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Technical Appendices

Scientist and Stakeholder Views on the Delta Ecosystem

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Appendix A: About the Surveys

Eliciting Scientist and Stakeholder Views

This report summarizes the results of two complementary surveys, one addressed to scientific experts on the Delta ecosystem, and the other addressed to a group of engaged stakeholders and policymakers.

Expert elicitations are often used to help understand complex problems for which there is no prevailing scientific consensus or for which there is high uncertainty. The most common applications are in risk assessments, to quantify uncertainty and build it into a decisionmaking process. Examples include identifying screening techniques for nanotechnologies that pose potential environmental risks (Flari et al. 2011), and identifying risks of cross-contamination in the food industry (Hoelzer et al. 2012). Some recent studies have used elicitations to inform ecosystem management (e.g., Halpern et al. 2007; Teck et al. 2010; McDaniels et al. 2012; Cvitanovic et al. 2013). The techniques range in formality, from methods that seek to control for expert knowledge and consistency to more "democratic" methods in which all experts are treated equally.[1] Sample sizes range from small groups (10–20 experts, often providing input through workshops) to larger groups contacted through surveys. Some studies have also sought input from groups other than scientific experts. For instance, for their food safety study, Hoelzer et al. (2012) elicited input from regulatory managers and food industry professionals. Cvitanovic et al. (2013) elicited perspectives of academics and managers on research needs for marine protected areas.

Our surveys for this study had two goals:

1. To develop a high-level, synthetic understanding of scientists' views on the ecosystem stressors contributing to the decline in the Delta's native fish populations and on the types of mitigation actions that are most promising; and
2. To gauge the extent to which the views of diverse policymaking and stakeholder groups involved in the Delta converge with those of scientific experts (and with each other).

Both types of insights are important for developing more effective ecosystem management strategies and the science policy to support this process. Although scientific understanding of the multiple causes of the Delta's native species declines has advanced considerably in the past two decades, the scientific literature provides incomplete guidance on forward-looking, ecosystem-based management (Natural Research Council 2012). The survey of scientists provides a near-term way of better informing policy, given the gaps and uncertainties in the scientific literature and limitations in the communication of science to policymakers. Understanding policymaker and stakeholder views is also important, because ecosystem management is ultimately a policy decision, taking into account costs and other societal considerations as well as insights from the science related to ecosystem management. Identifying gaps in perceptions between scientists and stakeholders can also inform the design of science policy and communication.

[1] One formal elicitation technique, known as the "Cooke method," weighs the opinion of each expert based on his or her ability to judge relevant uncertainties, using "seed" questions (Cooke 1991). For instance, in an exercise to gauge probabilities of time to failure of an old earth dam once the core starts to leak, experts were asked to provide answers to this seed question for a series of actual dam failures, and the accuracy of these answers was used to weight their estimated probabilities for hypothetical future failures (Aspinall 2010). Another formal method uses the technique of "probabilistic inversion" to model distributions of expert judgments, where respondents are asked to rank or rate a set of alternatives; this technique can be used to check for consistency of expert preferences (Kraan and Bedford 2005; Neslo and Cooke 2011).

To achieve the broadest possible participation from the groups surveyed, we sought to minimize the response time required of the respondents. The scientist survey was designed to require at most 30 minutes for completion, and the stakeholder survey at most 15 minutes. This constraint limited our ability to employ some of the more sophisticated techniques used in some elicitations. Our surveys are "democratic" in treating all respondents equally, with the understanding that each one came to the survey with various assumptions and limitations. We conducted various statistical tests to see whether patterns of answers varied by respondent characteristics and note those differences where relevant. The table notes in Appendix B report statistically significant differences in responses across stakeholder groups, and Appendix C provides more details on a variety of tests focusing on responses of scientists.

Survey Administration and Target Populations

Both surveys were administered through an online survey program, Qualtrics, which sent to each person invited to participate in the survey an email with a unique link that could only be used once. The invitation was extended by three of the authors of this report: Ellen Hanak at PPIC and Jay Lund and Peter Moyle at the University of California, Davis. Those contacted were initially given a two-week deadline, and subsequently a one-week extension, and they were sent a total of three reminders. They could exit and return to the survey until it was completed. They were assured that all responses would remain confidential. Scientists invited to participate in the survey could unsubscribe from further emails if they thought they had been mistakenly identified as an expert on the Delta's aquatic ecosystem. Stakeholders could unsubscribe if they felt they had been mistakenly identified as a Delta policymaker or stakeholder. Unsubscribed recipients are not counted in the response rate calculations presented below.

Scientific expert survey

The scientific expert survey was fielded from July 6 to 27, 2012.[2] The target population was scientists with research experience on the Delta's aquatic ecosystem. This group was identified through a bibliographic search on peer-reviewed scientific journal articles relating to the Delta ecosystem from 1980 to 2012. The search used the following keywords related to the Delta (searching over titles, abstracts, and keywords):

- Sacramento-San Joaquin Estuary
- Sacramento-San Joaquin River Delta
- Sacramento-San Joaquin Delta
- San Joaquin Delta
- San Joaquin Watershed
- San Francisco Bay
- San Francisco Bay Delta
- San Francisco Estuary
- San Francisco Bay Estuary
- San Francisco Bay-Delta Estuary
- Delta Smelt
- Suisun Marsh

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[2] One respondent who erroneously did not receive the initial emails completed the survey in early September 2012.

We retained articles pertaining to the Delta ecosystem and extracted author names from this search. Authors were automatically retained if they appeared on at least two different articles. Some of those appearing only once were also included following review of their experience, since our bibliographic search did not catch all articles written on the Delta ecosystem. We also invited all past and current members of the Delta Independent Science Board to participate in the survey, even if they did not appear through the bibliographic search. Additional experts were invited as the survey was being administered if respondents mentioned them as a leading expert in the field and they had relevant publications. (For additional information on the leading expert question, see below.) Emails and other contact information were found through an Internet search or provided by colleagues. In total, we sent the survey to 325 scientists, of whom 28 unsubscribed as having been mistakenly identified as experts on the Delta's aquatic ecosystem.

Stakeholder survey

The stakeholder survey was conducted from August 13 to 31, 2012. Our target population was policymakers and representatives of the various interests concerned with the outcome of Delta policies. We used the two major public planning processes on the Delta—the Bay Delta Conservation Plan (BDCP) and the Delta Stewardship Council's (DSC) Delta Plan—to identify stakeholders. We invited survey responses from attendees of BDCP meetings held on January 25, February 29, and March 28, 2012, as well as BDCP working group participants and speakers. We also invited speakers and panelists from DSC meetings held between April 1, 2010, and April 26, 2012, as well as anyone who submitted comments on the Fifth Staff Draft Delta Plan or the draft Environmental Impact Report (EIR) for the Delta Plan. We also invited senior officials and board members of key state regulatory agencies involved in the Delta (DSC, Delta Conservancy, Delta Protection Commission, State Water Resources Control Board, and San Francisco and Central Valley Regional Water Quality Control Boards) as well as non-administrative staff in the water branch of the Department of Fish and Wildlife, even if they did not appear on the presentation schedule for these meetings. (Many state and federal officials did appear on these schedules, including representatives of management agencies such as the Department of Water Resources). Contact information was found through Internet and phone searches. Overall we sent the survey to 793 individuals, of whom 26 unsubscribed as being mistakenly identified as a Delta policymaker or stakeholder.

Response Rates and Sample Characteristics

As shown in Table A1, we received 122 completed surveys from scientists (a 41% response rate, excluding those who unsubscribed) and 240 from stakeholders (31%). These counts include a few surveys for which biographical information at the end of the survey was not fully completed. In a few cases, stakeholder surveys were completed by a colleague of the original recipient; these respondents are treated as belonging to the same stakeholder group as the original recipient.

TABLE A1
Response rates

	Total surveyed	Unsubscribed	Surveys completed	Response rate [b]
Scientists	325	28	122	41%
Stakeholders	793	26	240 [a]	31%

NOTES: [a] This total includes a few surveys completed by a colleague of the person initially contacted as well as a few surveys without complete bibliographic information.

[b] Response rates are calculated relative to the total population surveyed, minus those who unsubscribed.

Scientific expert characteristics

We can compare characteristics of those scientists who responded to those who did not along several dimensions: main professional affiliation (employer), number and dates of publications on the Delta's aquatic ecosystem (from the bibliographic search), whether he or she was identified as a "leading expert" by peers in the survey, whether the scientist is based within or outside California, and whether he or she has been affiliated at some point as a graduate student, post-doc, or researcher with Peter Moyle's fish laboratory at the University of California, Davis. This information is useful for understanding whether there is any potential bias in the survey results.

Scientists in our sample came from several types of organizations. Just over half work at universities and research institutes, roughly a third work for state and federal government agencies, and the remainder work for an assortment of other employers, including advocacy organizations, local agencies, and consulting firms.[3] As Table A2 shows, the response rates across these three employer categories are very similar.[4]

TABLE A2
Scientific expert employers

	Invited population [a]		Respondents	
	Count	Share	Count	Share
State and federal government	100	34%	41	34%
University and research organizations	160	54%	65	53%
Other [b]	37	12%	16	13%
Total	297		122	

NOTES: [a] The invited population shown here excludes individuals who unsubscribed.

[b] The "other" group includes consultants and employees of advocacy groups and local water agencies.

Survey respondents differ significantly from nonrespondents in other ways, however (Table A3). On average, respondents had more total scientific publications and a longer overall length of publication experience, and their latest publication was more recent. In addition, they were more likely to be named as a leading expert on the Delta ecosystem by their peers (see below). These factors suggest that scientists responding to the survey are, on average, more actively engaged in research on the Delta ecosystem and more knowledgeable.

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[3] State and federal government scientists invited to participate in the survey work for regulatory and planning agencies (California Department of Fish and Wildlife, Delta Stewardship Council, National Marine Fisheries Service, State Water Resources Control Board, U.S. Fish and Wildlife Service, and U.S. Army Corps of Engineers), water management agencies (Department of Water Resources, U.S. Bureau of Reclamation), and research organizations (U.S. Geological Survey). This last group constituted the largest share of government scientists who received the survey.
[4] State and federal agencies employ 10 percent and 23 percent, respectively, of survey respondents, and the response rates for these two groups were similar.

TABLE A3
Characteristics of respondents and nonrespondents (mean values)

	Invited population [a]	Non-respondents	Respondents	P-value [b]
Number of journal articles	3.62	2.97	4.48	0.002
Year of latest journal article	2007	2006	2008	0.001
Years of publication experience	5.04	4.27	6.15	0.011
Based outside California (%)	21%	25%	16%	0.071
Moyle laboratory affiliation (%)	13%	5%	25%	0.000
Leading expert (%)	38%	33%	46%	0.026

NOTES: [a] Excludes scientists who unsubscribed from the survey. Leading experts are those named at least five times by their peers (roughly 20% of the total sample).

[b] The P-value column reports significance levels of t-tests (for continuous variables) or chi-squared tests (for categorical variables) of whether the mean or proportion values are the same for respondents and non-respondents.

Survey respondents also differed in two other respects: Those affiliated with the Moyle lab were more likely to respond to the survey, and those living outside California were less likely to respond. The higher participation rates for Moyle lab affiliates is not surprising, since Peter Moyle was one of the researchers extending the invitation to participate. This pattern introduces potential bias reflecting a particular "school of thought." It is also not surprising that scientists located outside of California were less likely to participate; many appear less actively involved in Delta science than California-based scientists (on average, more time had passed since they had published on the Delta than scientists based within the state; see Appendix Table C1). Because scientists based outside the state might have less–engaged perspectives on the Delta ecosystem, their lower participation also introduces potential bias.

To check for potential bias, we ran statistical tests to determine whether responses to key survey questions differed along the dimensions on which respondents differed from nonrespondents.[5] Appendix C reports the results of these tests. In general, we found relatively few statistically significant differences. Most noteworthy, given their over-representation in the sample, Moyle lab affiliates were significantly less optimistic about the potential impacts of many actions, particularly actions to reduce discharges and directly manage fish (Table B5), although this did not generally carry through to their choices regarding priority action areas (Table B8). Scientists with more journal publications and those named as leading experts also rated the potential impact of many actions lower, but again these differences did not carry through to priority actions. California-based scientists only differed from nonresidents on a few small points.[6]

Table A4 presents some characteristics of the "leading experts"—individuals who were named at least five times by their peers as exceptional in their ability to understand the complexities of the aquatic ecosystem of the Sacramento-San Joaquin Delta. Twenty-six of the scientists who responded (21%) fall into this category.[7] Leading experts are more likely to be associated professionally with a federal or state agency and affiliated with the Moyle laboratory. They also have a higher average number of publications, a larger breadth of publication across the stressor categories (Table B12), and more years of experience. Although only 54

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[5] We ran both bivariate and multivariate regressions for these tests, where the dependent variable was an answer to a question about historical stressor impacts (Table B1), future stressor impacts (Table B4), potential action impacts (Table B7), or choice of priority action areas (Table B9). The regressions were specified as ordered logits (for categorical variables) or logits (for the binary choice of any action in the nine priority action areas).
[6] California-based scientists were more likely to consider invasive species as an important historical stressor for pelagic fishes (Table B1) and more likely to consider two actions beneficial: control of invasive clams and improvement of upstream habitat (Table B5). See Tables C4 and C5.
[7] Although not all the scientists in this group responded to the survey, all were recipients of the survey instrument.

percent of respondents named leading experts (Table B13), this list does not appear to reflect undue influence of any of the potential "schools of thought" that are over-represented among them. In particular, there were no statistically significant differences between those who answered this question and those who did not by employer, Moyle lab affiliation, or base within or outside California.

TABLE A4
Leading expert characteristics

	Leading experts [b]	Other scientists
Professional affiliation		
Government	62%**	26%
Academic/research	31%	60%
Other	8%	15%
Number of journal articles	11.04***	2.72
Years of experience	21.62***	14.28
Breadth of publication [a]	0.62***	0.35
Based outside California	8%	19%
Moyle laboratory affiliation	42%**	21%

NOTES: [a] Breadth of publications is a measurement of the share of publications across the five stressor categories, calculated using responses on experience from the survey (Table B12). A value of 1 indicates Delta-related publication experience on all five stressors.

[b] *** $p<0.01$, ** $p<0.05$, * $p<0.1$ associated with significance levels of t-tests (for continuous variables) or chi-squared tests (for categorical variables) of whether leading experts differed from the rest of scientists surveyed. We also examined whether responses differed along other biographical information collected from survey respondents (Appendix Table C1).

Stakeholder characteristics

We assigned individuals who received the stakeholder survey into seven groups based on their professional roles and/or economic interests in relation to the Delta:

- **Delta-based interests** (38 respondents)
  Representatives of local governments, water agencies, and advocacy groups, and other engaged residents;
- **Fishing and other water-based recreation interests** (14 respondents)
  Principally representatives of recreational fishing within the watershed, but also several from the salmon and crabbing industries;
- **Upstream interests** (39 respondents)
  Representatives of agricultural and urban water agencies that divert water upstream of the Delta or that discharge pollutants into the watershed;
- **Export interests** (22 respondents)
  Primarily representatives of water agencies located outside of the watershed that depend on Delta exports;
- **Environmental advocates** (56 respondents)
  Employees and members of environmental organizations;
- **Federal and state officials** (56 respondents)
  Employees of regulatory and management agencies active in the Delta;
- **Other** (15 respondents)
  A mix of groups too small to analyze separately (employees of statewide advocacy groups, tribal representatives, and private sector consultants unaffiliated with the other groups).

Response rates varied somewhat across groups, with the highest participation from Delta interests and the lowest from the fishing and recreational interests and the "other" category (Table A4). Because we are interested in understanding how various groups view Delta ecosystem problems, we present results by stakeholder group rather than for the sample as a whole. Results of tests of whether the differences observed across groups are statistically significant are reported in notes beneath response tables in Appendix B.

TABLE A5
Stakeholder and policymaker group affiliations

	Invited population [a]		Respondents		Response rate
	Count	Share	Count	Share	Share
Delta	96	13%	38	16%	40%
Fishing and recreation	51	7%	14	6%	27%
Upstream	105	14%	39	16%	37%
Exporters	73	10%	22	9%	30%
Environment	192	25%	56	23%	29%
State and federal agencies	174	23%	56	23%	32%
Other	76	10%	15	6%	20%
Total	767		240		31%

NOTE: [a] These population counts exclude those who unsubscribed from the survey.

There is variation within some of these groups in the type of interest or organization represented, but the subsamples are not large enough to consider separately. For example, the fishing-recreation category includes a mix of representatives of in-Delta and coastal (salmon) fishing organizations; although they share some common goals, they do not have identical economic interests regarding the Delta ecosystem. In-Delta fishing is focused principally on alien fish (striped bass, largemouth bass); these fish do not necessarily benefit from the same types of ecosystem conditions as salmon (Moyle et al. 2012). Unlike the scientist survey, wherein most government agency employees work for federal agencies, most respondents in the state and federal agency group (86%) work for state agencies (including DWR, DFW, DSC, and the state and regional water boards).

Survey Format and Question Types

Both surveys principally contained multiple-choice questions, with the option for additional write-in responses to suggest additional alternatives or to clarify responses.

Scientific expert survey

This survey consisted of four main sections: historical and future impact of stressors on native fish (section I), impact and certainty of a suite of management actions (section II), priority actions (section III), and respondent characteristics (section IV). Section I focused on five stressor categories and their impact on three subcategories of native fish: pelagic, anadromous, and resident. Section II asked the experts to consider 32 management actions and the relative impact each could have on supporting native fish populations. Respondents were also asked to gauge the certainty of these impact assessments. Section III asked the experts to choose the five actions they would prioritize and in what order. The final section concentrated on biographical information including fields of training, highest degree earned, years of scientific experience in the Delta, and level of professional expertise in each of the five stressor categories (Table B12). We also asked respondents to provide names of up to ten scientific professionals other than themselves with exceptional understanding of the complexities of the Delta's aquatic ecosystem (which we used to create the "leading expert" variable discussed above). As with the variables reported above, we conducted statistical analysis to see whether there were significant differences in responses to key questions on stressors and actions based on these characteristics (Appendix C).

Stakeholder survey

The stakeholder survey was a simplified version of the scientific expert survey. Stakeholders were first asked about how stressors have and will affect the Delta's native fishes in general, not by fish category. Regarding management actions, stakeholders were only asked to choose their top five priorities and rank them by importance. They were presented with a slightly smaller list of actions (29) than were included in the scientific expert survey, because some of the more detailed actions from the expert survey were combined and or simplified. The stakeholder survey also finished with biographical questions, including fields of training, highest degree earned, years following policy in the Delta, and how frequently respondents access various types of information on the Delta and what their most trusted source of information is (Tables B21–B22). The statistical analysis focused primarily on whether there were significant differences across groups (reported in the notes to tables in Appendix B).

Randomization

To avoid bias associated with the order in which questions appeared, both surveys were set to randomize the order of presentation of the five stressor groups in the sections with questions on historical and future stressors. For the questions on mitigating actions, the actions were grouped by the stressor category they were associated with and the survey randomized both the order of stressor groups and the order of actions within those groups.

Appendix B: Survey Responses

This appendix presents the survey questions and related background information provided to respondents and summarizes answers to all closed-form survey questions, several open-form questions re-coded into specific categories, and several variables created using the survey responses. Responses to other open-ended questions are discussed where relevant in the main report. For instance, in both surveys, respondents could write in additional actions they believed could improve the Delta ecosystem for native fish. In most cases we were able to recode these as one of the actions offered in the survey (when they were more in the nature of clarification or additional details on how the action might be implemented); new actions are discussed in the main report.

Tables B1–B13 present results from the scientist survey, and Tables B14–B24 provide answers to the stakeholder survey, disaggregated into the seven stakeholder groups. Where relevant, we have included responses from scientific experts in these tables to facilitate comparisons. All of the biographical questions were voluntary, and some scientists and stakeholders did not provide complete biographical information.

Scientific Expert Survey

Responses to categorical questions are reported as the share of the sample answering in that way. The sample size is 122 unless otherwise stated.

Introduction

Background text from survey: "This survey seeks your input on the role of various ecosystem stressors in the long-term declines in populations of the Delta's native fishes and the potential effectiveness of various management actions to improve outcomes for native fishes."

Stressor categories used in this survey

Background text from survey: "To facilitate policy discussions regarding causes of stress and options for management, we have grouped stressors into the following five broad categories with similar processes, causes, or consequences:

- **Discharges**
  Land and water use activities that directly alter water quality in the greater Delta watershed by discharging various contaminants that degrade habitat, disrupt food webs, or cause direct harm to populations of native species (point and nonpoint sources of conventional pollutants, nutrients, toxics, endocrine disruptors, etc.).
- **Direct Fish Management**
  Activities that can adversely affect populations of native species through harvest (commercial or sport), hatcheries, or other management actions such as not installing fish screens.
- **Flow Regime Change**
  Alterations in flow characteristics due to water management facilities and operations, including volume, timing, hydraulics, sediment load, and temperatures (including upstream dams and diversions, as well as in-Delta diversions and exports).

- **Invasive Species**
  Alien (non-native) species that negatively affect native species by disrupting food webs, altering ecosystem function, introducing disease, or displacing native species.
- **Physical Habitat Loss and Alteration**
  Land use activities that alter or eliminate physical habitat that supports native species, including upland, floodplain, riparian, open water/channel, and tidal marsh (levees; channelization; diking and draining of wetlands; narrowing riparian zones, shallows, tidal, and fluvial marshes, etc.).

You will have an opportunity to consider the effects of other factors, such as climate change and ocean conditions, on likely future impacts of these five stressor categories. You will also have an opportunity to consider interactions among stressors."

Section I: Importance of Stressor Categories

Background text from survey: "In this section we ask you to consider the role of the five stressor groups on the historical decline of Delta ecosystem conditions and likely future ecosystem conditions. The questions ask you to think in general terms about the impact of each stressor group on the Delta's three main categories of native fish species. The three fish categories are:

1. Pelagic: delta smelt and longfin smelt
2. Anadromous: salmon, steelhead, sturgeon
3. Resident natives: splittail, blackfish, hitch, tullyhead, etc."

Historical Importance of Stressors for the Delta's Native Fishes

TABLE B1
Please indicate the impact you believe each stressor group has had on the decline of the Delta's three main categories of native fish.

General note to Tables B1a–d: For all questions, the numerical values assigned to valid categorical answers are as follows: "high impact" = 3, "moderate impact" = 2, "low impact" = 1, "no impact" = 0. The last column reports sample mean with standard deviation in parentheses.

a. Pelagic fishes

	No impact (%)	Low impact (%)	Moderate impact (%)	High impact (%)	Don't know (%)	Summary impact mean (std. dev.)
Discharges	1	15	34	32	19	2.19 (0.77)
Direct fish management	6	47	18	11	19	1.41 (0.81)
Flow regime change	0	2	19	76	3	2.77 (0.46)
Invasive species	0	14	30	47	9	2.36 (0.74)
Physical habitat loss, alteration	0	11	28	57	5	2.48 (0.69)

b. Anadromous fishes

	No impact (%)	Low impact (%)	Moderate impact (%)	High impact (%)	Don't know (%)	Summary impact mean (std. dev.)
Discharges	1	28	33	20	19	1.88 (0.79)
Direct fish management	0	11	30	43	16	2.39 (0.70)
Flow regime change	0	1	24	72	3	2.74 (0.73)
Invasive species	1	35	36	13	15	1.72 (0.73)
Physical habitat loss, alteration	0	3	20	73	3	2.72 (0.52)

c. Resident native fishes

	No impact (%)	Low impact (%)	Moderate impact (%)	High impact (%)	Don't know (%)	Summary impact mean (std. dev.)
Discharges	1	20	30	22	28	2.01 (0.80)
Direct fish management	8	33	23	10	26	1.46 (0.86)
Flow regime change	0	8	31	48	12	2.46 (0.66)
Invasive species	0	7	34	44	15	2.44 (0.64)
Physical habitat loss, alteration	0	1	19	70	10	2.77 (0.44)

d. Summary of historical impacts for all three fish groups

	Mean	SD	N	Don't know [a] (%)
Discharges	2.00	0.69	104	15
Direct fish management	1.80	0.65	108	12
Flow regime change	2.67	0.41	121	1
Invasive species	2.21	0.58	116	5
Physical habitat loss, alteration	2.66	0.38	120	2
Overall	2.32	0.36		

NOTES: This table presents averages for the three fish groups (responses in Tables B1a–B1c).

[a] "Don't know" responses are considered missing values and are not included in the averages. N = the number of valid responses. "Don't know (%)" is the share of respondents who responded "Don't know" for all three fish groups. (As Tables B1a–B1c show, these rates are sometimes higher for individual fish groups.)

TABLE B2
Considering interactions among different types of stressors, which two stressor groups have contributed most to the decline in the Delta ecosystem's overall ability to support native species?

(% of sample)

Discharges	Direct fish management	Flow regime change	Invasive species	Physical habitat loss and alteration	Don't know
12	2	78	27	77	2

NOTE: This table presents the share of respondents picking each category (two choices possible).

TABLE B3
In your opinion, which *single* stressor group has contributed the most to the decline in the Delta ecosystem's overall ability to support native species?

(% of sample)

Discharges	Direct fish management	Flow regime change	Invasive species	Physical habitat loss and alteration	Don't know
4	1	38	7	46	4

NOTE: This table presents the share of respondents picking each category (one choice possible).

Future Importance of Stressors for the Delta's Native Fishes

Background text from survey: "Future impacts of ecosystem stressors may differ from historical trends, given the potential natural and physical changes in the ecosystem from climate change and other factors."

TABLE B4
Please indicate how the impact of each stressor group will likely change in the future (e.g., by 2050) as a result of climate change and other factors. Assume management of each stressor group continues as it is today.

General note for Tables B4a–d: The numerical values assigned to valid categorical answers are as follows: "more impact" = 1, "less impact" = -1, "stay the same" = 0. The last column reports sample mean with standard deviation in parentheses.

a. Pelagic fishes

	Less impact (%)	Stay the same (%)	More impact (%)	Don't know (%)	Summary impact mean (std. dev.)
Discharges	14	23	42	21	0.35 (0.76)
Direct fish management	16	46	10	29	-0.08 (0.60)
Flow regime change	4	11	77	7	0.79 (0.51)
Invasive species	2	24	62	11	0.68 (0.53)
Physical habitat loss, alteration	11	28	55	7	0.48 (0.69)

b. Anadromous fishes

	Less impact (%)	Stay the same (%)	More impact (%)	Don't know (%)	Summary impact mean (std. dev.)
Discharges	15	28	38	20	0.29 (0.76)
Direct fish management	17	34	28	21	0.14 (0.75)
Flow regime change	2	14	76	7	0.80 (0.47)
Invasive species	5	39	41	16	0.43 (0.60)
Physical habitat loss, alteration	11	29	55	6	0.47 (0.69)

c. Resident natives fishes

	Less impact (%)	Stay the same (%)	More impact (%)	Don't know (%)	Summary impact mean (std. dev.)
Discharges	12	21	43	23	0.40 (0.75)
Direct fish management	15	43	9	33	-0.09 (0.59)
Flow regime change	3	18	68	11	0.72 (0.52)
Invasive species	2	24	58	16	0.66 (0.53)
Physical habitat loss, alteration	11	21	57	11	0.50 (0.72)

d. Summary of future impacts for all three fish groups

	Mean	SD	N	Don't know (%)
Discharges	0.36	0.73	102	16
Direct fish management	0.01	0.59	99	19
Flow regime change	0.77	0.45	115	6
Invasive species	0.60	0.51	112	8
Physical habitat loss, alteration	0.48	0.65	116	5
Overall	0.48	0.34		

NOTES: This table presents averages for the three fish groups (responses in Tables B4a–B4c). "Don't know" responses are considered missing values and are not included in the averages. N = the number with valid responses. "Don't know (%)" is the number of respondents who responded "don't know" for all three fish groups (as Tables B4a–B4c show, these rates are sometimes higher for individual fish groups).

Section II: Promising Actions for Each Stressor Category

Background text from survey: "Many actions have been suggested to mitigate the effects of stressors on the Delta's aquatic ecosystem. This section asks you to consider the potential effectiveness of a range of individual actions in improving the Delta ecosystem's ability to support native fishes.

For each stressor category some suggested actions are listed. Please indicate the potential impact of each action on the Delta's ability to improve the viability of native species populations and the degree of certainty of that impact. Consider implementation of each action relative to current conditions, without changing management of other factors affecting the Delta's ecosystem.

Section III will ask you to consider suites of actions and interaction effects."

TABLE B5
In your opinion, what is the potential impact of each of the following actions on the Delta ecosystem's ability to support native fishes?

a. Discharge actions

Action	Negative (%)	Neutral (%)	Weakly positive (%)	Moderately positive (%)	Strongly positive (%)	Don't know (%)	Summary impact score [a] mean (std. dev.)
Increase toxic substance regulation	0	1	27	42	21	9	1.92 (0.75)
Reduce farm fertilizer discharges	1	7	22	35	27	7	1.86 (0.99)
Reduce farm pesticide discharges	0	1	21	44	27	7	2.04 (0.75)
Reduce urban nonpoint discharges	0	2	33	38	20	7	1.81 (0.80)
Reduce urban point discharges	1	2	17	50	25	6	2.01 (0.81)
Dilute pollutant loads with increased freshwater flows	2	4	30	30	21	13	1.70 (1.07)
All discharge actions							1.87 (0.67)

NOTES: Table 1 in the main report presents the entire text description of each action. Scientist responses for the more condensed number of actions in the stakeholder survey are in Table B19.

[a] The last column reports sample mean with standard deviation in parentheses. Summary impact values are calculated using the following the numerical coding for valid categorical answers: "strongly positive" = 3, "moderately positive" = 2, "weakly positive" = 1,"neutral" = 0, and "negative" = -2.

b. Fishery management actions

Action	Negative (%)	Neutral (%)	Weakly positive (%)	Moderately positive (%)	Strongly positive (%)	Don't know (%)	Summary impact score [a] mean (std. dev.)
Manage hatcheries to separate hatchery fish from wild populations	1	7	17	27	27	21	1.92 (1.03)
Develop new conservation hatcheries to support native fish	11	16	26	25	9	12	0.94 (1.41)
Allow unrestricted fishing on non-native predatory fish	6	19	30	23	11	11	1.09 (1.24)
Reduce harvest of anadromous fish	0	11	28	31	24	7	1.73 (0.97)
Increase screening of water diversions	0	7	40	33	14	7	1.58 (0.83)
Increase enforcement to prevent poaching	0	12	45	25	6	11	1.28 (0.78)
Truck salmonids around Delta	22	14	25	20	3	16	0.35 (1.60)
Trap and truck fish around dams	7	19	31	24	4	16	0.92 (1.19)
All fishery actions							1.25 (0.65)

NOTES: See notes to Table B5a.

c. Flow management actions

Action	Negative (%)	Neutral (%)	Weakly positive (%)	Moderately positive (%)	Strongly positive (%)	Don't know (%)	Summary impact score [a] mean (std. dev.)
Increase net Delta outflow	1	3	9	36	46	5	2.28 (0.88)
Reduce Delta exports	0	2	15	25	56	2	2.37 (0.83)
Pattern flow variability to support native species	0	2	9	34	52	2	2.39 (0.76)
Divert Delta exports through canal/tunnel	12	8	20	25	11	23	1.03 (1.58)
Add gated structures within Delta to improve fish passage	5	13	25	30	3	24	1.11 (1.15)
Improve Flow regime upstream of the Delta	1	4	8	40	43	3	2.25 (0.89)
Reduce entrainment at export pumps	1	2	24	36	35	2	2.05 (0.90)
All flow management actions							2.01 (0.55)

NOTES: See notes to Table B5a.

d. Invasive species actions

Action	Negative (%)	Neutral (%)	Weakly positive (%)	Moderately positive (%)	Strongly positive (%)	Don't know (%)	Summary impact score [a] mean (std. dev.)
Directly control nonnative aquatic vegetation	0	6	26	40	16	11	1.76 (0.83)
Directly control invasive clams	4	8	18	34	20	15	1.64 (1.22)
Increase actions to prevent new invasions	0	4	22	30	41	2	2.11 (0.90)
Increase salinity variability in the Delta	2	2	10	42	29	15	2.05 (1.02)
All invasive species actions							1.91 (0.68)

NOTES: See notes to Table B5a.

e. Habitat actions

Action	Negative (%)	Neutral (%)	Weakly positive (%)	Moderately positive (%)	Strongly positive (%)	Don't know (%)	Summary impact score [a] mean (std. dev.)
Restore tidal marsh and shallow water habitat [b]	0	2	7	30	59	3	2.50 (0.70)
Expand seasonal floodplains	0	0	4	25	70	2	2.67 (0.56)
Improve in-Delta channel margin habitat	1	4	11	38	36	10	2.15 (0.92)
Improve/increase upstream habitat	0	2	8	25	63	2	2.53 (0.72)
Increase sediment loads flowing into Delta	2	9	20	27	17	25	1.64 (1.10)
Remove selected dams	0	4	6	29	49	12	2.40 (0.81)
Increase sub-tidal habitat	18	14	19	25	16	9	0.86 (1.70)
All habitat actions							2.15 (0.56)

NOTES: See notes to Table B5a.

[b] This is the combined value from two nearly identical actions, "Restore tidal marsh" and "Increase inter-tidal habitat (e.g., Liberty Island, Suisun Marsh)." (Responses were identical for most survey participants, and in the few cases where they differed, we assigned the higher of the two values). Combining these actions facilitates understanding the priority action choices (Table B7), as this was a popular choice and scientists almost always picked one or the other.

TABLE B6

How certain are the potential impacts of each action?

a. Discharge actions

Action	Low (%)	Moderate (%)	High (%)	Don't know (%)	Summary certainty score [a] mean (std. dev.)
Increase toxic substance regulation	31	37	18	14	1.85 (0.74)
Reduce farm fertilizer discharges	18	52	19	11	2.01 (0.65)
Reduce farm pesticide discharges	20	45	25	10	2.06 (0.71)
Reduce urban nonpoint discharges	27	48	16	10	1.87 (0.68)
Reduce urban point discharges	14	48	30	7	2.18 (0.67)
Dilute pollutant loads with increased freshwater flows	26	33	25	16	1.99 (0.79)
All discharge actions					2.01 (0.51)

NOTES: Table 1 in the main report presents the entire text description of each action. Scientist responses for the simplified actions in the stakeholder survey are in Table B21.

[a] The last column reports sample mean with standard deviation in parentheses. Summary impact values are calculated using the following numerical coding for valid categorical answers: "high" = 3, "moderate" = 2, "low" = 1.

b. Fishery management actions

Action	Low (%)	Moderate (%)	High (%)	Don't know (%)	Summary certainty score [a] mean (std. dev.)
Manage hatcheries to separate hatchery fish from wild populations	16	30	28	26	2.16 (0.76)
Develop new conservation hatcheries to support native fish	25	42	16	16	1.89 (0.70)
Allow unrestricted fishing on nonnative predatory fish	26	32	25	16	1.99 (0.79)
Reduce harvest of anadromous fish	16	43	34	8	2.20 (0.71)
Increase screening of water diversions	20	44	26	10	2.07 (0.71)
Increase poaching enforcement	27	34	24	16	1.96 (0.78)
Truck salmonids around Delta	25	34	20	21	1.94 (0.75)
Trap and truck fish around dams	33	30	16	21	1.78 (0.76)
All fishery actions					2.01 (0.51)

NOTES: See notes to Table B6a.

c. Flow management actions

Action	Low (%)	Moderate (%)	High (%)	Don't know (%)	Summary certainty score [a] mean (std. dev.)
Increase net Delta outflow	10	48	34	7	2.27 (0.64)
Reduce Delta exports	11	42	43	3	2.33 (0.68)
Pattern flow variability to support native species	14	48	32	7	2.19 (0.68)
Divert Delta exports through canal/tunnel	27	32	14	27	1.82 (0.73)
Add gated structures within Delta to improve fish passage	24	40	7	29	1.77 (0.62)
Improve flow regime upstream of the Delta	8	48	37	7	2.31 (0.63)
Reduce entrainment at export pumps	9	50	35	6	2.28 (0.63)
All flow management actions					2.16 (0.43)

NOTES: See notes to Table B6a.

d. Invasive species actions

Action	Low (%)	Moderate (%)	High (%)	Don't know (%)	Summary certainty score [a] mean (std. dev.)
Directly control nonnative aquatic vegetation	25	43	19	12	1.93 (0.71)
Directly control invasive clams	30	38	16	16	1.84 (0.73)
Increase actions to prevent new invasions	22	38	38	2	2.16 (0.77)
Increase salinity variability in the Delta	16	50	19	15	2.03 (0.65)
All invasive species actions					1.96 (0.57)

NOTES: See notes to Table B6a.

e. Habitat actions

Action	Low (%)	Moderate (%)	High (%)	Don't know (%)	Summary certainty score [a] mean (std. dev.)
Restore tidal marsh and shallow water habitat [b]	8	46	43	3	2.36 (0.63)
Expand seasonal floodplains	6	36	56	2	2.51 (0.61)
Improve in-Delta channel margin habitat	12	52	23	13	2.12 (0.63)
Improve/increase upstream habitat	10	31	55	4	2.47 (0.68)
Increase sediment loads flowing into Delta	21	38	13	28	1.89 (0.69)
Remove selected dams	10	39	38	14	2.32 (0.67)
Increase sub-tidal habitat	26	44	18	11	1.91 (0.70)
All habitat actions					2.23 (0.45)

NOTES: See notes to Table B6a.

[b] This is the combined value from two nearly identical actions, "Restore tidal marsh" and "Increase inter-tidal habitat (e.g., Liberty Island, Suisun Marsh)." (Responses were nearly identical, and in the few cases where they differed, we assigned the higher of the two values). Combining these actions facilitates understanding the priority action choices (Table B7), as this was a popular choice and scientists almost always picked one or the other.

Section III: Priorities for Action

Background text from survey: "Earlier you evaluated individual actions to address ecosystem stressors; in this section we will ask you to consider actions as a group. The following questions ask you to consider which actions could have the most beneficial impact on the Delta's native fish species. When making your selections, consider potential interactions and assume meaningful implementation of each action you select."

TABLE B7
Considering interactions, what are the five actions that would result in the most beneficial impact on the Delta's native fish species?

(You can pick any combination of actions, without regard to stressor categories).

Please rank the actions you chose, with 1 being the highest priority, 2 the next highest, and so on.

a. Discharge actions

Action	Top 5 (%)	Average ranked score [a]
1. Reduce urban nonpoint discharges	3	0.06
2. Reduce farm pesticide discharges	7	0.07
3. Reduce toxic substance discharges	11	0.19
4. Reduce urban point discharges	13	0.39
5. Reduce farm fertilizer discharges	6	0.16
6. Dilute pollutant loads with increased freshwater flows	4	0.10

NOTES: Although all respondents picked five actions from our list, they had the option of selecting up to three write-in actions. The table only counts actions that these respondents ranked in their top five.

[a] The average rank value is calculated by assigning an action ranked 1 a score of 5, an action ranked 2 a score of 4, etc.

b. Fishery management actions

Action	Top 5 (%)	Average ranked score [a]
7. Truck salmonids around Delta	1	0.01
8. Increase enforcement to prevent poaching	1	0.01
9. Increase screening of water diversions	2	0.04
10. Develop new conservation hatcheries to support native fish	5	0.10
11. Reduce harvest of anadromous fish	7	0.19
12. Trap and truck fish around dams	1	0.01
13. Allow unrestricted fishing on non-native predatory fish	6	0.11
14. Manage hatcheries to separate hatchery fish from wild populations	16	0.41

NOTES: See notes to Table B7a.

c. Flow management actions

Action	Top 5 (%)	Average ranked score [a]
15. Add gated structures within Delta to improve fish passage	0	0.00
16. Reduce entrainment at export pumps	11	0.34
17. Reduce Delta exports	39	1.53
18. Increase net Delta outflow	34	1.36
19. Improve Flow regime upstream of the Delta	30	0.96
20. Pattern flow variability to support native species	59	2.12
21. Divert Delta exports through canal/tunnel	7	0.22

NOTES: See notes to Table B7a.

d. Invasive actions

Action	Top 5 (%)	Average ranked score [a]
22. Directly control nonnative aquatic vegetation	7	0.15
23. Increase actions to prevent new invasions	11	0.24
24. Directly control invasive clams	5	0.15
25. Increase salinity variability in the Delta	23	0.60

NOTES: See notes to Table B7a.

e. Habitat actions

Action	Top 5 (%)	Average ranked score [a]
29. Restore tidal marsh and shallow water habitat [b]	59	1.44
26. Expand seasonal floodplains	60	1.88
27. Improve/increase upstream habitat	25	0.73
28. Remove selected dams	21	0.57
30. Improve in-Delta channel margin habitat	14	0.32
31. Increase sub-tidal habitat	3	0.06
32. Increase sediment loads flowing into Delta	8	0.19

NOTES: See notes to Table B7a.

[b] This is the combined value from two nearly identical actions, “Restore tidal marsh” and “Increase inter-tidal habitat (e.g., Liberty Island, Suisun Marsh).” Only six respondents picked both.

TABLE B8
Actions combined into nine action areas based on function

Action area (# of actions)	Top 5 (%)	Ranked 1st (%)	Ranked 2nd (%)	Ranked 3rd (%)	Ranked 4th (%)	Ranked 5th (%)	Average # of actions picked [a]
Delta habitat (5)	82	17	20	24	16	5	1.34
Flow variability (2)	65	21	19	10	5	10	0.82
Reduce diversions (3)	62	36	10	7	7	3	0.77
Upstream management (3)	61	11	15	16	11	9	0.76
Reduce discharges (4)	30	6	2	2	11	9	0.39
Manage hatcheries (3)	22	2	2	4	7	7	0.23
Diversion engineering (4)	20	3	4	6	2	5	0.20
Invasive control (2)	20	2	3	3	3	8	0.22
Manage harvest (3)	12	2	1	2	4	4	0.14

NOTES: The table presents calculated values for groups of individual actions, using the simplified actions created for comparison with the stakeholder survey (Table B20). Table 3 in the main report describes the action areas.

[a] "Average # of actions picked" is the average number of individual actions chosen within the action area.

Section IV. Expert Background and Biographical Information

TABLE B9
Please check the category(ies) of your professional and academic training

(% of sample)

Natural sciences only	Natural and physical sciences	Physical sciences only
67	22	11

NOTES: Multiple answers were possible. We recoded fields provided into natural sciences (biology and ecology) and physical sciences (chemistry, engineering, geosciences, and hydrology).

TABLE B10
What is your highest degree earned

(% sample)

B.A./B.S.	Masters	Ph.D.
11	21	67

TABLE B11
Years of scientific experience in the Sacramento-San Joaquin Delta

N	Average	<5 (%)	5 to 14 (%)	15 to 25 (%)	25+ (%)
121	15.9	8	36	36	21

TABLE B12
Please characterize your level of professional expertise and background for each of the specific stressor categories

	N	No background (%)	Background outside the Delta only (%)	Background for the Delta but no publications (%)	Publications on Delta ecosystem [a] (%)
Discharges	119	23	11	34	32
Fish management	118	27	13	33	27
Flows	120	10	7	38	46
Invasives	121	14	7	37	42
Habitat	119	8	10	27	55

NOTES: The above values reflect mutually exclusive categories calculated from a wider range of nonexclusive potential responses. Those without background in discharges or direct fish management were significantly more likely to respond “don’t know” to impact questions relating to the corresponding stressor (Tables B1 and B4). Those without background in habitat were significantly more likely to respond, “don’t know” to historical impact questions (Table B1), but not future impact questions (Table B4). There was no relationship for the invasive species and flow management stressors.

[a] This variable counts either scientific reports or refereed journal articles or books.

TABLE B13
Please provide names of up to ten scientific professionals, other than yourself, whom you consider exceptional in their ability to understand the complexities of the aquatic ecosystem of the Sacramento-San Joaquin Delta

	Total	In Sample
Names mentioned five or more times	36	26
Names mentioned ten or more times	20	13

NOTES: Fifty-four percent of respondents answered this question. However, there were no significant differences in response rates by key groups: employer, Moyle lab affiliation, or whether based within California. For characteristics of those named five times or more, see Appendix Table A4.

Stakeholder Survey

Results are presented by the seven stakeholder groups described in Appendix A. The “stakeholder group average” presents the simple average of responses for all seven groups, weighted equally. Results from the scientific expert survey are also included where relevant to facilitate comparisons.

Introduction

Background text from survey: “This survey seeks your views on the role of various ecosystem stressors in the long-term declines in the Delta’s native fish populations as well as priority actions to improve the Delta’s ability to support these species. We recognize that the Delta faces many other policy challenges, but we are seeking your views on this particular issue at this time.”

Stressor Categories Used in This Survey

This survey used the same descriptions of the five stressor categories as the scientist survey (see above).

Section I: Importance of Stressors for the Delta's Native Fishes

Background text from survey: "In this section we ask you to consider the role of the five stressor groups on the historical decline of Delta ecosystem conditions and likely future ecosystem conditions. The questions ask you to think in general terms about the impact of each stressor group on the Delta's native fish populations.

The three main categories of native fish are:

1. Pelagic fish that reside in the Delta's open waters, such as delta smelt, longfin smelt;
2. Anadromous fish that pass through the Delta on their way to/from upstream spawning and rearing areas and the ocean, such as salmon, steelhead, sturgeon;
3. Resident natives that live in the Delta and adjacent riparian areas, such as splittail, blackfish, hitch, tullyhead, etc.

Although these species may have different needs at different points in their lives, we ask you to consider the overall impacts of stressors on the Delta ecosystem's ability to support them**."**

Historical and Future Importance of Stressors

TABLE B14
Please indicate the level of impact you believe each stressor group has had on the historical decline of the Delta's native fishes

General notes for Tables B14a–e: The numerical values assigned to valid categorical answers are as follows: "high impact" = 3, "moderate impact" = 2, "low impact" = 1, "no impact" = 0. The last column reports sample mean with standard deviation in parentheses. Scientists' values are averages for three types of native fish (Table B1d).

a. Discharges

	N	No impact (%)	Low impact (%)	Moderate impact (%)	High impact (%)	Don't know (%)	Summary impact mean (std. dev.)
Delta	38	3	29	55	11	3	1.76 (0.68)
Fishing/recreation	14	0	7	50	43	0	2.36 (0.63)
Upstream	39	0	23	49	23	5	2.00 (0.71)
Exporters	22	0	0	18	82	0	2.82 (0.39)
Environmental	56	0	14	41	43	2	2.29 (0.71)
Federal/state agencies	56	0	11	59	23	7	2.13 (0.60)
Other	15	0	0	60	40	0	2.40 (0.51)
Stakeholder group average	7	0	12	47	38	2	2.25 (0.34)
Scientists	122					15	2.00 (0.69)

NOTES: Ordered logits revealed the following significant differences across groups at 90 percent significance or greater in two-tailed tests: Exporter interests had higher likelihood of ranking discharge impacts as high impact than all other groups. Delta interests had lower likelihood than all the other groups except upstream interests. Upstream interests had lower likelihood than environmental advocates and "other stakeholders." For these comparisons, scientist responses for pelagic fish were used (Table B2a).

b. Direct fish management

	N	No impact (%)	Low impact (%)	Moderate impact (%)	High impact (%)	Don't know (%)	Summary impact mean (std. dev.)
Delta	38	0	36	43	21	0	1.88 (0.81)
Fishing/recreation	14	0	15	46	31	8	1.86 (0.77)
Upstream	39	0	14	73	14	0	2.17 (0.70)
Exporters	22	2	29	43	20	7	2.00 (0.53)
Environmental	56	0	21	43	20	16	1.87 (0.77)
Federal/state agencies	56	0	27	60	7	7	1.98 (0.71)
Other	15	1	23	47	20	9	1.79 (0.58)
Stakeholder group average	7	0	24	51	19	7	1.94 (0.13)
Scientists	122					12	1.80 (0.65)

NOTES: Ordered logits revealed the following significant differences across groups at 90 percent significance or greater in two-tailed tests: Exporter and upstream interests had a lower likelihood of ranking flow regime changes as high impact than all other groups except fishing/recreation interests. Exporters' rankings were also lower than upstream interests, and environmental advocates' rankings were higher than government officials and other stakeholders. For these comparisons, scientist responses for pelagic fish were used (Table B2a).

c. Flow regime change

	N	No impact (%)	Low impact (%)	Moderate impact (%)	High impact (%)	Don't know (%)	Summary impact mean (std. dev.)
Delta	38	0	0	24	76	0	2.76 (0.43)
Fishing/recreation	14	0	0	0	100	0	3.00 (0.00)
Upstream	39	0	23	41	36	0	2.13 (0.77)
Exporters	22	0	50	41	9	0	1.59 (0.67)
Environmental	56	0	2	14	84	0	2.82 (0.43)
Federal/state agencies	56	0	5	23	70	2	2.65 (0.58)
Other	15	0	7	33	60	0	2.53 (0.64)
Stakeholder group average	7	0	12	25	62	0	2.50 (0.48)
Scientists	122					1	2.67 (0.41)

NOTES: Ordered logits revealed the following significant differences across groups at 90 percent significance or greater in two-tailed tests: Exporter and upstream interests had a lower likelihood of ranking flow regime changes as high impact than all the other groups except fishing/recreation. Exporters had a lower likelihood than upstream interests, and environmental advocates had a higher likelihood than government officials and other stakeholders. For these comparisons, scientist responses for pelagic fish were used (Table B2a).

d. Invasives

	N	No impact (%)	Low impact (%)	Moderate impact (%)	High impact (%)	Don't know (%)	Summary impact mean (std. dev.)
Delta	38	3	26	45	24	3	1.92 (0.80)
Fishing/recreation	14	0	57	36	7	0	1.50 (0.65)
Upstream	39	0	8	28	64	0	2.56 (0.64)
Exporters	22	0	0	27	73	0	2.73 (0.46)
Environmental	56	0	25	36	34	5	2.09 (0.79)
Federal/state agencies	56	0	9	41	46	4	2.39 (0.66)
Other	15	0	13	27	53	7	2.43 (0.76)
Stakeholder group average	7	0	20	34	43	3	2.23 (0.42)
Scientists	122					5	2.21 (0.58)

NOTES: Ordered logits revealed the following significant differences across groups at 90 percent significance or greater in two-tailed tests: Fishing/recreation interests had lower likelihood than all other stakeholder and scientists of ranking invasive species as high impact. Exporter and upstream interests had higher likelihood than scientists, government officials, and environmental interests. For these comparisons, scientist responses for pelagic fish were used (Table B2a).

e. Physical habitat loss and alteration

	N	No impact (%)	Low impact (%)	Moderate impact (%)	High impact (%)	Don't know (%)	Summary impact mean (std. dev.)
Delta	38	5	34	32	29	0	1.84 (0.92)
Fishing/recreation	14	0	0	29	71	0	2.71 (0.47)
Upstream	39	0	10	26	62	3	2.53 (0.69)
Exporters	22	0	0	18	82	0	2.82 (0.39)
Environmental	56	0	0	25	75	0	2.75 (0.44)
Federal/state agencies	56	0	2	21	75	2	2.75 (0.48)
Other	15	0	0	33	67	0	2.67 (0.49)
Stakeholder group average	7	1	7	26	66	1	2.58
Scientists	122					2	2.66 (0.38)

NOTES: Ordered logits revealed the following significant differences across groups at 90 percent significance or greater in two-tailed tests: Delta interests had a lower likelihood of ranking habitat loss and alteration as high impact than all the other groups. Exporters, environmental advocates, and governmental officials had a higher likelihood than scientists. For these comparisons, scientist responses for pelagic fish were used (Table B2a)

TABLE B15
Considering interactions among different types of stressors, which *two* stressor groups have contributed most to the decline in the Delta ecosystem's overall ability to support native species?

	N	Discharges (%)	Direct fish management (%)	Flow regime change (%)	Invasive species (%)	Physical habitat loss, alteration (%)	Don't know (%)
Delta	38	24	18	89	37	32	0
Fishing/recreation	14	29	21	93	0	50	0
Upstream	39	13	15	41	56	74	0
Exporters	22	68	0	0	50	82	0
Environmental	56	23	7	89	11	70	0
Federal/state agencies	56	14	7	68	27	80	4
Other	15	13	0	60	33	93	0
Stakeholder group average	7	26	10	63	31	69	1
Scientists	122	12	2	78	27	77	2

NOTES: ANOVA tests with a Bonferroni adjustment revealed the following significant difference across groups at 90 percent significance or greater: Exporters were more likely to choose discharges than all other groups. Scientists were less likely to choose direct fish management than Delta and upstream interests. Exporters were less likely to choose flow regime change than all other groups, and upstream interests were less likely to choose this stressor than all groups but exporters and "other stakeholders." Exporters were more likely to choose invasive species than upstream interests, government officials and scientists, and upstream interests were more likely to choose this stressor than fishing/recreation and environmental interests. Delta interests were less likely to choose physical habitat and alteration than upstream, exporters, environmental, "other stakeholders," government officials, and scientists. Scientist responses are from Table B2.

TABLE B16
In your opinion, which *single* stressor group has contributed the most to the decline in the Delta ecosystem's overall ability to support native species?

	N	Discharges (%)	Direct fish management (%)	Flow regime change (%)	Invasive species (%)	Physical habitat loss, alteration (%)	Don't know (%)
Delta	38	0	3	71	8	18	0
Fishing/recreation	14	7	7	71	0	14	0
Upstream	39	5	3	26	33	28	5
Exporters	22	27	0	0	9	55	9
Environmental	56	5	0	63	0	29	4
Federal/state agencies	56	5	0	43	7	39	5
Other	15	7	0	20	13	47	13
Stakeholder group average	7	8	2	42	10	33	5
Scientists [a]	122	4	1	38	7	46	4

[a] See Table B3.

NOTES: ANOVA tests with a Bonferroni adjustment revealed the following significant difference across groups at 90 percent significance or greater: Exporters were more likely to choose discharges than all other groups except fishing/recreation. Exporters were less likely to choose flow regime change than all other groups. Delta, fishing/recreation, and environmental interests were more likely than upstream, other stakeholders, and scientists to choose flow regime change. Upstream interests were more likely to choose invasive species than all other groups except "other stakeholders." Scientists were more likely than Delta interests to choose physical habitat loss and alteration.

TABLE B17
Please indicate how you believe the impact of each stressor group will likely change in the future (e.g., by 2050), as a result of changes in water demand, population growth, climate change and other non-managerial factors. Assume management of each stressor group continues as it is today.

General note for Tables B17a–e: The numerical values assigned to valid categorical answers are as follows: "more impact" = 1, "less impact" = -1, "stay the same" = 0. The last column reports sample mean with standard deviation in parentheses. Scientists' values are averages for three types of native fish (Table B4d).

a. Discharges

	N	Less impact (%)	Stay the same (%)	More impact (%)	Don't know (%)	Summary impact mean (std. dev.)
Delta	38	29	34	24	13	-0.06 (0.79)
Fishing/recreation	14	14	7	64	14	0.58 (0.79)
Upstream	39	44	33	15	8	-0.31 (0.75)
Exporters	22	36	23	41	0	0.05 (0.90)
Environmental	56	30	16	46	7	0.17 (0.90)
Federal/state agencies	56	32	25	36	7	0.04 (0.86)
Other	15	27	27	47	0	0.20 (0.86)
Stakeholder group average	7	30	24	39	7	0.10 (0.25)
Scientists	122				16	0.36 (0.73)

NOTES: Ordered logits revealed the following significant differences across groups at 90 percent significance or greater in two-tailed tests: Delta interests had a lower likelihood than all other groups to consider that discharges will have more impact in the future. Exporter interests had a higher likelihood than all other groups, and environmental advocates and "other stakeholders" had a higher likelihood than upstream interests. For these comparisons, scientist responses for pelagic fish were used (Table B4a).

b. Direct fish management

	N	Less impact (%)	Stay the same (%)	More impact (%)	Don't know (%)	Summary impact mean (std. dev.)
Delta	38	16	39	26	18	0.13 (0.72)
Fishing/recreation	14	29	14	36	21	0.09 (0.94)
Upstream	39	15	23	44	18	0.34 (0.79)
Exporters	22	14	45	36	5	0.24 (0.70)
Environmental	56	23	32	29	16	0.06 (0.79)
Federal/state agencies	56	14	41	23	21	0.11 (0.69)
Other	15	13	47	33	7	0.21 (0.70)
Stakeholder group average	7	18	34	32	15	0.17 (0.09)
Scientists	122				19	0.01 (0.59)

NOTES: Ordered logits revealed the following significant differences across groups at 90 percent significance or greater in two-tailed tests: Scientists had a lower likelihood than all other groups to respond that direct fish management will have more impact in the future. Upstream interest ranking of this stressor was also higher than environmental advocates' ranking. For these comparisons, scientist responses for pelagic fish were used (Table B4a).

c. Flow regime change

	N	Less impact (%)	Stay the same (%)	More impact (%)	Don't know (%)	Summary impact mean (std. dev.)
Delta	38	5	11	74	11	0.76 (0.55)
Fishing/recreation	14	7	0	93	0	0.86 (0.53)
Upstream	39	18	31	49	3	0.32 (0.77)
Exporters	22	27	64	5	5	-0.24 (0.54)
Environmental	56	7	14	73	5	0.70 (0.61)
Federal/state agencies	56	20	27	48	5	0.30 (0.80)
Other	15	40	13	47	0	0.07 (0.96)
Stakeholder group average	7	14	25	57	5	0.40 (0.37)
Scientists	122				6	0.77 (0.45)

NOTES: Ordered logits revealed the following significant differences across groups at 90 percent significance or greater in two-tailed tests: Exporters had a lower likelihood to respond that flow regime will have more impact in the future than all other groups except fishing/recreation. Upstream interests' rankings are lower than environmental advocates, government officials, and "other stakeholders." Environmental advocates' rankings are higher than government officials and "other stakeholders." For these comparisons, scientist responses for pelagic fish were used (Table B4a).

d. Invasives

	N	Less impact (%)	Stay the same (%)	More impact (%)	Don't know (%)	Summary impact mean (std. dev.)
Delta	38	3	21	61	16	0.69 (0.54)
Fishing/Recreation	14	0	50	29	21	0.36 (0.50)
Upstream	39	8	18	69	5	0.65 (0.63)
Exporters	22	0	36	64	0	0.64 (0.49)
Environmental	56	5	25	52	18	0.57 (0.62)
Federal/state agencies	56	7	23	63	7	0.60 (0.63)
Other	15	0	33	67	0	0.67 (0.49)
Stakeholder group average	7	3	29	58	10	0.60 (0.10)
Scientists	112				8	0.60 (0.51)

NOTES: Ordered logits revealed the following significant differences across groups at 90 percent significance or greater in two-tailed tests: Fishing/recreation interests had lower likelihood to respond that invasives will have more impact in the future than all other groups. Exporter rankings were higher than all other groups. Scientists ranked this stressor higher than fishing/recreation, Delta interests, and environmental advocates. Delta interests also had lower rankings than government officials, upstream interests, and "other stakeholders," and environmental advocates' rankings were also higher than government officials. For these comparisons, scientist responses for pelagic fish were used (Table B4a).

e. **Physical habitat loss and alteration**

	N	Less impact (%)	Stay the same (%)	More impact (%)	Don't know (%)	Summary impact mean (std. dev.)
Delta	38	24	45	18	13	-0.06 (0.70)
Fishing/recreation	14	14	14	71	0	0.57 (0.76)
Upstream	39	31	36	28	5	-0.03 (0.80)
Exporters	22	32	36	32	0	0.00 (0.82)
Environmental	56	18	13	64	5	0.49 (0.80)
Federal/state agencies	56	20	43	30	7	0.12 (0.12)
Other	15	40	27	33	0	-0.07 (0.88)
Stakeholder group average	7	26	31	39	4	0.15 (0.25)
Scientists	116				5	0.48 (0.34)

NOTES: Ordered logits revealed the following significant differences across groups at 90 percent significance or greater in two-tailed tests: Delta interest had a lower likelihood than all other groups to respond that physical habitat loss and alteration will have more impact in the future. Environmental advocates, government officials and exporters all had higher rankings than scientists. For these comparisons, scientist responses for pelagic fish were used (Table B4a).

TABLE B18
Overall ratings of stressor impacts (calculated values)

	Overall historical stressor impact	Overall future stressor impact
Delta	2.04	0.28
Fishing/recreation	2.29	0.54
Upstream	2.28	0.20
Exporters	2.39	0.13
Environmental	2.38	0.41
Federal/state agencies	2.39	0.26
Other	2.38	0.23
Scientists	2.32	0.48

NOTES: Overall historical and future stressor impacts are the averages of all valid responses on these questions (for scientists, from Tables B1 and B4, and for stakeholders from Tables B15 and B17, respectively). Pairwise t-tests revealed the following significant differences across groups at 90 percent significance or greater: Delta interests had lower historical impact scores than all other groups except fishing/recreation. Exporters had lower average future impact scores than upstream interests and scientists, and scientists had higher future impact scores than government officials and upstream interests.

Section II: Priorities for Improving Conditions for Native Fishes

Background text from survey: "In this section we provide you with a list of potential actions that may improve the outcome of the Delta's native fishes and ask you to pick and rank priorities. The actions are organized by stressor category and are summarized here:

- **Discharges:** Actions could include reducing various sources of pollutant discharges into the Delta's waterways. Actions might also include diluting pollutant loads with increased freshwater flows.
- **Direct Fish Management:** Potential actions include changes in hatchery policies, changes in the regulation and enforcement of commercial and recreational fishing, increased screening of diversions, and trucking fish in some places to facilitate their access to better habitat or to avoid harmful habitat.
- **Flow Management:** Actions could include altering flow volumes and patterns by changing reservoir releases and diversions, building new structures to alter flows, and undertaking various measures to reduce entrainment at the export pumps.

- **Invasive Species:** Actions could include directly controlling invasive vegetation and clams that are now in the Delta, increasing efforts to prevent new species invasions, and increasing salinity variability in the Delta to suppress existing invasives.
- **Physical Habitat:** Actions could include restoring and expanding various types of habitat within and upstream of the Delta, removing selected dams, and increasing sediment loads flowing into the Delta.

We understand that many of these actions could also have other effects—either positive or negative—but for the purposes of this survey we ask that you answer from the perspective of what will positively impact native fish populations."

TABLE B19

Considering interactions, what are the five actions that would result in the most beneficial impact on the Delta's native fish species? Please rank the actions you chose, with 1 being the highest priority, 2 the next highest, and so on.

(You can pick any combination of actions, without regard to stressor categories).

a. Discharge Actions

Action	Delta		Fishing/ recreation		Upstream		Exporters		Environment		Federal/state agencies		Other		Scientists	
	Top 5 (%)	Avg. rank	Top 5 (%)	Avg. rank	Top 5 (%)	Avg. rank	Top 5 (%)	Avg. rank	Top 5 (%)	Avg. rank	Top 5 (%)	Avg. rank	Top 5 (%)	Avg. rank	Top 5 (%)	Avg. rank
Increase toxic substance regulation	18	0.39	21	0.50	31	0.82	18	0.50	23	0.63	13	0.32	20	0.40	11	0.19
Reduce farm discharges [a]	11	0.24	7	0.07	13	0.36	5	0.14	21	0.55	16	0.36	13	0.27	11	0.25
Reduce urban nonpoint discharges	3	0.08	7	0.07	21	0.64	14	0.23	4	0.11	11	0.20	13	0.27	3	0.06
Reduce urban point discharges	16	0.45	0	0	18	0.51	86	3.27	23	0.70	21	0.61	40	1.13	13	0.39
Dilute pollutant loads with increased freshwater flows	13	0.29	29	0.79	3	0.03	5	0.05	11	0.27	7	0.18	13	0.60	4	0.10

b. Fishery management actions

Action	Delta		Fishing/ recreation		Upstream		Exporters		Environment		Federal/state agencies		Other		Scientists	
	Top 5 (%)	Avg. rank	Top 5 (%)	Avg. rank	Top 5 (%)	Avg. rank	Top 5 (%)	Avg. rank	Top 5 (%)	Avg. rank	Top 5 (%)	Avg. rank	Top 5 (%)	Avg. rank	Top 5 (%)	Avg. rank
Manage hatcheries to separate hatchery fish from wild populations	3	0.08	7	0.07	10	0.28	18	0.45	4	0.04	5	0.09	0	0	16	0.41
Develop new conservation hatcheries to support native fish	5	0.05	7	0.21	3	0.08	5	0.05	5	0.11	5	0.13	13	0.40	5	0.10
Allow unrestricted fishing on non-native predatory fish	13	0.50	0	0	56	1.82	41	1.05	7	0.14	16	0.39	7	0.07	6	0.11
Reduce harvest of anadromous fish	5	0.16	0	0	26	0.79	32	0.82	4	0.05	11	0.16	7	0.07	7	0.19
Increase screening of water diversions	18	0.55	14	0.29	10	0.21	5	0.14	18	0.46	5	0.14	7	0.13	2	0.04
Increase enforcement to prevent poaching	0	0	0	0	0	0	0	0	4	0.07	0	0	0	0	1	0.01
Truck fish around Delta and dams b/	3	0.03	43	1.07	0	0	0	0	2	0.07	0	0	0	0	2	0.02

c. Flow management actions

Action	Delta		Fishing/ recreation		Upstream		Exporters		Environment		Federal/state agencies		Other		Scientists	
	Top 5 (%)	Avg. rank	Top 5 (%)	Avg. rank	Top 5 (%)	Avg. rank	Top 5 (%)	Avg. rank	Top 5 (%)	Avg. rank	Top 5 (%)	Avg. rank	Top 5 (%)	Avg. rank	Top 5 (%)	Avg. rank
Increase net Delta outflow	55	2.26	50	1.86	3	0.08	0	0	29	1.13	25	1.09	13	0.6	34	1.36
Reduce Delta exports	79	3.47	86	4.21	41	1.69	0	0	59	2.59	32	1.38	13	0.67	39	1.53
Pattern flow variability to support native species	32	1.08	57	1.43	18	0.64	14	0.41	39	1.34	48	2.05	33	1.07	59	2.12
Divert Delta exports through canal/tunnel	5	0.26	0	0	13	0.51	55	1.91	2	0.14	11	0.21	40	1.47	7	0.22
Add gated structures within Delta to improve fish passage	8	0.24	0	0	8	0.13	5	0.18	4	0.07	2	0.04	13	0.47	0	0
Improve flow regime upstream of the Delta	16	0.42	7	0.14	3	0.08	0	0	20	0.61	20	0.66	20	0.53	30	0.96
Reduce entrainment at export pumps	32	0.79	43	1.36	10	0.41	0	0	7	0.18	20	0.55	27	0.87	11	0.34

d. Invasive species actions

Action	Delta		Fishing/ recreation		Upstream		Exporters		Environment		Federal/state agencies		Other		Scientists	
	Top 5 (%)	Avg. rank	Top 5 (%)	Avg. rank	Top 5 (%)	Avg. rank	Top 5 (%)	Avg. rank	Top 5 (%)	Avg. rank	Top 5 (%)	Avg. rank	Top 5 (%)	Avg. rank	Top 5 (%)	Avg. rank
Directly control existing invasive species [c]	24	0.58	0	0	38	1.05	14	0.45	13	0.36	14	0.23	13	0.53	11	0.30
Increase actions to prevent new invasions	5	0.16	0	0	18	0.31	5	0.23	7	0.11	11	0.29	13	0.40	11	0.24
Increase salinity variability in the Delta	5	0.11	7	0.14	23	0.56	27	0.82	4	0.05	9	0.27	7	0.33	23	0.60

e. Habitat actions

Action	Delta		Fishing/ recreation		Upstream		Exporters		Environment		Federal/state agencies		Other		Scientists	
	Top 5 (%)	Avg. rank	Top 5 (%)	Avg. rank	Top 5 (%)	Avg. rank	Top 5 (%)	Avg. rank	Top 5 (%)	Avg. rank	Top 5 (%)	Avg. rank	Top 5 (%)	Avg. rank	Top 5 (%)	Avg. rank
Restore tidal marsh and shallow water habitat	29	0.68	36	0.79	73	1.28	27	2.5	63	0.86	40	1.95	41	1.00	48	1.44
Expand seasonal floodplains	0	0.37	18	0	45	0.62	29	1.14	43	0.84	33	1.30	28	1.07	60	1.88
Improve in-Delta channel margin habitat	0	0.42	18	0	18	0.44	20	0.45	21	0.50	13	0.63	18	0.20	14	0.32
Improve/increase upstream habitat	29	0.47	18	0.50	9	0.41	41	0.09	36	1.05	20	0.84	28	0.73	25	0.73
Increase sediment loads flowing into Delta	0	0	5	0	5	0.13	4	0.14	2	0.07	0	0.02	0	0	8	0.19
Remove selected dams	29	0.08	3	0.71	0	0.10	21	0	9	0.55	7	0.21	29	0.07	21	0.57
Increase sub-tidal habitat	0	0.05	5	0	0	0.10	2	0	0	0.02	7	0	3	0.07	3	0.06

NOTES: "Top 5%" reports the percentage of that stakeholder group with the specific action in their top five choices. "Average rank" is calculated using a scoring system that gives an action ranked first a score of 5, an action ranked second a score of 4, etc. For full action descriptions as presented in the survey, see Table 1 of main report. In contrast to scientists, stakeholders could pick fewer than five actions.

[a] For scientists, this action combines responses to "reduce farm pesticide discharges" and "reduce farm fertilizer discharges."

[b] For scientists, this action combines "truck juvenile salmonids around the Delta" and "trap and truck fish around dams." For stakeholders, the survey only included the first action, written as "truck juvenile salmon and steelhead around the Delta"), but some respondents wrote in the second action.

[c] For scientists, this action combines "directly control invasive aquatic vegetation" and "directly control invasive clams."

TABLE B20
Actions combined into nine action areas based on function

General notes: Scientist's results for all B20 tables are from Table B8. For a description of which individual actions are included in action areas, see Table 3 in the main report. "In Top 5" reports the share of respondents within each group that chose at least one action in the area. "Actions picked" reports the mean number of actions chosen within the area. The shares "Ranked 1st" through "Ranked 5th"may not sum to the share in the "In Top 5" column because of rounding.

a. Delta habitat

	N	In Top 5 (%)	Ranked 1st (%)	Ranked 2nd (%)	Ranked 3rd (%)	Ranked 4th (%)	Ranked 5th (%)	Actions picked (out of 5)
Delta	38	53	0	13	13	13	13	0.63
Fishing/recreation	14	29	0	14	0	7	7	0.29
Upstream	39	64	10	18	21	10	5	0.82
Exporters	22	95	23	23	14	23	14	1.41
Environmental	56	52	7	21	7	11	5	0.80
Federal/state agencies	55	80	16	27	18	16	4	1.29
Other	15	67	7	7	27	7	20	0.93
Stakeholder group average	7	63	9	18	14	12	10	0.88
Scientists	122	82	17	20	24	16	5	1.34

NOTES: Logit regressions revealed the following significant differences across groups at 90 percent significance or greater in two-tailed tests: Scientists were more likely to include at least one Delta habitat activity in their top five than Delta, fishing/recreation, upstream, and environmental interests. Exporters chose this area more than all other groups except scientists. Government officials chose this area more often than fishing/recreation, Delta, and environmental interests. Fishing/recreation interests also chose this area less often than upstream interests and "other stakeholders."

b. Flow variability

	N	In Top 5 (%)	Ranked 1st (%)	Ranked 2nd (%)	Ranked 3rd (%)	Ranked 4th (%)	Ranked 5th (%)	Actions picked (out of 2)
Delta	38	32	8	11	3	8	3	0.37
Fishing/recreation	14	64	0	7	21	29	7	0.64
Upstream	39	36	10	5	3	10	8	0.41
Exporters	22	41	5	14	9	5	9	0.41
Environmental	56	43	9	14	5	7	7	0.43
Federal/state agencies	55	54	30	9	11	0	4	0.57
Other	15	40	13	0	20	7	0	0.40
Stakeholder group average	7	44	11	9	10	9	5	0.46
Scientists	122	65	21	19	10	5	10	0.82

NOTES: Logit regressions revealed the following significant differences across groups at 90 percent significance or greater in two-tailed tests: Scientists were more likely to include at least one flow variability action in their top five than environmental, upstream, exporter, Delta and "other stakeholder" interests. Delta and upstream interests were also less likely to choose this area than fishing/recreation interests and government officials.

c. Reduced diversions

	N	In Top 5 (%)	Ranked 1st (%)	Ranked 2nd (%)	Ranked 3rd (%)	Ranked 4th (%)	Ranked 5th (%)	Actions picked (out of 3)
Delta	38	89	74	8	3	3	3	1.47
Fishing/recreation	14	93	86	0	0	7	0	1.64
Upstream	39	44	21	13	5	3	3	0.46
Exporters	22	5	0	0	0	0	5	0.05
Environmental	56	71	54	5	7	0	5	0.98
Federal/state agencies	55	50	29	14	5	2	0	0.64
Other	15	33	27	7	0	0	0	0.40
Stakeholder group average	7	55	42	7	3	2	2	0.81
Scientists	122	62	36	10	7	7	3	0.77

NOTES: Logit regressions revealed the following significant differences across groups at 90 percent significance or greater in two-tailed tests: Exporters were less likely to choose at least one action in this area in their top five than all other groups. Delta and fishing/recreation interests were more likely to choose this area than upstream, government, "other stakeholders" and scientists. Environmental advocates were more likely to choose this area than government officials, upstream interests, and "other stakeholders."

d. Upstream management

	N	In Top 5 (%)	Ranked 1st (%)	Ranked 2nd (%)	Ranked 3rd (%)	Ranked 4th (%)	Ranked 5th (%)	Actions picked (out of 3)
Delta	38	37	3	8	5	11	11	0.42
Fishing/recreation	14	57	0	7	7	21	21	0.64
Upstream	39	21	0	5	5	5	5	0.23
Exporters	22	9	0	0	0	0	9	0.09
Environmental	56	59	14	5	14	14	11	0.82
Federal/state agencies	55	50	5	13	9	14	9	0.64
Other	15	27	7	7	7	0	7	0.47
Stakeholder group average	7	37	4	6	7	9	10	0.47
Scientists	122	61	11	15	16	11	9	0.76

NOTES: Logit regressions revealed the following significant differences across groups at 90 percent significance or greater in two-tailed tests: Scientists and environmental advocates were more likely than Delta, upstream, exporter, and "other stakeholder" interests to include at least one upstream management action in their top five. Government officials and fishing/recreation interests were more likely to choose this area than upstream and exporter interests, and Delta interests were more likely to choose this area than exporters.

e. Reduced discharges

	N	In Top 5 (%)	Ranked 1st (%)	Ranked 2nd (%)	Ranked 3rd (%)	Ranked 4th (%)	Ranked 5th (%)	Actions picked (out of 4)
Delta	38	45	0	11	13	8	13	0.47
Fishing/recreation	14	29	0	7	0	7	14	0.36
Upstream	39	62	10	8	18	15	10	0.82
Exporters	22	100	41	14	27	14	5	1.23
Environmental	56	45	5	9	18	7	5	0.71
Federal/state agencies	55	50	5	5	14	9	16	0.61
Other	15	80	7	13	7	40	13	0.87
Stakeholder group average	7	59	10	10	14	14	11	0.72
Scientists	122	30	6	2	2	11	9	0.39

NOTES: Logit regressions revealed the following significant differences across groups at 90 percent significance or greater in two-tailed tests: Exporter interests were more likely than all other groups to choose actions in this area, and scientists were less likely to choose this area than all groups but fishing/recreation interests. In addition, "other stakeholders" were more likely to choose this area than Delta interests, fishing/recreation interests, environmental advocates, and government officials. Upstream interests were also more likely to choose this area than fishing/recreation.

f. Hatchery management

	N	In Top 5 (%)	Ranked 1st (%)	Ranked 2nd (%)	Ranked 3rd (%)	Ranked 4th (%)	Ranked 5th (%)	Actions picked (out of 3)
Delta	38	11	0	0	3	0	8	0.11
Fishing/recreation	14	50	0	7	21	14	7	0.57
Upstream	39	13	0	3	8	0	3	0.13
Exporters	22	23	5	0	5	0	14	0.23
Environmental	56	7	0	2	2	0	4	0.11
Federal/state agencies	55	11	2	0	2	0	7	0.11
Other	15	13	7	0	0	0	7	0.13
Stakeholder group average	7	18	2	2	6	2	7	0.20
Scientists	122	22	2	2	4	7	7	0.23

NOTES: Logit regressions revealed the following significant differences across groups at 90 percent significance or greater in two-tailed tests: Fishing/recreation interests were more likely to include at least one action in this area in their top five than all other groups. Exporters and scientists were more likely to choose this area than environmental advocates and government officials.

g. Diversion engineering

	N	In Top 5 (%)	Ranked 1st (%)	Ranked 2nd (%)	Ranked 3rd (%)	Ranked 4th (%)	Ranked 5th (%)	Actions picked (out of 4)
Delta	38	61	5	18	13	13	11	0.63
Fishing/recreation	14	50	7	14	7	7	14	0.57
Upstream	39	31	13	5	0	8	5	0.41
Exporters	22	59	23	5	18	5	9	0.64
Environmental	56	29	4	5	7	9	5	0.30
Federal/state agencies	55	34	4	2	14	7	7	0.38
Other	15	60	13	33	13	0	0	0.87
Stakeholder group average	7	46	10	12	10	7	7	0.54
Scientists	122	20	3	4	6	2	5	0.20

NOTES: Logit regressions revealed the following significant differences across groups at 90 percent significance or greater in two-tailed tests: Scientists were less likely to include at least one action in this area in their top five than all stakeholder groups except upstream and environmental interests. Exporters, Delta and “other stakeholders” were more likely to choose this area than environmental advocates, government officials, and upstream interests.

h. Direct invasive species control

	N	In Top 5 (%)	Ranked 1st (%)	Ranked 2nd (%)	Ranked 3rd (%)	Ranked 4th (%)	Ranked 5th (%)	Actions picked (out of 2)
Delta	38	29	0	0	18	8	3	0.29
Fishing/recreation	14	0	0	0	0	0	0	0.00
Upstream	39	44	3	13	10	5	13	0.56
Exporters	22	18	5	9	0	5	0	0.18
Environmental	56	18	4	0	4	5	5	0.20
Federal/state agencies	55	25	2	4	2	5	13	0.25
Other	15	20	7	7	0	7	0	0.27
Stakeholder group average	7	22	3	5	5	5	5	0.25
Scientists	122	20	2	3	3	3	8	0.22

NOTES: Logit regressions revealed the following significant differences across groups at 90 percent significance or greater in two-tailed tests: Upstream interests were more likely to include at least one action in this area in their top five than all other groups except Delta interests and “other stakeholders.”

i. Harvest management

	N	In Top 5 (%)	Ranked 1st (%)	Ranked 2nd (%)	Ranked 3rd (%)	Ranked 4th (%)	Ranked 5th (%)	Avg. # of Actions picked (out of 3)
Delta	38	13	8	0	3	0	3	0.18
Fishing/recreation	14	0	0	0	0	0	0	0.00
Upstream	39	59	23	13	3	10	10	0.82
Exporters	22	59	5	14	5	27	9	0.73
Environmental	56	13	0	0	4	4	5	0.14
Federal/state agencies	55	23	4	0	4	7	9	0.27
Other	15	13	0	0	0	0	13	0.13
Stakeholder group average	7	26	6	4	3	7	7	0.32
Scientists	122	12	2	1	2	4	4	0.14

NOTES: Logit regressions revealed the following significant differences across groups at 90 percent significance or greater in two-tailed tests: Exporter and upstream interests were more likely to include at least one action in this area in their top five than all other groups. Government official were also more likely to choose this area than fishing/recreation interests and scientists.

Section III. Stakeholder Background and Biographical Information

TABLE B21
How often do you access the following sources of information regarding science and policy in the Delta?

General note for Tables B21a–h: The average is calculated by assigning the follow numerical values to valid categorical answers: "Never" = 0, "Less Often"= 4, "Weekly" = 50, "Monthly" = 12," Daily" = 250. These values act as a rough estimate for how many days the respondent accesses each type of information annually. Significance tests of differences across groups in frequency of access were performed using these annual averages and are only reported below for positive results.

a. Scientific books and journals

	N	Never (%)	Less often (%)	Weekly (%)	Monthly (%)	Daily (%)	Average (days/ year)
Delta	37	3	30	46	16	5	28
Fishing/recreation	13	0	54	31	8	8	31
Upstream	38	13	34	21	26	5	30
Exporters	21	5	24	38	29	5	32
Environmental	55	5	35	35	15	11	41
Federal/state agencies	55	4	31	35	24	7	35
Other	13	8	46	23	23	0	15

b. Government reports

	N	Never (%)	Less often (%)	Weekly (%)	Monthly (%)	Daily (%)	Average (days/year)
Delta	38	0	13	26	37	24	81
Fishing/recreation	14	0	29	43	21	7	34
Upstream	38	8	13	34	34	11	48
Exporters	20	0	15	35	35	15	60
Environmental	54	2	28	24	31	15	58
Federal/state agencies	56	0	5	43	27	25	81
Other	14	0	14	36	29	21	68

c. University and think tank reports

	N	Never (%)	Less often (%)	Weekly (%)	Monthly (%)	Daily (%)	Average (days/year)
Delta	38	0	39	29	29	3	26
Fishing/recreation	13	23	23	31	15	8	34
Upstream	38	11	37	34	13	5	25
Exporters	21	0	38	48	10	5	24
Environmental	53	4	30	34	26	6	33
Federal/state agencies	54	0	24	48	24	4	28
Other	14	0	29	43	21	7	31

d. Advocacy reports

	N	Never (%)	Less often (%)	Weekly (%)	Monthly (%)	Daily (%)	Average (days/year)
Delta	38	3	16	26	39	16	63
Fishing/recreation	14	0	7	21	36	36	115
Upstream	37	3	24	30	41	3	32
Exporters	20	5	25	40	25	5	31
Environmental	56	0	13	29	36	23	81
Federal/state agencies	55	4	45	24	22	5	29
Other	14	14	7	29	29	21	67

NOTES: On average, fishing/ recreation interests accessed advocacy reports more frequently than those from upstream, exporter interests, and government agencies; and environmental advocates accessed advocacy reports more frequently than exporters and government officials.

e. TV, radio, newspapers

	N	Never (%)	Less often (%)	Weekly (%)	Monthly (%)	Daily (%)	Average (days/year)
Delta	38	5	13	3	24	55	151
Fishing/recreation	14	0	21	21	7	50	123
Upstream	38	5	18	3	24	50	138
Exporters	20	5	0	5	15	75	196
Environmental	54	2	11	13	24	50	141
Federal/state agencies	56	4	4	9	38	46	136
Other	14	0	21	0	14	64	166

f. Blogs

	N	Never (%)	Less often (%)	Weekly (%)	Monthly (%)	Daily (%)	Average (days/year)
Delta	38	22	19	14	32	14	52
Fishing/recreation	14	29	29	14	21	7	33
Upstream	38	32	24	11	26	8	35
Exporters	20	20	30	20	15	15	49
Environmental	55	35	24	13	11	18	54
Federal/state agencies	54	30	33	15	17	6	25
Other	14	21	36	0	21	21	59

g. Public meetings

	N	Never (%)	Less often (%)	Weekly (%)	Monthly (%)	Daily (%)	Average (days/year)
Delta	38	0	26	37	32	5	34
Fishing/recreation	14	7	57	21	14	0	13
Upstream	38	8	29	37	26	0	19
Exporters	21	0	14	71	10	5	26
Environmental	54	13	35	30	15	7	31
Federal/state agencies	56	4	30	48	18	0	16
Other	13	0	15	46	23	15	49

h. Colleagues or acquaintances

	N	Never (%)	Less often (%)	Weekly (%)	Monthly (%)	Daily (%)	Average (days/year)
Delta	38	0	3	13	42	42	128
Fishing/recreation	14	0	0	29	36	36	115
Upstream	38	3	11	11	39	37	114
Exporters	21	0	5	5	19	71	189
Environmental	55	5	9	22	24	40	116
Federal/state agencies	55	0	4	11	40	45	135
Other	14	0	14	21	14	50	125

TABLE B22
What is your most trusted source of information on scientific aspects of the Delta?

	N	Universities/ think tanks (%)	Scientific journals/ reports (%)	Government agency (%)	Delta agencies/, programs [a] (%)	Advocacy groups (%)	Media, internet (%)	Consultants (%)	Colleagues (%)	All or assorted (%)	None/them-selves (%)
All	177	15	25	11	11	11	4	4	5	7	7
Delta	28	11	18	7	21	7	0	0	4	7	25
Fishing/recreation	10	10	10	20	0	30	0	10	0	10	10
Upstream	26	19	27	12	4	4	4	19	0	8	4
Exporters	16	25	44	13	0	0	0	6	0	0	13
Environmental	45	13	29	4	4	27	4	0	9	4	4
Federal/state agencies	44	14	23	18	18	2	5	0	9	11	0
Other	8	25	25	0	25	0	25	0	0	0	0

NOTES: Responses were coded from an open-form write-in question. Environmental interests were more likely than all other stakeholder groups except for fishing/recreation to choose advocacy groups as their most trusted source of information.

[a] Examples include the Delta Stewardship Council, the Delta Conservancy, and the Bay Delta Conservation Plan.

TABLE B23
What is the category(ies) of your professional and academic training?

	N	Natural sciences (%)	Physical sciences only (%)	No science (%)
Delta	38	34	21	45
Fishing/recreation	14	29	21	50
Upstream	39	31	41	28
Exporters	22	28	37	36
Environmental	56	41	11	48
Federal/state agencies	56	65	16	20
Other	15	40	27	33

NOTES: "Natural sciences" includes training in biology and ecology; these respondents may also have training in other areas. "Physical sciences only" includes training in chemistry, engineering, geosciences, and hydrology. These respondents may have training in non-science areas, but do not have natural science training. "No science" includes respondents with training in economics/business, law, policy, planning, and other non-science degrees, but no sciences.

TABLE B24
What is the highest degree you have earned?

	B.A./B.S. or less (%)	Masters (%)	J.D. (%)	Ph.D. (%)
Delta	53	21	11	13
Fishing/Recreation	77	8	8	8
Upstream	47	36	13	0
Exporters	20	45	18	9
Environmental	42	31	13	7
Federal/State Agencies	32	50	11	7
Other	36	18	18	24

NOTE: "J.D." = Juris Doctor, a law degree.

TABLE B25
For how many years have you followed policy in the Sacramento-San Joaquin Delta?

	N	Average	<5 (%)	5 to 15 (%)	15 to 24 (%)	25+ (%)
Delta	36	19.9	11	37	14	39
Fishing/recreation	14	24.8	7	21	14	57
Upstream	37	16.3	11	24	46	19
Exporters	21	20.2	0	24	33	43
Environmental	49	21.3	8	18	27	47
Federal/state agencies	55	17.5	16	36	20	29
Other	14	19.6	14	29	29	29
Scientists	121	15.9	8	36	36	21

NOTES: Significance testing revealed no difference across stakeholder groups. Pairwise t-tests comparing scientists (from Table B11, measuring their years of scientific experience on the Delta) and stakeholder groups revealed that fishing/recreation and environmental interests had on average more years' experience than scientists.

Appendix C: Analytical Methods

This appendix provides an overview of the statistical analysis conducted to examine respondent characteristics associated with survey responses. We focused on respondents' perceptions of historical and future stressor impacts, potential impacts of mitigation actions (only asked of scientists), and choice of top five management action priorities.

Some initial screening was done using pairwise t-tests and chi-squared tests—for instance, to test for sample characteristics (see Appendix A) or to examine respondent characteristics.[8] For respondent characteristics regarding stressor and action impacts, we conducted both bivariate and multivariate ordered logit regressions, where the dependent variable was an answer to a question about historical stressor impacts (Tables B1 and B14), future stressor impacts (Tables B4 and B17), or potential action impacts (Table B7, scientists only) and the independent variables were the characteristics of interest. For action area priorities (Tables B9 and B20), we ran bivariate and multiple regression logit analyses. Finally, we performed hierarchical clustering on choices of priority action areas (Tables B8 and B20). All analyses used Stata 12 except the clustering (done with SPSS version 20). The tables below primarily focus on results for scientists. For stakeholders, most analyses focused on analyzing differences across individual stakeholder groups and between these groups and scientists. These results are principally reported in notes to the survey answers in Appendix B.

Scientific Expert Characteristics

Publications and other experience

As a supplement to the discussion in Appendix A, Table C1 summarizes scientific expert characteristics along some of the dimensions that might reflect expert "school of thought": employer, California residence, and Moyle lab affiliation. We compared the following indicators: number of journal article publications and year of the most recent publication (from our bibliographic search); years of scientific experience on the Delta ecosystem (from the survey, Table B11); whether the respondent is in the "leading expert" group (named at least five times by other survey respondents, Table B13); and two indicators of scientific experience on stressors drawn from the survey (Table B12)—the overall "breadth" of publication experience on stressors and whether the respondent has any experience on discharges. This last indicator is of particular interest given that some stakeholder groups have alluded that local scientists have underappreciated this stressor's role on the Delta ecosystem.

[8] For variables with more than two categories, we used Bonferroni adjustments to account for multiple pairwise tests.

TABLE C1
Publications and experience for different types of scientists

	Sample size	Publications (ln)	Years since most recent publication	Leading expert	Experience (years)	Moyle lab	Based outside California	Breadth of publications [a]	Discharge experience [b]
Employer									
Government	41	1.25**	3.54	0.39*	19.4	0.22	0.05*	0.41	0.78
Research/ university	65	0.94	3.45	0.12	12.7**	0.22	0.23	0.38	0.78
Other	16	0.58	5.19	0.13	19.5	0.50**	0.19	0.51	0.75
Residence									
CA–Based	102	0.99	3.29	0.24	16.3	0.28*		0.40	0.77
Outside CA	20	1.04	5.80**	0.10	13.7	0.10		0.43	0.80
Moyle lab Affiliation									
Yes	31	0.96	4.75*	0.35**	15.3		0.06	0.40	0.71
No	91	1.00	3.34	0.16	16.0		0.20**	0.43	0.80

NOTES:

[a] "Breadth of publications" is a measurement of the share of publications across the five stressor categories, calculated using responses on experience from the survey (Table B12). A value of 0.2 indicates Delta-related publication experience on one stressor group, and a value of 1 indicates Delta-related publication experience on all five stressors.

[b] "Discharge experience" equals 1 if the respondent has some familiarity with discharges within the Delta or other watersheds (Table B12).

*** $p<0.01$, ** $p<0.05$, * $p<0.1$ indicate significance levels of differences between groups in pairwise tests. For employer these were done as an ANOVA with a Bonferroni adjustment; government employees have significantly higher publications than the "other" group. Research/university employees have significantly fewer years of experience on average than the other two groups, and Moyle lab affiliates are significantly more likely to be present in the "other" employer group. Government employees are marginally less significantly likely to live outside of California than the other two employment groups.

Significant differences included a higher presence of Moyle lab affiliates and government scientists in the leading expert group (see also Table A4), a higher rate of publications by government scientists than those in the “other employer” group, a longer time since publications for the non-California-based scientists, and a lower share of Moyle lab affiliates and government scientists based outside of California. In contrast to leading experts (Table A4), there were no significant differences along the three dimensions examined here for publication breadth. There were also no differences in background on discharges (the same is true for leading experts, not shown in Table A4).

Scientist Views on Historical Stressor Impacts

Table C2a summarizes the characteristics associated with scientist views on the importance of historical stressors on the three categories of native fishes (Table B1a–c) in bivariate ordered logit regressions in which individual expert characteristics are examined individually. Table C2b summarizes results from multivariate ordered logit regressions that control for a range of these characteristics simultaneously. To facilitate interpretation, the coefficients are expressed as marginal effects (semi-elasticities, ey/dx)—i.e., the percentage change in the probability of ranking the stressor as high impact with a unit change in the independent variable.

“Level of expertise” is obtained from the survey (Table B12). In Table C2a, it is constructed as three mutually exclusive categories: publications on the Delta in the stressor area, experience with the stressor but no publications (omitted category), and no experience; and in Table C2b it appears as a binary variable (publications on the Delta in the stressor area versus other/no experience). “Field” is the area of scientific training obtained from the survey (Table B9), and other variables are as described above.

In general, we found few statistically significant differences. In the bivariate regressions (Table C2a), several expert characteristics were associated with lower ratings of the impacts of discharges: leading experts (for all three fish groups), scientists with broader expertise and those without natural science background (for pelagic and anadromous fishes), and Moyle-lab affiliates (for resident natives). The impact of fishery management on anadromous fish was lower for scientists with no background on the stressor and higher for Moyle-lab affiliates. (Note that those without experience on discharges and fish management were also less likely to respond to these questions; see Table B1). Emphasis on the role of physical habitat differed somewhat across scientist groups: Moyle-lab affiliates were more likely to consider this an important stressor for anadromous and resident fishes, but less likely to consider it important for pelagics. Scientists without natural science training considered it less important for anadromous fish, as did those without background on this stressor. California-based scientists were more likely to consider invasives important for the pelagic fish group, and those with publications on invasives considered this stressor more important for all three fish groups. Employer type, years of Delta experience, and number of publications are generally not significant factors.

In a multiple regression framework (Table C2b), most of these differences are no longer significant, and a few new differences emerge. The most consistently important factor is whether the scientist has publication experience in the stressor area, which is positively associated with ranking invasives as important for all three fish groups, as well as flows for resident native fishes. Leading experts and Moyle-lab affiliates view discharges as less important for resident natives, in contrast to scientists with broader publication breadth. Other significant differences are mainly related to flows: the Moyle lab affiliates view flows as more important for resident natives, and leading experts view flows as more important for anadromous fish, in contrast to government scientists and those without natural science training.

TABLE C2a

Scientist characteristics and views of historical stressor impact, bivariate ordered logit regressions (marginal effects)

	Discharges			Fisheries			Habitat			Invasives			Flows		
	P	A	RN	P	A	RN	P	A	RN	P	A	RN	P	A	RN
1. Level of expertise (omitted: expertise but no Delta publications)															
Publication on Delta in stressor area	-0.38	-0.46	0.17	0.25	0.05	-0.52	0.00	-0.12	0.17	0.39*	0.78**	0.51**	0.01	-0.15	0.10
	(0.26)	(0.33)	(0.31)	(0.42)	(0.22)	(0.40)	(0.16)	(0.12)	(0.12)	(0.20)	(0.34)	(0.21)	(0.10)	(0.12)	(0.18)
No background on stressor	0.18	-0.16	-0.10	0.07	-0.55**	-0.43	-0.30	-0.38**	-0.36*	0.13	0.12	-0.14	0.23	0.28	0.27
	(0.34)	(0.38)	(0.37)	(0.42)	(0.24)	(0.43)	(0.29)	(0.18)	(0.20)	(0.27)	(0.49)	(0.29)	(0.24)	(0.28)	(0.30)
2. Physical science only	-0.638*	-0.81*	0.59	-0.02	-0.10	-0.08	0.11	-0.31**	-0.10	-0.04	0.23	-0.36	-0.02	-0.07	0.11
	(0.36)	(0.49)	(0.56)	(0.65)	(0.32)	(0.68)	(0.24)	(0.16)	(0.16)	(0.28)	(0.51)	(0.32)	(0.15)	(0.16)	(0.34)
3. Expertise breadth	-0.90**	-0.92*	0.26	-0.28	0.17	-0.33	-0.11	0.03	-0.26	0.15	0.33	0.02	-0.09	-0.33	0.02
	(0.43)	(0.54)	(0.52)	(0.65)	(0.35)	(0.63)	(0.29)	(0.20)	(0.19)	(0.34)	(0.59)	(0.35)	(0.18)	(0.22)	(0.32)
4. Employer (omitted: other)															
Government	-0.04	0.17	0.50	0.20	-0.33	-0.06	0.02	-0.29	0.11	0.33	-0.33	0.11	-0.02	-0.07	0.16
	(0.34)	(0.44)	(0.43)	(0.56)	(0.29)	(0.54)	(0.24)	(0.18)	(0.15)	(0.31)	(0.49)	(0.29)	(0.15)	(0.19)	(0.26)
Research/university	0.14	0.32	0.58	0.20	-0.03	0.38	0.09	0.04	0.13	0.22	-0.01	-0.02	0.09	-0.10	0.08
	(0.33)	(0.42)	(0.41)	(0.52)	(0.27)	(0.51)	(0.22)	(0.18)	(0.14)	(0.29)	(0.46)	(0.26)	(0.14)	(0.18)	(0.23)
5. California resident	-0.13	-0.02	-0.03	0.10	0.14	0.16	0.23	0.06	-0.09	0.46**	-0.10	0.30	0.05	0.11	0.27
	(0.30)	(0.42)	(0.34)	(0.44)	(0.25)	(0.44)	(0.20)	(0.14)	(0.15)	(0.23)	(0.42)	(0.24)	(0.12)	(0.14)	(0.23)
6. Publications (ln)	-0.20	-0.23	-0.10	-0.05	-0.09	-0.08	0.02	0.115*	-0.03	-0.06	0.10	0.07	0.04	0.02	0.02
	(0.12)	(0.16)	(0.15)	(0.20)	(0.10)	(0.19)	(0.08)	(0.07)	(0.05)	(0.10)	(0.17)	(0.10)	(0.06)	(0.06)	(0.09)
7. Years of experience	-0.01	-0.01	-0.01	-0.03	-0.01	-0.01	-0.01	-0.01	-0.01	-0.02*	-0.03	0.01	-0.01	0.00	0.00
	(0.01)	(0.02)	(0.02)	(0.02)	(0.01)	(0.02)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.01)	(0.01)	(0.01)	(0.01)
8. Moyle lab	-0.39	-0.01	-0.87***	-0.21	0.39*	-0.35	-0.29*	0.33**	0.26*	0.10	-0.17	-0.07	0.01	0.11	-0.28
	(0.27)	(0.32)	(0.34)	(0.39)	(0.22)	(0.38)	(0.17)	(0.17)	(0.15)	(0.20)	(0.35)	(0.20)	(0.11)	(0.13)	(0.20)
9. Leading expert	-0.76***	-0.78**	-0.80**	0.07	-0.08	-0.33	-0.25	0.23	-0.04	0.25	0.29	0.19	0.09	-0.22*	-0.15
	(0.29)	(0.36)	(0.37)	(0.42)	(0.22)	(0.40)	(0.19)	(0.17)	(0.13)	(0.22)	(0.37)	(0.23)	(0.13)	(0.13)	(0.22)

NOTES: Table reports marginal effects (ey/dx) of selecting the highest impact value from bivariate ordered logit regressions with the historical stressor impacts (Table B1a-c) as dependent variables (constants included but not shown here). P = pelagic fish, A = anadromous fish, and RN = resident natives. Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1 in two-tailed Wald tests that the coefficients are significantly different from zero.

TABLE C2b
Scientist characteristics associated with views of historical stressor impact, ordered logit multiple regressions (marginal effects)

	Discharges			Fisheries			Habitat			Invasives			Flows		
	P	A	RN	P	A	RN	P	A	RN	P	A	RN	P	A	RN
Publications in stressor area	-0.28	-0.16	0.01	0.36	0.21	-0.58	0.01	-0.12	0.16	0.46*	1.19***	0.79***	0.15	-0.02	0.69***
	(0.29)	(0.35)	(0.37)	(0.46)	(0.26)	(0.46)	(0.14)	(0.16)	(0.26)	(0.24)	(0.43)	(0.27)	(0.21)	(0.16)	(0.22)
Expertise breadth	-0.21	-0.15	1.38*	-0.63	0.03	0.28	-0.19	-0.16	0.03	-0.44	-1.23	-1.007*	-0.17	-0.27	-1.14***
	(0.57)	(0.71)	(0.72)	(0.80)	(0.50)	(0.82)	(0.26)	(0.30)	(0.46)	(0.47)	(0.86)	(0.52)	(0.42)	(0.35)	(0.39)
Field (physical science only)	-0.6	-0.68	0.23	-0.04	0.04	-0.38	-0.04	0.08	-0.09	0.21	0.59	-0.14	0.06	-0.41**	-0.09
	(0.39)	(0.52)	(0.62)	(0.71)	(0.34)	(0.73)	(0.17)	(0.18)	(0.37)	(0.32)	(0.59)	(0.36)	(0.25)	(0.17)	(0.19)
Employer (omitted: other)															
Government	-0.11	0.3	0.5	0.07	-0.21	-0.31	-0.11	-0.02	0.11	0.25	-0.56	-0.22	-0.12	-0.44**	0.23
	(0.39)	(0.51)	(0.51)	(0.61)	(0.32)	(0.60)	(0.16)	(0.21)	(0.30)	(0.35)	(0.54)	(0.34)	(0.27)	(0.22)	(0.20)
Research /university	-0.03	0.38	0.45	0.12	0.11	0.29	0.07	-0.11	0.07	0.25	-0.16	-0.23	-0.02	0.08	0.24
	(0.36)	(0.48)	(0.46)	(0.54)	(0.29)	(0.54)	(0.15)	(0.19)	(0.25)	(0.32)	(0.48)	(0.29)	(0.25)	(0.20)	(0.18)
Leading expert	-0.47	-0.73*	-1.12**	0.23	-0.13	-0.12	0.19	-0.18	-0.24	0.23	0.57	0.37	-0.18	0.49**	-0.06
	(0.35)	(0.44)	(0.46)	(0.51)	(0.29)	(0.50)	(0.16)	(0.16)	(0.28)	(0.26)	(0.49)	(0.30)	(0.22)	(0.21)	(0.17)
California resident	0.03	-0.02	0.16	0.03	0.12	0.61	0.09	0.13	0.35	0.43*	-0.09	0.3	0.353*	0.18	-0.12
	(0.33)	(0.45)	(0.39)	(0.49)	(0.28)	(0.49)	(0.13)	(0.15)	(0.25)	(0.25)	(0.45)	(0.27)	(0.21)	(0.17)	(0.17)
Moyle lab	-0.38	0.17	-0.73*	-0.22	0.40*	-0.4	-0.03	0.16	-0.32	0.02	-0.48	-0.29	-0.32	0.17	0.38**
	(0.32)	(0.38)	(0.39)	(0.42)	(0.24)	(0.42)	(0.13)	(0.15)	(0.22)	(0.23)	(0.40)	(0.24)	(0.20)	(0.18)	(0.19)
Sample Size	99	99	88	99	103	90	118	118	107	111	104	104	116	118	110
Regression Chi^2	12.47	8.68	15.89**	1.42	7.26	5	3.8	7.52	5.27	10	11.01	14.78*	7.23	26.15***	27.04***

NOTES: Table reports marginal effects (ey/dx) of selecting the highest impact value from ordered logit multiple regressions with the historical stressor impacts (Table B1a–c) as dependent variables (constants included but not shown here). P = pelagic fish, A = anadromous fish, and RN = resident natives. Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1 in two-tailed Wald tests that the coefficients are significantly different from zero.

Scientist Views on Future Stressor Impacts

Tables C3a and C3b present similar results for characteristics associated with scientists' views on the trends in future impacts of the stressor groups on the three categories of native fishes (Table B4a–c). There are even fewer systematic differences than for historical stressors. In the bivariate regressions (Table 3a), those with broader expertise and those not employed by government agencies or universities are less likely to view discharges as causing greater negative impacts in the future. Moyle lab affiliates are more inclined to view fish management as a growing problem for two fish groups (pelagic and anadromous), as are those without background on this stressor group. Those without natural science background and those with publications in the area are less likely to view habitat as a growing problem. And Moyle lab affiliates are less likely to view invasives as a problem for one fish group (pelagics) and flows for another (resident natives).

Only some of these results carry through in the multiple regressions (Table C3b)—greater concern about discharges by university scientists, greater concern about fish management impacts by the Moyle lab affiliates, and less concern about habitat by physical scientists. New results include significantly less concern about habitat by Moyle lab affiliates and leading experts, and less concern by physical scientists about flows.

TABLE C3a
Scientist characteristics associated with views of future stressor impacts, bivariate ordered logits (marginal effects)

	Discharges			Fisheries			Habitat			Invasives			Flows		
	P	A	RN	P	A	RN	P	A	RN	P	A	RN	P	A	RN
1. Level of expertise (omitted: expertise but no Delta publications)															
Publication on Delta in stressor area	-0.12	-0.08	-0.12	-0.01	-0.25	0.31	-0.17	-0.31*	-0.18	-0.05	0.09	-0.04	0.16	-0.11	0.02
	(0.21)	(0.24)	(0.20)	(0.45)	(0.29)	(0.47)	(0.16)	(0.17)	(0.15)	(0.13)	(0.09)	(0.21)	(0.10)	(0.14)	(0.23)
No background on stressor	-0.2	-0.09	-0.17	0.73	0.18	1.17**	0.19	-0.04	0.01	0.13	2.56	0.33	2.96	0.49	3.89
	(0.25)	(0.26)	(0.24)	(0.50)	(0.31)	(0.55)	(0.36)	(0.32)	(0.33)	(0.21)	(199.1)	(0.32)	(404.3)	(0.35)	(409.9)
2. Physical science only	-0.32	-0.41	-0.46	0.69	-0.05	0.28	-0.41*	-0.39*	-0.43*	0.09	-0.03	0	-0.02	0.21	-0.17
	(0.30)	(0.33)	(0.32)	(0.66)	(0.42)	(0.84)	(0.22)	(0.23)	(0.22)	(0.21)	(0.14)	(0.31)	(0.15)	(0.26)	(0.16)
3. Expertise breadth	-0.66*	-0.93**	-0.78**	-0.19	-0.35	0.9	-0.39	-0.19	-0.41	-0.19	0.2	-0.34	0.26	-0.2	0.05
	(0.36)	(0.40)	(0.33)	(0.71)	(0.47)	(0.74)	(0.29)	(0.29)	(0.26)	(0.23)	(0.18)	(0.37)	(0.19)	(0.25)	(0.21)
4. Employer (omitted: other)															
Government	0.66**	0.67*	0.59**	-1.17*	-0.49	-0.99	0.3	0.17	0.23	0.19	-0.02	0.28	-0.06	0.03	-0.01
	(0.29)	(0.33)	(0.29)	(0.61)	(0.40)	(0.63)	(0.25)	(0.24)	(0.23)	(0.19)	(0.15)	(0.30)	(0.15)	(0.21)	(0.17)
Research/university	0.82***	0.68**	0.79***	-0.66	-0.41	-0.39	0.24	0.21	0.25	0.1	-0.04	0.21	-0.02	0.02	0.13
	(0.28)	(0.32)	(0.29)	(0.56)	(0.37)	(0.58)	(0.23)	(0.23)	(0.21)	(0.18)	(0.14)	(0.28)	(0.15)	(0.19)	(0.16)
5. California resident	0.06	-0.02	0.03	-0.31	0.27	0.19	0.1	0.15	-0.05	0.16	-0.11	0.11	-0.1	0.09	-0.26
	(0.24)	(0.29)	(0.23)	(0.47)	(0.31)	(0.51)	(0.21)	(0.23)	(0.21)	(0.16)	(0.14)	(0.27)	(0.14)	(0.17)	(0.19)
6. Publications (ln)	0.03	-0.01	-0.02	0.03	0.02	-0.02	0.12	0.160*	0.03	0.07	0.02	0.09	0.05	0.1	0.02
	(0.10)	(0.11)	(0.09)	(0.21)	(0.14)	(0.22)	(0.09)	(0.09)	(0.08)	(0.07)	(0.05)	(0.11)	(0.05)	(0.08)	(0.06)
7. Years of experience	-0.02	-0.01	-0.02	-0.01	-0.01	-0.01	0.01	0.01	0	0	0.01	-0.02	0.01	0.01	0
	(0.01)	(0.01)	(0.01)	(0.02)	(0.01)	(0.02)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
8. Moyle lab	-0.31	-0.24	-0.29	0.88**	0.86***	0.39	-0.21	-0.08	-0.17	0.04	-0.20**	-0.15	-0.04	0.09	-0.27**
	0.06	(0.02)	0.03	(0.31)	0.27	0.19	0.10	0.15	(0.05)	0.16	(0.11)	0.11	(0.10)	0.09	(0.26)
9. Leading expert	-0.19	-0.2	-0.21	0.31	0.28	0.13	-0.13	-0.01	-0.303*	0.06	-0.12	-0.06	-0.05	-0.02	-0.1
	(0.22)	(0.24)	(0.20)	(0.46)	(0.29)	(0.47)	(0.19)	(0.19)	(0.17)	(0.16)	(0.10)	(0.24)	(0.10)	(0.16)	(0.13)

NOTES: Table reports marginal effects (ey/dx) of selecting the highest impact value from bivariate ordered logit regressions with the future stressor impacts (Table B4a–c) as dependent variables (constants included but not shown here). P = pelagic fish, A = anadromous fish, and RN = resident natives. Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1 in two-tailed Wald tests that the coefficients are significantly different from zero.

TABLE C3b
Scientist characteristics associated with views of future stressor impacts, multivariate ordered logit regressions (marginal effects)

	Discharges			Fisheries			Habitat			Invasives			Flows		
	P	A	RN	P	A	RN	P	A	RN	P	A	RN	P	A	RN
Publications in stressor area	0.15	0.22	0.22	-0.15	-0.44	-0.55	0.07	0.17	0.01	-0.02	0.02	-0.15	-0.06	-0.40*	-0.12
	(0.24)	(0.25)	(0.23)	(0.53)	(0.34)	(0.54)	(0.16)	(0.16)	(0.18)	(0.17)	(0.27)	(0.17)	(0.21)	(0.22)	(0.20)
Expertise breadth	-0.49	-0.84*	-0.63	-0.85	-0.57	1.02	0.39	0.26	0.23	-0.24	-0.34	-0.09	-0.24	0.31	-0.01
	(0.45)	(0.50)	(0.43)	(0.93)	(0.62)	(0.98)	(0.26)	(0.25)	(0.30)	(0.34)	(0.54)	(0.35)	(0.43)	(0.45)	(0.40)
Field (physical science only)	-0.35	-0.42	-0.58*	1.05	0.14	0.31	-0.15	-0.15	-0.33*	0.12	0.01	0.22	-0.50**	-0.45*	-0.44*
	(0.32)	(0.35)	(0.35)	(0.76)	(0.47)	(0.94)	(0.17)	(0.18)	(0.20)	(0.23)	(0.35)	(0.23)	(0.24)	(0.26)	(0.24)
Employer (omitted: other)															
Government	0.54	0.47	0.51	-1.10	-0.60	-1.06	0.05	0.06	-0.04	0.15	0.18	0.03	0.15	0.02	0.23
	(0.33)	(0.37)	(0.33)	(0.71)	(0.48)	(0.74)	(0.18)	(0.18)	(0.20)	(0.22)	(0.34)	(0.23)	(0.28)	(0.28)	(0.26)
Research /university	0.72**	0.47	0.67**	-0.63	-0.40	-0.34	-0.05	0.05	0.08	0.09	0.13	0.03	0.14	0.18	0.22
	(0.31)	(0.35)	(0.32)	(0.60)	(0.42)	(0.62)	(0.16)	(0.16)	(0.18)	(0.19)	(0.31)	(0.21)	(0.24)	(0.25)	(0.23)
Leading expert	-0.06	-0.03	-0.03	0.43	0.41	0.05	-0.27*	-0.20	-0.05	0.07	0.02	-0.03	0.05	0.10	-0.19
	(0.27)	(0.29)	(0.25)	(0.56)	(0.35)	(0.58)	(0.16)	(0.15)	(0.17)	(0.19)	(0.30)	(0.20)	(0.24)	(0.25)	(0.22)
California resident	0.26	0.12	0.19	-0.30	0.38	0.50	-0.12	-0.14	-0.20	0.16	0.15	0.10	0.14	0.21	-0.02
	(0.27)	(0.31)	(0.26)	(0.55)	(0.37)	(0.60)	(0.15)	(0.16)	(0.21)	(0.17)	(0.29)	(0.19)	(0.22)	(0.24)	(0.23)
Moyle lab	-0.22	-0.14	-0.20	0.91*	0.75**	0.16	-0.21*	-0.03	-0.32**	0.07	-0.12	0.14	-0.29	-0.18	-0.16
	(0.24)	(0.26)	(0.22)	(0.52)	(0.34)	(0.49)	(0.11)	(0.11)	(0.14)	(0.16)	(0.24)	(0.17)	(0.19)	(0.20)	(0.18)
Sample Size	96	98	94	87	96	82	113	113	109	108	103	103	114	115	109
Regression Chi^2	13.62*	10.66	15.55**	10.83	14.56**	5.81	12.07	6.02	11.82	3.18	1.95	3.46	8.78	9.21	9.41

NOTES: Table reports marginal effects (ey/dx) of selecting the highest impact value from multivariate ordered logit regressions with the future stressor impacts (Table B4a–c) as dependent variables (constants included but not shown here). P = pelagic fish, A = anadromous fish, and RN = resident natives. Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1 in two-tailed Wald tests that the coefficients are significantly different from zero.

Scientist Views on Potential Action Impacts

We next examined characteristics associated with scientist views on the potential impact of the 32 management actions (Table B7), presented by stressor group, first with bivariate ordered logit regressions (Tables C4a–e) and then with multivariate ordered logit regression (Tables C5a–e). The coefficients are again expressed as marginal effects (semi-elasticities, ey/dx)—i.e., the percentage change in the probability of ranking the action as having a high potential for positive impact with a unit change in the independent variable.

The bivariate regressions (Tables C4a–e) reveal that several groups of scientists were significantly less optimistic about the potential impacts of a range of actions: Moyle lab affiliates were generally less optimistic about reducing discharges, several fish management actions (conservation hatcheries and harvest management actions), two flow actions (gates and increasing net outflows), and the generally unpopular action of increasing sub-tidal habitat. Leading experts were less optimistic about various actions in all five stressor categories. Although the specific patterns varied slightly, the same was true for experts with broader publication expertise on stressors. Those with more publications also tended to give lower impact scores for many actions.

Some of these results carry through in multiple regressions (Tables C5a–e), with the Moyle lab affiliates, leading experts, and those with broader expertise still likely to be more pessimistic about some actions (in particular, continued pessimism by the Moyle lab affiliates and those with broader expertise about discharge actions). Consequently, for Moyle lab affiliates, leading experts, those with more experience breadth and those with more publications, the overall impact scores (calculated as the average across all actions) were significantly lower (Table C6).

TABLE C4a

Scientist characteristics associated with views of discharge-related action impacts (bivariate ordered logits, marginal effects)

	Reduce toxic discharges	Reduce farm fertilizer discharges	Reduce farm pesticide discharges	Reduce urban nonpoint discharges	Reduce urban point discharges	Dilute pollutant loads with increased freshwater flows
1. Level of expertise (omitted: expertise but no Delta publications)						
Publication on Delta in stressor area	-0.16	0.06	-0.17	0.07	-0.15	0.08
	(0.32)	(0.29)	(0.29)	(0.31)	(0.31)	(0.30)
No background on stressor	0.20	0.31	0.19	-0.23	0.16	-0.53
	(0.36)	(0.31)	(0.33)	(0.36)	(0.35)	(0.37)
2. Physical science only	0.16	-0.01	0.04	0.22	-0.15	-0.34
	(0.43)	(0.35)	(0.38)	(0.42)	(0.42)	(0.41)
3. Expertise breadth	-0.63	-0.33	-0.822*	-0.26	-0.08	-1.37***
	(0.54)	(0.48)	(0.49)	(0.51)	(0.49)	(0.52)
4. Employer (omitted: other)						
Government	0.00	-0.07	-0.04	-0.18	0.21	-0.05
	(0.45)	(0.40)	(0.40)	(0.45)	(0.46)	(0.41)
Research/university	0.00	0.11	-0.42	-0.03	0.55	0.13
	(0.44)	(0.38)	(0.39)	(0.43)	(0.46)	(0.38)
5. California resident	-0.31	0.15	-0.21	-0.26	-0.10	0.08
	(0.38)	(0.34)	(0.34)	(0.40)	(0.38)	(0.37)
6. Publications (ln)	-0.276*	-0.23	-0.13	-0.09	-0.19	-0.17
	(0.15)	(0.14)	(0.14)	(0.15)	(0.14)	(0.14)
7. Years of experience	-0.01	-0.01	0.02	0.00	-0.02	-0.01
	(0.02)	(0.01)	(0.01)	(0.01)	(0.02)	(0.02)
8. Moyle Lab	-0.601*	-0.86***	-0.84***	-0.79**	-0.83***	-0.19
	(0.32)	(0.29)	(0.30)	(0.33)	(0.32)	(0.30)
9. Leading expert	-0.53	-0.762**	-0.49	-0.35	-0.13	-0.43
	(0.33)	(0.31)	(0.30)	(0.32)	(0.31)	(0.32)

NOTES: Table reports marginal effects (ey/dx) of selecting the highest impact value from bivariate ordered logit regressions with management action impacts (Table B7) as dependent variables (constants included but not shown here). Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1 in two-tailed Wald tests that the coefficients are significantly different from zero.

TABLE C4b

Scientist characteristics associated with views of fisheries-related action impacts (bivariate ordered logits, marginal effects)

	Separate hatchery fish from wild populations	Develop new conservation hatcheries to support native fish	Allow unrestricted fishing on non-native predatory fish	Reduce harvest of anadromous fish	Increase screening of water diversions	Increase enforcement to prevent poaching	Truck juvenile salmonids around Delta	Trap and truck fish around dams
1. Level of expertise (omitted: experience but no Delta publications)								
Publication on Delta in stressor area	0.80***	-0.20	-0.52	-0.68**	-0.29	-0.42	-0.29	0.05
	(0.30)	(0.37)	(0.37)	(0.32)	(0.36)	(0.40)	(0.39)	(0.41)
No experience	-0.04	1.05***	-0.16	-0.34	0.00	-0.67	0.06	-0.24
	(0.32)	(0.40)	(0.37)	(0.32)	(0.37)	(0.44)	(0.45)	(0.42)
2. Physical science only	-0.01	1.67***	0.40	0.16	0.27	-0.67	1.44***	0.55
	(0.50)	(0.59)	(0.56)	(0.42)	(0.49)	(0.66)	(0.55)	(0.49)
3. Expertise breadth	0.59	-1.24**	-1.57***	-1.24**	-1.57***	-0.79	0.29	-0.92
	(0.45)	(0.59)	(0.57)	(0.49)	(0.58)	(0.62)	(0.62)	(0.62)
4. Employer (omitted: other)								
Government	0.31	0.16	0.00	-0.24	-0.60	0.36	-0.60	0.53
	(0.40)	(0.51)	(0.49)	(0.42)	(0.46)	(0.52)	(0.54)	(0.54)
Research	0.58	0.65	-0.08	-0.18	-0.67	0.01	-0.25	0.35
	(0.39)	(0.49)	(0.45)	(0.40)	(0.43)	(0.50)	(0.49)	(0.50)
5.California resident	0.565*	-0.42	0.48	0.47	0.20	0.38	-0.52	0.34
	(0.32)	(0.43)	(0.40)	(0.33)	(0.40)	(0.50)	(0.50)	(0.48)
6. Publications (ln)	-0.10	-0.08	-0.27	-0.295*	-0.51***	-0.17	0.04	0.01
	(0.13)	(0.17)	(0.17)	(0.15)	(0.18)	(0.18)	(0.18)	(0.18)
7. Years of experience	0.00	-0.01	-0.02	-0.01	-0.01	0.02	0.02	0.00
	(0.01)	(0.02)	(0.02)	(0.01)	(0.02)	(0.02)	(0.02)	(0.02)
8. Moyle lab	0.33	-0.80**	-0.89***	-0.73**	-0.44	-0.30	0.01	0.06
	(0.28)	(0.36)	(0.34)	(0.29)	(0.34)	(0.39)	(0.38)	(0.38)
9. Leading expert	-0.17	-0.91**	-0.71*	-0.48	-1.37***	-0.50	-0.35	-0.16
	-0.27	-0.40	-0.38	-0.31	-0.41	-0.41	-0.41	-0.41

NOTES: See notes to Table C4a.

TABLE C4c
Scientist characteristics associated with views of flow regime-related action impacts (bivariate ordered logits, marginal effects)

	Increase net Delta outflow	Reduce Delta exports	Pattern Delta flow variability to support native species	Divert Delta exports through canal/tunnel	Add gated structures within Delta to improve fish passage	Improve flow regime upstream of Delta	Reduce entrainment at export pumps
1. Level of expertise (omitted: experience but no Delta publications)							
Publication on Delta in stressor area	-0.09	-0.31*	0.02	-0.30	-0.96**	-0.22	-0.36
	(0.19)	(0.16)	(0.17)	(0.33)	(0.39)	(0.21)	(0.23)
No experience	0.18	0.49	0.04	-0.74	-0.38	-0.10	-0.51
	(0.33)	(0.36)	(0.30)	(0.59)	(0.69)	(0.33)	(0.38)
2. Physical science only	0.03	-0.07	-0.19	0.14	-0.61	0.01	0.14
	(0.28)	(0.23)	(0.25)	(0.49)	(0.54)	(0.31)	(0.36)
3. Expertise breadth	-0.53	-0.80***	-0.25	-0.75	-1.40**	-0.60*	-0.97**
	(0.34)	(0.30)	(0.32)	(0.56)	(0.66)	(0.36)	(0.44)
4. Employer (omitted: other)							
Government	-0.22	-0.39	-0.18	0.48	0.22	-0.16	-0.48
	(0.30)	(0.25)	(0.27)	(0.50)	(0.56)	(0.31)	(0.37)
Research/university	-0.04	0.00	-0.07	0.70	0.992*	0.12	-0.39
	(0.29)	(0.24)	(0.26)	(0.47)	(0.53)	(0.29)	(0.36)
5. California resident	-0.07	-0.07	0.06	0.55	0.13	0.12	-0.03
	(0.24)	(0.21)	(0.23)	(0.45)	(0.46)	(0.25)	(0.28)
6. Publications (ln)	-0.02	-0.14*	0.06	0.05	-0.20	-0.04	-0.26**
	(0.09)	(0.08)	(0.09)	(0.17)	(0.20)	(0.11)	(0.12)
7. Years of experience	0.00	0.00	-0.01	0.00	-0.01	-0.01	-0.01
	(0.01)	(0.01)	(0.01)	(0.02)	(0.02)	(0.01)	(0.01)
8. Moyle lab	-0.38*	-0.04	-0.16	0.43	-0.81**	-0.03	-0.35
	(0.21)	(0.17)	(0.19)	(0.34)	(0.39)	(0.22)	(0.25)
9. Leading expert	-0.11	-0.34*	-0.16	0.15	-1.10**	-0.82***	-0.91***
	-0.21	-0.17	-0.20	-0.36	-0.45	-0.25	-0.27

NOTES: See notes to Table C4a.

TABLE C4d
Scientist characteristics associated with views of invasives-related action impacts (bivariate ordered logits, marginal effects)

	Directly control invasive aquatic vegetation	Directly control invasive clams	Increase actions to prevent new invasions	Increase salinity variability in the Delta
1. Level of expertise (omitted: experience but no Delta publications)				
Publication on Delta in stressor area	0.04	0.35	0.51**	0.135
	(0.31)	(0.30)	(0.22)	(0.26)
No experience	-0.262	0.21	0.269	0.114
	(0.46)	(0.39)	(0.30)	(0.42)
2. Physical science only	-0.537	0.074	-0.55*	-0.66*
	(0.46)	(0.44)	(0.31)	(0.38)
3. Expertise breadth	-1.00*	-0.295	0.007	-0.80*
	(0.54)	(0.49)	(0.37)	(0.46)
4. Employer (omitted: other)				
Government	0.011	0.155	-0.034	-0.645
	(0.46)	(0.42)	(0.32)	(0.41)
Research/university	-0.267	-0.009	-0.206	-0.327
	(0.44)	(0.40)	(0.30)	(0.39)
5. California resident	0.375	1.05***	0.312	0.228
	(0.41)	(0.40)	(0.25)	(0.32)
6. Publications (ln)	-0.114	-0.13	0.041	-0.18
	(0.17)	(0.16)	(0.11)	(0.13)
7. Years of experience	0.004	-0.019	0.017	-0.01
	(0.02)	(0.02)	(0.01)	(0.01)
8. Moyle lab	-0.455	-0.051	-0.258	0.151
	(0.33)	(0.31)	(0.24)	(0.27)
9. Leading expert	-0.63*	-0.126	-0.293	-0.62**
	(0.36)	(0.34)	(0.25)	(0.29)

NOTES: See notes to Table C4a.

TABLE C4e
Scientist characteristics associated with views of habitat-related action impacts (bivariate ordered logits, marginal effects)

	Restore tidal marsh	Expand seasonal floodplains	Improve in-Delta channel margin habitat	Improve/ increase upstream spawning and rearing habitat	Increase sediment loads flowing into Delta	Remove Selected Dams	Increase sub-tidal habitat	Increase inter-tidal habitat
1. Level of expertise (omitted: experience but no Delta publications)								
Publication on Delta in stressor area	0.29	0.48	-0.84	-1.04	-0.49	-0.29	-2.13***	-0.22
	(0.64)	(0.62)	(0.70)	(0.81)	(0.75)	(0.62)	(0.63)	(0.63)
No experience	0.45	0.05	-0.62	-1.73**	-0.13	0.07	-2.02***	-0.11
	(0.69)	(0.68)	(0.75)	(0.84)	(0.81)	(0.69)	(0.68)	(0.69)
2. Physical science only	-0.38	-0.20	-0.08	-0.18	-0.50	-0.33	-0.10	0.20
	(0.27)	(0.17)	(0.35)	(0.20)	(0.41)	(0.26)	(0.45)	(0.30)
3. Expertise breadth	-0.63*	0.00	-0.686*	0.09	-0.36	-0.07	-0.90*	-0.64*
	(0.33)	(0.22)	(0.40)	(0.25)	(0.51)	(0.30)	(0.51)	(0.34)
4. Employer (omitted: other)								
Government	0.04	-0.15	-0.31	-0.11	0.02	-0.49	0.11	0.12
	(0.28)	(0.19)	(0.35)	(0.22)	(0.45)	(0.32)	(0.46)	(0.29)
Research/ university	0.52*	-0.04	-0.15	-0.08	0.22	-0.40	0.34	0.49*
	(0.27)	(0.19)	(0.33)	(0.21)	(0.43)	(0.31)	(0.43)	(0.28)
5. California resident	-0.04	-0.07	-0.09	0.33**	0.03	-0.43	0.15	-0.25
	(0.24)	(0.16)	(0.29)	(0.16)	(0.40)	(0.27)	(0.37)	(0.26)
6. Publications (ln)	0.02	0.07	-0.22*	0.01	-0.07	-0.08	-0.29*	-0.07
	(0.09)	(0.07)	(0.12)	(0.08)	(0.17)	(0.09)	(0.15)	(0.10)
7. Years of experience	-0.01	-0.01	0.00	0.00	-0.02	0.00	0.01	-0.02
	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.01)	(0.02)	(0.01)
8. Moyle lab	-0.01	0.15	-0.09	-0.23	-0.17	-0.13	-0.66**	-0.29
	(0.20)	(0.14)	(0.24)	(0.15)	(0.33)	(0.19)	(0.33)	(0.20)
9. Leading expert	-0.34	0.02	-0.50*	-0.22	-0.39	-0.25	-1.05***	-0.39*
	(0.22)	(0.15)	(0.27)	(0.16)	(0.34)	(0.20)	(0.35)	(0.22)

NOTES: See notes to Table C4a.

TABLE C5a
Scientist characteristics associated with views of discharge-related action impacts (multivariate ordered logit regression, marginal effects)

	Reduce toxic discharges	Reduce farm fertilizer discharges	Reduce farm pesticide discharges	Reduce urban nonpoint discharges	Reduce urban point discharges	Dilute pollutant loads with increased freshwater flows
Publications in stressor area	-0.26	-0.08	-0.19	0.16	-0.35	0.84**
	(0.36)	(0.32)	(0.32)	(0.35)	(0.35)	(0.34)
Expertise breadth	-0.04	0.30	-0.47	-0.13	0.48	-2.22***
	(0.71)	(0.62)	(0.63)	(0.66)	(0.68)	(0.70)
Field (relative to natural science)						
Physical science only	0.17	-0.18	-0.05	0.01	-0.48	-0.37
	(0.45)	(0.37)	(0.40)	(0.45)	(0.46)	(0.44)
Employer (relative to other)						
Government	-0.13	-0.20	-0.40	-0.42	-0.10	-0.30
	(0.50)	(0.45)	(0.46)	(0.52)	(0.52)	(0.45)
Research/ university	-0.23	0.01	-0.86**	-0.27	0.40	-0.10
	(0.46)	(0.41)	(0.43)	(0.47)	(0.49)	(0.40)
Leading expert	-0.37	-0.66*	-0.30	-0.16	0.25	0.06
	(0.38)	(0.36)	(0.36)	(0.38)	(0.40)	(0.40)
California resident	-0.26	0.43	-0.23	-0.02	0.13	0.49
	(0.41)	(0.37)	(0.37)	(0.43)	(0.40)	(0.39)
Moyle lab	-0.51	-0.97***	-0.85**	-0.81**	-1.07***	-0.04
	(0.36)	(0.33)	(0.33)	(0.36)	(0.36)	(0.33)
Sample size	111	113	114	113	115	106
Regression Chi^2	6.31	16.14**	15.90**	7.55	12.17	15.17*

NOTES: Table reports marginal effects (ey/dx) of selecting the highest impact value from multivariate ordered logit regressions with management action impacts (Table B7) as dependent variables (constants included but not shown here). Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1 in two-tailed Wald tests that the coefficients are significantly different from zero.

TABLE C5b

Scientist characteristics associated with views of fisheries-related action impacts (multivariate ordered logit regression, marginal effects)

	Separate hatchery fish from wild populations	Develop new conservation hatcheries to support native fish	Allow unrestricted fishing on non-native predatory fish	Reduce harvest of anadromous fish	Increase screening of water diversions	Increase enforcement to prevent poaching	Truck juvenile salmonids around Delta	Trap and truck fish around dams
Publications in stressor area	0.70**	-0.13	-0.26	-0.48	0.17	-0.19	-0.24	0.61
	(0.34)	(0.41)	(0.40)	(0.37)	(0.43)	(0.46)	(0.43)	(0.46)
Expertise breadth	0.48	-0.97	-1.45**	-1.09*	-1.32*	-0.28	0.82	-1.58*
	(0.59)	(0.80)	(0.71)	(0.64)	(0.77)	(0.82)	(0.81)	(0.82)
Field (physical science only)	0.03	1.69***	0.39	0.10	0.35	-0.63	1.50**	0.95*
	(0.54)	(0.61)	(0.59)	(0.44)	(0.52)	(0.70)	(0.59)	(0.53)
Employer (omitted: other)								
Government	0.68	-0.10	-0.38	-0.84*	-0.70	0.31	-0.23	0.54
	(0.44)	(0.58)	(0.56)	(0.48)	(0.52)	(0.59)	(0.59)	(0.58)
Research/ university	0.99**	0.15	-0.47	-0.71	-1.05**	-0.09	-0.20	0.26
	(0.40)	(0.56)	(0.48)	(0.44)	(0.48)	(0.54)	(0.53)	(0.53)
Leading expert	-0.55	-0.51	-0.12	-0.02	-1.05**	-0.47	-0.70	-0.04
	(0.35)	(0.51)	(0.49)	(0.38)	(0.48)	(0.51)	(0.53)	(0.51)
California resident	0.51	-0.04	0.90**	0.978***	0.48	0.46	-0.36	0.32
	(0.38)	(0.47)	(0.45)	(0.38)	(0.44)	(0.55)	(0.55)	(0.52)
Moyle lab	0.42	-0.44	-0.96**	-0.95***	-0.39	-0.24	0.41	0.38
	(0.31)	(0.39)	(0.38)	(0.33)	(0.39)	(0.44)	(0.43)	(0.44)
Sample Size	96	107	108	114	114	108	102	103
Regression Chi^2	18.71**	19.45**	19.73**	22.36***	21.41***	5.47	11.14	8.19

NOTE: See notes to Table C5a.

TABLE C5c
Scientist characteristics associated with views of flow regime-related action impacts (multivariate ordered logit regression, marginal effects)

	Increase net Delta outflow	Reduce Delta exports	Pattern Delta flow variability to support native species	Divert Delta exports through canal/tunnel	Add gated structures within Delta to improve fish passage	Improve flow regime upstream of Delta	Reduce entrainment at export pumps
Publications in stressor area	0.13	-0.15	0.30	0.29	0.03	0.25	0.22
	(0.28)	(0.22)	(0.25)	(0.49)	(0.60)	(0.28)	(0.31)
Expertise breadth	-0.74	-0.64	-0.54	-1.34*	-1.50	-0.33	-0.69
	(0.50)	(0.42)	(0.44)	(0.81)	(1.01)	(0.50)	(0.58)
Field (physical science only)	-0.16	0.00	-0.38	0.21	-1.08*	0.03	0.09
	(0.31)	(0.25)	(0.28)	(0.57)	(0.64)	(0.34)	(0.41)
Employer (omitted: other)							
Government	-0.45	-0.47*	-0.26	0.51	-0.59	0.00	-0.55
	(0.33)	(0.28)	(0.30)	(0.57)	(0.70)	(0.34)	(0.41)
Research/ university	-0.21	-0.10	-0.09	0.81	0.59	0.17	-0.60
	(0.30)	(0.26)	(0.27)	(0.51)	(0.63)	(0.31)	(0.39)
Leading expert	0.24	0.03	-0.06	0.21	-0.26	-0.92***	-0.82**
	(0.27)	(0.21)	(0.25)	(0.47)	(0.56)	(0.31)	(0.34)
California resident	0.11	0.08	0.18	0.61	0.864*	0.23	0.16
	(0.26)	(0.22)	(0.25)	(0.49)	(0.51)	(0.27)	(0.30)
Moyle lab	-0.44*	-0.01	-0.25	0.61	-1.34***	0.21	-0.28
	(0.23)	(0.20)	(0.21)	(0.40)	(0.48)	(0.25)	(0.29)
Sample size	116	120	119	94	93	118	119
Regression Chi^2	7.73	13.79*	5.06	9.70	21.43***	14.57*	16.65**

NOTE: See notes to Table C5a.

TABLE C5d
Scientist characteristics associated with views of invasive-related action impacts (multivariate ordered logit regression, marginal effects)

	Directly control invasive aquatic vegetation	Directly control invasive clams	Increase actions to prevent new invasions	Increase salinity variability in the Delta
Publications in stressor area	0.59	0.71**	0.71*	0.43
	(0.38)	(0.28)	(0.37)	(0.33)
Expertise breadth	-1.46**	-0.62	-1.18	-1.16*
	(0.74)	(0.53)	(0.73)	(0.63)
Physical science only	-0.27	-0.37	0.60	-0.36
	(0.52)	(0.34)	(0.50)	(0.43)
Employer (omitted: other)				
Government	-0.34	-0.24	-0.12	-0.76
	(0.54)	(0.37)	(0.52)	(0.47)
Research/university	-0.71	-0.47	-0.24	-0.49
	(0.49)	(0.34)	(0.50)	(0.43)
Leading expert	-0.41	-0.30	-0.10	-0.34
	(0.44)	(0.29)	(0.41)	(0.35)
California resident	0.36	0.34	1.09***	0.29
	(0.42)	(0.27)	(0.42)	(0.35)
Moyle lab	-0.60	-0.47*	-0.14	0.02
	(0.38)	(0.28)	(0.36)	(0.31)
Sample size	108	119	104	104
Regression Chi^2	12.90	16.23**	12.11	13.12

NOTE: See notes to Table C5a.

TABLE C5e
Scientist characteristics associated with views of habitat-related action impacts (multivariate ordered logit regression, marginal effects)

	Restore tidal marsh	Expand seasonal flood-plains	Improve in-Delta channel margin habitat	Improve/ increase upstream spawning and rearing habitat	Increase sediment loads flowing into Delta	Remove Selected Dams	Increase sub-tidal habitat	Increase inter-tidal habitat
Publications in stressor area	0.29	0.21	0.13	-0.32	0.28	-0.15	-0.43	-1.04**
	(0.25)	(0.17)	(0.19)	(0.24)	(0.25)	(0.29)	(0.41)	(0.40)
Expertise breadth	-0.87*	-0.33	0.05	0.48	-0.77	-0.37	0.44	1.07
	(0.51)	(0.34)	(0.39)	(0.48)	(0.52)	(0.59)	(0.79)	(0.78)
Field (Physical science only)	-0.47	-0.21	-0.27	-0.35	0.11	0.02	-0.52	0.09
	(0.29)	(0.18)	(0.21)	(0.28)	(0.32)	(0.37)	(0.44)	(0.47)
Employer (omitted: other)								
Government	0.04	-0.15	-0.26	-0.50	0.03	-0.30	0.01	0.24
	(0.32)	(0.21)	(0.26)	(0.36)	(0.33)	(0.39)	(0.51)	(0.51)
Research/ university	0.53*	-0.02	-0.18	-0.46	0.33	-0.28	0.21	0.26
	(0.29)	(0.20)	(0.23)	(0.33)	(0.30)	(0.35)	(0.47)	(0.46)
Leading expert	-0.05	0.11	-0.21	-0.18	-0.09	-0.36	-0.30	-1.13***
	(0.27)	(0.18)	(0.20)	(0.25)	(0.27)	(0.35)	(0.44)	(0.43)
California resident	0.17	-0.04	0.45**	-0.46	-0.05	0.01	0.10	0.42
	(0.27)	(0.17)	(0.18)	(0.29)	(0.27)	(0.31)	(0.42)	(0.39)
Moyle lab	0.04	0.10	-0.36**	-0.19	-0.16	0.02	-0.19	-0.45
	(0.23)	(0.16)	(0.18)	(0.21)	(0.22)	(0.28)	(0.40)	(0.38)
Sample size	118	120	119	107	116	110	91	111
Regression Chi^2	14.35*	4.99	13.20	10.73	10.38	5.86	4.38	19.60**

NOTE: See notes to Table C5a.

TABLE C6
Scientist characteristics associated with composite measures of stressor and action impacts (mean values)

	N	Overall historical impact	Overall future impact	Overall action impact
Employer				
Government	41	2.28	0.47	1.76
Research	65	2.36	0.52	1.86
Other	16	2.22	0.37	1.83
Residence				
CA-based	102	2.34	0.49	1.83
Outside CA	20	2.21	0.47	1.76
Moyle lab				
Yes	31	2.26	0.42	1.65
No	91	2.33	0.50	1.88***
Leading expert				
Yes	96	2.30	0.42	1.55
No	25	2.32	0.50	1.90***
Experience breadth	121/122	-0.13	-0.07	-0.35***
		(0.11)	(0.10)	(0.13)
Publications (ln)	121/122	0.02	0.04	-0.08*
		(0.04)	(0.03)	(0.04)

NOTES: Overall historical and future stressor impact and action impact are measured as the means (excluding don't know responses) across all categories (Table B18). *** p<0.01, ** p<0.05, * p<0.1 associated with significance levels of coefficients in pairwise t-tests (or for experience breadth and publications, two-tailed t-tests that the coefficient is significantly different from zero following linear regressions that also include a constant).

Scientist Views on Priority Action Areas

We also explored factors associated with scientists' choices of actions in the nine priority action areas (Table B9). Table C7a presents the results of bivariate logit regressions, where the dependent variable is the binary choice of at least one action in the area and the independent variable is the characteristic, and Table C7b presents the multivariate logit results. In Table C7c, an additional variable is added—the respondent's choice of top stressor (Table B3). Table C7d reports summary statistics for variables included in these regressions.

In the bivariate regressions, there were few significant differences. Flow variability was less popular with the small number of scientists with non-government, non-university employers, and it was more popular with leading experts and those with more publications. Scientists with broader expertise were less likely to choose reducing diversions, and those with publications in the relevant stressor areas were more likely to choose hatchery management and invasive control. Leading experts were also less likely to choose diversion engineering, and Moyle lab affiliates were less likely to choose upstream management.

In the multivariate regressions there were, again, few significant differences in scientist characteristics associated with these choices. The overall regression statistics (regression Chi-squared) are only significant for three of the action areas when the top stressor is excluded (Delta habitat, flow variability, and hatchery management); with the top stressor (Table C7c), reduced diversions is also significant at the 95 percent level, because those who chose flows as a top stressor were also much more likely to choose reduced diversions as a priority action. (These results are qualitatively similar when we use ranked choices instead with ordered logits, not shown here).

TABLE C7a

Scientist characteristics associated with top-rated action groups (bivariate logits, marginal effects)

	Delta habitat	Flow variability	Reduced diversions	Upstream management	Reduced discharges	Hatchery management	Diversion engineering	Direct invasive control	Harvest Management
1. Publications in stressor area	0.15	-0.17	-0.16	-0.14	0.23	1.36***	-0.35	0.91**	0.02
	(0.09)	(0.15)	(0.15)	(0.16)	(0.30)	(0.37)	(0.36)	(0.37)	(0.55)
2. Expertise breadth	-0.02	-0.14	-0.60**	-0.39	0.84	0.48	-0.27	0.94	-0.93
	(0.16)	(0.25)	(0.28)	(0.28)	(0.53)	(0.63)	(0.68)	(0.66)	(0.97)
3. Training: physical science only	0.04	0.23	-0.15	0.17	0.05	-0.38		-0.31	-0.50
	(0.15)	(0.24)	(0.22)	(0.25)	(0.45)	(0.63)		(0.64)	(0.95)
4. Employer (relative to "other")									
Government agency	-0.11	0.63***	0.02	0.04	-0.54	0.15	-0.27	0.27	-1.26*
	(0.13)	(0.24)	(0.23)	(0.23)	(0.43)	(0.58)	(0.52)	(0.59)	(0.73)
University or research institute	0.12	0.54**	-0.02	0.11	-0.85**	0.20	-0.73	-0.02	-0.76
	(0.14)	(0.22)	(0.22)	(0.22)	(0.41)	(0.55)	(0.51)	(0.57)	(0.61)
5. California-based	-0.29	0.09	0.14	0.11	-0.02	0.84	0.03	0.03	-0.25
	(0.20)	(0.18)	(0.19)	(0.20)	(0.38)	(0.61)	(0.49)	(0.49)	(0.61)
6. Publications (ln)	-0.02	0.13*	-0.04	0.10	-0.21	-0.11	-0.14	-0.10	-0.32
	(0.05)	(0.08)	(0.08)	(0.08)	(0.17)	(0.19)	(0.21)	(0.20)	(0.30)
7. Years of experience	-0.01	0.01	0.01	0.00	-0.02	-0.01	0.01	-0.01	-0.04
	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.02)	(0.02)	(0.02)	(0.03)
8. Leading expert	-0.02	0.36*	-0.02	-0.14	-0.11	-0.17	-1.06*	0.16	-1.27
	(0.10)	(0.20)	(0.17)	(0.18)	(0.35)	(0.43)	(0.62)	(0.42)	(0.93)
9. Moyle lab	0.09	0.13	0.05	-0.34**	-0.33	0.39	0.33	-0.08	-0.77
	(0.11)	(0.16)	(0.16)	(0.17)	(0.34)	(0.37)	(0.39)	(0.42)	(0.69)

NOTES: Table reports marginal effects (ey/dx) in bivariate logit regressions where the dependent variable is the choice of at least one action in the action area (Table B9) (constants included but not shown here). Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1 in two-tailed Wald tests that the coefficients are significantly different from zero. For diversion engineering, those with physical science training only were completely determined (none chose the option), so this variable is omitted from these regressions.

TABLE C7b
Scientist characteristics associated with action group priorities (logit multiple regressions, marginal effects)

	Delta habitat	Flow variability	Reduced diversions	Upstream management	Reduced discharges	Hatchery management	Diversion engineering	Direct invasive control	Harvest Management
Publications in stressor area	0.33**	-0.27	0.10	-0.05	-0.14	1.57***	-0.44	0.98**	0.31
	(0.15)	(0.21)	(0.21)	(0.20)	(0.36)	(0.47)	(0.49)	(0.48)	(0.66)
Expertise breadth	-0.46	0.00	-0.88**	-0.35	1.16	-0.47	0.84	0.21	-1.14
	(0.28)	(0.40)	(0.40)	(0.39)	(0.71)	(0.88)	(0.97)	(0.90)	(1.20)
Training: Physical science only	0.02	0.30	-0.14	0.11	-0.02	0.27		0.10	-0.52
	(0.16)	(0.27)	(0.24)	(0.27)	(0.48)	(0.69)		(0.71)	(1.00)
Employer (omitted: “other”)									
Government agency	-0.08	0.62**	-0.11	-0.15	-0.54	0.49	0.34	0.41	-1.61*
	(0.16)	(0.27)	(0.26)	(0.27)	(0.49)	(0.69)	(0.60)	(0.66)	(0.84)
University or research institute	0.15	0.61**	-0.08	-0.03	-0.92**	0.57	-0.59	-0.05	-1.17*
	(0.16)	(0.25)	(0.24)	(0.24)	(0.45)	(0.64)	(0.54)	(0.61)	(0.68)
Leading expert	0.09	0.37	0.18	0.05	-0.32	-0.56	-1.62**	-0.26	-0.57
	(0.13)	(0.23)	(0.22)	(0.22)	(0.43)	(0.60)	(0.74)	(0.55)	(1.01)
California–based	-0.26	0.02	0.18	0.24	-0.08	0.26	-0.10	-0.19	0.07
	(0.21)	(0.20)	(0.21)	(0.21)	(0.41)	(0.66)	(0.53)	(0.53)	(0.69)
Moyle lab	0.12	0.24	0.03	-0.358*	-0.56	0.54	0.59	-0.16	-1.09
	(0.12)	(0.20)	(0.19)	(0.19)	(0.41)	(0.45)	(0.45)	(0.48)	(0.77)
Sample size	122	122	122	122	122	122	122	122	122
Regression Chi^2	15.41**	17.45**	7.663	7.264	9.635	17.92**	10.61	7.790	8.218

NOTES: Table reports marginal effects (ey/dx) in multivariate logit regressions where the dependent variable is the choice of at least one action in the action area (Table B9) (constants included but not shown here). Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1 in two-tailed Wald tests that the coefficients are significantly different from zero. For diversion engineering, those with physical science training only were completely determined (none chose the option), so this variable is omitted from these regressions.

TABLE C7c
Scientist characteristics associated with action group priorities (logit multiple regressions marginal effects, with top stressor)

	Delta habitat	Flow variability	Reduced diversions	Upstream management	Reduced discharges	Hatchery management	Diversion engineering	Direct invasive control	Harvest Management
Publications in stressor area	0.28*	-0.28	0.11	-0.09	-0.13	1.98***	-0.55	0.96**	0.25
	(0.16)	(0.21)	(0.21)	(0.21)	(0.36)	(0.55)	(0.51)	(0.48)	(0.67)
Expertise breadth	-0.43	0	-0.90**	-0.34	1.14	-0.86	0.95	0.22	-1.12
	(0.31)	(0.40)	(0.41)	(0.39)	(0.71)	(0.95)	(1.01)	(0.90)	(1.21)
Training: physical science only	0.07	0.3	-0.24	0.13	-0.01	0.45		0.12	-0.55
	(0.18)	(0.27)	(0.26)	(0.27)	(0.48)	(0.71)		(0.72)	(1.01)
Employer (omitted: other)									
Government agency	-0.08	0.63**	-0.09	-0.13	-0.54	0.81	0.23	0.42	-1.64*
	(0.17)	(0.27)	(0.28)	(0.27)	(0.49)	(0.73)	(0.61)	(0.66)	(0.85)
University or research institute	0.14	0.62**	-0.05	-0.01	-0.92**	0.81	-0.76	-0.04	-1.23*
	(0.16)	(0.25)	(0.26)	(0.24)	(0.46)	(0.68)	(0.56)	(0.62)	(0.69)
Leading expert	0.08	0.37	0.23	0.08	-0.32	-0.62	-1.88**	-0.24	-0.64
	(0.15)	(0.23)	(0.23)	(0.22)	(0.43)	(0.61)	(0.80)	(0.56)	(1.03)
California-based	-0.23	0.02	0.22	0.21	-0.08	0.06	-0.03	-0.18	0.06
	(0.21)	(0.20)	(0.22)	(0.21)	(0.42)	(0.67)	(0.53)	(0.54)	(0.69)
Moyle lab	0.16	0.25	-0.03	-0.33*	-0.55	0.81*	0.57	-0.12	-1.09
	(0.13)	(0.20)	(0.20)	(0.19)	(0.41)	(0.49)	(0.47)	(0.48)	(0.77)
Top stressor (omitted: flows)									
Habitat	0.36**	0.02	-0.62***	0.18	0.12	0.42	0.52	0.3	0.2
	(0.14)	(0.16)	(0.19)	(0.17)	(0.32)	(0.42)	(0.45)	(0.41)	(0.58)
Other nonflow	-0.01	-0.03	-0.31	-0.17	0.02	-1.282*	1.13**	-0.18	0.64
	(0.12)	(0.23)	(0.24)	(0.23)	(0.46)	(0.74)	(0.57)	(0.62)	(0.74)
Sample size	122	122	122	122	122	122	122	122	122
Regression Chi^2	27.21***	17.51*	20.79**	10.01	9.795	24.61***	14.69*	8.784	8.941

NOTES: see notes to Table C7b.

TABLE C7d
Summary of dependent and independent variables used in logit regressions for scientist action areas

Variable	Obs	Mean	Std. Dev.	Min	Max
Priority Action Area					
Diversion engineering [a]	121	0.20	0.42	0	1
Delta habitat	121	0.82	0.39	0	1
Flow variability	121	0.65	0.48	0	1
Reduce diversions	121	0.62	0.49	0	1
Reduce discharges	121	0.29	0.46	0	1
Upstream management	121	0.61	0.49	0	1
Manage harvest	121	0.12	0.33	0	1
Manage hatcheries	121	0.22	0.42	0	1
Directly control invasives	121	0.21	0.41	0	1
Publications in stressor area					
Diversion engineering	121	0.56	0.50	0	1
Delta habitat	121	0.53	0.50	0	1
Flow variability	121	0.68	0.47	0	1
Reduce diversions	121	0.56	0.50	0	1
Reduce discharges	121	0.31	0.46	0	1
Upstream management	121	0.64	0.48	0	1
Manage harvest	121	0.26	0.44	0	1
Manage hatcheries	121	0.26	0.44	0	1
Directly control invasives	121	0.41	0.49	0	1
Expertise breadth	121	0.40	0.27	0	1
Training: physical science only	121	0.11	0.31	0	1
Employer (omitted: other)					
Government agency	121	0.33	0.47	0	1
University or research institute	121	0.54	0.50	0	1
Leading expert	121	0.21	0.41	0	1
California-based	121	0.83	0.37	0	1
Moyle lab	121	0.25	0.44	0	1
With top stressor (flow omitted)					
Habitat	121	0.46	0.50	0	1
Other nonflow	121	0.16	0.37	0	1

[a] Statistics are for the sample used in logit regressions, with observations matching the corresponding columns of Table C7c. For the full sample of experts, descriptive statistics are as follows: Diversion engineering, n = 121, mean = 0.20.

Cluster Analysis

Given the interactions among stressors and mitigating actions, we were interested in seeing which actions respondents picked together in their package of "top 5" actions. As one approach for examining this, we explored hierarchical cluster analysis, which groups together respondents based on similarities (closer distances) for a given set of variables. We initially explored clustering with the choices over the roughly 30 individual actions (for experts, 32; for stakeholders, 29). This proved problematic because so many actions had "zero" values for each respondent, given that they could only pick five priorities. With binary values, "one" if the action was chosen and "zero" if not, we could not identify stable clusters (i.e., membership in a cluster was sensitive to the order in which individual observations entered the sorting process). Clustering was possible when we used ranked values for the priorities, but the results were not particularly meaningful. The exercise did not distinguish between actions that are relatively similar (such as reducing exports or increasing net outflows, which are both ways to reduce diversions) and actions that are quite different (e.g., reducing discharges). We therefore proceeded to group actions into the nine action areas presented in the main report and Tables B9 and B20. With these groupings, it is easier to establish patterns of choices—for instance, the strong similarities in choices among most scientists, who prefer combinations including at least two, and generally at least three of the four habitat and flow action areas: Delta habitat, flow actions, and upstream management actions.

We also explored cluster analysis with these nine action area groupings. When expressed as binary variables, the clusters were again not stable. When they were assigned ranked values (based on the highest ranking action in the area, if more than one action was chosen), the clusters were much less sensitive to the order of the observations.

Scientist clusters

Table C8 presents the ranked values of action areas for a five-cluster grouping for scientists. These clusters were identical with two different random sortings of the observations. This exercise produced one very large cluster (102 scientists, or 84% of the sample), centered on the choice of the four habitat-flow action areas noted above. There were also four very small clusters, generally emphasizing one or more of the less popular areas: discharges, hatcheries, and invasive control (without flows) (4 scientists); diversion engineering and invasive control (6); diversion engineering and hatchery management (2); and fishery and habitat actions (without flows) (8). We explored whether there were any significant differences among the clusters relating to biographical variables presented above and found none.

Stakeholder clusters

Table C9 presents the ranked values of action areas for a six-cluster grouping for stakeholders. These groups were nearly identical in two random draws; we broke out two small subgroups that were not consistently in the same cluster. There are two large clusters, one emphasizing reducing diversions (123 stakeholders) and one emphasizing Delta habitat (82 stakeholders), and four small clusters generally emphasizing one or more of the less popular areas: invasive control (11 stakeholders); harvest management (10); hatchery management (2); and habitat action combinations including Delta and upstream (11). Table C10 shows the affiliation of stakeholder groups in each cluster and highlights statistically significant differences. These differences are consistent with the strong divergences in stakeholder group choices of action areas presented in the main report (Figures 8 and 9). Beyond the differences in the stakeholder compositions within a cluster, some stakeholder groups are more concentrated in one or two clusters. For example, 82 percent of Delta interests are in the reduced diversions cluster as are 86 percent of the fishing/recreation interests. Most upstream interests and state and federal agency representatives were in either the reduced diversions or Delta habitat cluster, while 82 percent of exporters were in the Delta habitat cluster.

TABLE C8
Scientist clusters by maximum rank in each action area (means, potential range 0 to 5)

Cluster focus	N	Delta habitat	Flow variability	Reduced diversions	Upstream management	Reduced discharges	Hatchery management	Diversion engineering	Invasive control	Harvest management
Habitat and flow	102	2.92	2.61	2.95	1.86	0.60	0.34	0.43	0.26	0.12
Diversion engineering, hatchery management, flow variability	4	1.50	3.00	1.50	0.00	0.00	5.00	3.00	0.00	0.50
Diversion engineering and invasive control	6	2.17	1.00	0.83	0.50	0.83	0.00	2.83	4.00	0.33
Discharges, hatcheries, and invasives (no flow)	2	1.50	0.00	0.00	1.50	5.00	1.50	0.00	1.75	0.25
Fish management and habitat	8	2.00	0.50	0.38	4.00	0.38	1.50	0.75	0.38	2.38

TABLE C9
Stakeholder clusters by maximum rank in each action area (means, range 0 to 5)

Cluster focus	N	Delta habitat	Flow variability	Reduced diversions	Upstream management	Reduced discharges	Hatchery management	Diversion engineering	Invasive control	Harvest manage-ment
Reduced diversions with habitat (Delta and upstream) and flow variability	123	1.30	1.35	4.74	1.33	1.20	0.19	1.00	0.33	0.25
Delta habitat with reduced discharges and diversion engineering	82	2.91	1.99	0.20	0.61	2.20	0.20	2.04	0.49	1.01
Invasive control with reduced discharges and Delta habitat	11	1.82	1.55	0.82	0.09	2.27	0.00	0.36	3.91	0.73
Harvest management with invasive control, Delta habitat and managed hatcheries	10	1.80	0.30	0.30	0.10	1.00	1.80	0.50	2.40	4.70
Hatchery management with reduced discharges, Delta habitat, and flow variability	2	2.50	3.00	0.00	0.00	4.50	5.00	0.00	1.00	0.00
Habitat combination (Delta and upstream)	11	4.00	0.09	0.27	4.27	0.45	0.82	0.64	0.45	0.73

TABLE C10
Stakeholder group breakdowns by action area clusters (percent of sample)

Stakeholder Group	Reduced diversions with habitat (Delta and upstream) and flow variability	Delta habitat with reduced discharges and diversion engineering	Invasive control with reduced discharges and Delta habitat	Harvest management with invasive control, Delta habitat and managed hatcheries	Hatchery management with reduced discharges, Delta habitat and flow variability	Habitat Combination (Delta and upstream)
Delta interests	82	5	3	8	0	3
Fishing/recreation	86	14	0	0	0	0
Upstream interests	33	44	8	13	0	3
Export interests	0	82	14	0	5	0
Environmental advocates	66	21	6	0	0	7
State and federal agencies	45	42	2	4	0	7
Other	33	53	0	0	7	7

NOTES: ANOVA tests with a Bonferroni adjustment revealed the following significant difference across groups at 90 percent significance or greater: Delta and fishing/recreation interests were more likely than upstream interests, exporters, government officials and "other stakeholders" to be in the reduced diversions cluster. Environmental advocates were more likely than exporters and upstream interests to be in the reduced diversions cluster. Exporters were more likely than Delta, fishing/recreation, upstream, environmental, and government officials to be in the Delta habitat cluster, and upstream interests were more likely than Delta interests to be in that cluster. Upstream interests were more likely than environmental advocates to be in the harvest management cluster.

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