AN ASSESSMENT OF THE ENTRAPMENT ZONE AND OTHER ESTUARINE SURROGATES FOR MANAGING FRESHWATER INFLOW TO THE SAN FRANCISCO BAY ESTUARY

Report of a Workshop
held at the
Bay Conference Center
Tiburon, California
27-29 August 1991

MARINE SCIENCES RESEARCH CENTER

STATE UNIVERSITY OF NEW YORK

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COAST Institute

of the

Marine Sciences Research Center

J.R. Schubel
Project Director

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INTRODUCTION

This report summarizes the principal conclusions and recommendations of a workshop held at the Bay Conference Center in Tiburon, California on 27-29 August 1991. The goals set for the workshop are stated in Exhibit 1.

EXHIBIT 1

PRE-WORKSHOP GOALS

•To critically review the current understanding of entrapment processes and phenomena in San Francisco Bay and to assess the importance of the entrapment zone (EZ) to the estuarine ecosystem. The workshop will examine how entrapment occurs, to what extent it occurs in a single, well-defined EZ, how various freshwater flow scenarios affect the position of the EZ and how EZ position affects biological components of the estuary. Participants will identify scientific areas of agreement and disagreement.

This assessment will provide the basis for pursuing the remainder of the goals -- the raison d'être of the workshop.

•To evaluate the scientific validity of using the position of the entrapment zone as a surrogate for managing freshwater inflow to protect the San Francisco Bay ecosystem and important societal values and uses.

•To identify and evaluate the scientific validity of other estuarine properties and phenomena as potential surrogates for managing freshwater inflows to protect the ecosystem and important societal values and uses of San Francisco Bay.

•To assess how the value of the position of the EZ and other surrogates for managing freshwater inflows to San Francisco Bay would be affected by other management and engineering actions.

The agenda for the workshop is included as Appendix A. The participants and their affiliations are listed in Appendix B.

White papers were prepared and distributed to workshop participants several weeks before the workshop. The papers summarized data and information relevant to the workshop so that meeting time at the workshop could be used more effectively. The titles and authors of the white papers are included in Appendix C. The papers are contained in a supplement to this report and are available upon request. Discussion of the issues identified in the white papers was the first important order of business for the workshop.

SUMMARY OF THE EVALUATION OF THE EZ AS A TOOL FOR MANAGING INFLOW TO THE BAY

Exhibit 2 summarizes the major points of agreement and conclusions of workshop participants on the use of the entrapment zone as a tool for managing freshwater inflow to San Francisco Bay. Exhibit 2 is based upon a facilitated discussion of the white papers by the workshop participants. The summary was presented at the workshop and all agreed that it was a comprehensive and accurate summary of the major conclusions they had reached.

EXHIBIT 2

CONCLUSIONS CONCERNING THE USE OF THE EZ AS A TOOL FOR MANAGING FRESHWATER INFLOW TO SAN FRANCISCO BAY

- The value of the position of the EZ as a tool for managing freshwater inflows may have been exaggerated because of the

(1) Large uncertainty in understanding the importance of EZ position and EZ processes to sedimentation, to nutrient cycling, to contaminant cycling, to biology, etc. It's not only EZ position that counts, but also strength of the EZ.

(2) Poor correlation between EZ position and important "values," e.g. success of year classes of striped bass.

(3) Difficulty in measuring the position of the EZ precisely and accurately.

(4) Existence in San Francisco Bay of multiple EZs of different kinds and causes.

- The terms entrapment zone, turbidity maximum and null zone are related, but are not synonymous.

- Measuring surface salinity is not the best way to establish the location of the EZ, the turbidity maximum or the null zone. Some measure of bottom salinity (combined with optical back scattering) would be better -- more diagnostic.

- There is significant scatter in the relationship of the position of the EZ to success of year classes of important species.

- The use of <u>surface</u> salinity to define the location of the EZ adds bias and ambiguity to apparent EZ position.

- A number of processes contribute to formation and maintenance of the EZ and, at certain times of the year there may be more than one EZ in San Francisco Bay.

- Although use of the EZ as a management tool may not be justified scientifically, there are advantages to using one, or more, estuarine properties and phenomena which respond clearly and unambiguously to freshwater inflow to manage freshwater inflow rather than relying entirely upon flow itself.

- The salinity distribution would be a better choice than the position of the EZ for this purpose.

It should be clear from Exhibit 2 that early in the workshop the participants rejected the EZ as the most appropriate response of the estuary to changes in freshwater inflow for use in managing inflow.

THE SEARCH FOR OTHER SURROGATES FOR MANAGING INFLOW

If a major purpose of setting discharge standards for the rivers that flow into San Francisco Bay is to conserve and, if appropriate, to restore important ecosystem functions and values and societal uses of the estuary, then the best "measures," upon which standards should be set are a combination of freshwater inflow and some response of the estuary to that input.

It is extremely desirable to add a second standard; one that measures the response of the estuary to the input of freshwater from Delta outflow. The ideal index for that standard is an index that is simple to measure, inexpensive to measure, one that can be measured accurately, one that has ecological significance, one that integrates a number of important estuarine properties and processes and one that is meaningful to a large number of contituencies.

The workshop examined a number of surrogates for managing freshwater inflow. The one which received the greatest attention was near-bottom salinity. Salinity was judged to be a better -- a more desirable and diagnostic measure -- than the EZ and, indeed, was judged to be the best measure for an estuarine standard for flows identified by workshop participants. The major advantages of salinity as a measure are summarized in Exhibit 3.

EXHIBIT 3

PRIMARY REASONS FOR SELECTING SALINITY AS THE MEASURE FOR CREATING A STANDARD FOR MANAGING FRESHWATER INFLOWS

(1) The salinity distribution is of fundamental importance to the ecosystem.

(2) The salinity distribution is a result of the interplay of freshwater inflow, geometry of the basin, diversion in the delta and tidal regime.

(3) Accurate measurement of salinity is direct, easy and economical; measurements are robust.

To clarify the advantages and disadvantages of the use of salinity as the basis for a flow standard, workshop participants engaged in an exercise of Six Hats Thinking as described by Edward DeBono. The strategy is designed to clarify thinking and analysis of complex issues, issues which often are emotionally charged. The use of salinity, or of any other property, as a surrogate for direct measurement of river inflow in managing inflow to the estuary meets these criteria. In six hats thinking, each of six colors is assigned to a particular mode of thinking (Exhibit 4), and only that mode of thinking is permitted while wearing a hat of that particular color. The procedure calls for the facilitator to orchestrate an appropriate sequence of the six modes of thinking by directing switching of hats at critical points in the discussion. All individuals in the group must wear hats of the same color at the same time.

The results of the six hats thinking session are summarized in Exhibits 5 through 8. The white hat was not used because much of the day had already been devoted to an enumeration and discussion of the "facts." The facilitator provided the blue hat thinking and the results are incorporated into the text.

EXHIBIT 4

SIX HATS THINKING

THE MEANING OF THE SIX COLORS

White: Like Joe Friday on "Dragnet" used to say: "Just the facts, Mam." Facts, figures, data, information, questioning, defining the need for information, neutral, objective.

Black: Negative, everything bad; but objections must have a logical basis.

Yellow: The flip-side of black. Advantages, opportunities, benefits. Everything good; but arguments must have a logical basis.

Red: The emotional reaction; NO reasons required. Feelings, hunches, insight, emotion, anxiety, doubt.

Blue: Conductor of the orchestra. The balance; the over-view; consideration of the subject at hand plus the thinking process itself, procedures, NOT substance. Should we reach a consensus? Do we need a new agenda?

Green: Creativity, generation, proposals, alternatives, suggestions. Reasons are not required; no value judgements are permitted.

EXHIBIT 5

THE GOOD POINTS OF SALINITY AS A SURROGATE FOR FRESHWATER INFLOW

YELLOW HAT THINKING

- •Salinity has biological significance.
- •Salinity is understandable by the public.
- •Salinity is easy and inexpensive to measure.
- •Salinity is a conservative property; it's easy to model.
- •Salinity integrates river flow and diversion.
- •Salinity accounts for physical changes in the system.
- •Salinity compensates for errors in flow measurements.
- •There is an established historical salinity record for comparison.
- •Salinity is a measure of habitat.
- •Salinity is important to endemic species.
- •A salinity standard would protect against salt water intrusion into freshwater intakes.
- •Salinity is an index to the location of the turbidity maximum.
- •Salinity is an index to the location of the EZ.
- •Salinity is a guide to the density gradient which has dynamic significance.
- •There is a precedent for salinity standards.
- •One can infer the general circulation and mixing patterns from the salinity field.
- •Salinity is useful in evaluating proposed dredging projects.
- •The use of salinity as a standard will encourage EPA involvement in managing freshwater inflows.

EXHIBIT 6

THE BAD POINTS OF SALINITY AS A SURROGATE FOR FRESHWATER INFLOWS

BLACK HAT THINKING

- •A salinity standard would be harder for management to operate than would delta outflow.
- •Salinity simplifies a set of complex phenomena.
- •A salinity standard would be difficult to manage to because of confounding effects of tides and climatology.
- •Salinity depends upon evapotranspiration which is poorly known.
- •Variability of salinity in the coastal ocean is poorly known.
- •Most biological data in the estuary are correllated with flow, not salinity.
- •Salinity covers up ignorance.
- •The use of salinity will pose additional cost to the State.
- •The ecological significance of salinity is not well defined.
- •Confusion on historial significance of salt intrusion in bay.
- •The use of salinity may lead to unachievable flow standards.
- •Salinity confuses direct toxic effects of salt with flow-correlated effects.
- •There are sources of salt to the estuary in addition to the ocean.
- •The use of salinity would decouple cause-effect relationships.
- •A salinity standard would be non-mechanistic.
- •The benefits associated with a particular salinity are difficult to quantify.
- •Increased inflow does not guarantee strong year classes of fish.
- •A salinity standard could encourage construction projects (dams, diversion canals).
- •A salinity standard may facilitate EPA getting involved in the decision making process in San Francisco Bay.

EXHIBIT 7

THE EMOTIONAL REACTIONS TO A POSSIBLE SALINITY STANDARD

RED HAT THINKING

- It might increase taxes.
- At least one participant expressed concern about the risk of the workshop prescribing too much.
- Another participant expressed concern that the workshop would not prescribe enough.
- People are ignoring the values.
- At what level are we protecting resources? Are we protecting fish or alfalfa?
- Need a tool to couple cause and effect; salinity doesn't do it.
- The San Francisco estuary needs goals - - not just numbers. What values and uses of the estuary are we striving for?
- Frustration: There already are standards. Why don't we enforce them? What scientific evidence do we have for these?
- A salinity standard has little relationship to the aesthetic appeal of the estuary; e.g. fish that smell like cucumbers.
- We do have historic records.
- An expression of elation at progress made in the workshop, but worry about the uncertainty that lingers.
- Let's get moving with what we have.
- There are good fisheries-flow data; they should be used. A salinity standard would decrease their management value.

EXHIBIT 8

THE CREATIVE APPROACH TO USING SALINITY AS A SURROGATE FOR FRESHWATER INFLOW

GREEN HAT THINKING

- It's difficult to set diagnostic standards if we don't know what we want to achieve. Start by stating goals and objectives, probably in terms of desired values and uses of the system.
- Make the best possible statements re: level of certainty associated with the proposed salinity standard and each issue.
- Management sets a high priority on certainty. Should we advise this?
- An assessment of existing standards needs to be done; an assessment of the consequences of remaining where we are. What will happen to the estuary and its living resources if present management policies and practices continue?
- Because of the level of uncertainty we need research and monitoring programs to track the environmental consequences of whatever decisions are made if we are to improve decision making in the future.
- We need to identify what <u>isn't</u> being done now that should be and do it. Enforce existing standards.
- The world is likely to remain uncertain; there are no permanent decisions, only interim decisions.
- We need a scale of uncertainty relative to other systems.
- There is information on physical processes in EZ available from the UK and other places; it should be exploited.
- We need a conceptual framework of how components of the EZ fit together -- biological relationships to physical processes.
- Don't ignore the value of using adaptive management to test hypotheses and conceptual models.

THE RECOMMENDED APPROACH

Following the six hats thinking exercise, there was further discussion of the use of salinity as the basis for a standard for managing delta outflow to protect important estuarine values and uses and living resources. The conclusions and recommendations are summarized in Exhibit 9. All were agreed to by the workshop participants.

The workshop concluded that a combination of measures associated with freshwater inflow are needed to develop standards to ensure the required levels of protection for the estuary and its living resources. The minimum combination is river inflow and near-bottom salinity. Salinity should be thought of as a complement to measuring inflow. Reliable direct measurements of delta outflow would have great benefit to managers and scientists and the USGS program should move from the research and development phase to the monitoring phase as soon as practicable. Until then, the combination of river inflow, diversion and near-bottom salinity are the most appropriate set of measures. It represents the response of the estuary to different combinations of river inflow, diversions and withdrawals, tidal climatology and basin geometry.

A position of the 2 ‰ near-bottom isohaline should be selected for each season which provides an appropriate level of ecosystem protection. These positions should become seasonal standards. They should be viewed as upstream limits of the excursions of the 2 ‰ isohaline needed to provide the minimum level of environmental protection given the present level of scientific uncertainty. The proposed strategy for managing Delta outflow is to fix the upstream position of the near-bottom 2 ‰ isohaline during different seasons using the best scientific evidence available to protect important ecosystem values and uses. The upstream position would vary from season to season and the downstream position of the 2 ‰ isohaline would be unconstrained. There are different levels of scientific certainty/uncertainty associated with these positions for different species/values/uses for different seasons. Because of the uncertainty, the positions are somewhat elastic. From the environmental perspective, the uncertainty dictates taking a conservative approach, i.e. pushing the 2 ‰ isohaline farther downstream than might be required with more information.

These seasonal standards should not be interpreted as static targets for location of the 2 ‰ isohaline throughout any given season, year after year. Variability in flow, in circulation and mixing, in the salinity distribution and in the distribution of other important properties and processes is important in maintaining a healthy estuarine ecosystem.

The biological importance of seasonal and interannual variability and of extreme stochastic events should not be underestimated. For example, very successful year classes of striped bass are always, or almost always, associated with high inflow, but not all high flow years produce strong year classes. During years when there are extraordinarily strong year classes, the striped bass occupy an extended area (and volume) of the system. This has been demonstrated in a number of estuarine systems including: San Francisco Bay, the Hudson River estuary, Chesapeake Bay and the Santee-Cooper estuary. In the Hudson River system (NY), for example, very strong year classes of striped bass are associated with large riverflows which push the EZ well downstream spilling freshwater out of the channel and onto extensive shoal areas that border the channel. Suisun Bay may be the San Francisco Bay estuary analog of the New York situation.

The positions prescribed for the near-bottom 2 ‰ isohaline would be for operation of the existing State and Federal water diversion and distribution system. Any proposed change in that system should trigger a reevaluation of the positions. The movement of the 2 ‰ isohaline to the prescribed position would be achieved through some combination of adjustments in river inflow and diversion.

Scientists at the workshop not only felt comfortable in advocating the position of 2 ‰ near-bottom isohaline as the basis for the proposed management strategy, but were enthusiastic about it. They were not comfortable, however, in prescribing specific positions (i.e. specific salinity standards) during the workshop. All believed that this required the analysis and interpretation of data and information which were not available at the workshop and considerably more time for a critical and thoughtful assessment. Discussion turned to developing a strategy for selecting the most appropriate position of the 2 ‰ isohaline for each season.

Table 1 is an attempt to relate the strength of the coupling of outflow, delta diversion and EZ processes to the success of a variety of species. A selected group of species representing the broad range of organisms found in the San Francisco Bay estuary was rated as to what effect delta outflow, diversions and entrapment zone processes had on the importance of determining a strong year class of each species.

The rating system consisted of +1, 0, -1 and U. Plus one (+1) denotes a reasonable degree of confidence among workshop participants that a positive relationship exists between the particular variable and species year class strength. Negative one (-1) denotes a reasonable degree of confidence that a negative relationship exists. Zero (0) denotes reasonable certainty that no relationship exists. "U" denotes that participants are uncertain if any relationship exists.

Certainty or confidence is based on relationships of abundances to outflow and/or diversion and on the combined best professional judgement of the working group of fishery biologists at the workshop. They drew upon their collective knowledge of species biology and numerous studies both in the San Francisco Bay estuary and in other estuarine systems.

EXHIBIT 9

SALINITY AS A BASIS FOR A STANDARD IN MANAGING FRESHWATER INFLOW

- Salinity should be measured at 1m above the bottom.
- The position of the 2 ‰ isohaline at +1m is recommended for use as an interim standard. (Note: the leading edge of the turbidity maximum is located at about 2 ‰).
- Salinity should be measured at six stations located along the channel between Emmaton and Carquinez Bridge.
- Optical backscatterer sensors should be combined with conductivity probes at these stations.
- Surface salinity should also be monitored at these stations and correlated with bottom salinity.
- The data should be telemetered to a convenient location for timely analysis and interpretation.
- The monitoring data should be supplemented with detailed salinity surveys to map the distribution of salinity in three dimensions.
- The salinity standard should take the form of the position of the 2 ‰ isohaline in near-bottom (+1m) channel waters as a function of season.

TABLE 1

Summary of best professional judgement of workshop participants of the relationship of success of different species with outflow, delta diversion and EZ processes. +1 indicates reasonable confidence in a positive relationship; -1 indicates reasonable confidence in a negative relationship; 0 indicates reasonable confidence that no relationship exists and U indicates the level of uncertainty is too high to make a judgement.

Species	Outflow	Delta Diversion	EZ Processes-recruitment
Sturgeon	+1	0	U
Longfin smelt	+1	U	+1
C. Franciscorum	+1	0	U
Starry Flounder	+1	0	0
Delta Smelt	U	-1	U
Splittail	+1	U	0
Striped Bass	+1	-1	0
American Shad	+1	-1	0
Salmon	+1	-1	0
Neomysis	+1	U	+1
Eurytemora	U	0	+1
Anchovy and Marine Species	0	0	0
Palaemon m.	0	0	U
White catfish	0	-1	0
Largemouth Bass	0	0	0
Primary organic carbon food supply	+1	-1	+1

For chinook salmon there is a positive relationship with outflow for San Joaquin River stocks, but for Sacramento River stocks there was some uncertainty as to if a positive relationship exists.

For both salmon and American shad inflow to the delta may be a better variable than delta outflow.

Primary food sources consist of organic carbon input plus phytoplankton.

The strategy developed for selecting the most appropriate position of the 2 ‰ isohaline was to array all relevant information in a matrix similar to that shown in Exhibit 10. This matrix was developed and applied at the workshop for the spring season for the San Francisco Bay estuary. The actual data are not included in this report. Their omission is intentional. The matrix data was developed over a period of less than two days without access to published data or information. The only sources available were the memory banks of the assembled experts. While the participants have confidence in the merits of the approach, many were reluctant to have the data printed because of the ways in which they were generated and the potential for casting an unreasonable degree of authority over them.

A matrix is a useful way of summarizing a large number and diverse variety of complex estuarine responses to fluctuations in freshwater inflow and the accompanying changes in the salinity distribution driven by those fluctuations. A matrix is not however, a powerful or persuasive tool for packaging that information either for decision makers responsible for setting and enforcing freshwater or salinity standards, or by the public in understanding the scientific basis for those standards.

The workshop participants developed a new tool for those purposes. It is a graphical tool which summarizes diagnostic environmental information for critical species -- species which if protected will provide protection for other important species, ecosystem values and functions -- in clear, concise and compelling ways. The curves are easy to understand and difficult to ignore. An illustrative example of such a curve is shown in Exhibit 11.

Exhibit 11 is an illustrative sketch of the normalized probability of a strong year class of a key species plotted against the distance downstream of the near-bottom 2 ‰ isohaline. The lower curves represent the level of uncertainty associated with the estimates. The figure indicates that within the zone extending from the origin to X_1, the slope of the curve is nearly flat, indicating that the probability of a strong year class changes little within this region of the system. This zone might correspond to the region of the delta where displacement of the 2 ‰ isohaline farther seaward yields relatively little ecological benefit because of the controlling influence of entrainment losses. Seaward of this zone from X_1 to X_2, the probability of a strong year class increases relatively rapidly with increased displacement of the 2 ‰ downstream. Seaward of X_2, the rate of increase again flatters out and displacement of the 2 ‰ isohaline beyond some limit may actually decrease the probability of a strong year class.

The proposal is to construct a series of such curves for appropriate life history stages of key species of the San Francisco Bay-Delta estuary and to aggregate them by season. The next step is to use the family of curves for each season to select a position of the near-bottom 2 ‰ isohaline that would provide an appropriate level of ecological protection for the sum of these species, and presumably for protection of the estuary, that is based upon the best scientific evidence available. The position of the near-bottom 2 ‰ isohaline selected for each season would be the salinity standard for that season. Riverflow and diversion would be modified to ensure that the 2 ‰ isohaline did not migrate farther upstream than the position associated with the salinity standard.

EXHIBIT 10

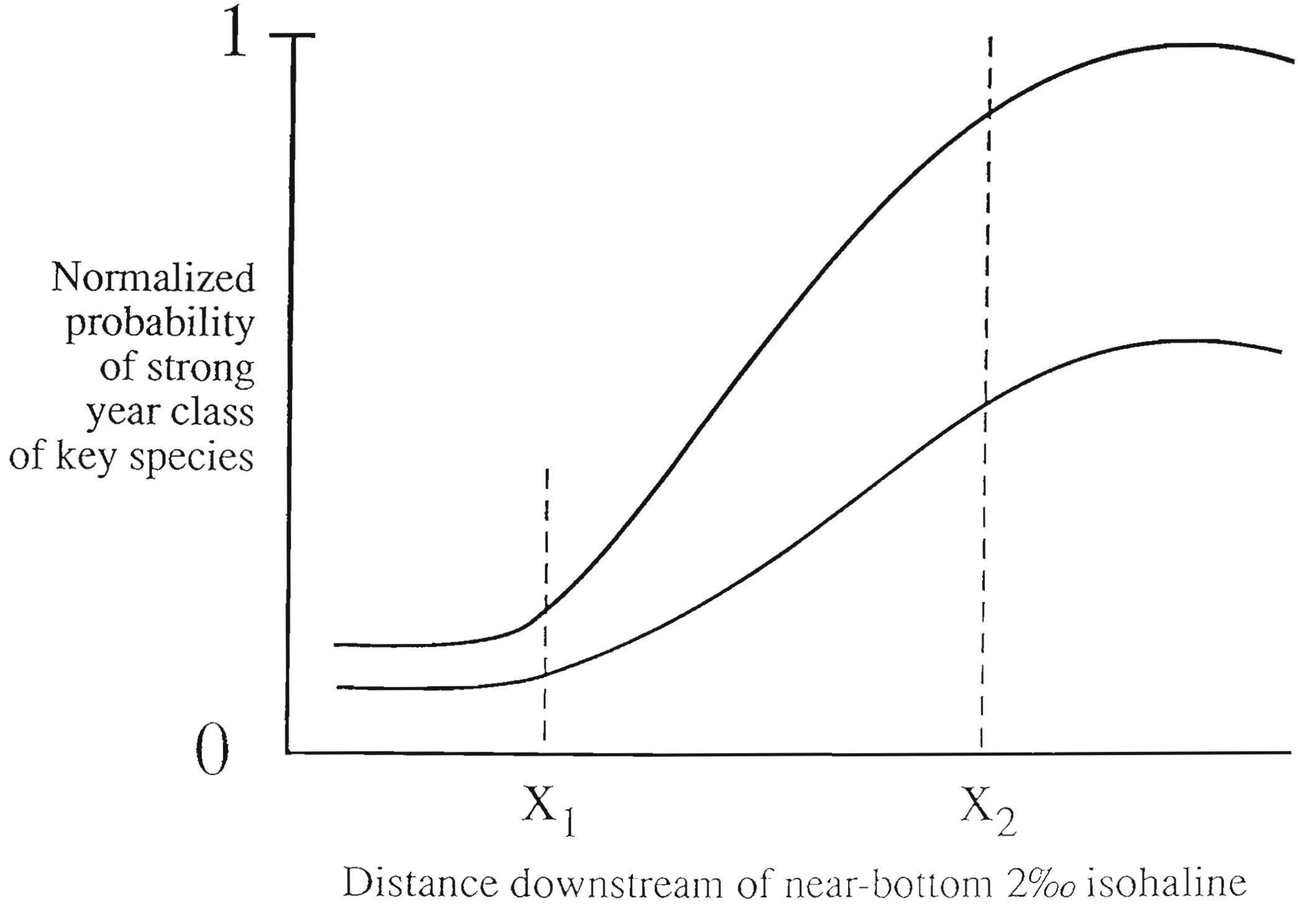
THE MATRIX

AN EXAMPLE OF A MATRIX TO USE IN IDENTIFYING THE APPROPRIATE POSITION FOR LOCATING THE 2 ‰ NEAR-BOTTOM EFFECTS ON VARIOUS PROCESSES AND PROPERTIES BY PLACING ISOHALINE AT DIFFERENT LOCATIONS WITHIN THE ESTUARY (SEASON ___)

PROCESSES AND PROPERTIES	SALINITY MEASURED 2PPT + 1 M FROM BOTTOM LOCATION 1 (Farthest Upstream)	LOCATION 2	LOCATION 3 (Farthest Downstream)
FW FLOW			
FW & EZ HABITAT			
TURBIDITY MAXIMUM			
SUSPENDED SEDIMENTS Mass Lost to System Budget			
INPUTS AND FATES OF PARTICLE-BOUND TOXICS			
VOL. AGR. RETURN WATER			
PHYTOPLANKTON Prim. Productivity Biomass Distribution Abundance			
NEOMYSIS			
MARINE & EST. FISHES			
UPSTREAM LIMITS Vol. of habitat Abundance Suscept. to Delta Div. To entrainment Survival of yr. class Food supply Migration			
TIDAL MARSH			
MANAGED MARSH			
INVASION BY MARINE SPP.			
ENDANGERED SPP.			

EXHIBIT 11

A Graphical Tool for Selecting a Salinity Standard for San Francisco Bay and Delta



CONCLUSIONS AND RECOMMENDATIONS

Members of the workshop recommend in the strongest terms possible that the strategy of assessing the effects associated with different flow scenarios and salinity responses outlined in this report be refined, enriched and extended using the best scientific and technical information possible. We recommend further that the results of this analysis should be used to set temporary seasonal salinity standards for managing freshwater inflows to the San Francisco Bay estuary.

The San Francisco Estuary Project should form a working group that draws together the best scientific and technical minds to refine the matrix, to complete the scientific and technical analysis required to produce the curves needed to set the seasonal salinity standards and to establish the levels of uncertainty associated with the predicted effects. The Working Group should involve the best scientists and engineers from agencies, academic institutions, environmental groups and consulting companies who have the required expertise. Heads of these agencies should ensure that the appropriate individuals are available and committed to this effort.

The analysis should be done outside of any federal or state agency and should be decoupled from on-going policy analyses. The objective of the analysis should be to provide, with existing information, the most rigorous scientific basis possible, for defining for each season the position of the near-bottom 2 ‰ isohaline to protect important ecosystem functions, values and uses. The results of this analysis can be used to evaluate the consequences of different water-use policy alternatives on the estuary and its living resources, but it should not be captive to the policy process. The analysis should be completed and become the input for a second workshop to be held no later than 31 December 1991.

The working group should attempt to anticipate and address questions that managers, regulators and policy makers will ask. These include such questions as:

(1) How much water discharge is required and for how long to achieve the desired results? What are the advantages and disadvantages of pulsing versus a continuous, uniform discharge?

(2) If diversion of water from the Delta were eliminated during summer months, could the upstream limit of the 2 ‰ bottom isohaline be moved farther upstream? If so, how far? If not, why not?

The results of the analysis should provide a template for an expanded research and monitoring program targeted at reducing critical areas of uncertainty in the effects associated with fixing the position of the 2 ‰ isohaline at different locations.

Some important research topics that should be pursued are summarized in Exhibit 12.

EXHIBIT 12

SOME IMPORTANT RESEARCH QUESTIONS

- What are the relationships between inflow, Delta outflow, tides and the salt field? How well do the existing relationships between biological entities and flows translate into relationships with the position of the 2 ‰ isohaline?

- How are biologically important materials transported from the rivers either to the estuary or to the export pumps, and how does this transport change with position of the 2 ‰ isohaline?

- What role does the exchange of particles and organisms between shoals and channels play in mediating the observed relationships between EZ position, biological abundance and year class strength?

- To what extent are the observed relationships between biological entities (abundance or year class strength) and flow or EZ position a function of food limitation as opposed to direct physical control or other alternative mechanisms?

- What are the important sources, sinks, and fates of organic matter and sediment in the estuary, and how do these vary with position of the 2 ‰ isohaline?

APPENDICES

APPENDIX A

AGENDA

27 AUGUST 1991

0900	**I. Welcome & Introductions**	**T. Vendlinski G. Thomas W. Kimmerer J.R. Schubel**
0915	**II. Background on Workshop:** How We Got To Where We Are	**T. Vendlinski**
0930	**III. Some Environmental Management** Goals to Guide the Workshop	**G. Thomas T. Vendlinski**
1000	**IV. An Overview of the Workshop:** Objectives; Format; Ground Rules; Measures of Success	**J.R. Schubel**
1030	**Break**	
1100	**V. Review and Clarification of the Eight Issues**	**W. Kimmerer et al.**
1230	**Lunch**	
1330-1500	**V. Review and Clarification of the Eight Issues, Continued**	
1500	**Break**	
1530	**VI. Wrap-up and Recap of Discussion of the Big "8"**	**W. Kimmerer J.R. Schubel**
1630	**VII. Brainstorming Session to Identify Other Potential Surrogates For Managing Freshwater Inflows To Protect the Ecosystem and Important Societal Values and Uses of the San Francisco Bay-Delta Estuary**	**J.R. Schubel, Facilitator**

1700	VIII. Preliminary Ranking of Surrogates For Managing Freshwater Inflows	J.R. Schubel,
1730	IX. Recap	
1800	Adjourn	

28 AUGUST 1991

0900	I. A Brief Recap and Overview of the Day	J.R. Schubel, Facilitator
0930	II. Scientific and Technical Assessment of the EZ and Other Top Candidates As Facilitator Surrogates for Managing Freshwater Inflows	J.R. Schubel,
	A. Plenary	
	B. Working Groups, as appropriate	
1030	Break	
1100	II. Continuation of Scientific and Technical Assessment of the EZ and Other Top Candidates As Surrogates for Managing Freshwater Inflows	
1200	Lunch	
1300	II. Continuation of Scientific and Technical Assessment of the EZ and Other Top Candidates As Surrogates for Managing Freshwater Inflows	
1430	III. Ranking of the Surrogates	J.R. Schubel, Facilitator
1500	Break	
1530	IV. Discussion of Ranking	J.R. Schubel, Facilitator
1630	V. Brief Summary	J.R. Schubel

1700	VI. Identification of Specific Research Questions and Hypotheses to Reduce the Facilitator Level of Uncertainty of the Value of Selected Surrogates and For Development of Others; Short-term, Intermediate-term and Long-term Research Strategies	W. Kimmerer, Facilitator
1800	Adjourn	

29 AUGUST 1991

FROM SCIENCE TO POLICY

0900	I. Overview & Summary of Days 1 & 2; The Goals Revisited	J.R. Schubel
0930	II. (Continuation of Item VI on Previous Day) Identification of Specific Research Questions and Hypothese to Reduce the Level of of Uncertainty of the Value of Selected Surrogates and For Development of Others; Short-term, Intermediate-term and Long-term Research Strategies	W. Kimmerer
1030	Break	
1100	III. Discussion of the Range of Options for Selecting Goals for Improving Environmental Conditions in San Francisco Bay Estuary	T. Vendlinski G. Thomas
1200	Lunch	
1300	III. Discussion of the Range of Options for Selecting Goals for Improving Environmental Conditions in San Francisco Bay Estuary	T. Vendlinski G. Thomas

	IV. Identification of Potential Management Actions to Mitigate Reductions in Freshwater Inflow and Discussion of How They Would Affect the Management Value of the Position of the EZ and Other Freshwater Inflow Surrogates	**J.R. Schubel**
1500	**V. From Science to Policy: Formulation of a Scientifically-Based Policy Statement of the Relationship of Freshwater Inflow to Ecosystem Value and Functions of the San Francisco Bay Estuary - - Developing a Consensus**	**J.R. Schubel T. Vendlinski W. Kimmerer, Facilitators**
1600	**Summary**	**J.R. Schubel**
1630	**Closing Comments**	**T. Vendlinski**

APPENDIX B

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APPENDIX C

TITLES AND AUTHORS OF BACKGROUND (WHITE) PAPERS

1. A Discussion of Issues Relevant to the Entrapment Zone in the San Francisco Bay Estuary
   Wim Kimmerer

2. Synopsis of Evidence Presented to the State Water Resources Control Board in the Bay-Delta Hearings on the Functioning and Benefits of the Entrapment Zone
   David Fullerton

Copies are available from the Marine Sciences Research Center upon request.

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