Planning and Evaluation with the Analytic Hierarchy Process

Steller Sea Lion Mitigation Committee

Seattle

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Resource Decision Support

This presentation includes

- **Introduction to strategic planning**
  - How the planning process works
  - Philosophies of planning
- **Dealing with complexity: Systems Analysis and the The Analytic Hierarchy Process**
  - Applications
  - Structuring and the rating scale
  - Criteria
  - Making and combining judgments
  - Synthesis and examples
- **Strawdog**

Introduction to Strategic Planning

- **Strategic:** Long term future based on goals
  - Most fisheries plans have a 3-5 year time horizon

- **Planning:** A repetitive decision making activity involving thinking & social processes that help to design what is perceived as a desirable outcome based on future goals.

"Are we doing the right thing?"

How the Planning Process Works

- **Recognize there is a problem**
- **Who should participate and how?**
  - **Who will clarify the situation and define criteria?**
  - **Who will offer judgments (vote)?**
  - **Will participation be through review, panel, or at the table?**
- **Identify the scope**
  - **Geographic area**
  - **Cast of characters**
  - **Time frame(s); e.g., short term, long term**
- **Identify expected products and time line**

How the Planning Process Works

- **Select a planning approach**
  - **Top/down: You know the ruling, but are not sure which proposals will help to stay above the "jeopardy bar"**
- **Select a decision technique. The benefits of using a formal decision technique include:**
  - **clearly defined objectives**
  - **the ability to incorporate various information sources**
  - **consideration of multiple perspectives**
  - **an increased likelihood of finding an optimal solution.**
- **Prepare for the meeting**

Philosophies of Planning

- **Incremental (see Lindblom)** Identifies a course of action that is just good enough to produce reasonable improvement
  - political bargaining
  - building coalitions

- **Operations Research (see Hillier & Lieberman)** Quantitative models & optimization methods seek a solution which is in an objective state
  - forecasting models
  - decision analysis (MAUT, decision trees)

- **Systems Analysis (see Saaty)** The whole of a complex system and the relationships of its parts is analyzed
  - Analytic Hierarchy Process (AHP)

Dealing with Complexity

- **A complex problem is characterized by:**
  - **Diffused authority, multiple jurisdictions across a vast area**
  - **Research or management involves many disciplines**
  - **Incomplete knowledge and uncertainty**
- **1950's: Systems research developed for solving complex problems**
- **1970's: AHP applied in the fields of military science, medicine, engineering, policy, business**
- **1990's: AHP applied in the fields of fisheries, natural resource allocation and restoration**

Fisheries Applications of the AHP

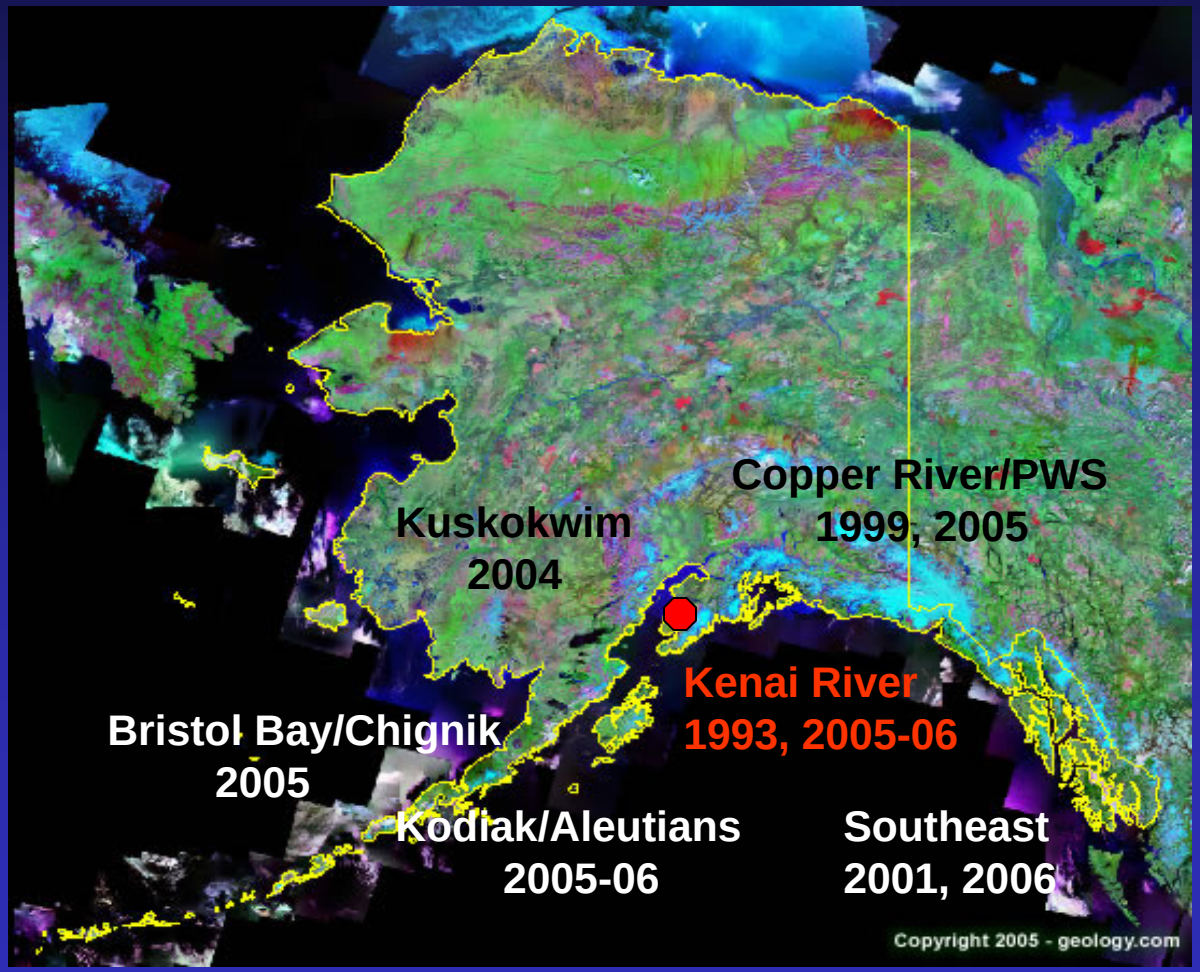
Strategic planning for salmon (and non-salmon) research and management

Merritt & Criddle 1993

Merritt 1999, 2004

Merritt & Skilbred 2001

USFWS 2005, 2006

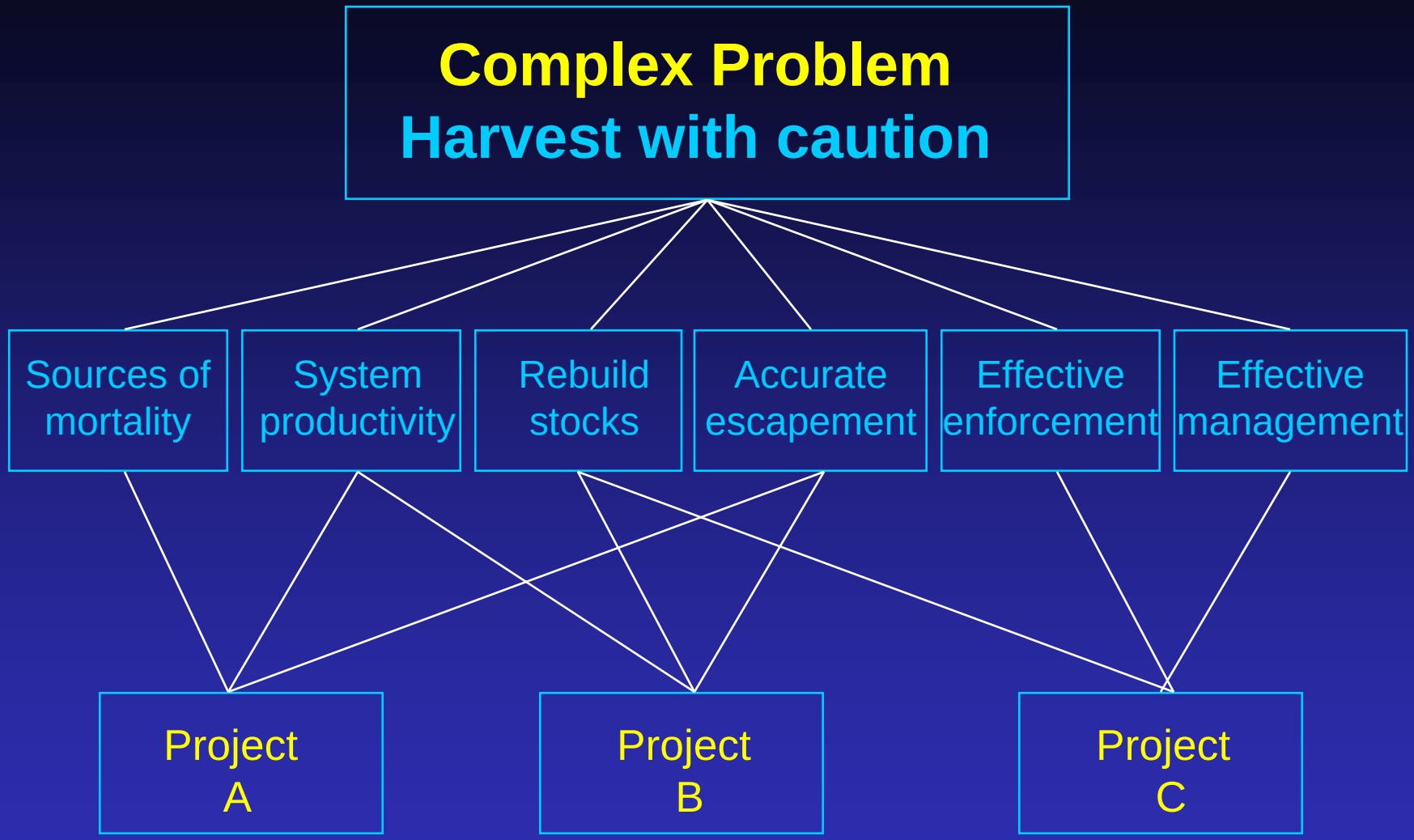


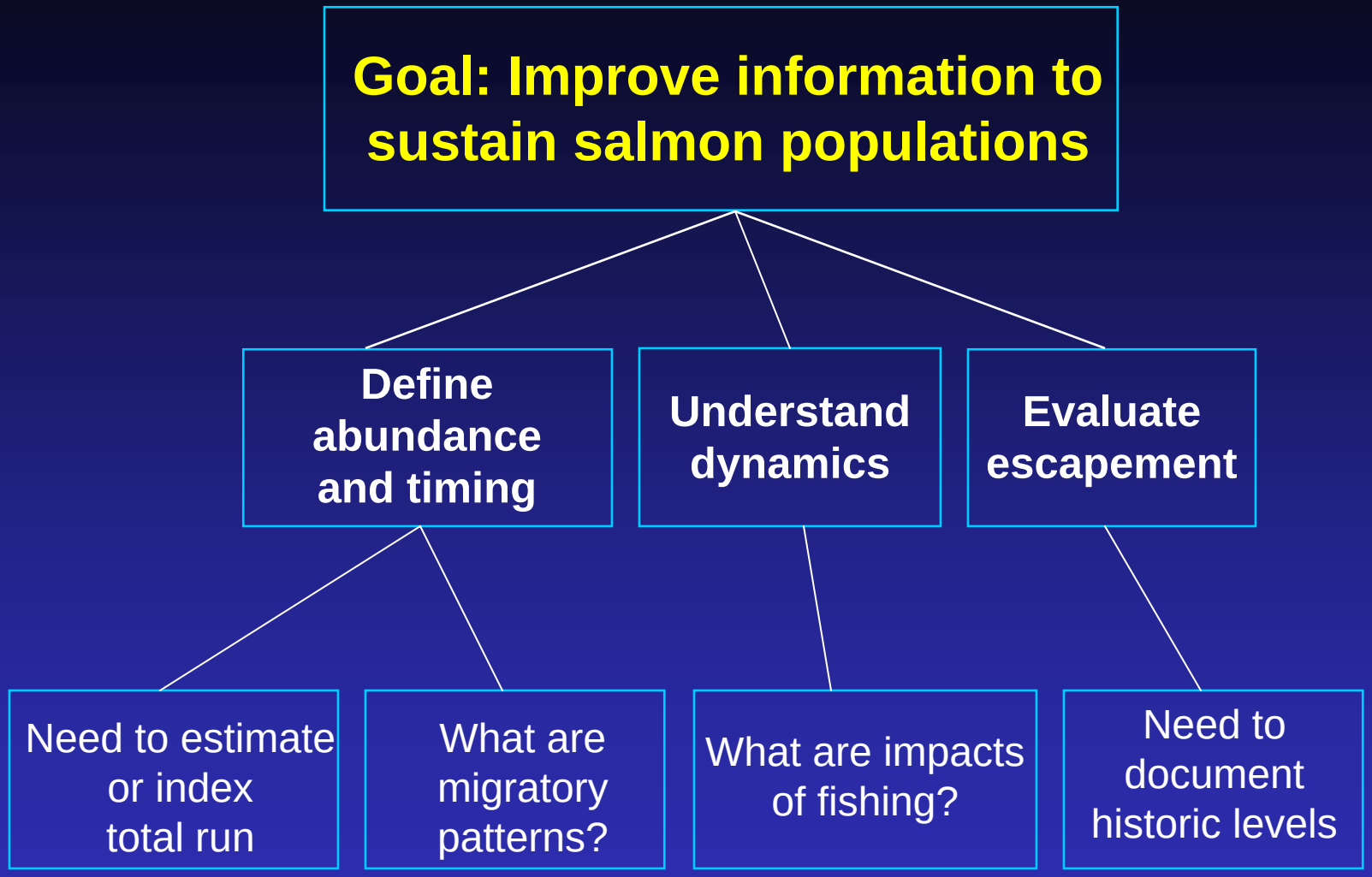
More Applications of the AHP

- **PingSun Leung, Univ. Hawaii 1998-2006**
  - **Evaluating fisheries management options**
- **Mark Ridgley, Univ. Hawaii 1994-2006**
  - **Evaluation of restoration policies for a Rhine estuary**
- **Gerard DiNardo, Univ. of Maryland 1989**
  - **Manage Maryland's river herring fishery**
- **NEFC, NMFS 1990**
  - **Guidance on the FY91 research program (cutbacks)**
- **Dave Mackett, SWFC, NMFS 1985**
  - **Systems Analysis: Strategic planning for research and management of the albacore tuna fishery**

Analytic Hierarchy Process

- **What is AHP?**
  - A systems approach for thinking: examine parts of the whole system and their linkages
  - A tool for integrating expert judgments
- **Why AHP?**
  - Clearly & concisely communicates the problem
  - Considers different points of view
  - Encourages explicit statements of preference, importance
  - Increases the likelihood of finding an optimal solution
- **How does it work?**
  - Structures the problem into a hierarchy
  - Prioritizes elements based on judgments


Complex Problem
Harvest with caution
Sources of mortality
System productivity
Rebuild stocks
Accurate escapement
Effective enforcement
Effective management
Project A
Project B
Project C


Goal: Improve information to sustain salmon populations
Define abundance and timing
Understand dynamics
Evaluate escapement
Need to estimate or index total run
What are migratory patterns?
What are impacts of fishing?
Need to document historic levels

Rating Scales

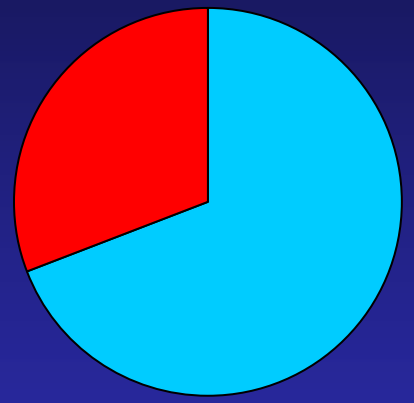
9 Extremely important

7 Very strong

5 Strong

3 Moderate

1 Slight

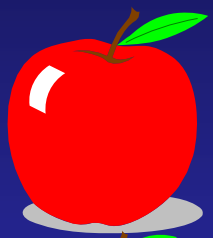


Criteria for Weighting

Use criteria to help judge importance (or preference) among elements in a group:

- **Degree of allocation conflict & intensity of management**
- **Degree of conservation concerns; or, vulnerability of stocks to overexploitation**
- **Is there a sequential nature, where inquiry into one area is pending the results from some other area?**

Use Expert Judgment to Compare

Size Comparison	Apple A	Apple B	Apple C	Resulting Priority Eigenvector	Relative Size of Apple
 Apple A	1	2	6	6/10	0.6
 Apple B	1/2	1	3	3/10	0.3
 Apple C	1/6	1/3	1	1/10	0.1

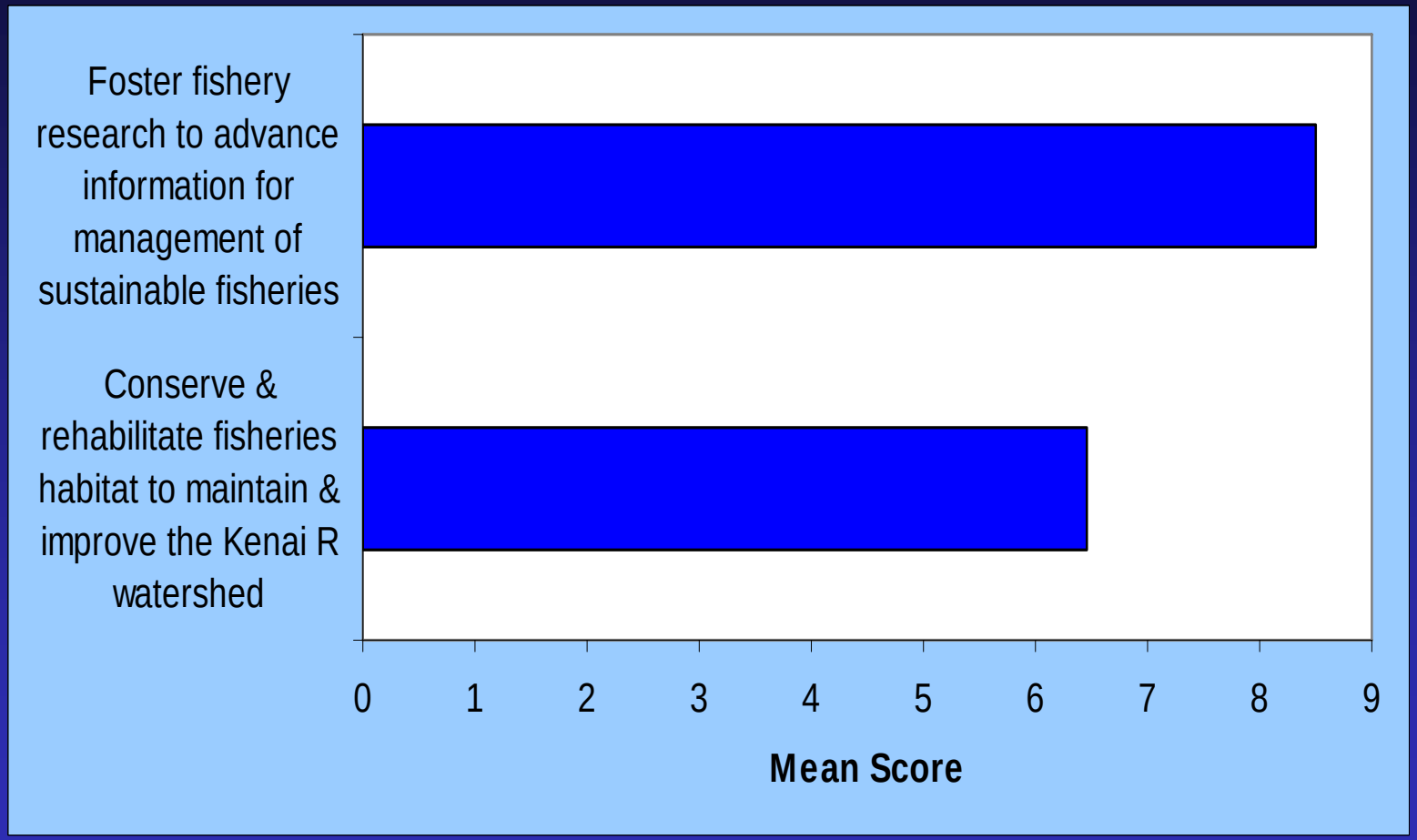
Sum column numbers.
Divide each number by column total to obtain a normalized matrix.
Obtain the average across each row.
This gives normalized relative priorities = approximate eigenvector.

Combining Judgments

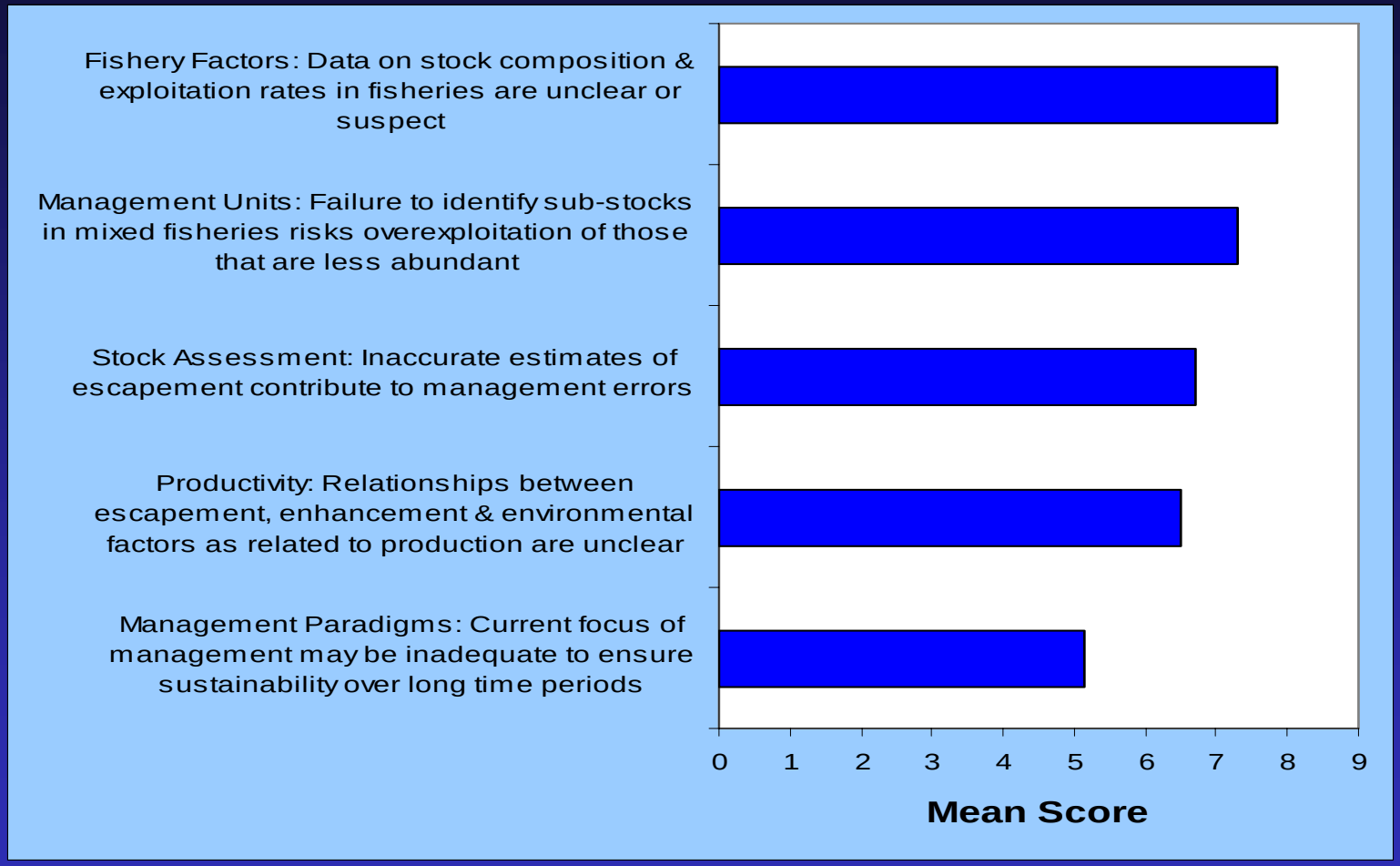
- **Dissent & debate**
  - Explores alternative viewpoints
  - Debate can bring judgments closer through learning
  - Leads to understanding & cooperation
  - A well-informed person can effect change in belief !

- **When consensus is lacking:**
  - The geometric mean is the appropriate method for combining judgments made on a ratio scale
  - We record the spread

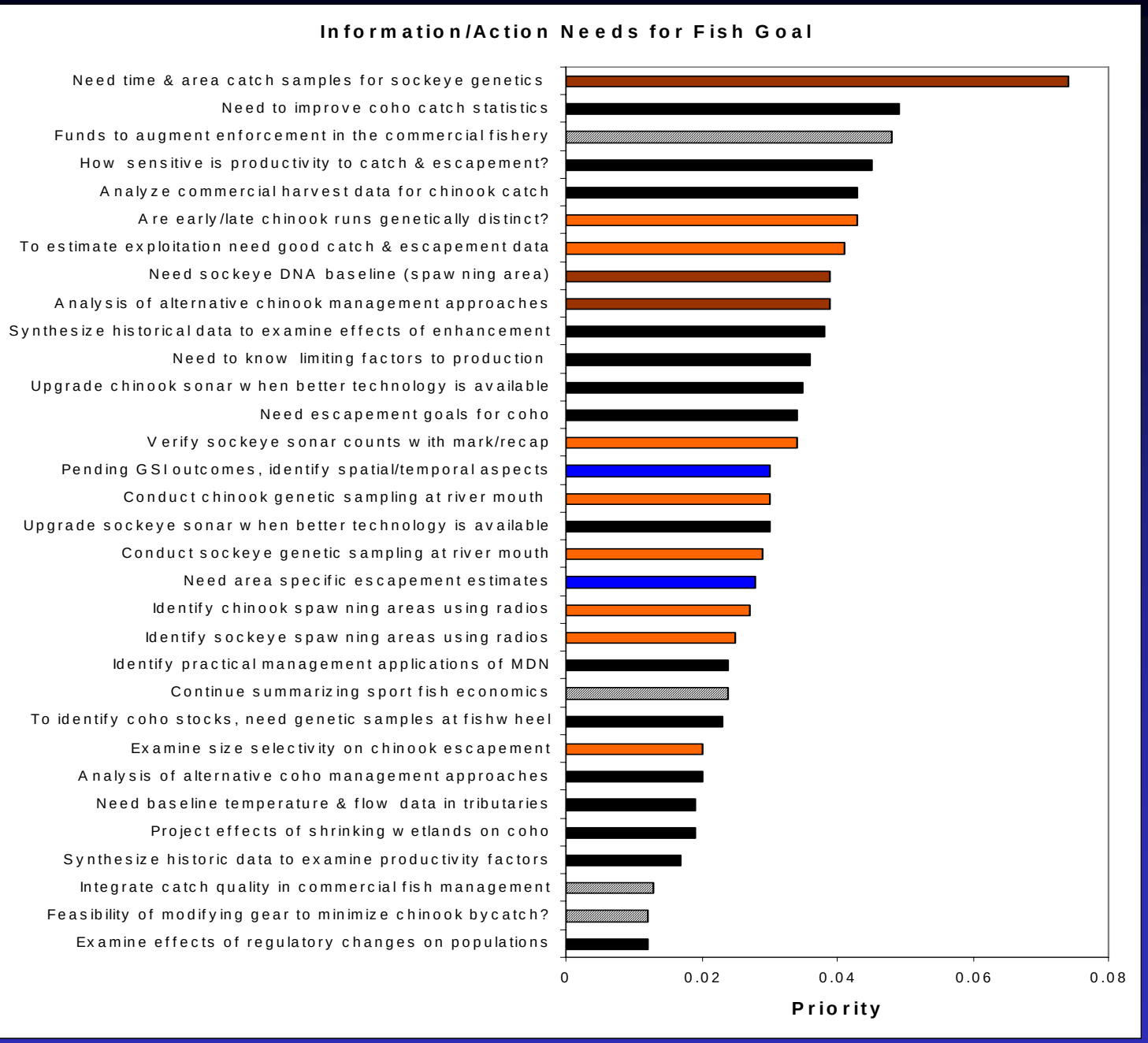
Synthesize to Get Priorities



Fishery Problems



GOAL		PROBLEM		OBJECTIVE		INFORMATION/ACTION NEED	
				0.045	1.Determine accuracy/precision of stock composition estimates in sport & commercial harvests	0.025	a.Need commercial fishery time & area catch samples for sockeye genetics (ADFG study)
						0.020	b.Need to improve coho sport & commercial catch statistics
		0.133	A. "Fishery Factors" Data on stock composition & exploitation rates are unclear or suspect.				
				0.045	2.Evaluate the occurrence, variability & risks of & selectivity and exploitation rates in sport & commercial fisheries	.030	a.To estimate exploitation first need good basic harvest & escapement data
						.015	b.Need to examine size selectivity effects on Chinook escapement & diversity
				0.043	3.Explore methods for minimizing incidental Chinook catch & maximizing target sockeye catch in commercial fisheries.	0.020	*a.Need funds to augment enforcement in the commercial fishery.*
						0.018	b.The existing commercial harvest data base can be analyzed more extensively to examine Chinook time & area stock composition
0.568	1.Foster fishery research to advance information for management of sustainable salmon fisheries.					0.005	*c.What is feasibility of gear modifications to minimize Chinook bycatch ?*
				0.051	1.Determine if Chinook (early/late runs), sockeye (late run), coho (early/late runs) are comprised of genetic substocks returning to different areas.	0.021	a.Need to know if "early" & "late" designations of the Chinook return are genetically distinct by sampling trib & mainstem spawn areas
						0.019	b.Need to have a DNA baseline (spawning area) for all sockeye stocks (ADFG study)
						0.011	c.Pending GSI outcomes from Chinook, sockeye, coho, synthesize to examine identification of spatial/temporal aspects
		0.124	B. "Management Failure to identify sub-stocks in mixed risks overexploitation those that are less			0.010	a.Need to conduct Chinook genetic sampling at river mouth (ADFG study)
						0.009	b.Need to identify important spawning areas for Chinook using radio telemetry
				0.040	2.Determine if genotypic differences are reflected in phenotypic characteristics (e.g., timing, size)	0.008	c.Need to identify important spawning areas for sockeye using radio telemetry
						0.007	d.Need to conduct sockeye genetic sampling at river mouth
						0.006	e.To understand & estimate coho stock ID, need fishery genetic samples at fishwheel
				0.033	3.Identify habitat conditions (e.g., temperature, hydrograph) related to differences in substock structure & characteristics.	0.017	a.Need baseline annual temperature & flow data in tributary streams.
						0.016	b.Project effects of shrinking wetlands on coho



Key

Black: open to proposals

Blue: funded & remains open

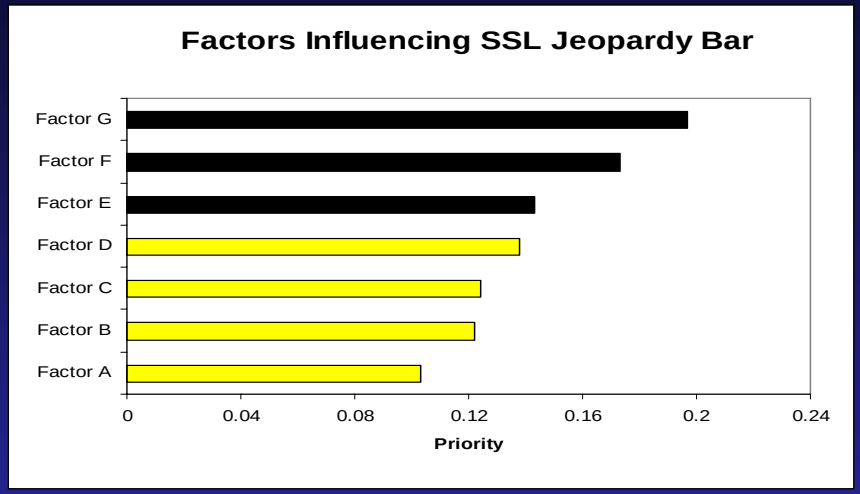
Orange: funded, not open

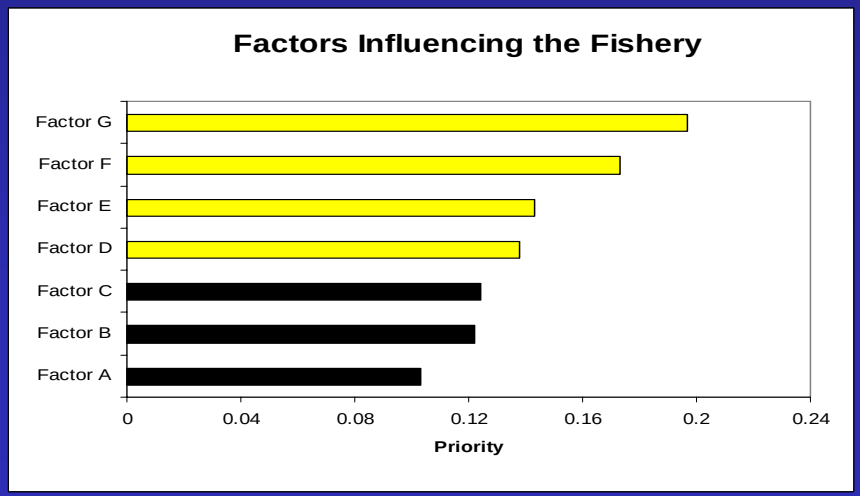
Brown: other funds, not open

Striped: not eligible

Stage I: Strawdog

- **Goal: Evaluate proposals for change in SSL protection measures. To what degree would a proposal affect SSL? the fishery?**
  - **Factors influencing degree of benefits (impacts) to the SSL. The objective is to identify scenario that will keep situation "above jeopardy bar".**
    - **Fish**
      - **Abundance of target species**
      - **Diversity of fish assemblage (alternative prey)**
      - **Response of fish to fishing**
      - **Proximity to SSL site (3, 10, 20 nm)**
    - **SSL**
      - **Type of site**
      - **Abundance of SSL during fishing season**
    - **Predators**
      - **Abundance at SSL site**
    - **Fishery**
      - **Gear type**
      - **Proximity of fishing to SSL site**
      - **Duration of fishery**
      - **Season of fishery**
  - **Factors influencing degree of benefits (profit loss) to fishing industry. The objective is to identify scenario with positive socioeconomics.**
    - **Fish**
      - **Abundance of target species**
      - **Diversity of fish assemblage (bycatch)**
      - **Response of fish to fishing**
    - **SSL**
    - **Fishery**
      - **Gear type (social issue)**
      - **Proximity of fishing to fish (economic issue)**
      - **Duration of fishery**
      - **Season of fishery**
      - **Catch rate**
    - **Public opinion**





Stage II:
Develop Criteria to Evaluate Proposals

Weight	Criterion
9	Addresses strategic priorities
9	Resolves or lessens conflict
7	Collects information to address data gaps
6	Technical merit, feasibility, likelihood of success
5	Develops partnerships
5	Public outreach, improves public opinion
4	Administrative/implementation cost

Summary

- **Strategic planning using the AHP can achieve these products:**
  - **Identification and prioritization of objectives and factors impacting objectives;**
  - **A clear and concise framework for communication;**
  - **Increased knowledge of research and management concerns through facilitated discussions; and,**
  - **An increased chance of finding an optimal solution that will have credibility and acceptance.**