DETERMINING THE ECONOMIC VALUE OF AQUATIC RESOURCES WITHIN THE IMPACT AREA OF PROPOSED HIGHWAY CONSTRUCTION

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ABSTRACT

Proposed construction of a new highway through Prairie Creek State Park and Redwood National Park prompted concern for the potential impacts to aquatic resources. To serve as a basis for evaluating impacts and determining degree of mitigation, an economic evaluation of these resources was prepared. The method employed to make this evaluation could prove useful in other areas where such a determination is required in the absence of long-term monitoring data.

INTRODUCTION

U.S. Highway 101 is the only major north-south highway in northwestern California. A portion of the highway passes through Prairie Creek Redwoods State Park which lies within the boundaries of Redwood National Park. U.S. 101 is the only road traversing the length of the State Park. During the peak visitor months, long lines of cars, recreation vehicles and logging trucks frequently congest the highway. The legislation that expanded Redwood National Park in 1978 also directed that a bypass highway be built east of the State park. The eastern alignment was recommended because it best solves the problems of conflicts between tourists and through-traffic and minimizes the destruction of old-growth redwoods and other significant park resources. However, the proposed alignment traverses very steep terrain and some of the most unstable soils in the region (USDI, NPS 1981).

The environmental analysis of the bypass highway recognized the potential for significant negative effects to aquatic resources within the area of impact. At that time, available data illustrated the need for stringent erosion control measures but the data were not of a nature that would lead to an economic evaluation of the resource. In order to develop adequate mitigating measures, an economic evaluation of the resource was required.

Methods available for placing a dollar value on fishery resources utilize data on numbers of fish, figures which we did not have. Therefore, we developed a procedure to estimate the numbers of adult fish that might reasonably be expected to use sections of an affected stream. Given time constraints, our method of analysis had to be fast and simple. About 30 mi of stream on six different streams needed evaluation.

METHODS

We walked stream reaches that would be affected by highway construction and physically measured spawning gravels, classified them as to what species of fish would potentially use them, evaluated their present-day potential productivity by considering quality factors, and then calculated net economic value.

Stream sections were surveyed, and within each area of spawning gravel a determination was made of which species were most likely to be utilizing the area, based upon gravel size, water depth and flow. The potential spawning sites were then quality rated based on both gravel composition and compaction. The site was assigned a value of high, medium, or low, reflecting its overall quality as a spawning site. For example, a potential king salmon spawning site would be rated as high if it contained 10% or less fines (less than 3 mm), medium for 10% - 30% fines, and low if fines exceeded 30%. On the north coast, gravels may become compacted and affect their suitability as spawning sites.

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erefore, ratings of good (meaning little compaction) medium, poor, or very poor were also assigned ach site.

Information on area and quality of spawning sites was used to estimate the numbers of chinook mon *Oncorhynous tshawytscha*, silver salmon *O. kisutch*, steelhead *Salmo gairdneri*, and cutthroat ut *S. clarki* that could potentially use each area. Literature was researched (Briggs 1953, Shapovalov d Taft 1954) and biologists were consulted to determine the average redd size in the affected streams ell as the number of fish that might be expected on each redd (see Table 1).

Table 1

Estimated Mean Redd Sizes, Sex Ratios, and Fish Per Redd for Prairie Creek

Species	Redd Size (sq ft)	Sex Ratios M	Sex Ratios F	Fish/Redd
Chinook Salmon	60	2.1	1	3.1
Coho Salmon	30	1.5	1	2.5
Steelhead	25	1.0	1	2.0
Cutthroat	10	1.0	1	2.0

By dividing the redd size into the area of the spawning site, the numbers of redds per site is lculated. Multiplying this by the number of fish per redd yields numbers of fish per site. However, is would assume ideal conditions of high quality gravel and very little compaction. In order to correct r variations in these characteristics, a matrix was developed of correction factors (Table 2). The mbers in parenthesis are adjusted values that reflect our experience in the area with fish utilization of or quality spawning sites.

Table 2

Matrix for Determing Correction Factors [Adjusted Values in ( )]

		Quality: High 1	Quality: Medium 2	Quality: Low 3
Compaction	Good 1	1.0	.2	.3
	Medium 2	.2	.4	.6 (.5)
	Poor 3	.3	.6 (.5)	.9 (.8)
	Very Poor 4	.4	.8 (.7)	1.2 (.9)

The following example illustrates how these correction factors were used:

Sample Calculation

Riffle Size: 8 Ft. x 22 Ft. = 176 Sq. Ft.

For Coho Salmon: 176 Sq. Ft./30 Sq. Ft. Per Redd = 5.9 Redds

Number Fish: 5.9 Redds x 2.5 Fish Per Redd = 14.75 Coho Salmon

Gravel Quality Adjustment: Medium/Medium = 40% Reduction

Total Number Silver Salmon: 14.76 x .6 = 8.85 Fish

After we calculated the potential numbers of fish, we used the methods of Kesner (1977), Everest (1978), and Smith (1982) to provide an economic evaluation of the fishery. A procedure for evaluating a hypothetical escapement of 100 king salmon, steelhead, and cutthroat trout was then modeled (Fig. 1). The area specific factors used and the values assigned for our calculations are as follows:

Catch/Escapement Ratios	Salmon	=	4.0:1
	Steelhead	=	0.3:1
Commerical/Sport Fisheries Ratio	80:20%		
Dressed Weights	King	=	10.6#
	Silver	=	5.7#
Price/Pound	King	=	$2.00
	Silver	=	$1.50
Sport Catch	Ocean	=	81.3%
	Inland	=	18.7%
Angler Days/Fish	Ocean	=	1.0/Fish
	Inland	=	2.3/Fish
Value Per Angler Day	Ocean	=	$63.00
	Inland	=	$28.00

These were derived from current market conditions and discussions with local fishery biologists.

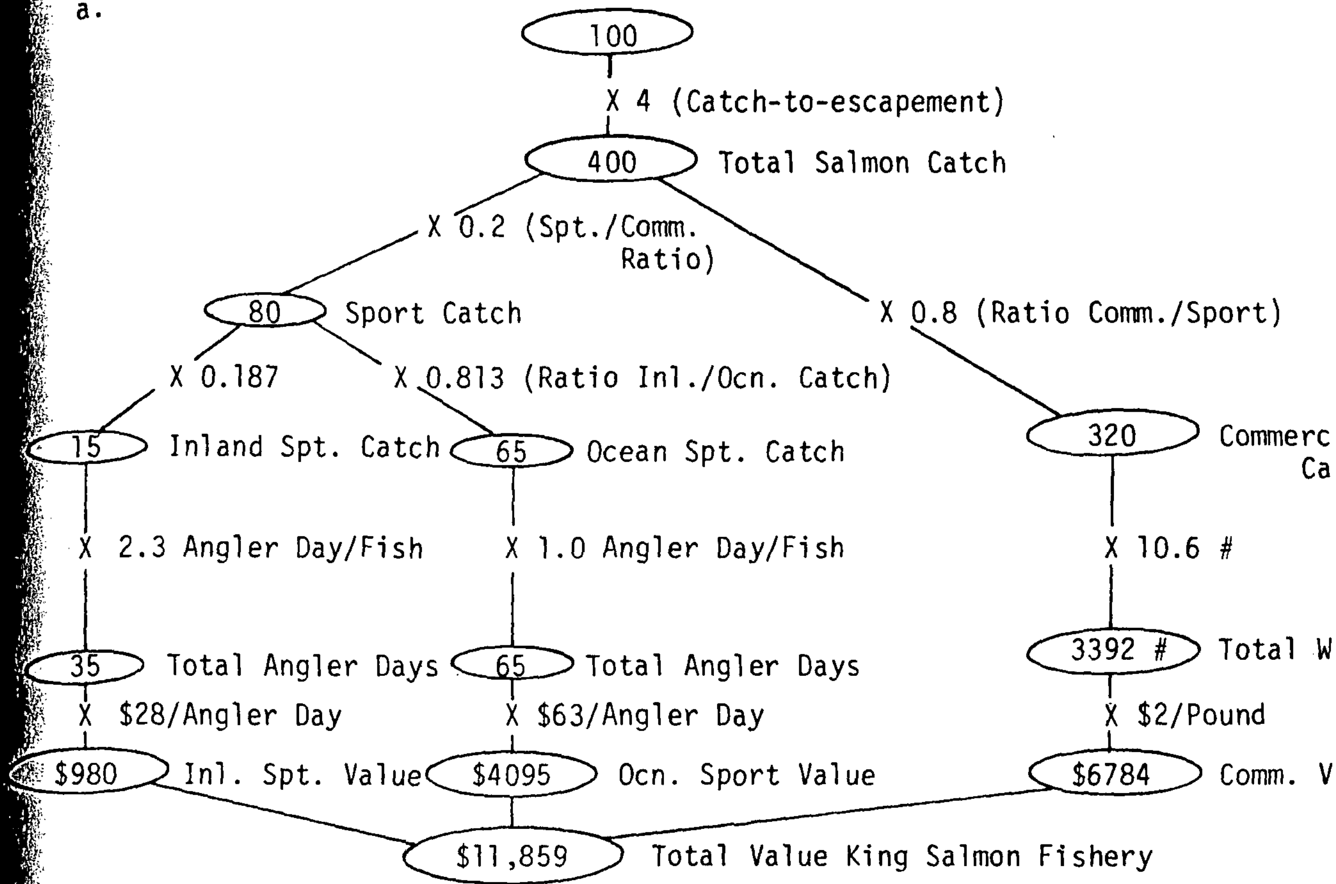
RESULTS

The fisheries valuation for streams within the proposed project area was calculated. The fisheries valuation for a portion of Prairie Creek, Humboldt County, California is included here (Table 3).

DISCUSSION

We found the method employed herein to be a relatively quick, simple means of evaluating fisheries resources. The economic evaluation is relatively realistic and one that is based upon stream specific surveys. It is inexpensive and can be quickly implemented. Values for determining correction factors can be specifically tailored for the geographic region in question.

a.



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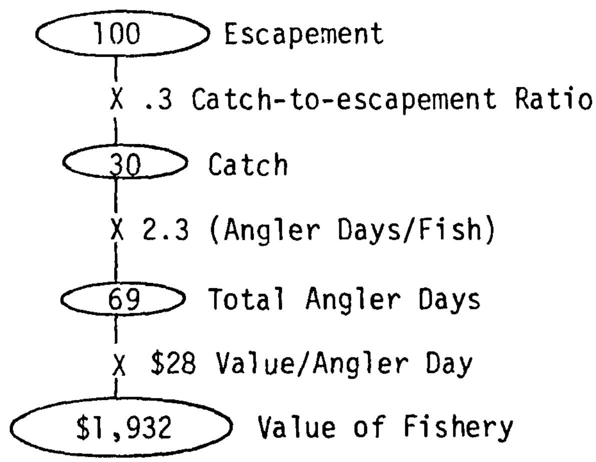

Figure 1

Procedure for Evaluating an Escapement of 100 King Salmon[a], Steelhead or Cutthroad Trout[b]

Table 3

Valuation of Fisheries Resources, Prairie Creek, California

	King Salmon		Silver Salmon	
	Potential	Adjusted	Potential	Adjusted
Number Redds	196	119	499	309
Fish/Redd	3.1	3.1	2.5	2.5
Total Fish	608	369	1,248	773
Total Catch	2,432	1,181	3,994	2,472
Commercial Catch	1,946	1,181	3,994	2,472
Sport Catch	486	295	998	618
$ Commercial	41,255	25,037	34,149	21,136
$ Sport - Ocean	24,892	15,110	51,117	31,653
$ Sport - Inland	5,853	3,555	12,019	7,442
$ Total	72,000	43,702	97,285	60,231

	Steelhead	
	Potential	Adjusted
Number Redds	657	388
Fish/Redd	2.0	2.0
Total Fish	1,314	776
Total Catch	394	233
Total Ang. Day	906	536
$ Value	26,612	15,714

CONCLUSIONS

Our method may have practical applications wherever information is required on fish populations in the absence of long-term monitoring or where such monitoring is economically unfeasible. While some of the assumptions made were admittedly judgmental, they were nevertheless based upon the experience of a professional fisheries biologist.

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