Special Publication No. 01-07

Strategic Plan for Salmon Research in the Kuskokwim River Drainage

by
Margaret F. Merritt

November 2001

Alaska Department of Fish and Game **Division of Sport Fish**

Symbols and Abbreviations

The following symbols and abbreviations, and others approved for the Système International d'Unités (SI), are used in Division of Sport Fish Fishery Manuscripts, Fishery Data Series Reports, Fishery Management Reports, and Special Publications without definition. All others must be defined in the text at first mention, as well as in the titles or footnotes of tables and in figures or figure captions.

Weights and measures (metric)

centimeter	cm
deciliter	dL
gram	g
hectare	ha
kilogram	kg
kilometer	km
liter	L
meter	m
metric ton	mt
milliliter	ml
millimeter	mm

Weights and measures (English)

cubic feet per second	ft^3/s
foot	ft
gallon	gal
inch	in
mile	mi
ounce	oz
pound	lb
quart	qt
yard	yd

Spell out acre and ton.

Time and temperature

day	d
degrees Celsius	°C
degrees Fahrenheit	°F
hour (spell out for 24-hour clock)	h
minute	min
second	s

Spell out year, month, and week.

Physics and chemistry

all atomic symbols	
alternating current	AC
ampere	A
calorie	cal
direct current	DC
hertz	Hz
horsepower	Hp
hydrogen ion activity	pH
parts per million	ppm
parts per thousand	ppt, ‰
volts	V
watts	W

General

All commonly accepted abbreviations.	e.g., Mr., Mrs., a.m., p.m., etc.
All commonly accepted professional titles.	e.g., Dr., Ph.D., R.N., etc.
and	&
at	@
Compass directions:	
east	E
north	N
south	S
west	W
Copyright	©
Corporate suffixes:	
Company	Co.
Corporation	Corp.
Incorporated	Inc.
Limited	Ltd.
et alii (and other people)	et al.
et cetera (and so forth)	etc.
exempli gratia (for example)	e.g.,
id est (that is)	i.e.,
latitude or longitude	lat. or long.
monetary symbols (U.S.)	$, ¢
months (tables and figures): first three letters	Jan,...,Dec
number (before a number)	# (e.g., #10)
pounds (after a number)	# (e.g., 10#)
registered trademark	®
trademark	™
United States (adjective)	U.S.
United States of America (noun)	USA
U.S. state and District of Columbia abbreviations	use two-letter abbreviations (e.g., AK, DC)

Mathematics, statistics, fisheries

alternate hypothesis	H_A
base of natural logarithm	e
catch per unit effort	CPUE
coefficient of variation	CV
common test statistics	F, t, χ^2, etc.
confidence interval	C.I.
correlation coefficient	R (multiple)
correlation coefficient	r (simple)
covariance	cov
degree (angular or temperature)	°
degrees of freedom	df
divided by	÷ or / (in equations)
equals	=
expected value	E
fork length	FL
greater than	>
greater than or equal to	≥
harvest per unit effort	HPUE
less than	<
less than or equal to	≤
logarithm (natural)	ln
logarithm (base 10)	log
logarithm (specify base)	$\log_2$, etc.
mideye-to-fork	MEF
minute (angular)	'
multiplied by	x
not significant	NS
null hypothesis	H_O
percent	%
probability	P
probability of a type I error (rejection of the null hypothesis when true)	α
probability of a type II error (acceptance of the null hypothesis when false)	β
second (angular)	"
standard deviation	SD
standard error	SE
standard length	SL
total length	TL
Variance	Var

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November 2001

The Special Publications series was established in 1991 for the publication of techniques and procedures manuals, informational pamphlets, special subject reports to decision-making bodies, symposia and workshop proceedings, application software documentation, in-house lectures, and other documents that do not fit in another publication series of the Division of Sport Fish. Special Publications are intended for fishery and other technical professionals. Special Publications are available through the Alaska State Library and on the Internet: http://www.sf.adfg.state.ak.us/statewide/divreports/html/intersearch.cfm This publication has undergone editorial and peer review.

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This document should be cited as:
Merritt, M. F., 2001. Strategic plan for salmon research in the Kuskokwim River drainage. Alaska Department of Fish and Game, Special Publication No. 01-07. Anchorage.

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ABSTRACT

At the request of the Commissioner's Office, staff from Commercial Fisheries, Sport Fish, Habitat and Subsistence divisions, Alaska Department of Fish and Game, held discussions to develop an internal guide for ensuring the wise use of funds in the pursuit of research and related activities targeting stocks of concern (chinook and chum salmon) and healthy stocks (coho and sockeye salmon) in the Kuskokwim River drainage. The mission was two-fold: to fulfill the department's obligation to the Alaska Board of Fisheries by drafting a research plan for inclusion into a board-mandated Action Plan for stocks of concern; and, to direct funds from various sources towards meeting the information needs and thus the goals of the Alaska Sustainable Salmon Fisheries Policy. A multi-criteria decision analysis technique, the Analytic Hierarchy Process, was used to facilitate the description of the problem. Through consensus, the group prioritized projects and related activities. Five goals were established, which mirror principles in the Sustainable Salmon Fisheries Policy. The description of the problem and its solution was large, consisting of 255 elements. Of the 170 options generated, 101 are unique. The top 10% of options primarily deal with obtaining a total river abundance estimate for salmon employing either mark-recapture or radio telemetry. It is not surprising that the highest ranked options drive right to the heart of the problem in the Kuskokwim, because the greatest weight of importance is assigned to the goal, "Maintain wild salmon stock escapements within ranges to sustain salmon production, diversity and normal ecosystem functioning". Repeatedly, throughout the model, are issues related to lack of knowledge regarding total run abundance, proportion of spawning escapement throughout the drainage, and stock specific run timing and exploitation in the Kuskokwim River drainage. Lack of knowledge has frustrated the advancement of establishing a Biological Escapement Goal for salmon in the Kuskokwim River drainage. This strategic research plan acts as an internal guide to the department in identifying projects and actions most likely to answer pressing questions facing state managers of Kuskokwim River salmon. In 2001, the plan was applied in directing research priorities of the Sport Fish Division and influenced revisions to the Kuskokwim fishery resource disaster prevention proposals.

PREFACE

In response to guidelines established in the state's Sustainable Salmon Fisheries Policy, the Alaska Board of Fisheries (BOF) during the September 28-29, 2000 work session classified Kuskokwim River chinook and chum salmon as yield concerns. A yield concern is defined as "…arising from a chronic inability, despite the use of specific management measures, to maintain expected yields or harvestable surpluses, above a stock's escapement needs". The BOF made the determination based on yield concerns since 1998 and the anticipated low harvest level in 2001. Actions Plans are mandated through the state's Sustainable Salmon Fisheries Policy for stocks of concern, and each Action Plan "…shall include a research plan as necessary to provide information to address [stock] concerns".

On November 7-9, 2000 a meeting was held at the request of the Alaska Department of Fish and Game (department) Commissioner's Office to initiate the development of an internal guide for research and related management activities directed towards stocks of concern (chinook and chum salmon) in the Kuskokwim River drainage. Additional stocks deemed in healthy condition (coho and sockeye salmon) were included in the plan at the request of staff. The mission was to:

> Develop a strategic research plan for chinook, chum, coho and sockeye salmon in the Kuskokwim River drainage so that stock assessment funds made available to the department through the Disaster program, Federal Subsistence program, and traditional sources (General Fund, Fish and Game Fund, Federal Aid in Fish Restoration Funds, Capitol Improvement Program Funds) are directed towards meeting the information needs and thus the goals of the Sustainable Salmon Fisheries Policy.

The product of the discussions was intended to fulfill the department's immediate obligation to the BOF concerning the development of the Action Plans, and their associated research plans, deliverable to the BOF at their January 2001 meeting.

This strategic research plan is the result of discussions with key research, management and supervisory staff in four divisions (Commercial Fisheries, Sport Fish, Habitat, and Subsistence). This plan establishes a framework for developing and evaluating goals and objectives, and a process for determining the most important priorities. Goals in the strategic research plan incorporate principles of the Sustainable Salmon Fisheries Policy. Statements of purpose were articulated as objectives. Difficulties of achieving objectives were outlined, and projects and actions to address these issues were identified.

A timeline for development and application of the strategic plan is outlined in Table 1.

Table 1.-Timeline of development and application of the strategic research plan for salmon in the Kuskokwim River drainage.

	Date	Stage of Review
✓ ✓	Nov. 7-9, 2000	Department staff meeting to develop the strategic plan. Daily summaries e-mailed to key department staff.
✓ ✓	Nov-Dec	Provide synopsis of research plan for Action Plan. Provide AC's and RAC's with one page notice of plan effort.
✓	Late Dec	Draft strategic plan sent for review to participants.
✓	Jan-mid Feb	Use working draft plan and issues from work sessions as guidance for OSM pre-proposal submissions
✓	Feb 1	Review comments on draft strategic plan due
✓	Summer 2001	First field season under strategic plan
	Mar 2002	Annual review of strategic plan

INTRODUCTION

Management of the Kuskokwim area fisheries is complex because of the difficulty in determining run size and timing, harvesting of mixed stocks, overlapping multispecies runs, allocation issues and the size of the Kuskokwim drainage (Figure 1). All five species of Pacific salmon occur in the Kuskokwim, however only chinook, coho, chum and sockeye salmon are harvested in directed fisheries. The overall goal is to manage the salmon runs for sustained yield; information is not adequate to determine the escapement levels needed to produce maximum sustained yield. Management of the commercial fisheries must take a conservative approach to maintain the subsistence priority and to provide for spawning escapements (Burkey et al. 1999).

Average annual commercial harvests during the previous 10 years are: 514,277 coho, 334,029 chum, 61,443 sockeye and 27,238 incidentally-caught chinook salmon. Average annual subsistence harvests during the previous 10 years are: 87,095 chinook, 84,234 chum, 40,896 sockeye, and 40,004 coho salmon. Sport harvests are low.

Large and unanticipated declines of salmon runs occurred in Western Alaska in 1997 - 2000. Extremely poor returns of chum and chinook salmon in 1999, coupled with low prices, resulted in the lowest harvest of these species since 1983. Commercial salmon sales were 83% below the most recent 10-year average. In 1999, harvests were below the previous 10-year average as follows: coho 95%, chum 83%, chinook 51% and sockeye 50%. Due to low returns in 1999, there were only two commercial fishing periods in District 1 and none in District 2.

The 2000 Kuskokwim River chinook and chum salmon runs were among the poorest on record. Pink salmon escapement was also very poor. Due to the extremely poor chinook and chum salmon run strength, very few commercial fishery openings were permitted in the in-river districts. This resulted in chinook and chum salmon commercial harvests of 2% (444 chinook) and 4% (11,571 chum) of their ten year averages, and an incidental sockeye harvest (4,130) that was 93% below average. In contrast to other salmon runs, the drainage experienced a good return of coho salmon in 2000. The commercial harvest was less than may have otherwise been taken because the commercial fishery was closed until August 1 to provide protection for the weak chum salmon run. The total in-river coho salmon harvest was 261,379 fish, about 56% of the recent 10 year average.

While ocean climatic conditions were thought to be primarily responsible for the declines, a long term research program was proposed to examine Alaska's responsiveness to changes in salmon productivity. A congressional appropriation in 1998 for salmon research in the Kuskokwim ("Disaster" funds) proposed long term research to:

1. understand stock productivity through long-term information on distribution, timing and magnitude of escapement, recruitment, rearing and spawning carrying capacity, genetic diversity;
2. evaluate the appropriateness of current management policies and escapement goals during times of low productivity;
3. implement abundance-based management regimes; and,
4. improve preseason forecasts of abundance for industry planning and establishing quotas.

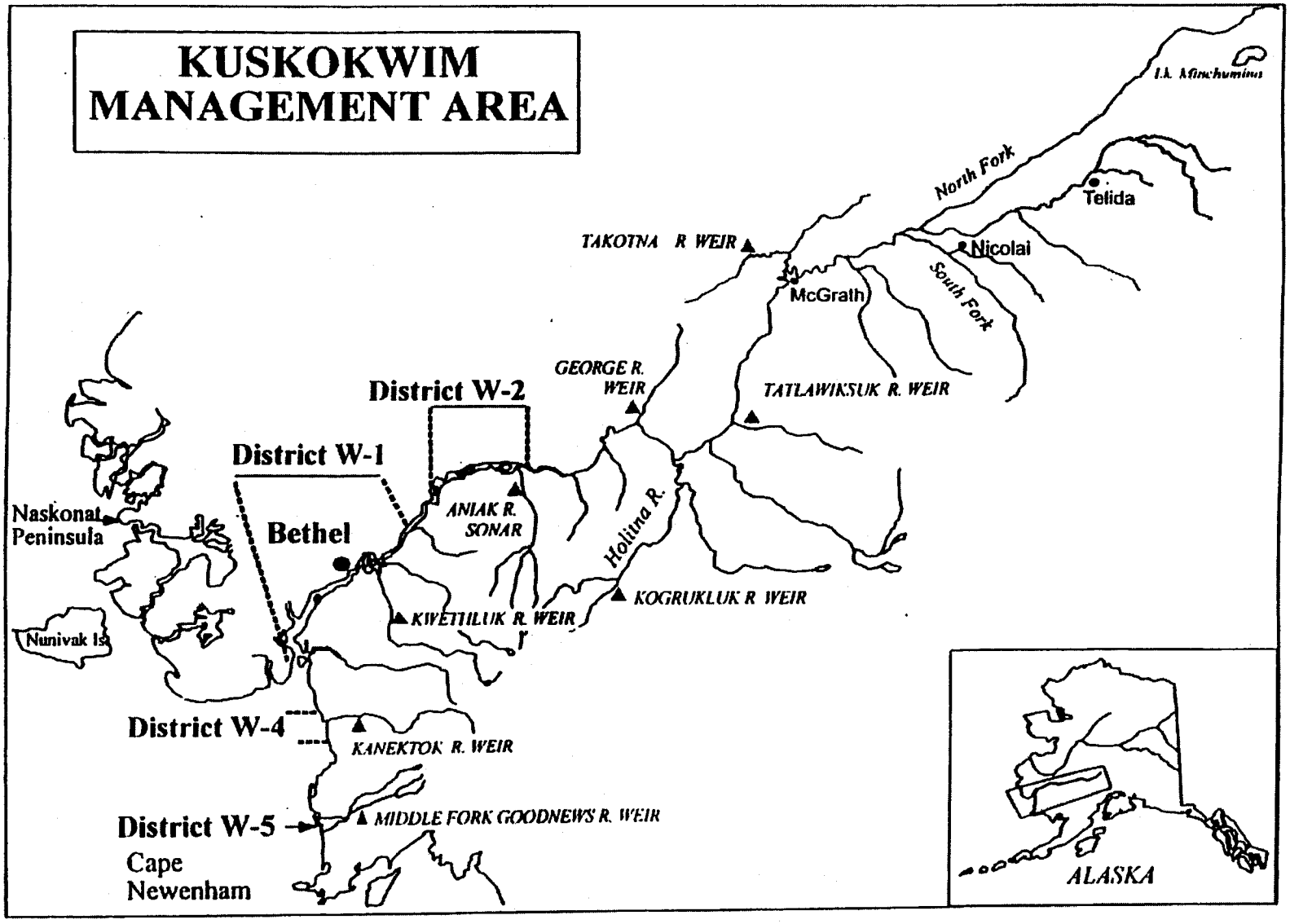


Figure 1.-Kuskokwim area map showing salmon management districts and escapement monitoring projects.

Additional sources of funds for salmon research, such as through the Federal Subsistence Resource Monitoring Program, and state Capitol Improvements Program, provided a unique opportunity for large scale research not previously possible. Millions of dollars for salmon research in the Kuskokwim also posed the problem of how to allocate funding wisely across project proposals, given the various missions of the funding sources and intents from various agencies and stakeholders.

Concurrent with the unique problem posed with allocation of funds was the designation of Kuskokwim chinook and chum salmon as stocks of concern by the BOF. The department responded with a call for a strategic research plan to address both the BOF requirements associated with the yield concern designations and the allocation of research funds. The purposes of the planning meeting were to:

1. review existing policy;
2. discuss and develop fishery management goals;
3. articulate research objectives and related activities to achieve goals; and,
4. determine which of the desired objectives and methods our current research and management programs are addressing, and which remain to be addressed to assist in the long term development of budget proposals and their prioritization.

The multi-criteria decision analysis technique, the analytic hierarchy process (AHP; Saaty 1990), was used to develop the plan and rank options. Decision analysis has been used extensively for strategic planning, conflict resolution, budget prioritization and policy development in such disciplines as economics, engineering and military science for decades, and has been applied to natural resource management beginning in the 1970's (see for example Hilborn and Walters 1977, Walker et al. 1983, Mackett 1985, Merritt and Criddle 1993, Merritt, 2000). The AHP is a tool for facilitating decision making by structuring the problem into levels comprising a hierarchy. Breaking a complex problem into levels permits decision makers to focus on smaller sets of decisions, improving their ability to make accurate judgments. Structuring also allows decision makers to think through a problem in a systematic and thorough manner. The AHP encourages people to explicitly state their judgments of preference or importance; options in the form of research projects or management actions are ranked according to weights of preference or importance assigned to the goals, objectives and issues that the option addresses.

BACKGROUND OF EXISTING POLICY AND MANAGEMENT STRATEGY

Board of Fisheries Policy

The return is currently managed under a Kuskokwim River Salmon Management Plan (5 ACC 07.365) that provides guidelines for management of the commercial fishery. It is the intent of the BOF that chinook salmon be managed conservatively consistent with sustained yield and the subsistence priority, thus there may not be a directed commercial chinook salmon fishery. The incidental catch guideline harvest level for chinook is 15,000 – 50,000 fish (see Appendix A).

Escapement Objectives

No Biological Escapement Goals (BEGs) exist for the Kuskokwim due to insufficient information to allow this level of analysis. In the recent past the management of fisheries in the Kuskokwim was based on attaining aerial survey targets, however the recent BEG committee (Sandone *In prep*) concluded that targets are inadequate to describe a BEG for achieving sustained yield. The committee recommended replacing what was termed "BEGs" with a more

accurate description (Sustainable Escapement Goal) for most systems, and discontinuing goals for species not actively managed (sockeye) (Gene Sandone department memorandum, dated October 20, 2000).

Management Strategy

Commercial Fisheries Management

Commercial salmon fishing takes place in the mainstem in two districts – District 1 is the lower 146 mi of the river from the mouth to 9 mi upstream of the Tuluksak River. District 2 is in the middle Kuskokwim River, and is 50 mi long. Prior to 1983, a management strategy of conservatively increasing the commercial catch harvest guidelines allowed development of the fishery. In 1983 management was changed to an escapement objective-based strategy. Coho salmon are the most important commercial fishery in terms of abundance and value. Chum salmon are second in importance, and sockeye are the third most commercially important salmon species, however direct efforts are primarily in districts located in Kuskokwim Bay. Sockeye salmon are not actively managed in the in-river districts. Because of its importance as subsistence food, the directed chinook salmon commercial fishery was discontinued in 1987. Pink salmon occur throughout the area however there is a lack of commercial harvest and little interest by subsistence fishers (Charles Burkey, Pacific salmon fisheries in the Kuskokwim area, Alaska, 2000, handout; and department news release, October 2, 2000 Bethel).

Stocks are managed primarily as an aggregate stock based on escapement monitoring of selected streams and lower river test fish indices. Commercial fishing is based on pre-season run projections, test fish indices, and subsistence fishery performance. The fisheries are adjusted in-season based on run strength indicators. Management also relies on salmon age-sex-size sampling, commercial catch statistics and verbal reports from fishers to augment escapement and test-fish information. There is a district-wide 6-in maximum gillnet mesh size restriction applied to all commercial salmon fisheries. Fishing periods are usually 6 hours in duration. Adjustments of the number and duration of commercial fishing periods and time intervals between periods are the primary methods for distributing the harvest throughout the run. When runs are weaker than projected, low levels of commercial and subsistence harvests that occur early in the season may reduce the numbers of fish available for escapement and result in subsistence restrictions later in the season. Late season subsistence restrictions tend to disproportionately impact subsistence fisheries in the middle and upper basin.

Subsistence Fisheries Management

Subsistence users have priority use of all Kuskokwim area fish resources. The subsistence salmon fishery in the Kuskokwim is one of the largest and most important in the state. Subsistence catches of chinook salmon exceed commercial harvests, however subsistence catches of chum and coho are typically a small fraction of the commercial catches. Prior to 1999, licenses and permits were not required to participate in the subsistence fishery in the Kuskokwim area, nor were restrictions on harvest applied. Legal gear included fishwheels, seines, and drift and set gillnets of any mesh size. In 1999, the BOF allowed rod and reel as a legal gear for subsistence fishing. Areas within commercial fishing districts are periodically closed to subsistence fishing 16 hours before, during and 6 hours after commercial fishing periods to discourage illegal commercial fishing. Subsistence salmon harvest surveys collect data annually using annual catch calendars, post-season household surveys and postcard surveys.

Sport Fisheries Management

The sport fishery management objectives that have been identified are to: 1) manage sport fisheries for salmon in Kuskokwim River tributaries so that sport harvests do not threaten sustained yield from any stock; 2) increase public awareness of fishing opportunities; 3) improve access to salmon fishing locations; and, 4) achieve benefits to the angling public that out weigh the costs of management and research.

In comparison to commercial and subsistence fisheries, sport fisheries for salmon in the Kuskokwim River and Kuskokwim Bay have very limited impact on the salmon stocks. In recent years the sport harvest has on average been less that 2% of the total use of any salmon species in the area. Hence, there is very little effect that management of the sport fishery can have on the annual status of the various salmon stocks. Therefore, the goal of sport fishery management is to maintain a reliable level of opportunity for anglers to participate in the fisheries throughout the season. To this end, emergency actions to restrict harvest and/or season regulations for the sport fishery are generally not contemplated unless it becomes apparent that the size of the run is so small that significant restrictions in the subsistence fishery will be necessary.

Habitat Management

Protecting fish habitat is a principle goal of the Habitat and Restoration Division (H&R). In the Kuskokwim River watershed, H&R protects salmon habitat by issuing permits for activities affecting fish-bearing waters and by participating in the permitting and planning activities of other state and federal agencies, including: land use plans, oil and gas leasing and development, timber harvesting, mining, community expansion, hydroelectric projects, and a variety of other activities. For project and plan reviews, the division acquires and analyzes biological, engineering, hydrological and other technical information, including information on fish abundance, habitat use, human use, and associated economic values. An additional responsibility is to recommend and participate in ways to mitigate negative effects of current development activities and to restore past fish habitat damages. H&R issues fish habitat permits and provides land use recommendations based on the best available information regarding the spatial and temporal distribution of fish and the characteristics of the habitats they use. H&R can exercise its salmon habitat protection authorities only where those habitats that have been explicitly confirmed to support anadromous fish. These habitats are cataloged in the division's Anadromous Waters Atlas and Catalog. In 1985 and 1986, H&R conducted two Fish Habitat Surveys in and near the Holitna River drainage. Two weeks of field work yielded a 20% increase in the number of cataloged salmon streams in the Kuskokwim drainage. These results and other observations confirm that the distribution of salmon habitat in the Kuskokwim drainage is poorly understood. Undocumented salmon habitat can not be protected by the department statutory authorities. In the Kuskokwim watershed, H&R reviews between 25 and 40 placer mining projects per year. In addition, H&R is actively involved with the Donlin Creek Mine, a large open pit hard rock project now on Crooked Creek. Another hard rock project, the Nixon Fork Mine, is currently inactive but may reopen when gold prices rebound. Recent mineral mapping in the upper drainage may increase interest in mining activities, particularly hard rock mining. Salmon habitat in several Kuskokwim tributaries have been degraded through historic industrial placer mining activities. Proposals to rehabilitate these areas will receive increased attention in the near future. H&R has reviewed an increasing number of land use permit applications for commercial

recreation facilities (fishing and/or hunting guide camps) on state lands. Small-scale timber harvest activities on state lands continue along the mainstem and on larger tributaries. Timber prices, which historically are strongly cyclic, are currently depressed. As markets improve, we anticipate renewed interest in large-scale timber harvest of forests along the main river systems. In addition to timber harvest itself, potential impacts may arise through the transportation of timber to markets. A recent industry-advocated proposal was log rafting down the Kuskokwim to Bethel.

METHODS

A total of 12 research, management and/or supervisory staff from four divisions (Commercial Fisheries, Sport Fish, Habitat, and Subsistence) participated in facilitated discussions regarding four species of salmon in the Kuskokwim River drainage. A modification of the Nominal Group Technique (Delbecq et al. 1975) was used in eliciting goals, objectives, and issues, and brainstorming (Osborn 1963) was encouraged in the identification of options (see Glossary for definition of terms). The AHP (Saaty 1990) was used to structure elements of the plan, and to assign scores of importance based on judgment. Importance was judged according to how critical the goal, objective, or issue is to achieving the mission.

Consensus within a score of 2 points (on a ratio scale of 1 to 9) on the rating of goals, objectives, issues and sub-issues was negotiated and achieved among participants. When disparity in judging weights of importance occurred, it meant there was disagreement, and debate was encouraged. During debate participants were exposed to different points of view and a clearer understanding of definitions was forged. Advancement on the understanding of important concepts, such as a Sustainable Escapement Goal, was fostered through debates. The seeking of consensus not only encouraged dialogue, it also formed the group's solution, not individual solutions.

The software program Expert Choice[1] was used interactively to depict the influence of weights and derive the priority of options. Priorities approximate the strength of judgments for each option adjusted to reflect the importance assigned to the goals, objectives and issues addressed by that option. Each option's priority rating represents its fraction of the total proportion of points available from the sub-issues, issues, objectives, and goals at successively higher levels derived from weights of importance. Within a field of many options, however, more discrimination is required to separate the better options from those not as good. To discriminate among options, a simple filter was created consisting of six criteria, and each of the 101 unique options was rated against these criteria:

1. species of concern (king and chum);
2. extent to which the option addresses the establishment of a BEG and sustained yield;
3. likelihood of success of the option or its current effectiveness;
4. degree of precision associated with the option's product;
5. a benefit/cost rating; and,
6. likely political or local support for the option.

[1] Forman, E., T. Saaty, M. Selly, and R. Waldron. Expert Choice, Decision Support Software, McLean VA. 1983.

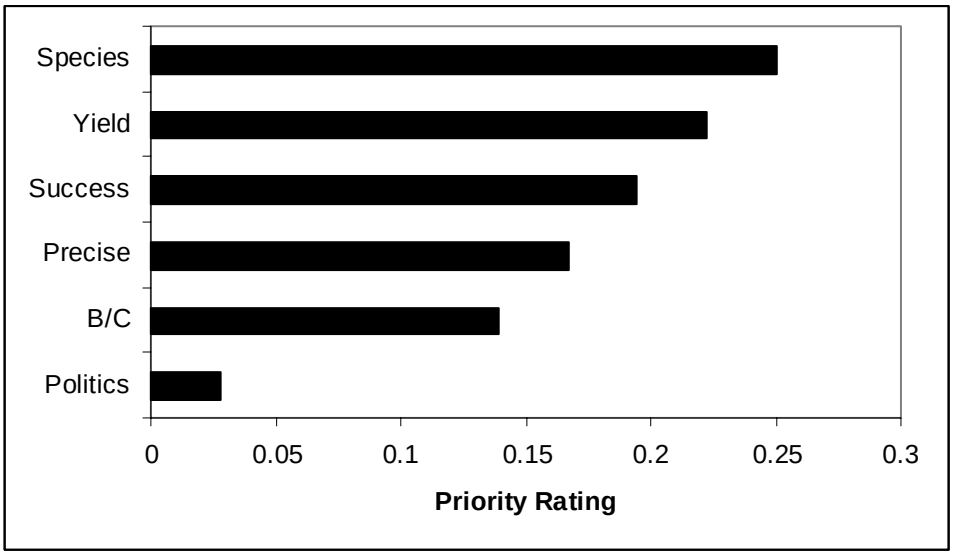
These criteria were given broad values, and assigned ratings as follows:

Criterion	Values	Ratings
Species	Both concern & healthy	9
	Concern (king, chum)	8
	Healthy (coho, red)	3
	None	0.3
Sustained Yield	Yes	9
	Not much	3
Likelihood of success	High	9
	Moderate	3
	Risky	0.3
Degree of precision	Good	7
	Fair	3
	Poor	.3
Benefit/Cost ratio	(see below)	
Political or local support	Favorable	7
	Neutral	3
	Unpopular	0.3

The benefit/cost rating was generated by first identifying the first three criteria as benefits (species of concern, sustained yield, and the option's likely success) and the cost was broadly apportioned into under- or over $100,000. The rating given to each of the benefits was summed, then divided by the rating given to the cost to produce one of four benefit/cost ratios:

Possible B/C Outcome	Verbal Equivalent	Priority Score
High Benefits/ Low Cost	Best case scenario	9
High Benefits / High Cost	Good scenario	5
Low benefits / Low Cost	Fair	0.2
Low benefits / High Cost	Worst	0.1

Using expert judgment, the six criteria were weighted as to their importance as follows:



The option scores from the filter were then inserted at the option level into the hierarchical model, and the total model was then synthesized. Thus, the ranking of options is a result of:

1. the weights of importance of the sub-issues, issues, objectives and goals which they address;
2. their efficiency in addressing multiple issues; and,
3. the extent to which they produce high benefits at low cost, are relatively precise, and enjoy public support.

Mathematically, relative ratings of importance are entered into a vector and normalized. The values from the vector are then multiplied by the weight in the next highest level, and the result is the weight of importance for issues. Then, the full weight of importance in the node preceding the option is assigned to the best option derived through the filter, and proportionately smaller shares of the weight of importance are distributed to the remaining options. The total score for each option is then calculated by adding the weighted proportions over all issues for each option:

$$T_m = \sum_{k=1}^{d} W_k p_{k,m}$$

where

T_m = the total weighted score for option m,
W_k = the weight for issue k,
$p_{k,m}$ = the weighted proportion of the total score for option m addressing issue k
d = the number of options.

RESULTS

STRUCTURE OF THE STRATEGIC PLAN

The strategic plan is structured as a hierarchy of goals, objectives, issues, sub-issues and options, segregated into groups directly related to each goal (Figure 2). Options form the base of the hierarchy. Goals are long term achievements that contribute to accomplishing a mission. Five goals were identified to ensure the conservation and wise management of salmon in the Kuskokwim River drainage. Figure 2 has been partitioned into the five goals (Figures 2a – 2e) so that the plan may be easier to follow. Objectives are measurable statements of purpose that contribute to achieving a goal. The goals and their associated objectives are:

Goals	Objectives
1. Escapement: Maintain wild salmon stock escapements within ranges to sustain salmon production, diversity and normal ecosystem functioning	1a. Establish BEG for drainage 1b. Establish SEG for tributaries where appropriate 1c. Establish acceptable standards for escapement quality.
2. Harvest: Harvest with caution commensurate with uncertainty	2a. Manage escapement for the drainage 2b. Incorporate system productivity into management decisions 2c. Evaluate the effects of enhanced stocks on wild stocks 2d. Rebuild depleted stocks 2e. Understand sources of mortality and exploitation of stocks in fisheries 2f. Evaluate management systems 2g. Develop reliable forecasting tools 2h. Evaluate enforcement for effectiveness
3. Habitat: Protect marine, coastal and watershed habitat for wild salmon migration, spawning and rearing	3a. Identify critical habitat 3b. Characterize critical habitat and understand variability 3c. Monitor habitat for change 3d. Evaluate habitat management and enforcement for effectiveness 3e. Restore degraded habitat if warranted
4. Public Involvement: Promote public support and involvement for sustained use and protection of salmon resources	4a. Distribute information about the planning effort to build public support 4b. Develop field research projects with public involvement 4c. Continued public involvement in working group
5. Socioeconomics: Consider net social and economic benefits from the fisheries to users	5a. Assess the impact of management decisions on socioeconomic benefits 5b. Derive local benefits for development and use of Kuskokwim fisheries 5c. Evaluate long term viability of fisheries to promote economic health

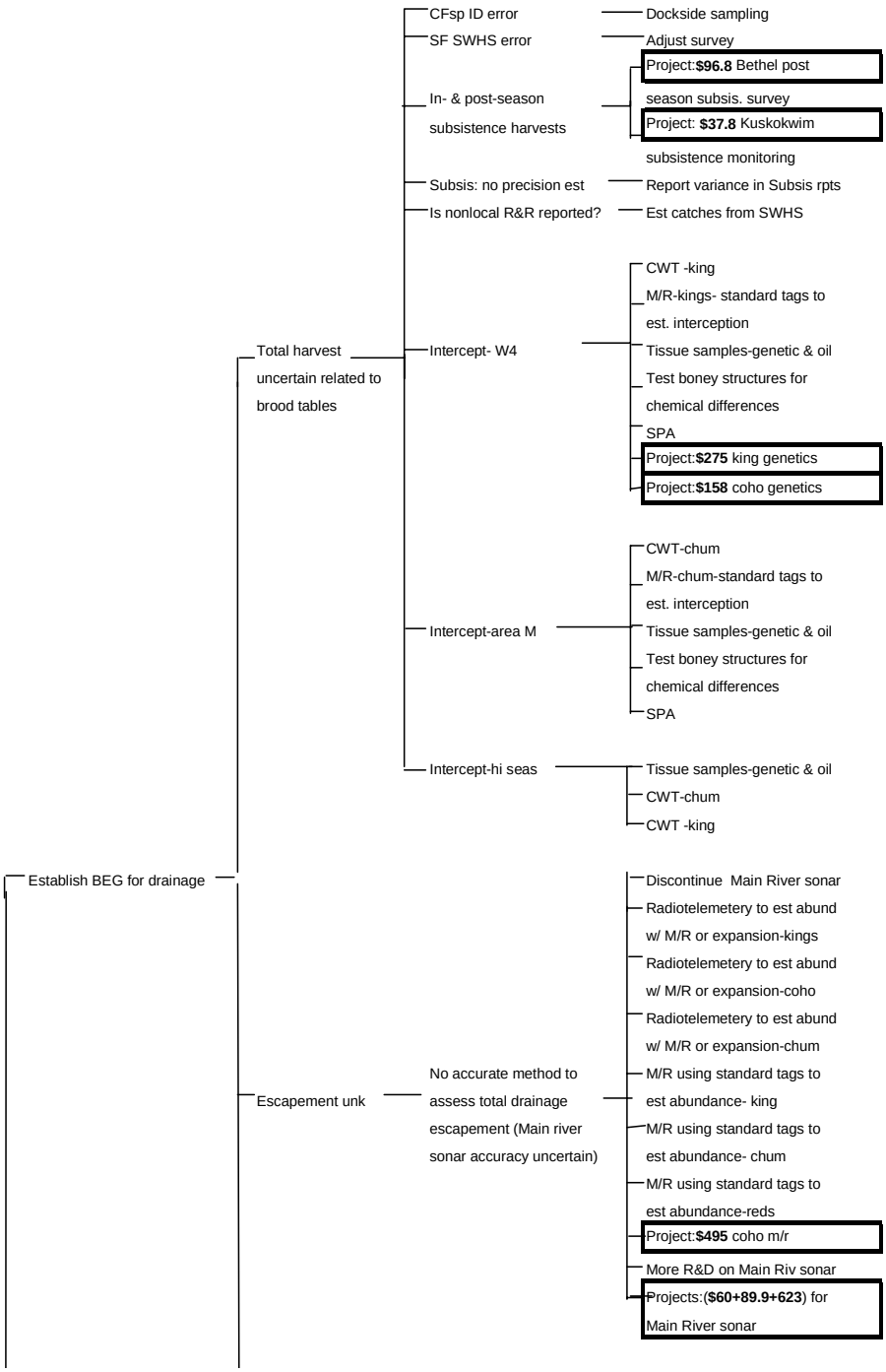


Figure 2a.-Strategic research plan for salmon in the Kuskokwim River drainage: goal to maintain wild salmon stock escapements.

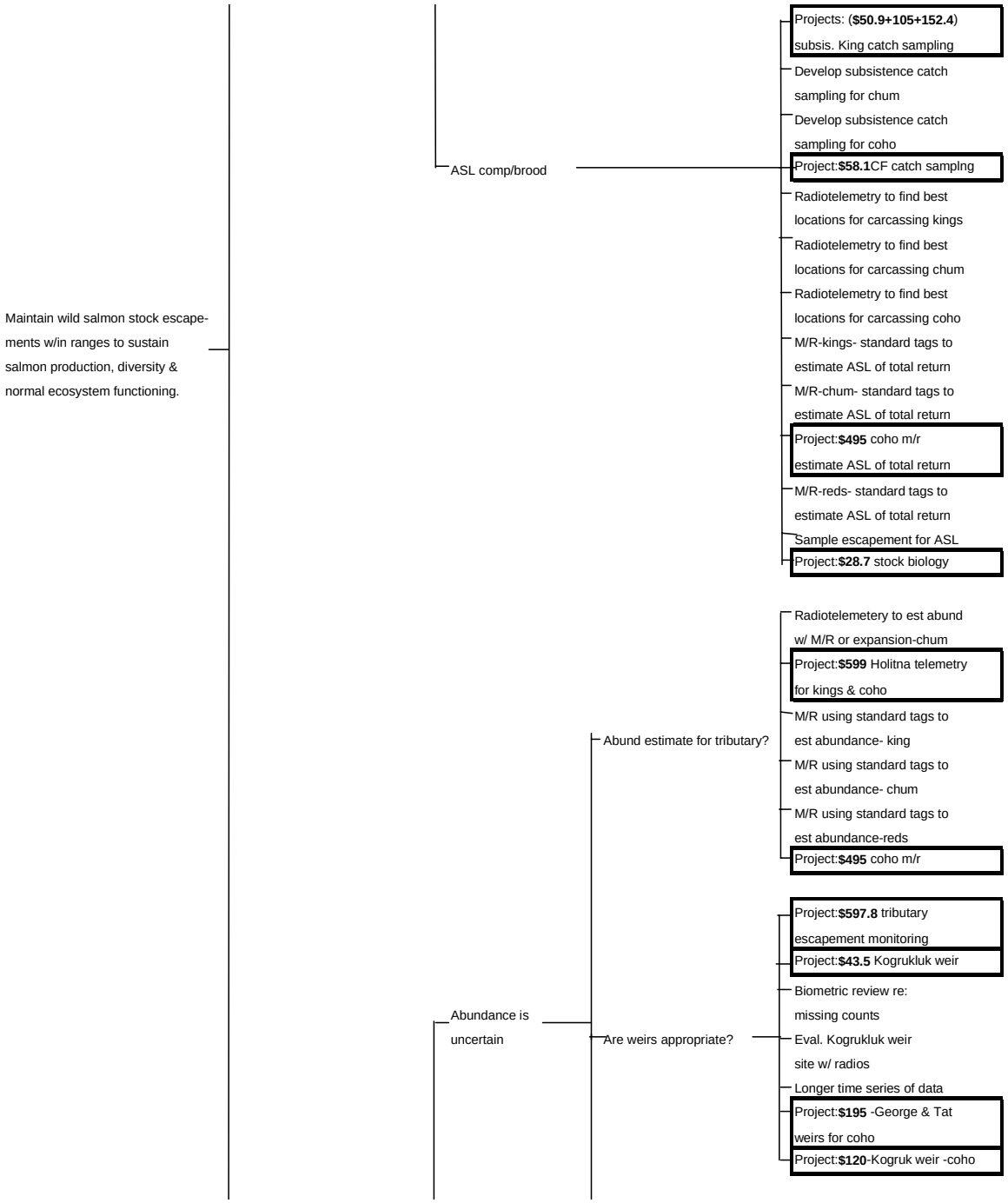


Figure 2a.-Page 2 of 3.

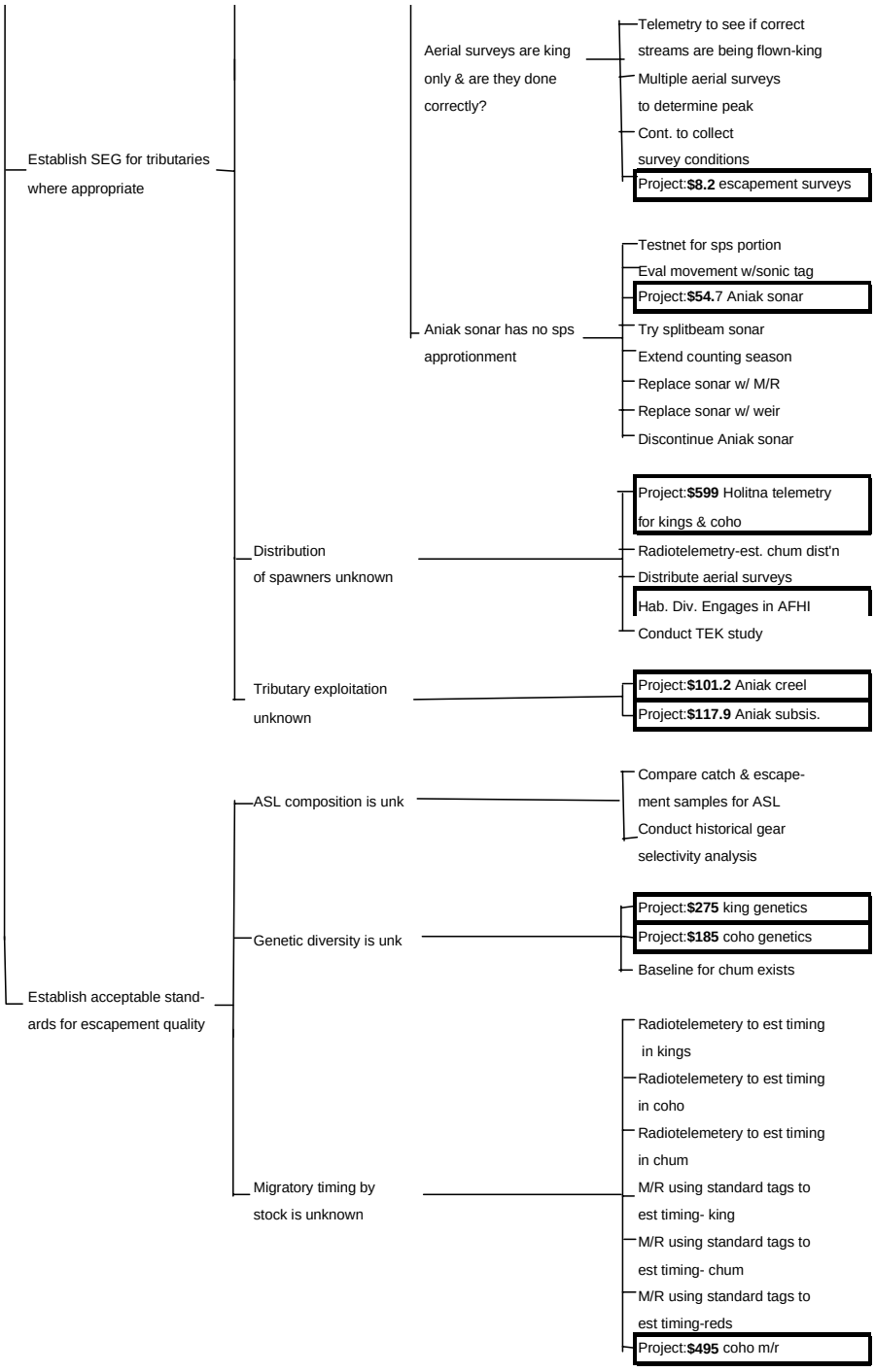


Figure 2a.-Page 3 of 3.

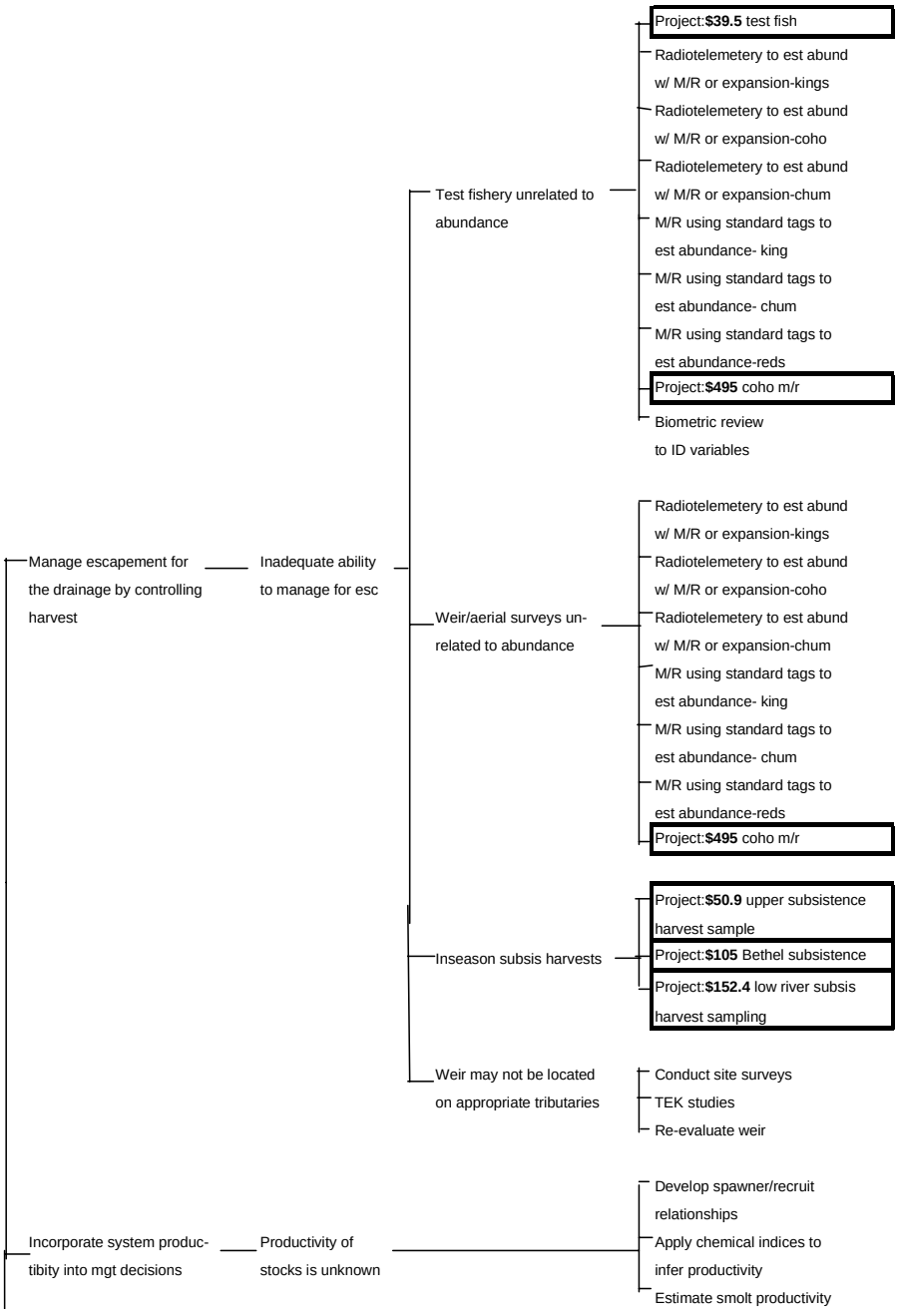


Figure 2b.-Strategic research plan for salmon in the Kuskokwim River drainage: goal to harvest with caution.

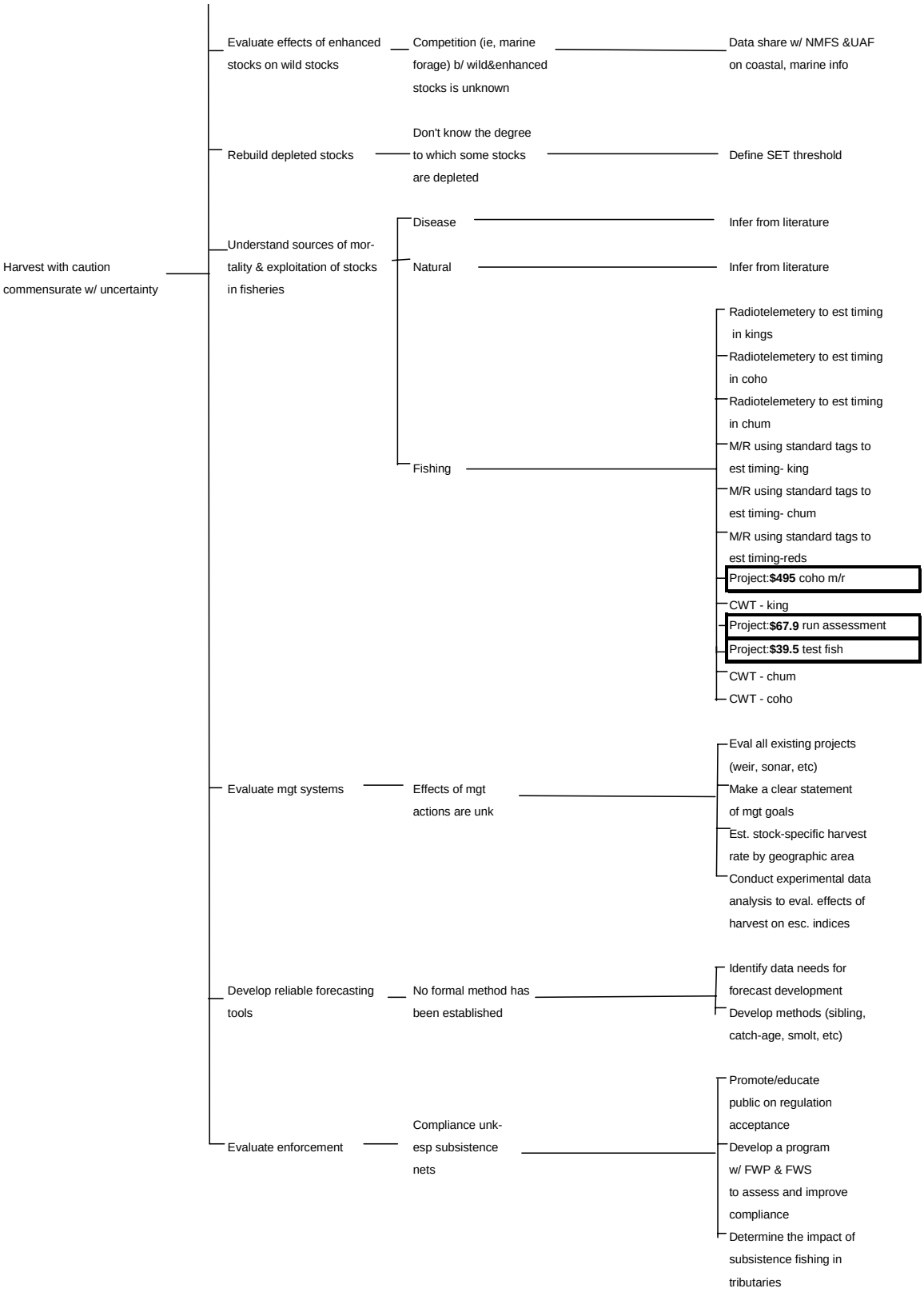


Figure 2b.-Page 2 of 2.

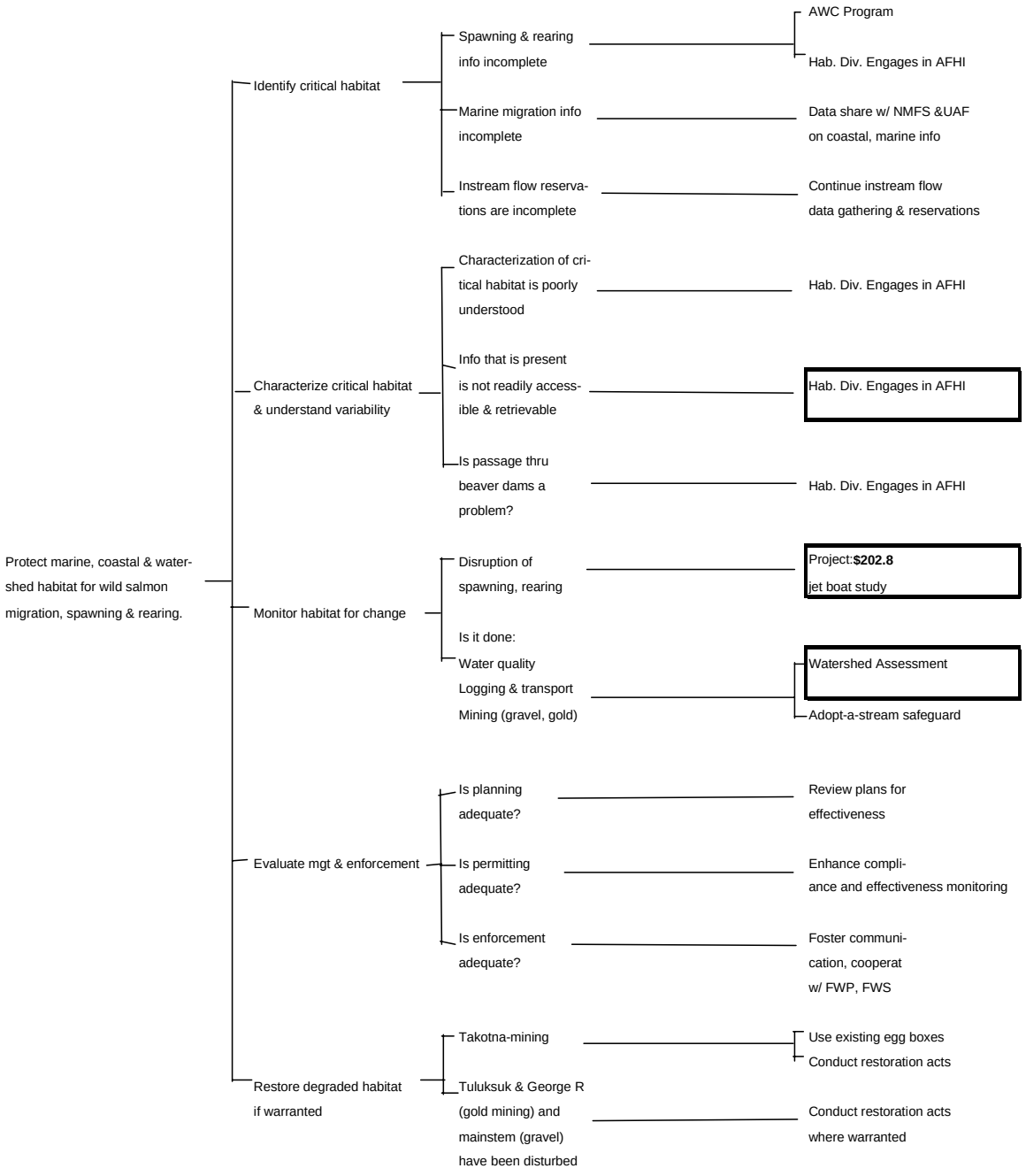


Figure 2c.-Strategic research plan for salmon in the Kuskokwim River drainage: goal to protect marine, coastal and watershed habitat.

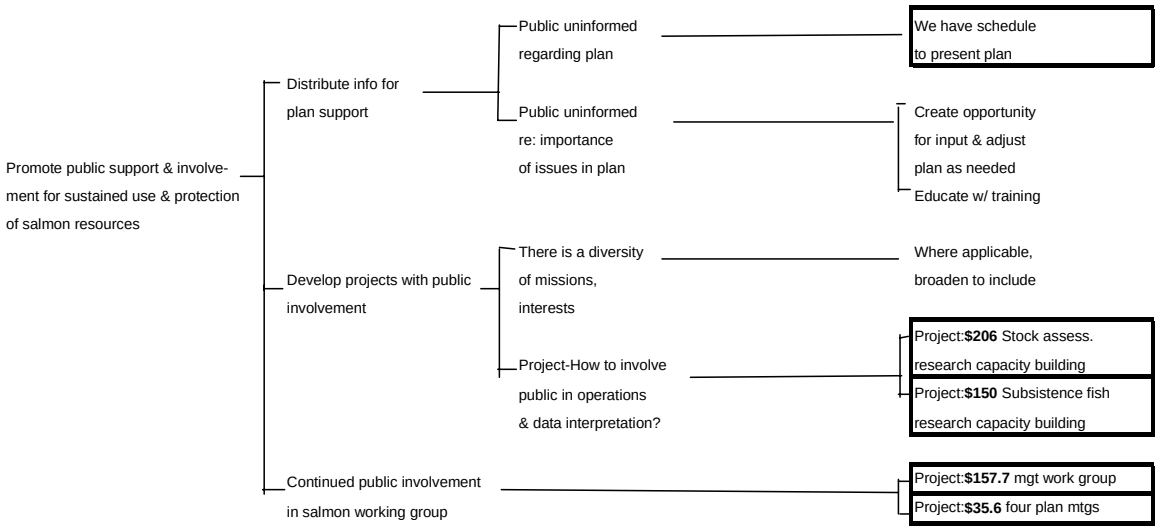


Figure 2d.- Strategic research plan for salmon in the Kuskokwim River drainage: goal to promote public support and involvement.

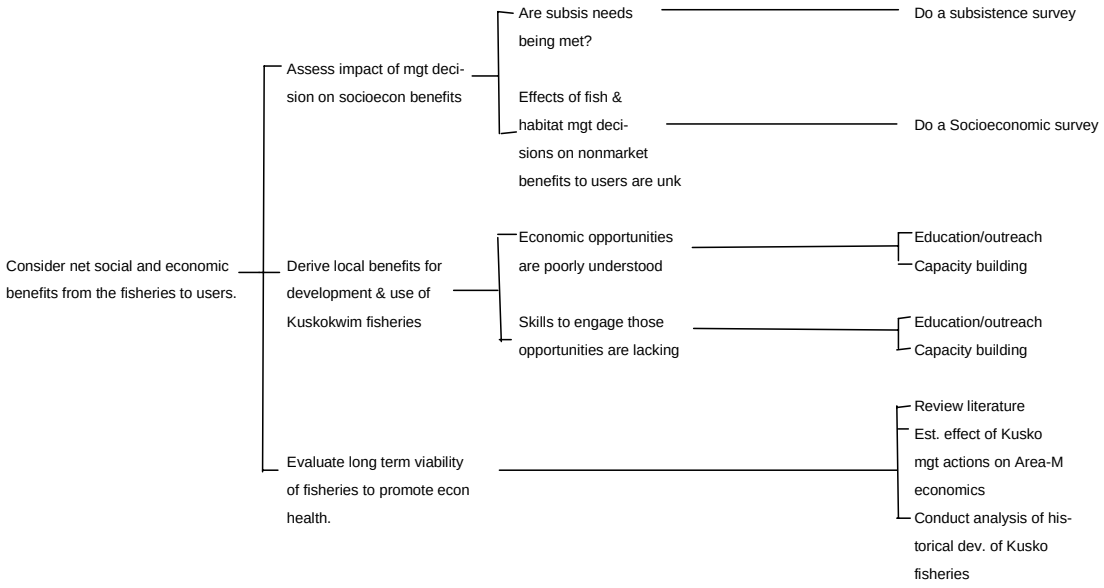


Figure 2e.- Strategic research plan for salmon in the Kuskokwim River drainage: goal to consider net social and economic benefits.

For each objective, there are one or more issues (concerns or problems) that need to be addressed in the planning and carrying out of options. Options are defined as a possible solution or course of action to take to address an issue, such as a research project. Some issues are already being addressed by existing research projects or research activities. One option can address issues across several objectives or even goals. If one option can solve multiple issues, then that option is efficient.

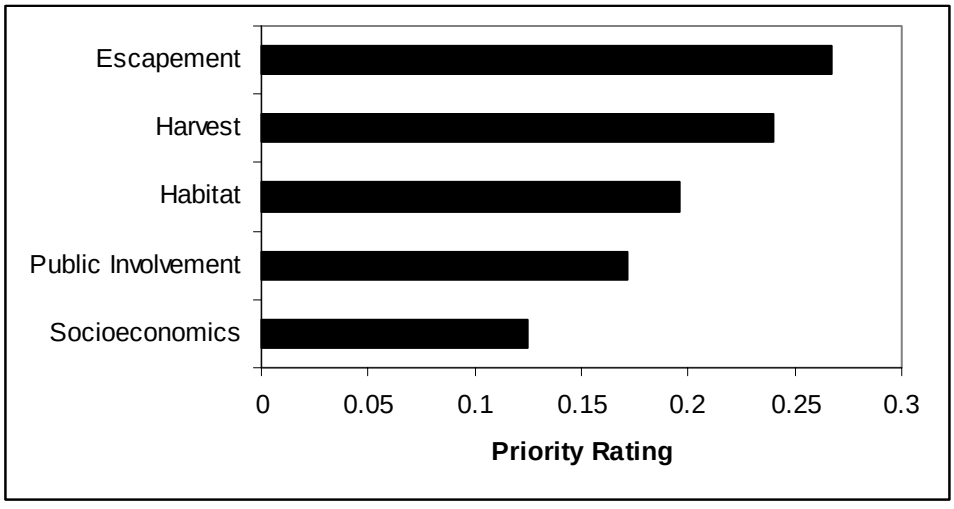
The hierarchical model of the problem and solution set was very large - a total of 255 elements:

Goals	5
Objectives	22
Issues & Sub-issues	58
Options	170
Total	**255**

Of the 170 options, 101 were unique. The goal that generated the greatest number of issues and solutions was, "Maintain wild salmon stock escapements…"; 44.3% of the model's elements were located under this goal.

WEIGHTS OF IMPORTANCE FOR GOALS

The five goals were weighted by the group as to their importance to achieving the mission as follows:



SYNTHESIS OF THE MODEL

Ranked options for the overall model are shown in Figure 3. The top 10% primarily deal with obtaining a total river abundance estimate for king, chum, coho and red salmon employing either mark-recapture or radio telemetry. Although details associated with mark-recapture or radio telemetry methods are not specified, implicit in the recapture and identification of marked fish are such methods as weirs, catch sampling, and harvest surveys. It is not surprising that the highest ranked options drive right to the heart of the problem in the Kuskokwim, because the greatest weight of importance is assigned to the goal, "Maintain wild salmon stock escapements within ranges to sustain salmon production, diversity and normal ecosystem functioning". Repeatedly, throughout the model, are issues related to lack of knowledge regarding total run abundance.

Also in the top 10% of model options are support for public involvement in salmon working groups and planning meetings. The commitment to public involvement by department staff in the Kuskokwim drainage is demonstrated not only in weights of importance directed toward this goal, but also in the funding of projects to achieve this goal.

Within the top 25% of overall model options are analyses and reviews such as:

"Evaluate all existing projects"

"Conduct literature reviews for inference from other studies"

"Analyze the historical development of the Kuskokwim fisheries"

"Conduct an historical gear selectivity analysis"

"Define the Sustained Escapement Threshold"

"Develop forecasting methodology"

"Identify data input needs for the development of forecast methods"

The number of options requesting analytical actions and their rankings suggest that the Kuskokwim River could benefit from the attention of a biometric and scientific team devoted to accomplishing these tasks. Uncertain information impedes the progress of some analyses.

Ranked options by specific goal are found in Appendix B.

DISCUSSION

Basic information on total salmon abundance, proportion of spawning escapement throughout the drainage, and stock specific run timing and exploitation are absent in the Kuskokwim River drainage. This lack of knowledge has frustrated the advancement of establishing a BEG for salmon by managers in the Kuskokwim River drainage. The establishment of a BEG, and thus the ability to manage wild salmon stock escapement within ranges to sustain salmon production, was articulated as the highest priority by the collective expertise of department staff assembled

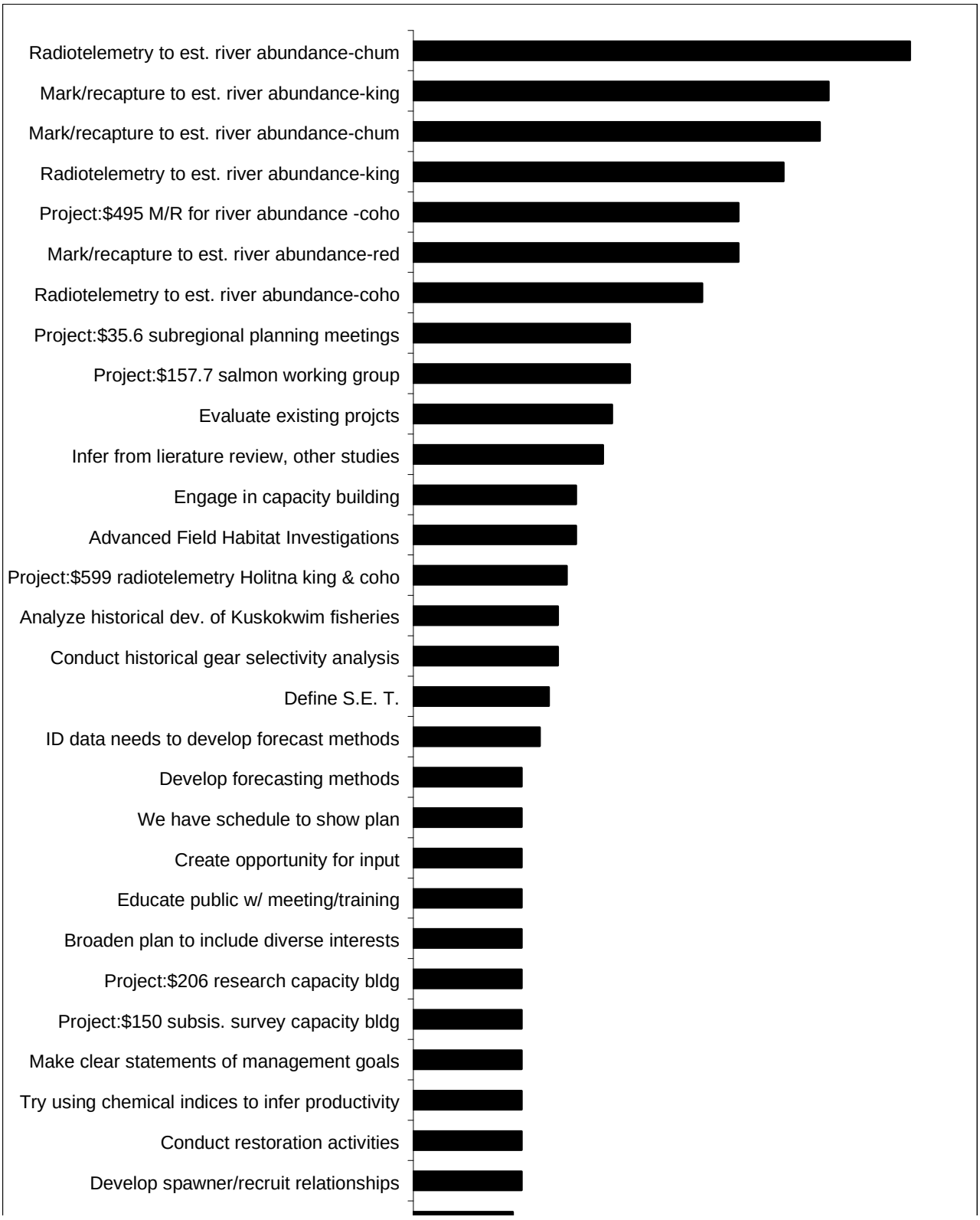


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Figure 3.-The priority of options for addressing issues in the strategic research plan for salmon in the Kuskokwim River drainage.

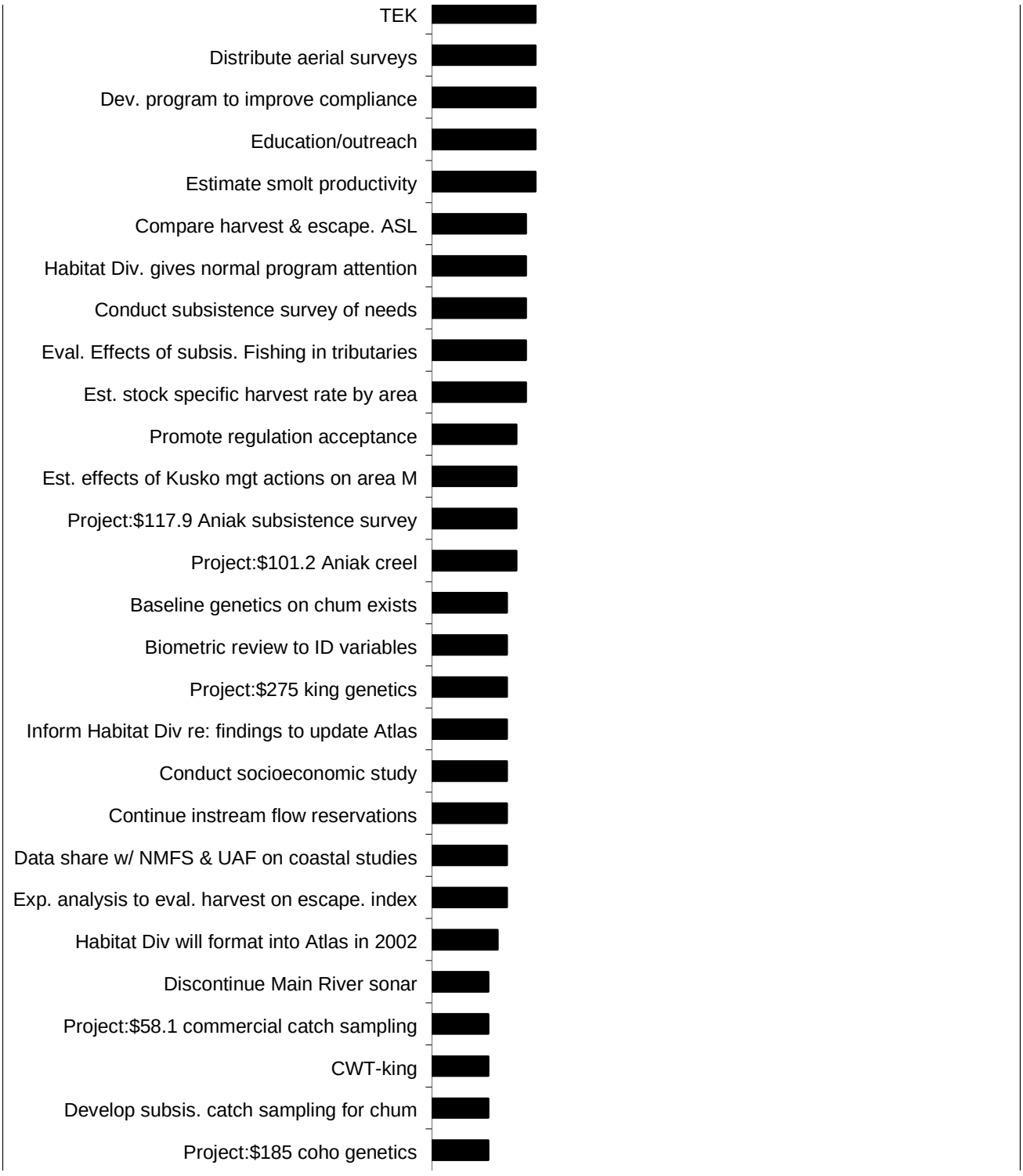

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Figure 3.-Page 2 of 4.

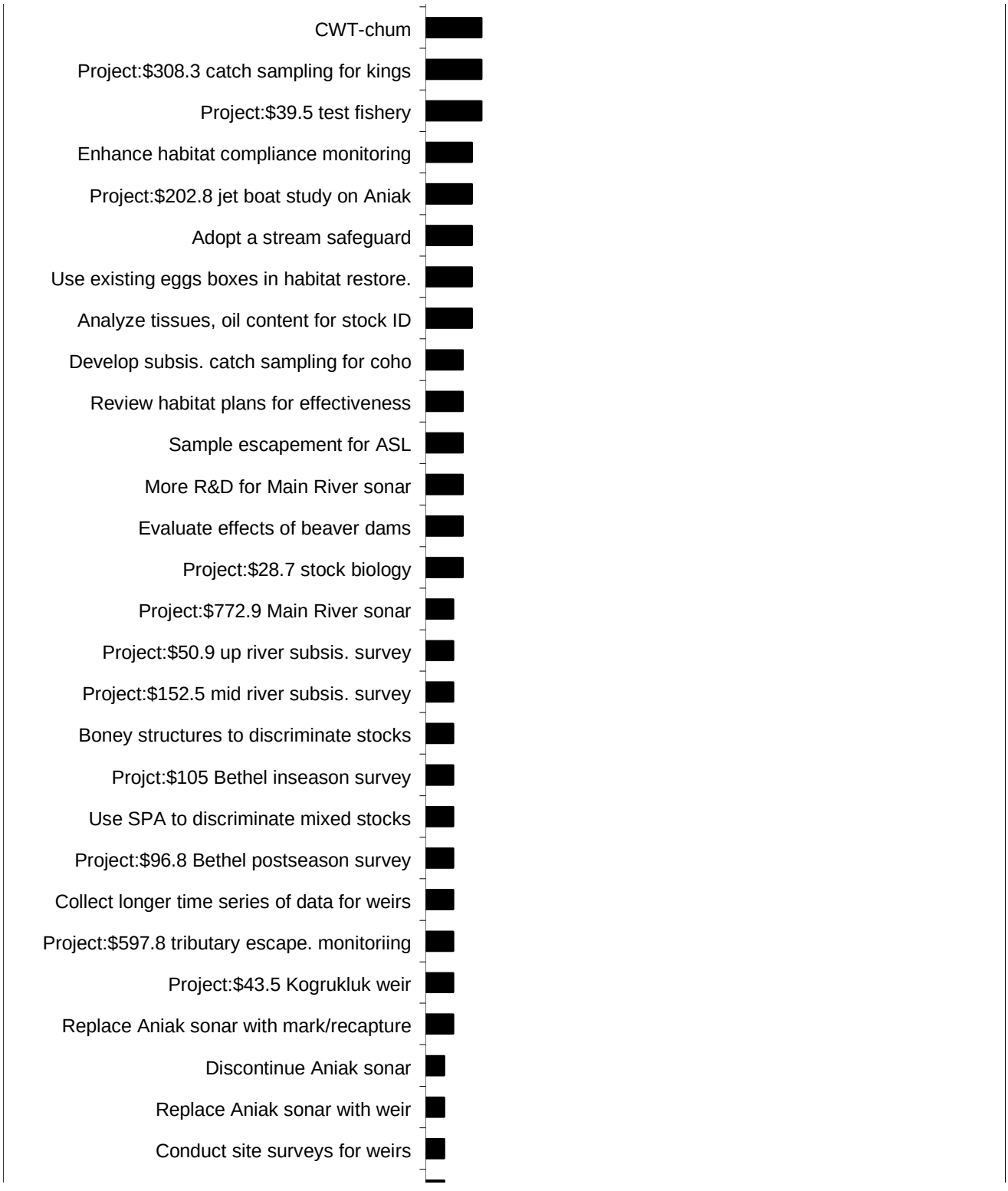

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Figure 3.-Page 3 of 4.

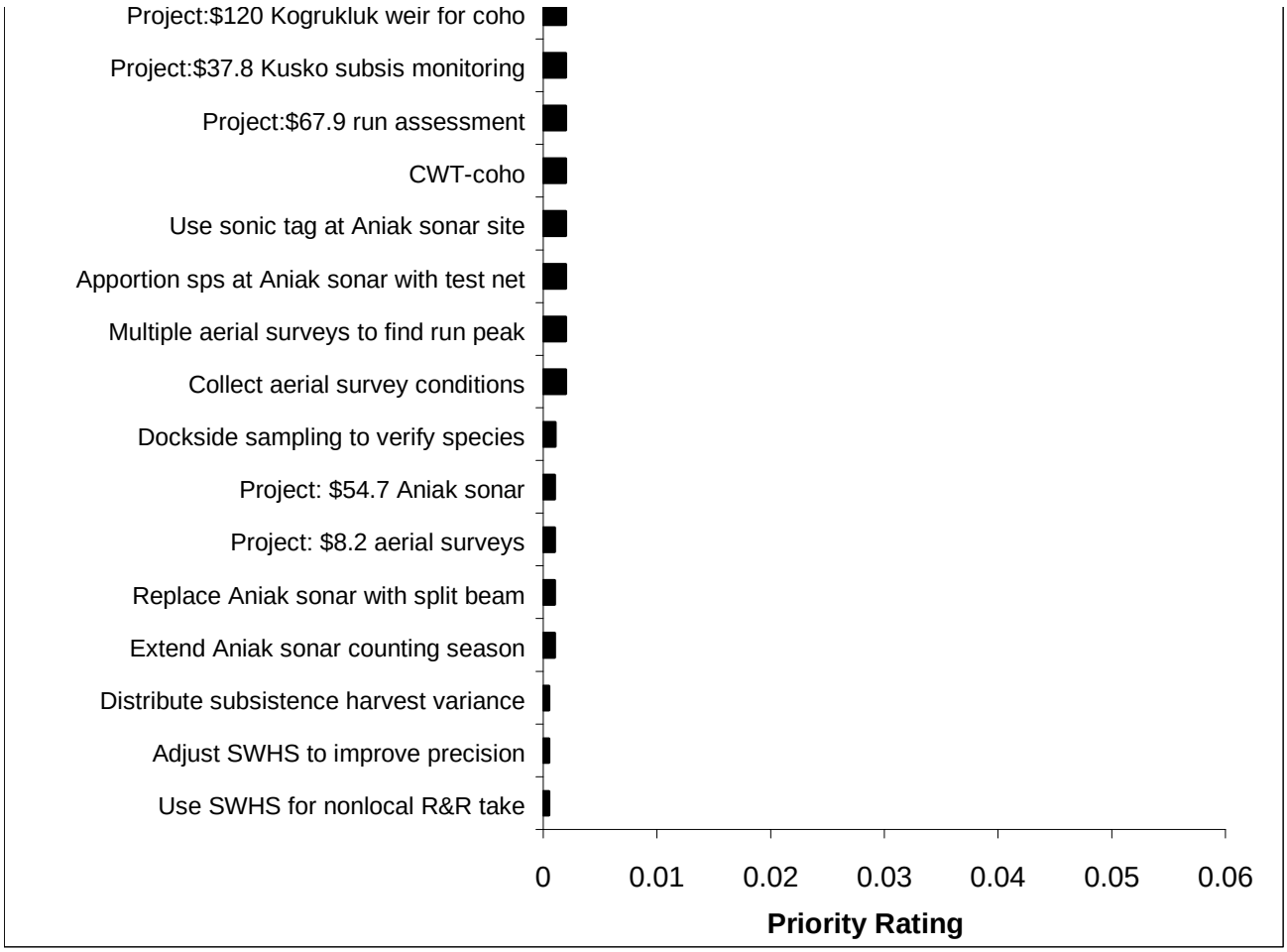

Figure 3.-Page 4 of 4.

for the strategic planning meeting. The department has the sole statutory responsibility in Alaska to manage salmon for sustained yield. This strategic research plan provides an effective structure for defining the complex issues involved in managing for sustained yield in the Kuskokwim. This plan's major achievement is the identification of the projects and actions most likely to answer pressing questions facing state managers of Kuskokwim River salmon, specifically those addressing stocks of concern. The highest priority options identified by the group through consensus are to:

1. Use radiotelemetry and mark/recapture techniques to estimate total run abundance, distribution of the spawning escapement throughout the drainage, and estimate stock-specific run timing through the fisheries for chum salmon.
2. Use radiotelemetry and mark/recapture techniques to estimate total run abundance, distribution of the spawning escapement throughout the drainage, and estimate stock-specific run timing through the fisheries for chinook salmon.
3. Use radiotelemetry and mark/recapture techniques to estimate total run abundance, distribution of the spawning escapement throughout the drainage, and estimate stock-specific run timing through the fisheries for coho/sockeye salmon.

In addition to the above urgently-needed assessment projects for stocks of concern identified in the plan as high priority, are projects with funds designated for public involvement in decision-making related to salmon management in the Kuskokwim drainage.

CONCLUSION

The utility of the strategic research plan can be found in its immediate application in several areas during 2001:

1. Elements were incorporated into a board-mandated Action Plan for stocks of concern.
2. The plan directed research priorities for the Sport Fish Division Fiscal Year 02-03 budget request.
3. The plan was used to develop a $322,000 proposal to the Office of Subsistence Management for salmon research in a major tributary, the Holitna River.
4. Revisions were made to the Kuskokwim Fishery Resource Disaster package to request funding for inriver abundance estimation of chinook and coho salmon.

RECOMMENDATION

A process that ensures the wise use of funds to promote the long term health of salmon and their habitat in the Kuskokwim River drainage includes input from stakeholders. Public input on issues of concern and support of the planning process is vital to the long term success of a strategic approach to salmon research. Next steps in the planning process include defining representation of stakeholders, and assessing the extent of alignment between issues of concern to agency personnel and to stakeholders.

ACKNOWLEDGMENTS

Thanks to Matt Evenson for taking notes during the planning meeting and to Klaus Wuttig for providing technical support with the Expert Choice software. John Burr with Sport Fish Division contributed the section on sport fisheries management, and Mike Wiedmer with Habitat Division supplied text on habitat management in the Kuskokwim drainage. Thanks to Sara Case for formatting and editing the report. Bill Romberg provided helpful review comments.

GLOSSARY

Goal: long term achievement that contributes to accomplishing of mission.

Issue: problems, uncertainties to meeting objectives.

Objective: measurable statement of purpose.

Option: possible solution or course of action to take to address an issue.

Strategic Planning: a continuing process to develop new strategies in response to progress, changes and emerging issues; a systematic activity.

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APPENDIX A

Appendix A.-5 AAC 07.365. Board of Fisheries sanctioned Kuskokwim River salmon management plan.

(a) The objective of the Kuskokwim River Salmon Management Plan is to provide guidelines for the management of the Kuskokwim River commercial salmon fishery which will result in sustained yields of the salmon stocks large enough to provide for subsistence needs and an economically viable commercial fishery.

(b) It is the intent of the Board of Fisheries that the Kuskowkim River king salmon stock be managed in a conservative manner consistent with sustained yield principles and the subsistence priority and, consistent with this intent, that the available surpluses of other salmon stocks be taken. To accomplish these objectives, the department shall mange the Kuskokwim River commercial salmon fishery as follows:

(1) there may not be a directed commercial king salmon fishery;

(2) repealed (6/14/90;

(3) only those waters of District 1 downstream of ADF&G regulatory markers located at Bethel may be open during the first fishing period;

(4) there must be at least three eight-hour fishing periods in June.

(5) Although no directed fishery on king salmon is allowed, the incidental catch guideline harvest level for king salon taken during fisheries directed on other species is 15,000 – 50,000 fish;

(6) To the extent possible, the department shall provide at least 24 hours' advance notice of the opening of District 1 and District 2 fishing periods.

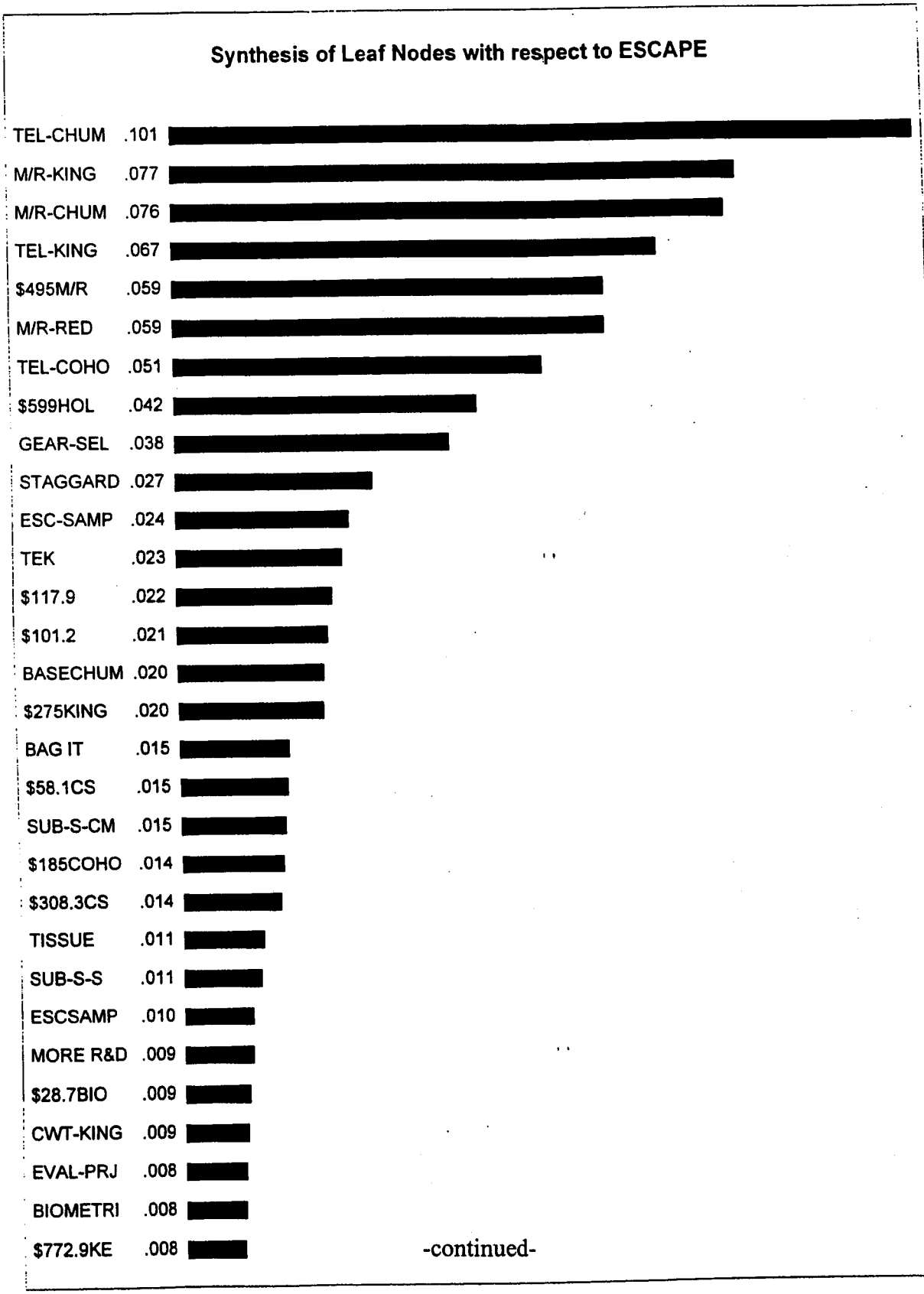
(7) District 1 and District 2 fishing periods are from 1:00 p.m. until 7:00 p.m.; when longer periods are allowed, the extra time is to be divided before 1:00 p.m. and after 7:00 p.m.

(c) A person may not sell salmon roe taken to Districts 1 and 2. (Eff. 6/10/87, Register 102; and 4/2/88, Register 105; am 6/14/90, Register 115; am 6/10/98, Register 146)

Authority: AS 16.05.060 AS 16.05.251

APPENDIX B

Appendix B.-Ranked options by goal.



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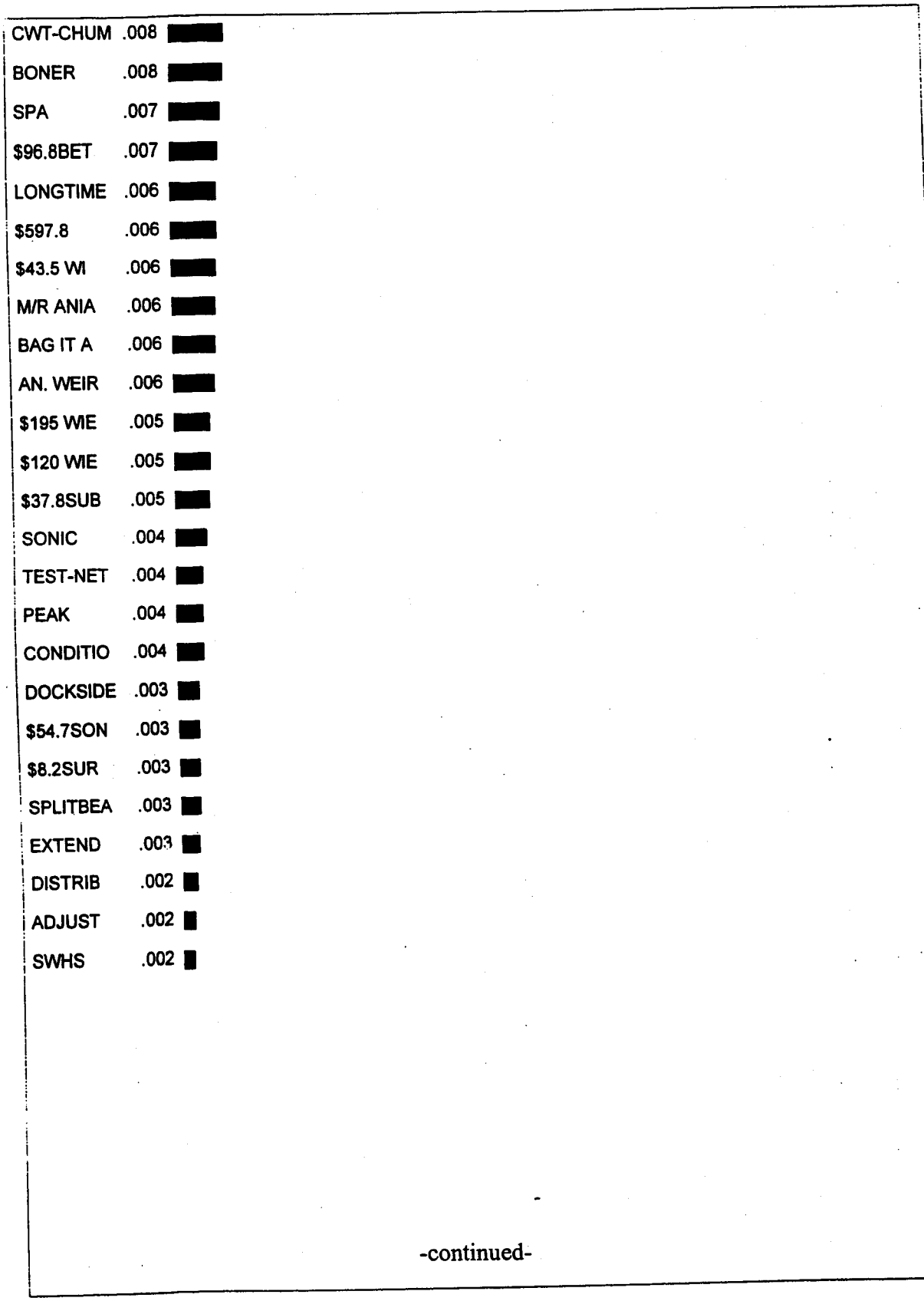
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BONER .008
SPA .007
$96.8BET .007
LONGTIME .006
$597.8 .006
$43.5 WI .006
M/R ANIA .006
BAG IT A .006
AN. WEIR .006
$195 WIE .005
$120 WIE .005
$37.8SUB .005
SONIC .004
TEST-NET .004
PEAK .004
CONDITIO .004
DOCKSIDE .003
$54.7SON .003
$8.2SUR .003
SPLITBEA .003
EXTEND .003
DISTRIB .002
ADJUST .002
SWHS .002

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Synthesis of Leaf Nodes with respect to ESCAPE

Abbreviation	Definition
TEL-CHUM	Radiotelemetry to est abund, timing, inter, distn etc-chum
M/R-KING	M/R using standard tags to est. abund, timing, inter. etc in king
M/R-CHUM	M/R using standard tags to est. abund, timing, inter, etc in chum
TEL-KING	Radiotelemetry to est abund, timing, intercept, distn, etc-kings
$495M/R	Project:$495 for coho mark/recapture study in main stem
M/R-RED	M/R using standard tags to est timing, ASL, intercept in reds
TEL-COHO	Radiotelemetry to est abund, timing, inter, distn etc in coho
$599HOL	Project:$599 Holitna telemetry for kings and coho
GEAR-SEL	Conduct historical gear selectivity analysis
STAGGARD	Distribute aerial surveys to determine distribution of spawners
ESC-SAMP	Compare catch and escapement ASL samples for similarity
TEK	Traditional ecological knowledge study...local knowledge
$117.9	Project:$117.9 Aniak subsistence harvest survey
$101.2	Project:$101.2 Aniak creel
BASECHUM	Baseline genetics information for chum exists
$275KING	Project:$275 king genetics
BAG IT	Discontinue Main River sonar
$58.1CS	Project:$58.1 CF commercial catch sampling program
SUB-S-CM	Develop a subsistence catch sampling program for chum
$185COHO	Project:$185 coho genetics
$308.3CS	Project:$308.3 catch sampling program for kings 50.9+105.0+152.4)
TISSUE	Analyze tissues, oil content to discriminate between stocks
SUB-S-S	Develop a subsistence catch sampling program for coho
ESCSAMP	Sample escapement for age, sex, length composition
MORE R&D	More research-water col, sps distn, site, equipment, sonic tags
$28.7BIO	Project:$28.7 stock biology
CWT-KING	CWT-king
EVAL-PRJ	Evaluate all existing projects..weir,sonar,m/r catch sampling,ect
BIOMETRI	Biometric review to ID variables, examine missing counts
$772.9KE	Project:$772.9 keep Main R sonar (funds 3 sources) 60+89.9+623
CWT-CHUM	CWT-chum
BONER	Test boney structures to discriminate stocks-chemical differences
SPA	Examine Scale Pattern Analysis to discriminate between stocks
$96.8BET	Project:$96.8 Bethel postseason survey (by Sub. Div.)
LONGTIME	Collect a longer time series of escapement data for weirs

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$597.8	Project:$597.8 tributary escapement monitoring
$43.5 WI	Project:$43.5 the existing weir project for Kogrukluk
M/R ANIA	Discontinue Aniak sonar & replace sonar with mark/recapture
BAG IT A	Discontinue Aniak sonar
AN. WEIR	Replace sonar w/weir
$195 WIE	Project for $195.0 George & Tat Riv weirs for coho
$120 WIE	Project for $120.0 for Kogrukluk weir for coho
$37.8SUB	Project:$37.8 Kuskokwim subsistence monitoring
SONIC	Use a sonic tag to eval backdown and sps behavior at sonar site
TEST-NET	Test netting project to apportion species at Aniak sonar site
PEAK	Conduct multiple aerial surveys to determine peak of spawning
CONDITIO	Continue to collect aerial survey conditions to interpret data
DOCKSIDE	Conduct dockside sampling to verify species correct identity
$54.7SON	Project:$54.7 Aniak sonar
$8.2SUR	Project:$8.2 aerial surveys
SPLITBEA	Replace existing sonar with split-beam sonar
EXTEND	Extend counting season of Aniak sonar
DISTRIB	Distribute variance of reported subsistence harvest estimates.
ADJUST	Make adjustments to SWHS to improve precision of angler harvest
SWHS	Try to use SWHS to est nonlocal rod & reel subsistence harvest

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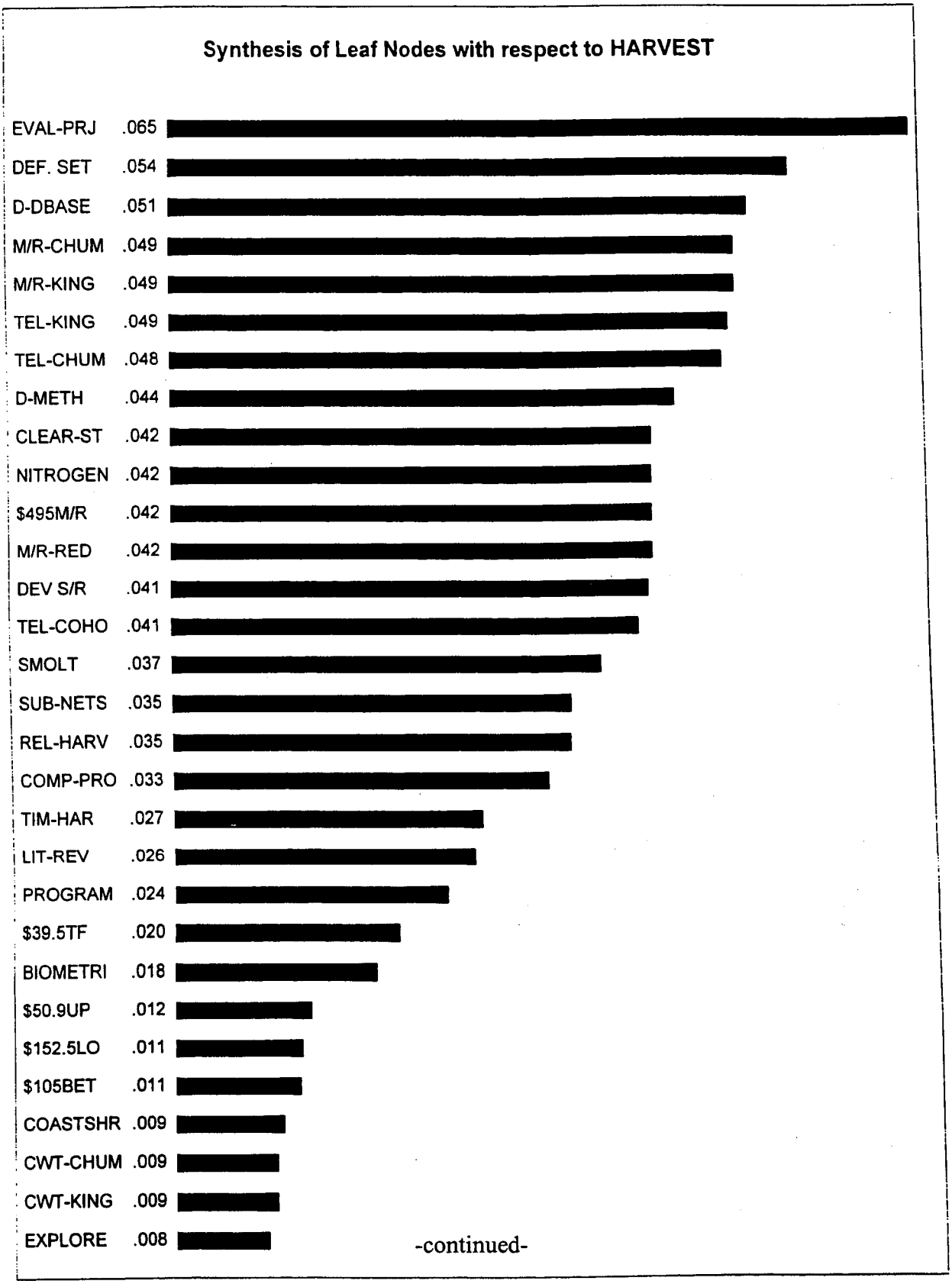
Synthesis of Leaf Nodes with respect to HARVEST
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DEF. SET .054
D-DBASE .051
M/R-CHUM .049
M/R-KING .049
TEL-KING .049
TEL-CHUM .048
D-METH .044
CLEAR-ST .042
NITROGEN .042
$495M/R .042
M/R-RED .042
DEV S/R .041
TEL-COHO .041
SMOLT .037
SUB-NETS .035
REL-HARV .035
COMP-PRO .033
TIM-HAR .027
LIT-REV .026
PROGRAM .024
$39.5TF .020
BIOMETRI .018
$50.9UP .012
$152.5LO .011
$105BET .011
COASTSHR .009
CWT-CHUM .009
CWT-KING .009
EXPLORE .008

-continued-

$67.9RUN	.007	[redacted]
CWT-COHO	.007	[redacted]
TEK	.006	[redacted]

Abbreviation	Definition
EVAL-PRJ	Evaluate all existing projects..weir,sonar,m/r catch sampling,ect
DEF. SET	Define SET threshold
D-DBASE	Identify data needs to develop forecast methods
M/R-CHUM	M/R using standard tags to est. abund, timing, inter, etc in chum
M/R-KING	M/R using standard tags to est. abund, timing, inter. etc in king
TEL-KING	Radiotelemetry to est abund, timing, intercept, distn, etc-kings
TEL-CHUM	Radiotelemetry to est abund, timing, inter, distn etc-chum
D-METH	Develop methods for forecasting: catch-age,sibling,smolt, etc
CLEAR-ST	Managers should make clear statements of management goals
NITROGEN	Examine using chemical indices (N, alk, P) to infer productivity
$495M/R	Project:$495 for coho mark/recapture study in main stem
M/R-RED	M/R using standard tags to est timing, ASL, intercept in reds
DEV S/R	Develop spawner/recruit relationships
TEL-COHO	Radiotelemetry to est abund, timing, inter, distn etc in coho
SMOLT	Estimate smolt productivity
SUB-NETS	Evaluate the impact of subsistence fishing in tributaries
REL-HARV	Estimate stock specific harvest rate by geographic area
COMP-PRO	Promote/educate public regulation acceptance/understanding
TIM-HAR	Experimental data anal. to eval. effects of harv. on escap. index
LIT-REV	Infer from literature review, other studies
PROGRAM	Dev. program w/FWS & FWP to assess and improve compliance.
$39.5TF	Project:$39.5 test fishery
BIOMETRI	Biometric review to ID variables, examine missing counts
$50.9UP	Project:$50.9 upper subsistence harvest survey
$152.5LO	Project:$152.4 lower (mid) river subsis. sampling survey
$105BET	Project:$105 Bethel inseason subsistence harvest survey
COASTSHR	Data share w/ NMFS, UAF on coastal marine information
CWT-CHUM	CWT-chum
CWT-KING	CWT-king
EXPLORE	Conduct site surveys for weirs
$67.9RUN	Project:$67.9 run assessment

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CWT-COHO	CWT coho
TEK	Traditional ecological knowledge study...local knowledge

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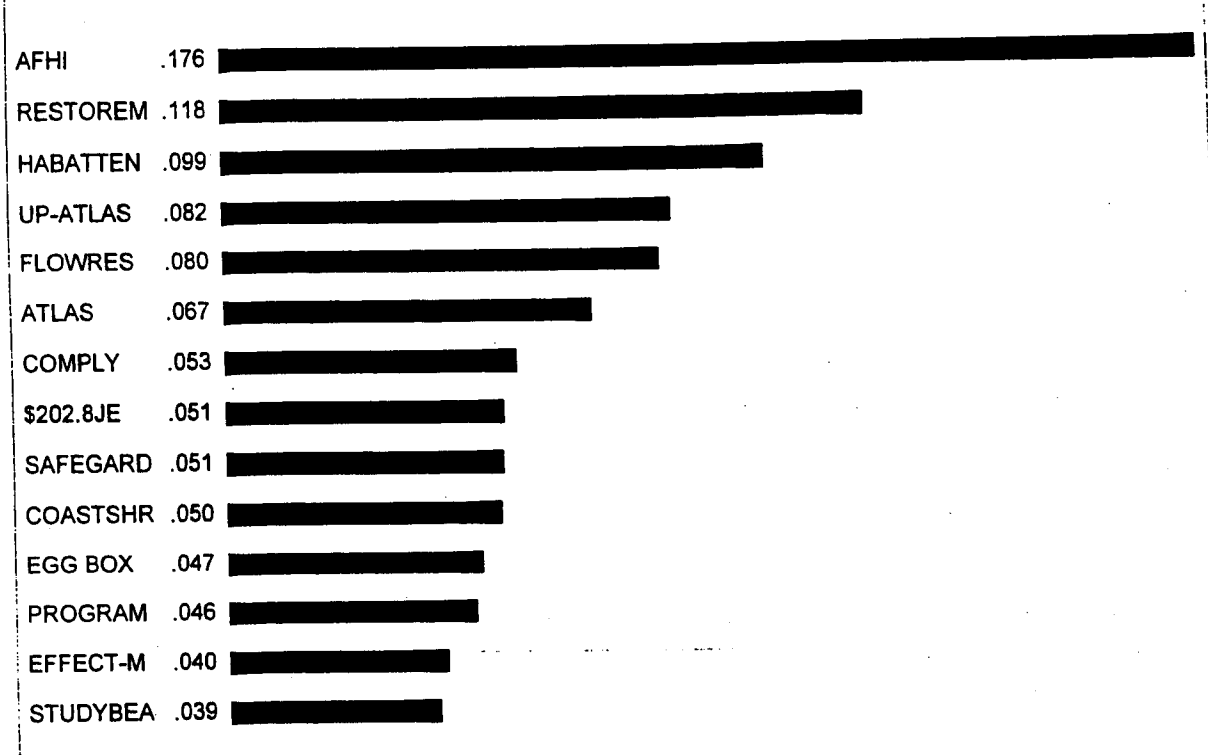

Abbreviation	Definition
AFHI	Accelerated field habitat investigations (AFHI) project $200k
RESTOREM	Conduct restoration activities
HABATTEN	Habitat Div gives normal attention as part of its regular program
UP-ATLAS	Inform Hab. Div re: research findings so they can update Atlas
FLOWRES	Continue instream flow data gathering & reservations
ATLAS	Habitat Div will format existing info into Atlas in 2002
COMPLY	Enhance compliance monitoring
$202.8JE	Project: $202.8 jet & prop boat study in Aniak
SAFEGARD	Adopt a stream safeguard
COASTSHR	Data share w/ NMFS, UAF on coastal marine information
EGG BOX	Use existing egg boxes
PROGRAM	Dev. program w/FWS & FWP to assess and improve compliance.
EFFECT-M	Review habitat plans for effectiveness
STUDYBEA	Evaluate the effects of beaver dams by species-study

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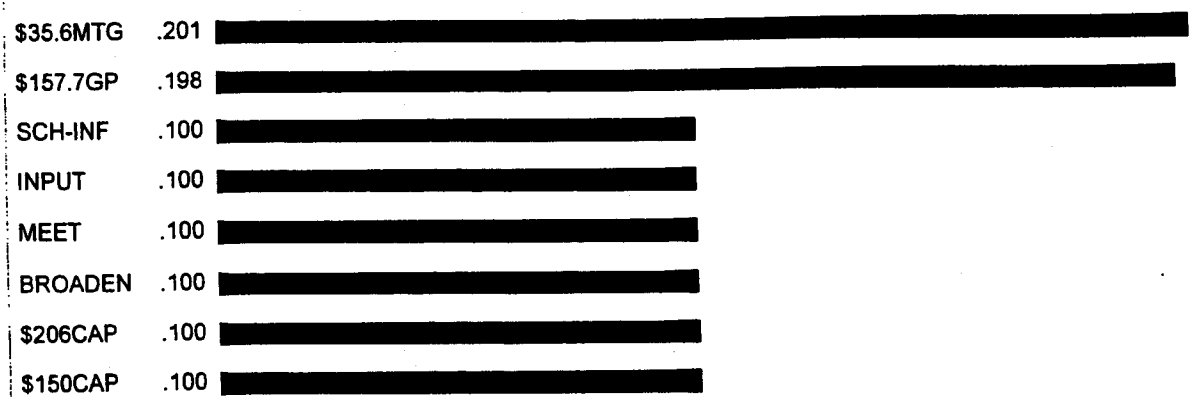
Synthesis of Leaf Nodes with respect to PUBLIC



Abbreviation	Definition
$35.6MTG	Project:$35.6 for four subregional planning meetings
$157.7GP	Project:$157.7 for public salmon working group
SCH-INF	We have a schedule by which to inform stakeholders of plan
INPUT	Create opportunity for input and adjust plan as needed
MEET	Educate with meeting/training
BROADEN	Where applicable, broaden plan to include diverse interests
$206CAP	Project:$206 stock assessment research capacity building
$150CAP	Project:$150 subsistence survey capacity building

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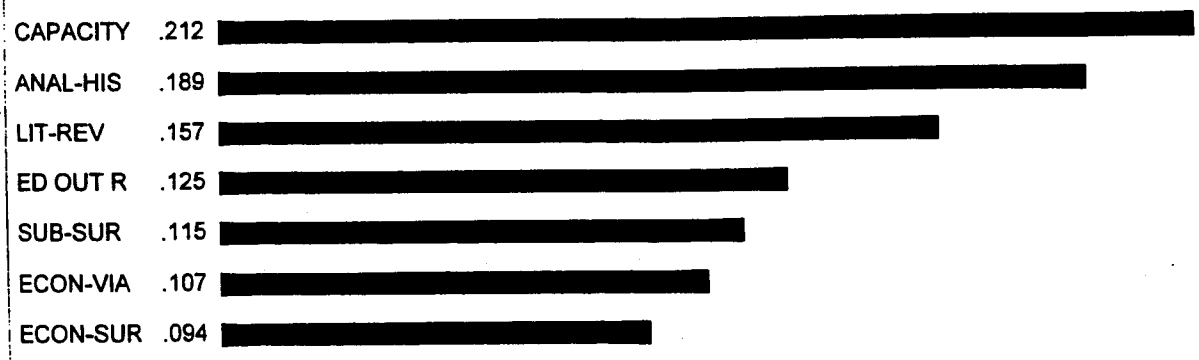
Synthesis of Leaf Nodes with respect to SOC-ECON



Abbreviation	Definition
CAPACITY	Engage in capacity building
ANAL-HIS	Analysis of historical development of Kuskokwim fisheries
LIT-REV	Infer from literature review, other studies
ED OUT R	Education/outreach
SUB-SUR	Conduct subsistence survey of needs
ECON-VIA	Estimate affect of Kusko management actions on area-M economics
ECON-SUR	Conduct a socioeconomic survey

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