each zone.

Table 10. Predicted Number of S-S Days Taken by the Five Distance Zones With Assumed Increases in S-S Fishing Costs Per Day

Distance zone	Assumed Increases in Daily S-S Fishing Costs					
	0[1]	1	2	4	6	8
	S-S days	*S-S days*	*S-S days*	*S-S days*	*S-S days*	*S-S days*
1	171,429	144,800	122,900	88,500	63,400	45,500
2	298,587	253,500	213,600	153,700	110,400	79,100
3	317,617	269,100	227,700	163,500	117,400	84,300
4	56,921	48,200	40,900	29,200	21,100	15,100
5	286,839	242,800	206,500	147,800	105,900	76,100
Total for state[2]	1,131,392	958,300	811,500	582,800	418,200	300,000

[1] Estimated days taken in 1962 are in this first column.
[2] Sums may not check exactly because of rounding.

Projected numbers of S-S days taken at several assumed increased levels of daily costs are shown in Table 10. Figures in the bottom row of Table 10 indicate the projected total of S-S fishing days for the state of Oregon, using Clawson's method of analysis. These total S-S days of fishing for various assumed increases in price are graphed in Figure 3. The curve in Figure 3 corresponds to Clawson's derived demand for visits at national parks at various assumed fee structures.[34] Estimates from the curve in Figure 3 assume that the main reason for the difference in the number of S-S fishing days taken by near distance zones as compared to far, is the extra money cost involved in traveling from the far distance zones. Ignoring this complication for the moment, the revenue which could supposedly be obtained by charging for the S-S fishery resource would be as follows:

Daily charge per angler per day	Predicted S-S days taken	Predicted possible annual revenue
$1	958,300	$ 958,300
$2	811,500	$1,623,000
$4	582,800	$2,331,200
$5	493,500	$2,467,500
$6	418,200	$2,509,200
$7	354,100	$2,478,700
$8	300,000	$2,400,000

According to the preceding predictions, a maximum net economic value of about $2.5 million per year could be obtained from the salmon-steelhead fishery resource by charging anglers around $6 for

[34] Cf. Marion Clawson, *Methods of Measuring the Demand for and Value of Outdoor Recreation,* Reprint No. 10, (Resources for the Future, Inc., Washington, D. C.), February 1959.

each day of S-S fishing. Of course, the assumption is that anglers would react to such a daily charge the same way they react to their other variable fishing costs, such as traveling expenses, purchase of bait or lures, charter boats, and so forth, as listed on page 2 of the questionnaire in the Appendix. It should be noted that the estimate of net economic value of $2.5 million per year is conservative as compared to estimates based on total consumer's surplus since no price discrimination is permitted in the above computation.

The above analysis leaves the following question unanswered: What are the underlying structural relationships involved in the demand for S-S fishing? That is, what are the individual equations which define the process by which variables such as number of S-S fishing days, S-S fishing cost per day, and salmon-steelhead caught are generated? An exploration of this question is presented below.

Further classification of the data

To examine more closely the effects of other variables, such as family income, on the S-S fishing days per capita of the various distance zones, a further stratification of the data was needed. The numbers of S-S angling families who returned sufficiently completed questionnaires are shown in Table 11. These 2,281 families in the five main distance zones were further subdivided into income level groups within the distance zones. To illustrate the procedure: in zone 1, the 70 families in the lowest income subgroup were chosen mainly from families indicating an income under $3,000. (The seven possible income groups are shown at the bottom of the first page of the questionnaire in the Appendix.) However, because there were only 55 families in this lowest income group in zone 1, another 15 families

Table 11. Division of Five Main Distance Zones into Subzones Based on Family Income Levels

Distance zone	Number of completed questionnaires per zone	Number of income subzones	Number of families per subzones[1]
1	349	5	69.8
2	629	10	62.9
3	582	9	64.7
4	196	3	65.3
5	525	8	65.6
Total	2,281	35	....

[1] An integer number of families was grouped within each subzone. For example, in zone 1 there were four subzones with 70 families and one subzone with 69.

Table 12. Correlation Between Variables From Thirty-Five Subzones

			Variables[1]				
X_{1j}	X_{2j}	X_{3k}	X_{4j}	Y_{1j}	Y_{2j}	Y_{3j}	
1.0	.47544	–.08717	.14375	.73385	.32196	.02869	X_{1j}
	1.0	.07422	.28222	.39074	.49330	.17967	X_{2j}
		1.0	.79836	–.47989	.62656	–.54557	X_{3k}
			1.0	–.40582	.87286	–.66454	X_{4j}
				1.0	–.15314	.65239	Y_{1j}
					1.0	–.50251	Y_{2j}
						1.0	Y_{3j}

[1] Variables were defined as the following:

X_{1j} = sum of S-S caught in j^{th} subzone divided by S-S fishing days of j^{th} subzone.

X_{2j} = average family income of j^{th} subzone.

X_{3k} = average miles per S-S fishing trip of the k^{th} main distance zone.

X_{4j} = sum of S-S miles in j^{th} subzone divided by the sum of the S-S fishing days of that subzone.

Y_{1j} = sum of S-S caught in j^{th} subzone divided by the estimated population for that subzone (each subzone was allocated equal portions of the main distance zone's population).

Y_{2j} = sum of variable cost of the j^{th} subzone divided by the sum of S-S fishing days for that subzone.

Y_{3j} = sum of S-S fishing days for the j^{th} subzone divided by the estimated population for that subzone.

needed to be selected from the next lowest income group, \$3,000 to \$5,000.[35]

Following the subdivision of responding families into 35 subzones based upon both distance and income, a more thorough analysis was possible. Some idea of the relationship between different variables can be obtained from an inspection of the correlation coefficients listed in Table 12. Income X_2 in Table 12, is highly correlated with variable cost per S-S fishing day (Y_2 in Table 12). Later, it was found that income also exerted a significant influence on per capita catch of salmon and steelhead, Y_1, and on per capita S-S fishing days taken (Y_3). However, inspection of the correlation coefficients in Table 12 does not by itself indicate which variables would be most useful for prediction purposes. For example, X_1, average S-S caught per fishing day in the j^{th} subzone is highly correlated with Y_1, the S-S caught per capita in the j^{th} subzone. However, this relationship is of a spurious nature since both variables have the same numerator.

The 35 observations for the basic variables for each subzone are listed in Appendix Table 1.

[35] To select 15 families from the next lowest income group, \$3,000 to \$5,000, all families in the \$3,000 to \$5,000 group were stratified between families that had fished and families that had not fished (the month that they received the questionnaire). Then, the same proportion who had fished were selected for the 15 as for the entire \$3,000 to \$5,000 income group. This procedure reduced unnecessary variation.

Estimation of net economic value with simultaneous equations

With the division of the five main distance zones into 35 subzones and the computation of variables such as those listed in Table 11, a more thorough analysis is possible. It was originally anticipated that an interdependent system of structural equations might best describe how variables such as per capita S-S days and S-S variable costs per day are generated. Such an hypothesized relation was as follows:

$$(1)\quad Y_{1j} = \beta_{10} + \beta_{13} Y_{3j} + \gamma_{11} X_{1j} + \gamma_{12} X_{2j} + u_{1j}$$
$$(2)\quad Y_{2j} = \beta_{20} + \beta_{23} Y_{3j} + \gamma_{22} X_{2j} + \gamma_{24} X_{4j} + u_{2j}$$
$$(3)\quad Y_{3j} = \beta_{30} + \beta_{31} Y_{1j} + \beta_{32} Y_{2j} + \gamma_{32} X_{2j} + \gamma_{33} X_{3k} + u_{3j}$$

where Y_{1j} is S-S caught per unit of population of subzone j;
Y_{2j} is average S-S variable cost per day of subzone j;
Y_{3j} is S-S days taken per unit of population of subzone j;
X_{1j} would be some index of fishing success, say the expected quantity of S-S caught per hour of angling effort;
X_{2j} is average family income;
X_{3k} is average miles per S-S trip for the main distance zone in which the j^{th} subzone falls;
X_{4j} is average miles per S-S day for the j^{th} subzone.[36]

A satisfactory measure of S-S fishing success was not directly available from the mail questionnaire data. The variable X_1 as defined in Table 14 could not be used without introducing a spurious correlation with Y_1 which would, in turn, distort the relationship of Y_1 to the other variables.

Estimation of the structural parameters of equations (1), (2), and (3) by two-stage least squares[37] failed to reveal anything approaching a significant effect by Y_{3j} in equation (2). Further reflection on this problem raised the question as to whether S-S variable cost per S-S fishing day should be affected by the quantity of S-S days taken, as would be true for an ordinary market. For most commodities, the producers and consumers of the commodity are different groups of people for the most part, and price and quantity produced tend to be interdependent. In the case of the outdoor recreationist (in our case the S-S angler), his "price" or variable cost per unit taken is already to a great extent predetermined by his income and distance from the recreational site. If this viewpoint is correct, variable Y_{2j} can be considered as exogenous or as a linear combination of other exogenous variables.

[36] A more detailed definition of these same variables is given in Table 12 except for X_{1j} which is not the same.

[37] J. Johnston, *Econometric Methods* (McGraw-Hill Book Company, Inc., New York, N. Y.), pp. 231-272.

Assuming that Y_{2j}, variable cost per S-S day, is a function only of S-S miles per S-S day of fishing and income, two structural equations were hypothesized:

(3) $Y_{1j} = \beta_{10} + \beta_{13} Y_{3j} + \gamma_{11} X_{2j} + \gamma_{12} X_{3k} \qquad + u_{1j}$

(4) $Y_{3j} = \beta_{20} + \beta_{23} Y_{1j} + \qquad \gamma_{23} Y'_{2j} + u_{2j}$

The symbols are the same as previously except that Y'_2 is from the ordinary least squares equation

(5) $Y'_2 = 0.51351 + 0.01917 X_2 + 0.09070 X_4$ [38]

$R^2 = 0.828$ (.00545) (.00869)

fitted from the 35 subzone observations.

First stage least squares estimates of Y_1 and Y_3 were

(6) $\hat{Y}_1 = 0.84983 + 0.00717 X_2 - 0.00215 X_3 - 0.07438 Y'_2$

$R^2 = 0.458$ (.00210) (.00227) (.04650)

and (7) $\hat{Y}_3 = 2.40586 + 0.01408 X_2 + 0.00233 X_3 - 0.30543 Y'_2$

$R^2 = 0.594$ (.00317) (.00343) (.07020)

Structural equations from the second stage were

(8) $\hat{Y}_1 = 0.26389 = 0.00374 X_2 - 0.00272 X_3 + 0.24354 \hat{Y}_3$

$R^2 = 0.458$ (.00162) (.00199) (.15225)

(9) $\hat{\bar{Y}}_3 = 1.40732 + 1.45823 \hat{Y}_1 - 0.09866 Y'_2$

$R^2 = 0.559$ (.32366) (.03771)

Although the exact sampling distribution of the structural estimates is not known, an approximate test of significance can be made on the basis of their sample standard deviations.[39] In equation (8) the t ratio for income, X_2, is 2.31. For average distance per trip, X_3, the t ratio is —1.37, and 1.60 for $\hat{Y}_3$. Although the last two are below statiscal significance at the 0.05 level, the variables are retained because of their logical importance in the structural system.

It should be noted that the formulation of the system of structural equations in (3), (4), and (8), (9) is different from equations (1), (2), and (3) in that variable X_{3k} is placed in the first equation. Logically, X_{3k} should be in the second structural equation, (9), above. However, when placed in this equation, X_{3k} takes the wrong sign, although not statistically significant. This results from the high intercorrelation between Y_{2j} and X_{3k}. This problem of high correlation between Y_{2j} and X_{3k} likely could be reduced by more careful measurement of distance traveled and cost of travel by the anglers. Perhaps actual travel time should have been requested, as well as cost and distance.

---

[38] Standard errors of regression coefficients are in parentheses below the respective coefficients.

[39] R. L. Basmann, "The Computation of Generalized Classical Estimates of Coefficients in a Structural Equation," *Econometrics*, Vol. 27 (No. 1), January 1959, pp. 72-81.

Disregarding these complications, net economic value can again be computed for various hypothesized increases in daily S-S fishing costs. The procedure is the same in principle as for the Clawson model, although there are more computations involved.[40] A maximum net economic value of around $2.8 million was predicted at an assumed increase in cost of $5 per day.

Estimation of net economic values with single equation models

Although a system of structural equations has certain logical advantages when estimating relationships between interdependent variables, such as S-S days taken and S-S caught, results from a simultaneous-equation model are not always to be preferred, especially where the data are limited. It may be that S-S cost per day is not interdependent with S-S days taken per subzone. If so, it is possible to regress S-S days per subzone against S-S cost per day and certain other variables such as distance and income. The following function was obtained

$$(10)\quad \hat{Y}_{3j} = 2.4730 + 0.00993\,X_{2j} - 0.00320\,X_{3k} - 0.17456\,Y_{2j}$$
$$R^2 = 0.512 \qquad (.003004) \qquad (.002995) \qquad (.05380)$$

where Y_{2j} is average S-S variable cost per day of subzone j;
Y_{3j} is S-S days taken per unit of population of subzone j;
X_{2j} is average family income;
X_{3k} is average miles per S-S trip for the main distance zone in which the j^{th} subzone falls.

Numbers in parentheses below the regression coefficients are the standard errors for the regression coefficients. It can be seen that all coefficients have the logically expected sign. Also, all coefficients are very highly significant except for distance, X_{3k}. Average distance per main distance zone is not more significant statistically because of the difficulty of separating out the effect of the money cost of distance and the time "cost." (If this problem had been anticipated before designing the questionnaire, this difficulty could have been greatly reduced.) Nevertheless, the distance variable needs to be retained, even though highly correlated with S-S cost per day.

Equation (10) can be used like the Clawson model to estimate the net economic value of the Oregon S-S sport fishery. Conceptually, all that is involved is to take the average value by subzones of the two independent variables, distance and income, and to substitute the values into equation (10). Then, one has 35 equations, one for each of the 35 subzones, in terms of the remaining two variables, S-S days taken and S-S variable cost per day. The only difference between,

[40] Cf. Ajmer Singh, *An Economic Evaluation of the Salmon-Steelhead Sport Fishery in Oregon*, Ph.D. thesis, August 1964, Oregon State University Library, pp. 101-112.

Table 13. PREDICTED NUMBER OF S-S DAYS TAKEN WITH ASSUMED INCREASES IN S-S FISHING COSTS PER DAY (SINGLE EQUATION MODEL)

Assumed increases in S-S fishing costs per day	Predicted S-S days to be taken	Predicted net economic value
$0	1,128,500	$ 0
1	1,008,300	1,008,300
2	891,700	1,783,400
3	775,100	2,325,300
4	658,500	2,634,000
5	541,900	2,709,500
6	428,400	2,570,400
7	327,300	2,291,100
8	238,500	1,908,000

say, the equations for subzone 1 and subzone 2 will be that relatively less fishing is predicted in subzone 1 at each dollar increase in S-S cost per day since subzone 1 has a lower income average (Appendix Table 1). In other words, when the subzone values X_{2j} and X_{3k} are substituted into equation (10), equation (10) reduces to a linear Clawson model.

Making these substitutions and calculations, the predicted net economic values are presented in Table 13 and again follow the same general pattern exhibited by the Clawson model.

A maximum net economic value of slightly over $2.7 million is predicted at an increased cost of $5 per S-S fishing day. The result in Table 13 is somewhat similar to the result from Clawson's model, except that predicted net economic value from the Clawson model peaked at around $6 additional S-S variable cost per day. Actually, however, the comparison between the Clawson model and equation (10) is not completely valid because equation (10) is a linear function, whereas the Clawson model was exponential, that is, of the form

(11) $Y_3 = b_0 e^{b_1 Y_2}$

where $b_1 = -0.1659$

To make a fairer comparison of the simple Clawson model to a regression including income and distance as variable, the regression should be of the same algebraic form

(12) $\hat{Y}_{3j} = b_0 e^{b_1 X_{2j} + b_2 X_{3k} + b_3 Y_{2j}}$

Fitting this function to the data from the 35 subzones gave the following result:

(13) $\ln Y_{3j} = 0.95061 + 0.00727\, X_{2j} - 0.00201\, X_{3k} - 0.12769\, Y_{2j}$

$R^2 = \quad 0.653 \quad (.00159) \quad (.00159) \quad (.0286)$

Variables in the above equation are the same as those included in equation (10). It should be noted that the R^2 of 0.653 in equation (13) is in terms of the logarithms. In terms of ordinary real numbers, computed by summing the squares of actual minus predicted values, the R^2 term drops to 0.547. However, this R^2 is still greater than for the linear model, equation (10).

Predictions from equation (13) are presented in Table 14. A net economic value of approximately $3.1 million per year is inferred for an assumed increase in fishing costs of about $8 per day. The net economic value estimates in Table 14 from equation (13) seem more valid than the estimates from the simple Clawson model or the estimates from the multiple linear regression, equation (10). The linear regression, equation (10), underestimates the number of S-S days to be taken at higher S-S fishing costs.

Equation (13) can also be used to project S-S fishing days and net economic value of the Oregon S-S sport fishery for 1972. If income and population trends in Oregon from 1963 to 1972 are similar to the trends from 1953 to 1962 from census figures, income can be expected to increase by 49% and population by 13%. Increasing the income figures in each subzone by 49% and then multiplying the predicted S-S fishing days by 1.13 allows a projection for 1972 to be made from equation (13). These projected 1972 figures are also shown in Table 14. Maximum net economic value is again predicted to occur at an increased cost per day of $8. On the average, net economic value of the Oregon S-S sport fishery is predicted to increase approximately 50% or to nearly $4.7 million per year by 1972.

Table 14. PREDICTED NUMBER OF S-S DAYS TAKEN AT VARIOUS ASSUMED INCREASES IN FISHING COSTS PER DAY (USING MULTIPLE VARIABLE EXPONENTIAL FUNCTION)

Assumed increases in S-S fishing costs per day	1962 predictions		1972 predictions	
	S-S days to be taken	Net economic value	S-S days to be taken	Net economic value
$ 0	1,084,000	$	1,624,300	$ 0
1	954,000	954,000	1,429,600	1,430,000
2	839,700	1,679,000	1,258,200	2,516,000
3	739,000	2,217,000	1,107,400	3,322,000
4	650,400	2,602,000	974,600	3,898,000
5	572,500	2,862,000	857,800	4,289,000
6	503,800	3,023,000	753,500	4,521,000
7	443,400	3,104,000	664,500	4,652,000
8	390,300	3,122,000	584,800	4,678,000
10	302,300	3,023,000	453,000	4,530,000

As mentioned earlier, the method used in this study for computing net economic value yields a monetary value for the sport fishery resource which supposedly could be obtained by charging for salmon-steelhead fishing. This procedure yields a lower estimate of economic benefit as compared to an estimate based upon capturing total consumer's surplus. Using this concept in conjunction with equation (10), an economic value of over $5.7 million per year is indicated. This figure is slightly over twice the predicted net economic value of $2.7 million shown in Table 13. However, as pointed out earlier, net economic value based upon consumer's surplus is more difficult to interpret.

APPENDIX

In the following pages a sample questionnaire is presented. On the first mailing, an introductory letter and a questionnaire were sent.[1] If no reply was received within about two weeks, a first reminder letter and another questionnaire were mailed to the respondent. If there was still no response within the next two weeks, a second reminder and another questionnaire were mailed. This procedure was followed for each month during 1962.

[1] Copies of the introductory and follow-up letters are presented by Ajmer Singh, *An Economic Evaluation of the Salmon-Steelhead Sport Fishery in Oregon,* Ph.D. thesis, August, 1964, Oregon State University Library, pp. 144-146.

Appendix Table 1. SUBZONE VALUES FOR THE BASIC VARIABLES USED IN THE DEMAND ANALYSIS[1]

Main distance zone	Sub-zone number	Sum of S-S days per subzone	Sum of S-S variable costs per subzone	Sum of S-S caught per subzone[2]	Families per subzone	Average income per family (Coded)	Sum of S-S miles per subzone	Average S-S miles traveled per trip: By main zone	Average S-S miles traveled per trip: By subzone	Population per subzone
1	1	43	116.06	4.34	70	24	1,004	38	40	36,829
1	2	149	391.40	49.67	70	40	2,467	38	31	36,829
1	3	96	369.32	52.00	70	55	1,520	38	26	36,829
1	4	86	394.13	39.33	70	67	1,830	38	49	36,829
1	5	81	558.60	71.67	69	109	2,298	38	41	36,829
2	6	34	208.00	12.00	63	20	1,712	104	98	45,592
2	7	38	313.64	17.33	63	40	2,391	104	106	45,592
2	8	47	186.15	10.00	63	40	1,668	104	68	45,592
2	9	81	413.33	11.67	63	49	3,900	104	101	45,592
2	10	55	383.24	29.00	63	60	3,474	104	123	45,592
2	11	84	387.81	28.66	63	60	3,333	104	86	45,592
2	12	119	493.23	23.32	63	60	3,824	104	100	45,592
2	13	79	466.67	16.00	63	85	4,511	104	116	45,592
2	14	68	385.94	48.67	63	85	3,282	104	87	45,592
2	15	116	1,191.21	57.33	62	171	5,249	104	142	45,592
3	16	56	248.01	12.67	65	20	2,062	140	139	52,652
3	17	48	350.82	18.33	65	40	3,726	140	133	52,652
3	18	77	539.13	19.33	65	40	5,239	140	161	52,652
3	19	89	483.25	35.33	65	60	4,240	140	116	52,652
3	20	156	487.22	32.00	65	59	3,352	140	104	52,652
3	21	64	353.80	21.00	64	62	3,103	140	109	52,652
3	22	121	740.17	88.66	64	85	6,124	140	139	52,652
3	23	51	435.97	21.33	64	88	4,265	140	151	52,652
3	24	42	586.08	30.00	65	176	4,334	140	203	52,652
4	25	33	400.02	10.00	66	31	3,295	221	168	76,595
4	26	48	619.90	19.00	65	61	4,735	221	228	76,595
4	27	63	708.33	30.00	65	115	7,719	221	256	76,595
5	28	57	201.44	12.33	66	28	2,344	120	73	60,178
5	29	102	476.34	26.32	66	40	4,676	120	102	60,178
5	30	146	874.64	24.00	66	60	6,661	120	110	60,178
5	31	95	875.07	22.67	66	60	6,332	120	122	60,178
5	32	96	559.35	31.00	66	80	4,919	120	111	60,178
5	33	71	730.43	14.00	65	84	5,312	120	159	60,178
5	34	88	670.50	28.33	65	105	4,355	120	115	60,178
5	35	153	1,030.74	49.67	65	175	8,373	120	139	60,178

[1] Sample sums in table represent approximately 1/399.5 of the population.

Did any member of your family fish in Oregon during June, 1962? Yes ☐ No ☐
If yes, please fill in the information below for days fished in Oregon.

	Give number of family members fishing each day for:			If fish were caught, how many?				Transportation on fishing trips		
June 1962	Salmon	Steelhead	Other fish	Salmon	Steelhead	Jacks	Other fish	Mileage for your own car	Amount paid to you by others (not	Other transportation costs family)
Fri. 1										
Sat. 2										
Sun. 3										
Mon. 4										
Tue. 5										
Wed. 6										
Thu. 7										
Fri. 8										
Sat. 9										
Sun. 10										
Mon. 11										
Tue. 12										
Wed. 13										
Thu. 14										
Fri. 15										
Sat. 16										
Sun. 17										
Mon. 18										
Tue. 19										
Wed. 20										
Thu. 21										
Fri. 22										
Sat. 23										
Sun. 24										
Mon. 25										
Tue. 26										
Wed. 27										
Thu. 28										
Fri. 29										
Sat. 30										

How much did you spend during June for:

Lodging	Food and beverage including liquor	Charter boats and guide service	Bait, lures and other tackle	Rental of		Other
				Boat and motor	Tackle and gear	

SALMON-STEELHEAD EXPENDITURE QUESTIONNAIRE

1) How many members are in your family (residing at home)? ....

How many 1962 angling licenses (excluding one-day licenses) have been purchased by your family? ....

How many one-day angling licenses? ....

How many salmon-steelhead tags? ....

What was the total cost of these 1962 licenses for your family? .... (Include only half the cost of combination angler's and hunter's licenses.)

2) Please record below the expenditures made for equipment during the past 12 months because your family engages in fishing. We realize it will be necessary to charge only a part of certain costs to angling but we believe you can do this better than we can.

EXAMPLE: *Assume you purchased a boat this past year and used it a total of 100 hours. Of this 100 hours, 50 hours were used for all angling of which 25 hours were for salmon and steelhead angling. In this case 50 percent should be allocated to all angling and 25 percent should be allocated to salmon and steelhead fishing.*

For tackle, all of the cost is allocated to angling.

	Cost (only if purchased during past 12 months)	Percent of cost for past 12 months allocated to angling	Percent of cost for past 12 months allocated to salmon-steelhead angling
Tackle			
Rod		100	
Reel		100	
Line		100	
Creel		100	
Tackle box		100	
Landing net		100	
Other tackle		100	
Boating equipment			
Boats			

Boat trailer	....	....	....
Outboard motor	....	....	....
Other	....	....	....
Special clothing			
Rubber boots	....	....	....
Coats	....	....	....
Rainwear	....	....	....
Waders	....	....	....
Other	....	....	....
Camping equipment			
Tents	....	....	....
House trailer	....	....	....
Campers	....	....	....
Sleeping bag	....	....	....
Lantern	....	....	....
Stove	....	....	....
Other	....	....	....
Other equipment expenditures not enumerated above			
	....	....	....
	....	....	....
	....	....	....

3) What was the approximate total yearly income of your family in 1961? (Check appropriate space.)

- Under $3,000 ☐
- $3,000- $5,000 ☐
- $5,000- $7,000 ☐
- $7,000-$10,000 ☐
- $10,000-$15,000 ☐
- $15,000-$20,000 ☐
- Over $20,000 ☐