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Understanding The Driving Forces of Bay/Delta Administrative Agency Officials Towards the Delta Smelt Resiliency Strategy: Outflow Augmentation

Arushi Patel[1], Tien-Chieh Hung[#] and Kate Flowers Rossner[#]

[1]Santa Clara High School, USA
[#]Advisor

ABSTRACT

The Delta Smelt (Smelt) is an endangered fish native to the Sacramento–San Joaquin Delta. The Smelt is vital to its ecosystem as it is considered as an indicator species, meaning that it represents the overall health of the Bay/Delta. Its recent decline resulted in a significant shift in the Bay/Delta ecosystem, causing poor conditions for inhabiting species. After the Delta Smelt was listed under the state and federal Endangered Species Act, scientists identified water diversion by pumping plants away from the Bay/Delta as one of the primary causes of their population decline. Following multiple failed Smelt conservation strategies, the CNRA devised a plan to "reduce the mortality of Smelt and boost the rate at which they grow, reproduce, and survive" by counteracting the pumping plant water diversions: The Delta Smelt Resiliency Strategy. The strategy proposed an additional 250,000 acre-feet of water to be purchased for outflow augmentation or water diversion towards the Bay/Delta. Though this strategy was never passed, there is clear future potential for similar or identical policies. Understanding the controversy surrounding such a policy, this paper strives to examine the driving forces that influence stakeholders impacted by water diversions to support or oppose outflow augmentation.

Introduction

Delta Smelt Biology

The Delta Smelt (Smelt) is an endangered fish[1] native to the Sacramento–San Joaquin Delta (Bay/Deta). The Smelt has a short life-span, with most living just one year and growing to a length of 65-90mm (Moyle et al., 2016).

There are several factors that impact the Smelt's lifespan. The Smelt are weak swimmers leading to them being easily entrained[2] at pumping plants. Moreover, they need turbid water to both see their prey and remain invisible to predators. Such requirements have made the Smelt increasingly vulnerable to habitat change.

[1] "The Delta Smelt population declined by more than 80 percent in the early 1980s, leading to state and federal threatened listings. Smelt numbers fluctuated during the 1990s, and then increased following the cessation of drought in 1992. Abundance again declined drastically in 2002, dropping more than 80 percent in just three years. The Smelt population in 2005 was the lowest ever measured, just 2.4 percent of what it was when the species was listed in 1993. Numbers of juvenile Smelt found in 2007 surveys were the lowest ever recorded by an order of magnitude" (Center for Biological Diversity, 1989)

[2] In this paper, fish entrainment is defined as the loss of fish due to their transportation when streams, creeks, or rivers are diverted for irrigation and other uses through pumping plants into unnatural or harmful environments (Wyoming Game & Fish Department; Bureau of Reclamation).

The Smelt have also adapted to cool water, making them at risk of high temperatures within their habitat (Hobbs et al., 2017) and inhabit areas of 0-7 practical salinity units[3] (Feyrer et al., 2007). The Smelt's need for cool water and specific salinity prevents them from foraging in food-rich water habitats. All of these factors combined led to instability and steep declines of Smelt populations.

The Smelt is vital to its ecosystem as it is an indicator species, meaning that it represents the overall health of the Bay/Delta. Its recent decline resulted in a significant shift in the

Bay/Delta ecosystem, causing poor conditions for inhabiting species (Sommer et al., 2007).

California Water and Pumping Plants

In California, agriculture uses about 62% of all water, with urban and industrial accounting for 16% (Hanak et al., 2011). Thus, over 70% of California's water is moved through the Bay/Delta for usage by means of pumping plants[4]. These pumping plants divert water *away* from the Bay/Delta, directly impacting the Smelt by intensifying the aforementioned issues that affect its lifespan.

Implemented Conservation Strategy

After the Delta Smelt was listed under the state and federal endangered species act[5], scientists identified water diversion by pumping plants to the Bay/Delta as the primary cause of their population decline (Moyle et al. 1996). Following multiple failed Smelt conservation strategies, (CNRA, 2016) and the *Annual Summer Townet Survey Index* for Delta Smelt[6]equalling 0 for two years consecutively[7] (Hobbs et al., 2017), the CNRA[8] put forth a plan to prevent the species decline: *The Delta Smelt Resiliency Strategy.*

The overall strategy included a set of immediate emergency actions that were put in place to benefit the Smelt. In addition to environmental control, the strategy proposed an additional 250,000 acre-feet of water to be purchased for outflow augmentation, or the diversion of water towards the Bay/Delta, in the years 2017 and 2018, called *The Delta Smelt Resiliency Strategy:Outflow Augmentation* (DSRS).

Ultimately, the DSRS would "reduce the mortality of Smelt and boost the rate at which they grow, reproduce, and survive" by counteracting the pumping plant water diversions (CA.gov, 2017). However, a problem arises as the DSRS reduced the amount of water available for agriculture use, leading to significant political conflict (CNRA, 2016).

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[3] Practical Salinity Units or PSUs are a unit based on the properties of sea water conductivity (Reul et at., 2011).

[4] Large pumping plants are used to get water to farming areas in the San Joaquin Valley, over 15 million people in Southern California, and 1.5 million people in the South Bay.

[5] "Through federal action and by encouraging the establishment of state programs, the 1973 Endangered Species Act provided for the conservation of ecosystems upon which threatened and endangered species of fish, wildlife, and plants depend." (fws.org)

[6] "The Delta Smelt index was developed about 1990 in response to declining Delta Smelt abundance. It has proven valuable in gauging the health of the estuary; Delta Smelt abundance trend data was used as supporting evidence for their listing as threatened in 1992 under the Federal and State Endangered Species Acts," (California Department of Fish and Wildlife, 2020).

[7] Meaning that the Smelts abundance was at critically low levels

[8] California Natural Resources Agency. State cabinet-level agency in California, "responsible for protection history, natural landscapes, cultural sites, monitoring and stewarding state lands and waterways, and regulating fish and game use, as well as private lands and the intersection with federal lands waters" (California Natural Resources Agency, 2018).

Policy Controversy

Previous attempts of outflow augmentation in the Bay/Delta have been controversial as individuals claimed that water was wasted in protecting Smelt instead of providing it to farmers (Cloern et al. 2017) leading to attention for farmers who had lost “crops and jobs” to protect the Smelt (Hobbs et al., 2017).

Even though the DSRS policy was not implemented, there is clear future potential for similar or identical policies. Looking at the controversy of the DSRS, the driving forces[9] that influence individuals impacted by water diversions to either support or oppose outflow augmentation need to be considered. These individuals, called stakeholders, have considerable influences on the ability of policymakers to pass a similar policy to the DSRS.

Given these matters, one would expect to find groups with divergent opinions. It is known that environmental and fishery groups favor conservation, and San Joaquin farmers and Southern California water users oppose it (Zafonte et al., 1995). However, the views of administrative agency officials (AAOs)[10] are far less predictable. Therefore a need arises to understand their views towards the DSRS, as they can affect whether the policy will be passed. To understand what driving forces and factors influence the AAOs beliefs, their human dimensions must be understood first. Human dimensions refers to "how humans affect or are affected by natural resource management decisions," (HD.gov, 2020). Human dimensions can help “make the best compromises between humans’ needs and uses of natural resources and the protection of those natural resources” (HD.gov, 2020), which is vital when proposing conservation efforts for endangered species.

Thus, the question driving the research presented in this paper is "Through Evaluating The Human Dimensions Of Bay/Delta Administrative Agency Officials, What Driving Forces Affect Their Support Or Opposition Towards *The Delta Smelt Resiliency Strategy: Outflow Augmentation*?"

Literature Review

The Delta Smelt has faced controversy due to conservation efforts targeted to prevent its extinction. This controversy was primarily between two stakeholders: farmers and scientists. According to the Ninth Annual Environmental Law Conference, there is a history of water issues in the Bay/Delta. The speaker claimed that the agricultural community is dissatisfied with policies like the DSRS as it reduces the amount of water their farms receive (Patterson, 1995). However, on the other hand, the environmental community is pleased with the DSRS as it provides one million acre-feet of water to environmental needs each year (Patterson, 1995). Thus, it is established that farmers generally dislike the DSRS and therefore have utilitarian views, indicating that they believe in the betterment of society above the environment. In contrast, scientists agree with the DSRS and have environmental views, signifying that they consider it human beings' responsibility to look after and respect all living things. However, within the Bay/Delta, farmers and scientists makeup only a small percentage of the stakeholders. According to leading researchers in the field, Zafonte and Sabatier, there are 20 major stakeholder groups in the Bay/Delta. Moreover, out of the 20, there are three influential groups: farmers, scientists, and AAOs. As established, farmers' and scientists' views are known with farmers falling utilitarian and scientists environmental (Zafonte et al., 1995); however, what is and remains unknown is the views of the AAOs.

To understand such views, human dimensions can be utilized. According to the Bitterroot Social Research Institute, human dimensions are defined as "how human knowledge and attitudes towards natural resources affect how natural resources are managed." (Smith, 2000). Another study follows a similar line of reasoning. It proposes that understanding human dimensions of stakeholders' towards conservation efforts can be

[9] The reasons behind an individual's decision (HD.gov, 2020).

[10] Organizations that work with Bay/Delta water policy and are responsible for both water quality, water rights, and water flows (EPA.gov, 1999).

helpful during conservation efforts (Decker et al., 2012). The peer-reviewed book *Who Cares About Wildlife?* cites human dimensions as "a field of study that applies the social sciences to examine human-wildlife relationships, and, in doing so, provides information that contributes to effective wildlife conservation efforts" (Manfredo, 2008). Comprehensively, both (Decker et al., 2012; Manfredo, 2008) conclude that human dimensions gather information to help understand the underlying motives of stakeholder's decisions to overall help conservation efforts towards species. Thus, to put in perspective in terms of the research, human dimensions can explicate AAO's attitudes towards species conservation efforts, and can act as an accurate way of judging how they affect or are affected by species conservation decisions (HD. gov, 2020).

Human dimensions only give an explanation behind AAOs attitudes towards a conservation effort. But, to deduce the reasons behind AAO's decisions to support or oppose conservation efforts, their driving forces need to be evaluated. Driving forces are the reasons AAOs would either support or oppose a policy; they are the reasons behind an AAOs decision. Therefore researchers can use human dimensions to identify driving forces to overall understand AAO's views (HD.gov, 2020).

All the articles point to one topic: to identify the human dimensions of AAOs to understand their driving forces behind their decision to support or oppose a species conservation effort. This research is focused on a specific species conservation effort, the DSRS. A study by UC Hastings Law establishes that there are severe economic and political interests at stake as Delta Smelt conservation efforts can cost more than $15.8 million a year, impacting agriculture and farming lands (Zafonte et al., 1995). Therefore, the authors of this study send out a questionnaire to individuals who wanted to influence Bay/Delta conservation efforts (Zafonte et al., 1995) and discover that their beliefs significantly impact the endangerment of species and can hinder conservation. Though the text has a similar goal to the one of this paper, it has limitations. As it was conducted in 1995, California's politics as well as endangered species policies have changed drastically, making most of the research outdated. The study was conducted over a mail questionnaire, so the responses were one-dimensional and not informative about individuals within a group. Additionally, the study does not address specific stakeholders; instead, it focuses on all 20 stakeholders in the Bay/Delta, giving only a general glimpse of their views. Lastly, it focuses on Bay/Delta as a whole rather than a specific policy and does not consider human dimensions or driving forces.

This study will attempt to bridge this gap in knowledge by identifying the current driving forces behind AAOs' decision to support or oppose the DSRS by evaluating their human dimensions. This paper's contributions are important as it will underscore the specific human dimensions and, thus, driving forces that influence stakeholder decision-making when supporting or opposing a conservation policy. With this knowledge, stakeholders' opinions can be considered when implementing a policy similar to the DSRS, garnering more support for endangered species conservation.

Methods

The researcher utilized a mixed-methods approach, administering both a questionnaire and interview to six stakeholders employed in water-related organizations[11] in the Bay/Delta region. A mixed-methods approach was the most suitable for this research as a questionnaire provided the ability to gauge the participant's general viewpoints[12] before conducting interviews to formulate specific interview questions. Moreover, through conducting a mixed methods approach, the researcher was able to understand the contradictions between qualitative and quantitative data while still gathering data that reflected the participants view and were grounded in their experiences (Wisdom et al., 2013).

[11] Organizations that work with Bay/Delta water policy and are responsible for both water quality, water rights, and water flows.

[12] Viewpoints is defined as the participants' degree of agreement/disagreement with a statement.

Questionnaire

The questionnaire was adapted from the Zafonte study on the "views of Bay/Delta activists towards endangered species issues" (Zafonte et al., 1995). The questionnaire in this paper uses a five-point Likert scale[13], focused on agreement (strongly agree to strongly disagree), with a sixth option of leaving the question blank (signifying "not understood"). The sixth option's use improved the validity of the results by reducing the participants' likelihood of randomly choosing an answer even though they did not understand the statement provided. The scale numbering was as shown:

1= Strongly disagree
2= Disagree
3= Neutral
4= Agree
5= Strongly Agree

Using this scale allows the participants multiple degrees of opinion (or no opinion at all), helping garner more informative answers. When interpreting the answers one and two indicate the respondent has a utilitarian perspective[14], three indicates neutral, and four and five indicate the respondent has an environmental perspective[15].

The first section of the questionnaire asked participants about their views towards standards whose scope is broader than Bay/Delta water policy (Zafonte et al., 1995). The researcher took five statements from *The Utilitarian View of Nature Scale*[16] and gave the participants the option to rank their agreement using the Likert scale above. Statements focused on topics like "conservation efforts," "species protection," and more (refer to Appendix B). This section's purpose was to understand the participant's perspective on environmental matters.

The next portion of the questionnaire provided participants with four statements from the *Bay/Delta Environmental Concern Scale*[16] dealing with several environmental policy aspects within the Bay/Delta. For example, some questions discussed Bay/Delta water issues as a whole and others with significant aspects such as fisheries[17]. The statements included themes such as
"environmental quality," "economic development," and more (refer to Appendix B). This section's purpose was to narrow down the area (focusing on the Bay/Delta) to discern the participant's beliefs towards management decisions and environmental concerns.

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[13] Five-point (or seven in other circumstances) scale that allows an individual to express the amount they agree or disagree with a particular statement (Likert, 1932).

[14] In this paper specifically, the utilitarian perspective is accordant with those who believe that mankind has power over nature and should therefore disregard it when it comes to gainful employment or expenses (Zafonte et al., 1995).

[15] In this paper specifically, the environmental perspective correlates with those who believe that "all species have an inherent right to exist, and mankind should conserve those that are endangered" (Zafonte et al., 1995).

[16] Found in study: The Views of Bay/Delta Water Policy Activists on Endangered Species Issues, focuses on statements such as "One person's right to a clean environment is not as important to another's right to gainful employment" (Zafonte et al., 1995).

[16] Found in study: The Views of Bay/Delta Water Policy Activists on Endangered Species Issues, focuses on statements such as "The San Francisco Bay/Delta is a resource of importance to people beyond the local level, and thus should be subject to state and federal policies" (Zafonte et al., 1995).

[17] Place where fish (those that are endangered) specific in this instance, are either breeded or re-introduced to their environment

The third section concentrated primarily on Bay/Delta flows[18] and fisheries. The three statements in this section were focused on the perceived impact of water diversions on the Bay/Delta fisheries and a preference that water flow requirements be sufficient to restore fish populations pre-1976 levels (Zafonte et al., 1995). Statements with issues ranging from "political power," "Bay/Delta fisheries" and more were included (refer to Appendix B). This section's purpose was to narrow the scope of questions in the direction of fishery policy and species conservation actions.

In the fourth section, participants were instructed to choose whether they supported or opposed the DSRS. The researcher used a short excerpt summarized from a non biased source[19]about the DSRS and a disclaimer that the policy had never been implemented; however, its proposition had caused significant controversy to provide context for the AAOs[20].

In the final section, the researcher asked for the participants' consent for an interview along with sample interview questions.

Interview

In addition to the questionnaire, the researcher conducted an interview with the AAO's.

The purpose of the interview was to receive in-depth, qualitative results specific to the human dimensions that lead AAOs to their stance on the DSRS policy and question the reasons behind some of the Likert rankings in the questionnaire.

The interview questions addressed three main concerns:

1. The human dimensions behind stakeholders decisions
2. The effects of outflow augmentation on stakeholder's quality of life (monetary…)
3. The management strategies stakeholders want to see to address change (smaller amount of water diversion, specific season, etc.)

Researcher-created questions were reviewed by a leading scientist in the field of the Smelt from University of California Davis to ensure their relevance and clarity. 30-minute interviews were conducted via video conference due to the COVID-19 pandemic.

The researcher used semi-structured interviews as they allowed them to prepare questions beforehand as well as give the participants the freedom to express their views in their own terms (DeJonckheere et al., 2019). In this method, interviews are conducted through introducing the topic being studied and following up with a list of predetermined questions which are asked in a specific order. Both open and close ended questions[21] were utilized to obtain reliable qualitative data. Moreover, the researcher specified questions based on the prior questionnaire responses, for example, "You indicated that you oppose *The Delta Smelt Resiliency Strategy: Outflow Augmentation*. Can you tell me a little more about this decision?"

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[18] Refers to outflow and inflow of Bay/Delta

[19] California Natural Resources Agency, government agency that focuses on stewarding California's natural environment

[20] Excerpt: *Delta Smelt Resiliency Strategy: Outflow Augmentation*: "The Strategy included 13 near- and mid-range actions aimed at creating better habitat, increasing the outflow into the delta by 250,000 acre-feet, more food, and higher turbidity, along with reduced levels of weeds, predators, and harmful algal blooms. Ultimately, the actions should reduce mortality of Delta smelt and boost the rate at which the fish grow, reproduce, and survive" (CA.gov). Disclaimer: "Even though the outflow augmentation policy was not necessary for the water year 2016-17, one of the wettest on record, there is future potential for similar policies. Therefore, understanding views towards the policy can be significant" (CA.gov).

[21] Open ended questions are those that elicit in-depth, free-form responses from participants. Close ended questions can be answered with a yes or no.

Thematic Analysis

The researcher then used a thematic analysis[22]to explicate AAO's views, opinions, knowledge, experiences, or values. This method was chosen because it provides a more comprehensive review of the data by exploring the explicit and implicit meanings.

To begin, the researcher used a transcription software (Otter.ai) to transcribe the audio from the recorded interviews. Using an inductive[23] and semantic[24] approach, the researcher established the major driving forces within the data. To do this, the researcher highlighted phrases or sentences that corresponded to various human dimensions. As more text is read, more human dimensions are added in a dynamic cycle. Next, after the major human dimensions were created, the researcher identified patterns among them and began coming up with driving forces (several human dimensions could be combined to form a driving force). Once the final list of driving forces were identified, the researcher defined and named them. Finally, to elucidate the phenomenon, the researcher extracted the central driving forces identified and made informed conclusions.

Results

Questionnaire

The questionnaire generated results from AAOs from three different water-related organizations in the Bay/Delta. The results from the questionnaire are found in Figures 1, 2, 3, and Table 1, shown below.

Each section of the questionnaire that dealt with participants ranking their agreement with statements was scored. As mentioned, one and two indicate the respondent is congruent with the utilitarian perspective, three indicates neutral, and four and five confer the respondent corresponds with the environmental perspective. The researcher used five steps to collate the responses:

1. Participant's scores for each section were taken and added up.
    a. For example, if a participant had scored three statements from the first section a 4 and two statements a 3, they would have received a score of 18.
2. After every section was calculated, each score was divided by the number of questions to get the section's average score.
    a. For example, 18 ÷ 5= 3.6
3. Steps 1 and 2 were repeated for each participant.
4. The averaged Likert scores were used to create a box plot for the section.
5. Steps repeated above for all remaining sections

The data is depicted in a box-plot.

Figure 1 presents the data for section 1 of the questionnaire that concerns fundamental normative orientations whose scope is broader than Bay/Delta water. The median of the data set is 1.8 and the range is 3. This shows that though there is a wide distribution of scores within participants, the data is skewed towards lower values indicating that most participants incline towards one and two. Therefore, the participants are inherently utilitarian in their views towards fundamental normative orientations.

[22] Thematic analysis is defined as defining, analyzing, and interpreting patterns/themes within qualitative data (Scribbr, 2019)

[23] Where the data determines the themes (Scribbr, 2019)

[24] Where the researcher analyzes the explicit content and focuses on stated opinions (as opposed to conjecturing assumptions) (Scribbr, 2019)

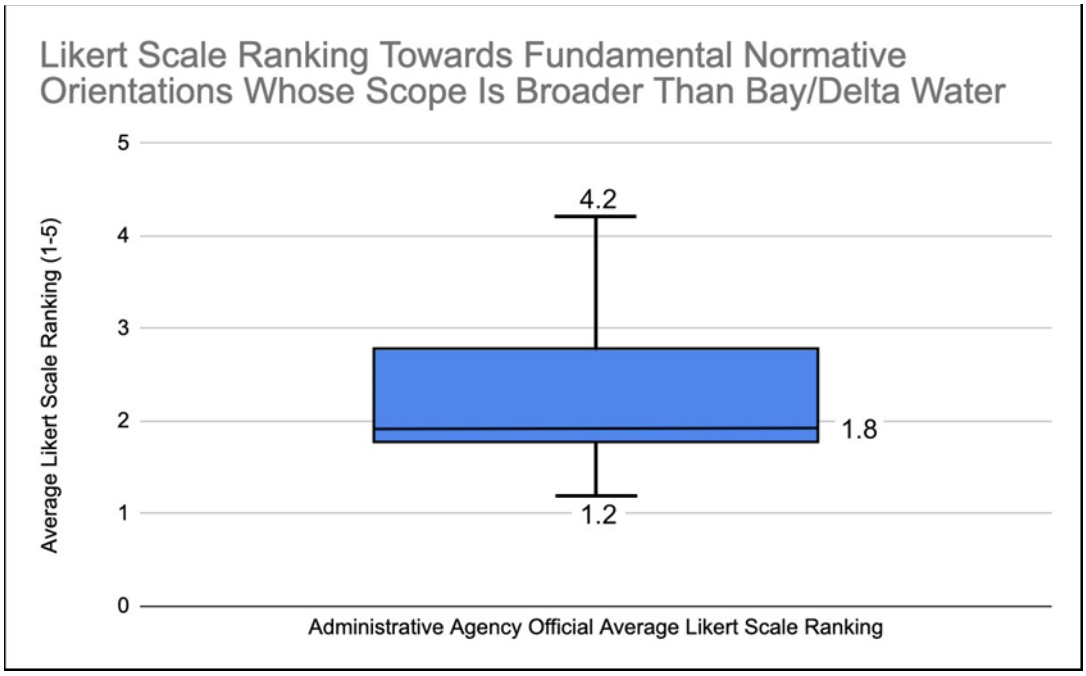

Figure 1.

Figure 2 illustrates data from section 2 of the questionnaire dealing with Bay/Delta water issues as a whole and others with significant aspects such as fisheries. From the plot, one can ascertain that the median of the data set transpires at 2.125 and the range at 3. Similar to the previous figure, despite the distribution of values, the graph is skewed to lower values. Consequently, AAOs are innately utilitarian in their views towards Bay/Delta water issues.

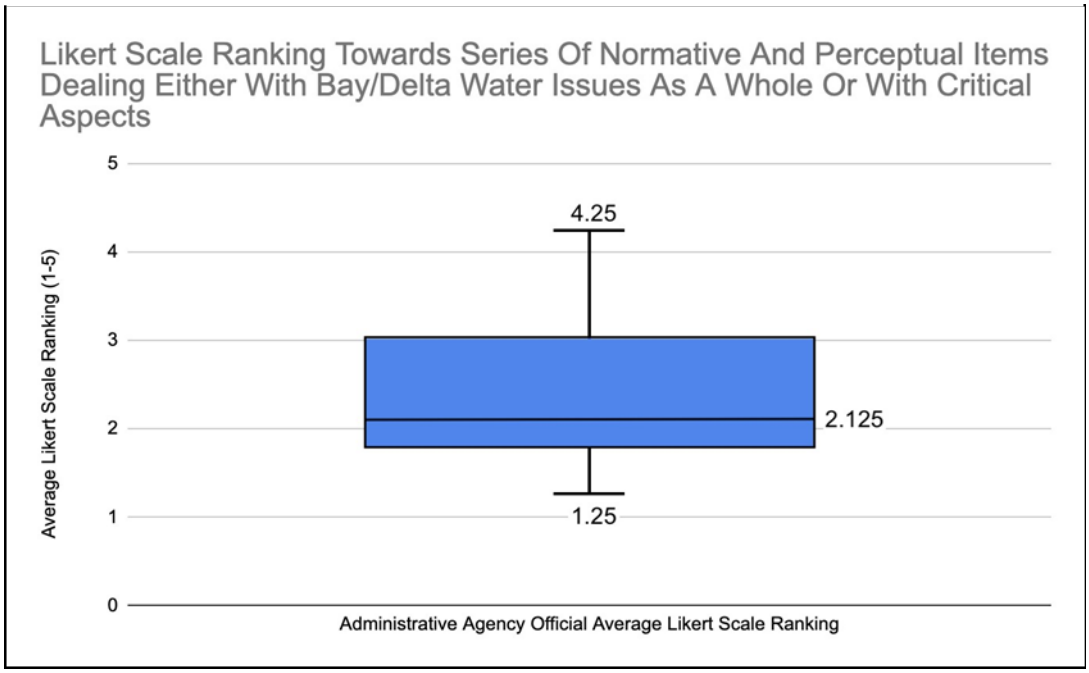

Figure 2.

Figure 3 displays data from section 3 of the questionnaire regarding several environmental policy aspects within the Bay/Delta. As one can see, the median of the data set is equal to 2.5 and the range is 3.4. This score distribution varies from the others as the graph is skewed to the higher values such as three and four. Hence, the researcher can conclude that AAOs, in terms of environmental policy aspects, are moderately environmental.

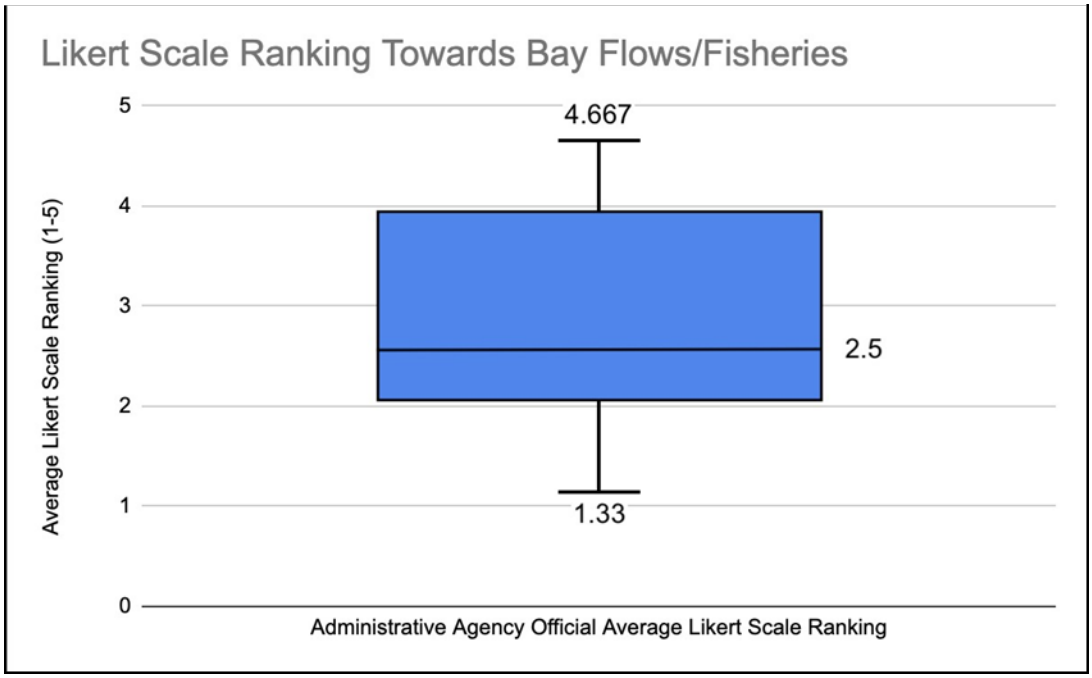

Figure 3.

The researcher formulated Table 1 to understand whether utilitarian or environmental partisan influences whether AAOs supported or opposed the DSRS by using a summation of all the Likert scale rankings. For example, if a participant had chosen one for all of their responses (signifying that they strongly disagreed with all of the statements), they would have had a score of 12; conversely, if they conveyed five for all, they would have a score of 60. As 36 falls between the two numbers, participants with a score of 12-36 would be utilitarian, and those with a score of 36-60 would be environmental. As seen in column 1 of the table, to provide confidentiality, the participants' names and organizations were not listed. They were referred to in the order they took the questionnaire and were consequently interviewed. Column 2 interprets the participant's score, ranking it above or below the benchmark of 36 to show whether the participant falls in the utilitarian or environmental category. Column three displays whether the participants support or oppose the DSRS policy. The questionnaire was based on a study by Zafonte and Sabatier on Bay/Delta activists' views towards endangered species issues. This study claimed that farmers' and scientists' views were known, with utilitarian farmers opposing the policy and environmental scientists supporting it; however, AAOs' views were unexplored (Zafonte et al., 1995). Thus, column four explicated whether AAO's partisan influenced their support/opposition of the DSRS and whether it matched the conclusions found in the paper (environmental supporting and utilitarian opposing). The results validate the conclusions, with participants with a score less than 36 (utilitarian) opposing the DSRS and participants with a score greater than 36 (environmental) supporting it.

Table 1.

Participant #	Less or Greater than 36	Support/Oppose	Does the Conclusion Match the Paper?
Participant 1	↓	Oppose	✓
Participant 2	↓	Oppose	✓
Participant 3	↑	Support	✓
Participant 4	↓	Oppose	✓
Participant 5	↓	Oppose	✓
Participant 6	↑	Support	✓

Interview

All six participants consented to an interview at the end of their questionnaire. The researcher thematically analyzed the participant's responses with five themes emerging. Each theme is a driving force that influenced AAOs' decision to support or oppose the DSRS. Table 2 below explicates these themes and their definitions.

Table 2.

Theme	Definition
Financial Interests	Officials believe that the Bay/Delta surrounding community will make or lose business revenue due to the DSRS
Knowledge	Officials' knowledge about the DSRS policy is insufficient
Environmental Stewardship	Officials maintain that the DSRS has an environmental footprint
Moral/Ethical Values	Officials conclude that the DSRS is in conjunction or against their values and beliefs
Social/Environmental Balance	Officials surmise that there should be a balance between the Bay/Delta population and DSRS

The researcher arranged the results from the interview in Table 3.

Table 3.

Participant #	Key Human Dimensions That Influenced Support/Opposition	Corresponding Driving Forces	Support /Oppose

Participant 1	Though species conservation is essential, the home, residents, agriculture, industry, and economic needs are just as, if not more important. Such a policy would severely impact economic growth, raising the question of whether this is a good use of public money.	Social/Environmental Balance Financial Interests	Oppose
Participant 2	Preference for solutions where all parties reach an agreement, a mutualistic compromise where all individuals, environmental and agricultural, profit. Never heard of the Delta Smelt or Outflow Augmentation	Social/Environmental Balance Knowledge	Oppose

	beforehand; primarily gathered knowledge during the questionnaire and through questions in the interview.		
Participant 3	Resiliency strategy has strong potential to help agriculture as well as species conservation. It is the moral obligation of all humans to help conserve species that are being endangered due to our negligence.	Environmental Stewardship Moral/Ethical Values	Support

Participant 4	Definite need for balance, though human necessities would be placed at a higher priority. --- Spending an exceedingly large sum of money on a policy is unnecessary when other demands would lead to a much better future.	Social/Environmental Balance --- Financial Interests	Oppose
Participant 5	Figure out how much water is needed for the Delta Smelt and how much is needed for human consumption; find a balance. --- DSRS policy creates extra pressure for businesses on top of COVID and all the other financial concerns.	Social/Environmental Balance --- Financial Interests	Oppose
Participant 6	Americans tend to treasure the outdoors; therefore, conservation of species that would help maintain the outdoors (Bay/Delta) is vital. --- Was not aware of the Smelt or Outflow Augmentation and received most knowledge during the interview by asking questions.	Environmental Stewardship --- Knowledge	Support

The first column lists the participants in the order they took the questionnaire and were interviewed. This means that each row denotes a single administrative agency official's human dimensions and, by extension, their driving forces.

The second column has a summary of the most influential human dimensions from each interview as AAOs attribute these dimensions to their choice to support or oppose the DSRS.

The third column in the table displays each human dimension's corresponding driving force. These driving forces[25] were allocated based on how strongly an AAO felt it impacted their verdict regarding the DSRS. Each complements a human dimension from their interview. Driving forces are significant as they exhibit the reasons behind why an AAO would support or oppose the DSRS. Sequentially, column four lists whether each participant supported or opposed the DSRS, giving insight into what human dimensions and driving forces led

[25] Listed and defined in Table 2

to each resolution. For example, in participant 3's interview, a key human dimension listed in the second column is "resiliency strategy has strong potential to help agriculture as well as species conservation." Therefore, the analogous driving force is "Environmental Stewardship," as the human dimension explained that the Administrative Agency official affirmed that the DSRS had a positive environmental footprint leading them to "support" the DSRS.

Discussion

Quantitative Data

From Figure 1, one can see that AAOs mostly responded with one and two when concerned with humans' role in nature. Thus, values of four and five, or high scores, indicate strong agreement with statements such as "all species have an inherent right to exist, quite apart from any instrumental use to mankind" (Zafonte et al., 1995). Values of one and two, or low scores, denote strong disagreement with such views. AAOs responded with low scores; they strongly disagreed with these statements, signifying a utilitarian perspective. Therefore, through this graph, one can conclude that it is likely that AAOs strongly believe that humans have power over nature and therefore should ignore it for their benefit.

Furthermore, from comparing Figures 1, 2, and 3, the researcher can conclude whether AAOs' views towards a human's role in nature will influence their attitudes towards endangered species issues.

Thus, when looking at Figure 2, one can discern that most AAOs answered with two regarding several environmental policy aspects within the Bay/Delta. As one can see, AAOs primarily answered with a low score, reflecting that they do not agree with the statement that environmental problems are severe and that environmental quality should be a priority value.

The two figures are congruent with one another; Figure 1 illustrates AAOs' utilitarian values towards humans' role within nature, signifying that they can ignore it. Likewise, Figure 2 shows their beliefs that environmental problems are not severe and should not be prioritized.

However, Figure 3 has discordant data.

Figure 3 discusses the perceived impact of water diversions on the Smelt. The researcher would expect that the results would continue in the same fashion, with AAOs responding with low scores. However, the majority of the officials responded with two and three, much higher than previous responses. This signified that they concur that conservation efforts towards the Smelt are necessary due to water diversions impacting them. Therefore, with such results, one would expect that the majority of the officials, despite their previous ranking, would support the DSRS; however, that is counterfactual.

As evidenced in Table 1, the majority of the officials opposed the DSRS. The averages of their views supported the concept that utilitarian officials were more inclined to oppose the DSRS than those who were environmental. However, in Figure 3, most AAOs agreed that a conservation policy was necessary, but when deciding whether to support the policy they chose to oppose it.

Overall, the researcher found that most AAOs fell towards the utilitarian view, through analyzing the quantitative data, and believed that Bay/Delta environmental problems were not critical. Moreover, all of the utilitarian officials tended to oppose the DSRS, whereas those who were environmental supported it. However, there is a dispute in the data because AAOs agreed that Smelt conservation in the Bay/Delta is necessary and, consequently, measures should be taken to aid them. But, when choosing whether to support or oppose the DSRS, a policy that utilizes such efforts to help the Smelt, AAOs chose innately to oppose. This discrepancy is explained in the qualitative data in the officials' decision to oppose the DSRS.

Qualitative Data

The human dimensions collected through the six interviews delineate the driving forces of AAOs that lead them to support or oppose the DSRS. This next segment will examine the thematic analysis results and the implied conclusion. Moreover, it will clarify phenomena from the questionnaire that will contribute to the overall conclusion. Understanding the repeating themes among the interviews will help identify the major driving forces that influence AAOs' stance on the DSRS. There are two sides to the stance; there will be two categories to the thematic analysis: oppose and support. Through six driving forces, only three were repeated consistently— two in opposition and one in support.

As one can see, 2 of the 6 participants supported the DSRS policy, whereas the other four opposed it. This section delves into the most prevalent reasons why most AAOs opposed the policy.

Opposition

Recurring Theme 1: Social/Environmental Balance

All four AAOs who opposed the DSRS— participants 1, 2, 4, and 5— cited human dimensions falling under social/environmental balance[26] as a significant factor influencing their decision to oppose the DSRS. Generally, this involved officials ascertaining that the DSRS policy focused mainly on the well-being of the Smelt and not enough on the interest of the surrounding community. Participant 1 stated in their interview that, “It's the balance between how much outflow augmentation you want to do versus the human needs. This includes home needs, residents needs, agriculture needs, industry needs, economy needs, and more which are all significant when it comes to deciding whether to support it [DSRS policy].”

Participant 2 agreed that they preferred that all parties, the surrounding community and the Bay/Delta, to reach a mutualistic agreement. They concluded that if a policy existed that took both sides into account, they would be more likely to support it. The other participants lay on a similar spectrum. Participant 4 deviated slightly, claiming that though a balance would be advantageous, in present-day events, human needs would need to be placed at a higher priority to garner any support for the DSRS. Participant 5 was in concurrence, stating that, "I think what we have to do is figure out what all the needs are, and find a water balance. We should be asking questions such as how much water is needed for the fish? And what are the [water] flows at different times of the year?"

Though participant's broad human dimensions were different, the root driving force was Social/Environmental Balance. Seeing as all the participants who opposed the DSRS were in unanimity, the researcher can conclude that a request for more human needs into the DSRS is a part of the reason why AAOs oppose such a policy. Moreover, most are looking for a social balance and an agreement between the two sides. This implies that by adding social aspects into the DSRS, focusing on human needs, officials would be more likely to support it.

Recurring Theme 2: Financial Interests

Three out of the four AAOs cited financial interests[27] as a reason for their opposition of the DSRS. Expressly, Participants 1, 4, and 5 stated in their interviews that the economic costs of the DSRS far outweighed any benefit it has on the environment. Consequently, this led them to oppose the DSRS. This is seen in Participant 4's interview, “If you tell me that spending $10 billion on schools, or on a disadvantaged community will lead to a

[26] Officials believe that there should be a balance between the Bay/Delta surrounding communities' welfare and the DSRS policy.

[27] Officials presume that the community surrounding the Bay/Delta will make a profit or loss in business revenue due to the DSRS.

much better future; I'd say spend that money there versus spending it in the Delta. But if the other way around is spending 10 billion on the Delta and leading to a better future than all the ones, then spend it in the Delta."

Participants 1 and 5 had similar contentions. They both elaborated on economic interest in the Bay/Delta being affected, raising a need for it to be considered. Participant 1 focused heavily on whether the DSRS policy was a "good use of public money." Moreover, participant 5 worried about the strain the DSRS would put on surrounding businesses, declaring that "If this [DSRS] puts pressure for businesses to leave, on top of COVID, and all the other financial concerns, there will be drastic economic consequences."

This is similar to officials who listed social/environmental balance as a motive behind their opposition, wanting a balance between the community and the Bay/Delta. Within this driving force, officials are stating that they want a balance between the economic situation of the Bay/Delta and the environmental condition. Therefore, we can observe that the officials in the Bay/Delta oppose the DSRS due to its heavy inclination towards the environment without considering other important factors of the surrounding society.

Now that the driving forces that led AAOs' opposition towards DSRS have been examined, let's investigate the prevailing reason why the AAOs supported the policy.

Support

Recurring Theme 3: Environmental Stewardship

As mentioned, two out of the six AAOs who the researcher interviewed supported the DSRS policy. Both supporters indicated human dimensions falling under the driving force of environmental stewardship[28] led to their decision to support the policy. Participants 3 and 6 indicated that human dimensions within this driving force were a significant factor in influencing their decision to support the DSRS. For instance, Participant 6 stated during their interview that, "I think most Americans treasure the outdoors just based on what they do during their time off. Since they choose to spend their time outdoors, having a stable environment is key to preserving their satisfaction. Moreover, this policy [DSRS] would provide species conservation for the Smelt, which would benefit the surrounding environment largely." Participant 3 had a similar belief towards the DSRS: that the DSRS would help not only the surrounding environment but agriculture as well. Therefore, these two participants cited that the benefit the DSRS brings to the environment was a driving force that led them to support the policy. Moreover, the researcher can conclude that the environmental stewardship of the DSRS is a significant factor that makes it appealing to AAOs. This signifies that by keeping such a component, AAOs are more inclined to support the DSRS.

Implications, Limitations, and Future Research

Implications

Through analyzing the qualitative data, it can be concluded that AAOs have varying driving forces that led them to either support or oppose the DSRS. Through narrowing down these driving forces into five categories, the researcher was able to thematically analyze the results and extrapolate two significant driving forces that led AAOs to oppose the DSRS and one that led them to support it. These findings show that three factors must be taken into account to grow support when implementing a policy similar or identical to the DSRS:

1. Adding more social constituents to the DSRS policy to maintain a social/environmental balance regarding the policies species conservation intentions

[28] Officials surmise that the DSRS has an environmental footprint that would impact the Bay/Delta and its surrounding community.

2. Developing the policy to be more cognizant of the financial situation of the surrounding Bay/Delta community
3. Keeping the environmental stewardship aspect of the policy to maintain a stable and salubrious Bay/Delta environment

Furthermore, the supplemental quantitative data show that AAOs inherently lean towards the utilitarian perspective in terms of the human role in nature; this influences their opinion that environmental problems are not severe and should not be prioritized. However, despite this, AAOs are aware that conservation efforts towards the Smelt are necessary due to water diversions impacting them. Thus, we can resolve that if the issues mentioned above are absolved, and the DSRS policy is revised, AAOs, despite their utilitarian outlook, will be more disposed to support it.

Limitations

Nevertheless, there are multiple limitations to this research that need to be addressed. Firstly, the sample size of this study is limited. The researcher reached out to various AAOs within the Bay/Delta, but only six responded. A larger sample size of AAOs would have made conclusions more sound and definitive. Similarly, these participants only came from three water-related organizations. This leads to the results obtained from this sample not being representative of the Bay/Delta population due to a lack of diverse opinion. Moreover, due to the ongoing COVID-19 pandemic, the researcher was limited to conducting 30-minute virtual interviews. Therefore, participants may have been reluctant to share information they may have shared in a more personal setting. There is also a possibility of human error during data interpretation. The researcher may have missed an essential human dimension and, thus, a driving force by not examining a transcription precisely. This would have led to an erroneous data set, skewing the results.

Future Research

Future research should be done to further the understanding of this topic. Though the driving forces that led Bay/Delta AAOs to support or oppose the DSRS have been established, there are many aspects that have not been examined, such as the human dimensions and driving forces of other stakeholders within the Bay/Delta and AAOs human dimensions towards policies unalike to the DSRS. Additionally, future research could be centered on implementing conclusions or methods from this study to other wildlife conservation efforts regionally or globally.

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References

August 09, 2. (2016, December 15). Will California's SWRCB Allow Delta Smelt To Go Extinct? Retrieved September 17, 2020, from https://www.nrdc.org/experts/kate-poole/will-californias-swrcb-allow-delta-smelt-go-exti nct

Bennett, W. A., & Moyle, P. B. (1996). Where have all the fishes gone?: interactive factors producing fish declines in the Sacramento-San Joaquin Estuary. San Francisco State University.

Brown, L. R. (2000). Fish communities and their associations with environmental variables, lower San Joaquin River drainage, California. Environmental Biology of fishes, 57(3), 251-269.

C. (2017, June). Delta Smelt Resiliency Strategy. Retrieved from https://resources.ca.gov/CNRALegacyFiles/docs/Delta-Smelt-Resiliency-Strategy-Updat e.pdf

California, S. of. (n.d.). California Water Action Plan Implementation Report 2014–2018. Organization Title. https://files.resources.ca.gov/california_water_action_plan/implementation_report/.

California, S. (n.d.). About the DELTA Stewardship Council. Retrieved April 22, 2021, from https://deltacouncil.ca.gov/about

Caulfield, J. (2020, August 14). How to Do Thematic Analysis: A Step-by-Step Guide & Examples. Scribbr. https://www.scribbr.com/methodology/thematic-analysis/#:~:text=Thematic%20analysis%20is%20a%20method,meaning%20that%20come%20up%20repeatedly.

Decker, D. J., Siemer, W. F., Evenson, D. T. N., Stedman, R. C., McComas, K. A., Wild, M. A., … Leong, K. M. (2012). Public Perceptions of Wildlife-Associated Disease: Risk Communication Matters. DigitalCommons@USU. https://digitalcommons.usu.edu/hwi/vol6/iss1/13/.

Delta Smelt Resiliency Strategy. CA.gov. (2017). https://resources.ca.gov/CNRALegacyFiles/docs/Delta-Smelt-Resiliency-Strategy-Updat e.pdf.

Environmental Protection Agency. (2020, December 8). Workshop: Economic Research and Policy Concerning Water Use and Watershed Management (1999). EPA. https://www.epa.gov/environmental-economics/workshop-economic-research-and-policyconcerning-water-use-and-watershed-0.

Farmers ponder the effect of the smelt ruling on agriculture. (n.d.). Retrieved September 17, 2020, from https://www.watereducation.org/aquafornia-news/farmers-ponder-effect-smelt-ruling-agri culture

Feyrer, F. (n.d.). Multidecadal trends for three declining fish species ... https://www.waterboards.ca.gov/waterrights//water_issues/programs/bay_delta/docs/cmnt 081712/sldmwa/feyreretal2007.pdf.

Fisch, K.M., Henderson, J.M., Burton, R.S. et al. Population genetics and conservation implications for the endangered delta smelt in the San Francisco Bay-Delta. Conserv Genet 12, 1421–1434 (2011). https://doi.org/10.1007/s10592-011-0240-y

Gray, B. (2013). Integrated management of delta stressors institutional and legal options.

Hanak, E., Phillips, C., Mount, J., Durand, J., Lund, J., & Moyle, P. (2013). Scientist and stakeholder views on the delta ecosystem. Public Policy Institute of California.

HD.gov. (n.d.). Retrieved April 22, 2021, from https://doi.sciencebase.gov/hd/

Hobbs, J., Moyle, P. B., Fangue, N., & Connon, R. E. (2017). Is extinction inevitable for Delta Smelt and Longfin Smelt? An opinion and recommendations for recovery. San Francisco Estuary and Watershed Science, 15(2).

Howitt, R., Medellín-Azuara, J., & MacEwan, D. (2009). Measuring the employment impact of water reductions. Department of Agricultural and Resource Economics and Center for Watershed Sciences. University of California, Davis, California, available at http://swap. ucdavis. Edu.

LM;, D. J. M. V. (n.d.). Semi Structured interviewing in primary care research: a balance of relationship and rigour. Family medicine and community health. https://pubmed.ncbi.nlm.nih.gov/32148704/.

Manfredo, M. J. (2008). Who Cares About Wildlife? Social Science Concepts for Exploring Human-Wildlife Relationships and Conservation Issues. Springer New York.

Marks, S. A., & Smith. (2000). The imperial lion: human dimensions of wildlife management in central Africa. Routledge.

Moyle, P. B., Brown, L. R., Durand, J. R., & Hobbs, J. A. (2016). Delta smelt: life history and decline of a once abundant species in the San Francisco Estuary. San Francisco Estuary and Watershed Science, 14(2).

Moyle, P. B., Herbold, B., Stevens, D. E., & Miller, L. W. (1992). Life history and status of delta smelt in the Sacramento-San Joaquin Estuary, California. Transactions of the American Fisheries Society, 121(1), 67-77.

Moyle, P., Bennett, W., Dur, J., Fleenor, W., Gray, B., Hanak, E., ... & Mount Jr, J. (2012). Where The Wild Things Aren't Making the Delta a Better Place for Native Species.

Moyle, Peter B., James A. Hobbs, and John R. Durand. "Delta Smelt and water politics in California." Fisheries 43.1 (2018): 42-50.

Nichols, F. H., Cloern, J. E., Luoma, S. N., & Peterson, D. H. (1986). The modification of an estuary. Science, 231(4738), 567-573.

Patterson, R., & Cain, B. (1995). Who Gets the Water in California's Great Central Valley? Envirns, 18(12), 66–71.

Sabatier, P., & Zafonte, M. (1997). Are bureaucrats and scientists members of advocacy coalitions? Evidence from an intergovernmental water policy subsystem. Unpublished manuscript.

Sommer, T., Mejia, F. H., Nobriga, M. L., Feyrer, F., & Grimaldo, L. (2011, January 1). The Spawning Migration of Delta Smelt in the Upper San Francisco Estuary. San Francisco Estuary and Watershed Science. https://escholarship.org/uc/item/86m0g5sz.

Summer townet survey. (n.d.). Retrieved April 22, 2021, from https://wildlife.ca.gov/Conservation/Delta/Townet-Survey

Wang, J. C. (1986). Fishes of the Sacramento-San Joaquin estuary and adjacent waters, California: A guide to the early life histories. Technical Report 9. Prepared for the Interagency Ecological Study Program for the Sacramento San Joaquin Estuary.

Wisdom, J., & Creswell, J. (n.d.). Mixed Methods: Integrating Quantitative and Qualitative Data Collection and Analysis While Studying Patient-Centered Medical Home Models. AHRQ. https://pcmh.ahrq.gov/page/mixed-methods-integrating-quantitative-and-qualitative-datacollection-and-analysis-while.

Forces towards the delta smelt resiliency strategy

Zafonte, M., & Sabatier, P. (1998). Shared beliefs and imposed interdependencies as determinants of ally networks in overlapping subsystems. Journal of theoretical politics, 10(4), 473-505.