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Assessing coastal manager science needs and disseminating science results for planning

U.S. Geological Survey, Western Ecological Research Center

Data Summary Report Prepared for the
California and North Pacific Landscape Conservation Cooperatives

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1. Introduction

Coastal land managers are faced with many challenges and uncertainties in planning adaptive strategies for conserving coastal ecosystems under future climate change scenarios. As transitional ecotones between the marine and terrestrial environment, nearshore habitats are particularly sensitive to climate change. Projected climate change effects on coastal environments include sea-level rise, changing storm magnitude and frequency, salt water intrusion, accelerated erosion, shifting mudflat profiles, and increased water temperature and acidity (Huppert et al. 2009). Sea-level rise ranging from 0.43 m to 1.66 m by 2100 (NRC 2012) could potentially inundate thousands of acres of coastal habitats if accretion processes are not able to keep pace. Climate effects will vary both temporally and spatially; therefore, planning, coordination, and data collection is best performed at local sites that can be compared across a wide range of Pacific coast sites.

The USGS Coastal Ecosystems Response to Climate Change (CERCC) program (http://www.werc.usgs.gov/cercc) uses a bottom-up local approach to assess the vulnerability of tidal wetland habitats from climate change. Our goal is to use detailed site data and analyses of elevation, inundation, tidal range, accretion, and plant communities to examine effects of climate change on these habitats. By collecting extensive field data, monitoring site conditions, and developing site-specific sea-level rise response models, our approach informs management decisions at a local level, but is applicable at a regional level.

To facilitate communication and outreach of sea-level tidal marsh modeling results, we convened managers, biologists, Tribes, and other important decision makers and partners and hosted in-person workshops with stakeholders in six Pacific coast estuaries. Our objectives were: (1) disseminate site-specific baseline data and modeling results, reveal coast-wide trends, and identify data gaps; (2) identify how local climate science results may be incorporated into habitat conservation, planning, and adaptation strategies; and (3) develop an understanding of coastal climate change science needs to inform the California and North Pacific Landscape Conservation Cooperatives (LCC).

2. Methods

Staff members from the U.S. Geological Survey, Western Ecological Research Center, San Francisco Bay Estuary Field station organized and facilitated six workshops between September and December, 2014 at Nisqually National Wildlife Refuge (NWR), Willapa Bay NWR, Siletz NWR, Humboldt Bay NWR, San Pablo Bay NWR, and Tijuana Sough NWR (Figure 1) with a focus on their estuary.

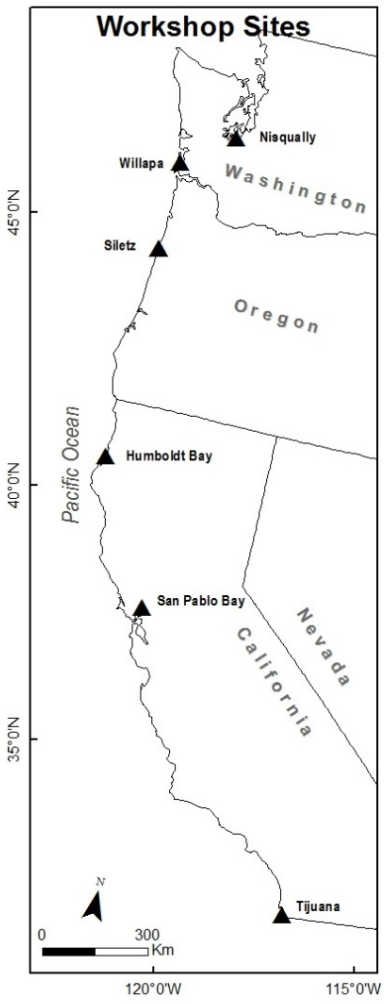


Figure 1. Workshops were held at six estuaries along the Pacific coast with a focus on U.S. Fish & Wildlife Service coastal National Wildlife Refuges.

At these workshops site specific results from our Northwest and Southwest Climate Science Center funded research were presented. Results included sea-level rise response modeling for tidal marshes, coast wide trends, and summaries of baseline data. Presentations were also given about Climate-Smart

Conservation principles and practices (NWF 2013), wetland plant ecology and tolerance to flooding, and updates on the current state of climate change science. Notes were taken during workshops and participants were asked to complete:

- a pre-survey (administered before the workshop using Survey Monkey)
- workshop exercises/group map exercises (Figure 2)
- a post-survey (a paper survey administered at the end of the workshop)

Workshops participants were local land managers and their partner and other interested groups. Participants were recommended by the Refuge managers and biologist as persons who are involved in management decisions or planning in official or unofficial capacity. The number of invitations ranged from 20 – 56 depending on the workshop location. Invite lists were diverse and included representatives from Tribes, federal agencies, state agencies, local agencies, and community members (Appendix I).

To improve attendance and decrease attendee travel costs all workshops were held at each of the estuaries. Humboldt Bay NWR and Nisqually NWR workshops were two 6-hour days, but due to participant feedback we condensed the other workshops into one 8-hour day. The format and content presented at each workshop was similar, but varied slightly between workshops to make examples and results relevant to that particular location. Presentations were interspersed with loosely structured focus groups (4-6 people per group), USGS researchers acted as facilitators, as the group worked through questions focused on identifying key resources within the estuary, climate change and non-climate change related stressors to key resources, potential adaptation strategies, and related data needs.

Group exercises were conducted in small groups (4-6 people) where participants were prompted (Figure 2) to answer a set of questions using a USGS quad map of their estuary. These exercises helped participants to interact and identify key management resources and concerns, and to evaluate what they thought would be impacted by climate change in the near and long-term. These exercises were used to find consensus within and across groups on important topics. Results from these exercises were presented to the larger group by a spokesperson from the map group. Map exercise results are summarized in site specific results sections.

Introduction: To better understand management concerns and develop a coastal manager needs assessment for the California and North Pacific Landscape Conservation Cooperatives (LCC) and the USGS Climate Science Centers (CSC) we are asking managers at eight coastal locations to provide answers to the following questions while working through exercises about your estuary. We hope participants will use this time as an opportunity to work together and generate ideas.

Exercise #1

Background: This exercise will identify science needs that will help inform adaptation strategies for climate change. This will be synthesized into a final report that will be provided to all attendees and the LCCs and CSCs.

To do:

1. Develop a set three goals for your estuary in 2050.
2. Identify the geographic extent of key ecological features or resources (e.g., species, habitats, ecosystem processes, ecosystem services, cultural resources) on the map by drawing a circle or line.
3. Rate the ecological importance and climate change vulnerability of the areas identified in the exercise above. Write ratings on the map using the key below.

Importance	**Climate change vulnerability**
H - high	1 - high
M - medium	2 – medium
L - low	3 – low

4. With climate change does the importance of the key ecological features or resources identified in question #1 change? Write ratings on the map using the key below.

Future Importance
FH- high
FM- medium
FL – low
NC – No change

Hang up maps and report out to group

Exercise #2

Background: Work together to develop a list of management adaptation strategies for key ecological features or resources identified in exercise #1. Work through the questions below and use the maps and modeling results provided to help inform your

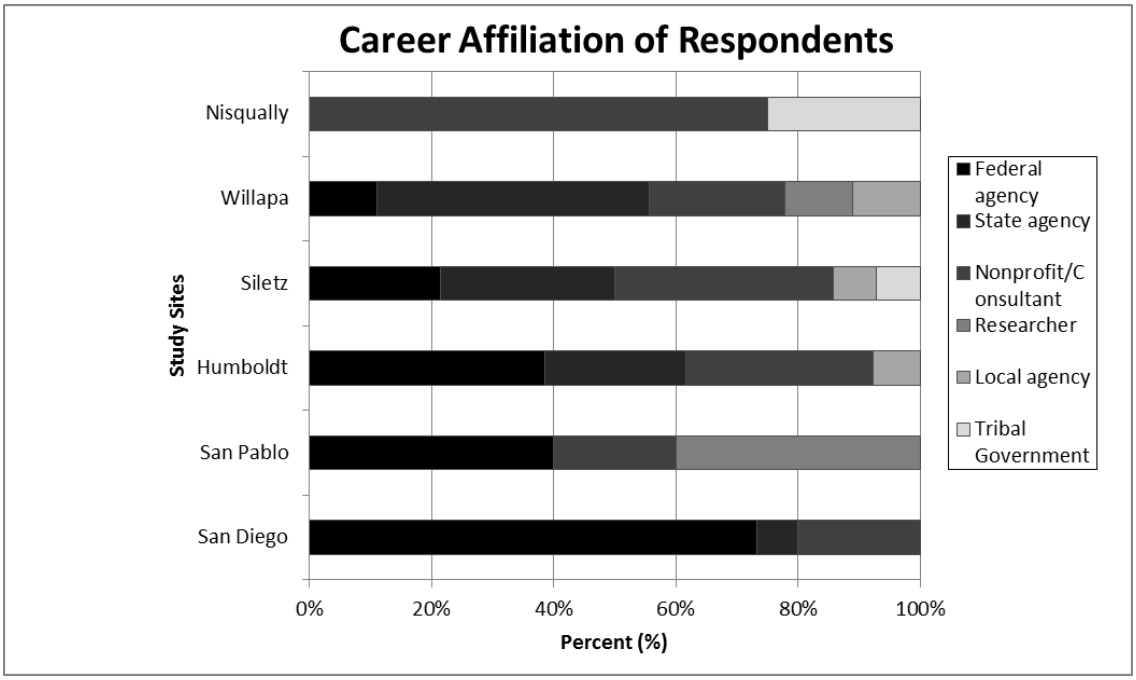
Figure 2. Workshop exercises were conducted in small groups where participants were prompted to answer a set of questions using a USGS quad map of their estuary. See site specific results below.

3. Summary Results

The workshops were attended by a total of 125 participants representing 51 agencies or groups. Overall participants varied in their backgrounds but either had a Bachelor's or graduate degrees. Participants of the workshops were asked a set of pre-survey questions to assess what they thought were the biggest management concerns for their estuaries, including climate change drivers. Our pre-survey results showed that 46% pre-survey participants, across all workshop sites said they had received some formal training in climate change science. Averaged across all workshop sites the pre-survey showed that respondents ranked sea-level rise as their highest concern, while hydrologic change and water temperature tied for second as the most likely climate change driver to affect their estuary. When averaging management concerns across sites, tidal wetland loss and threatened and endangered species tied for the highest ranked concern, followed by restoration and water quality concerns.

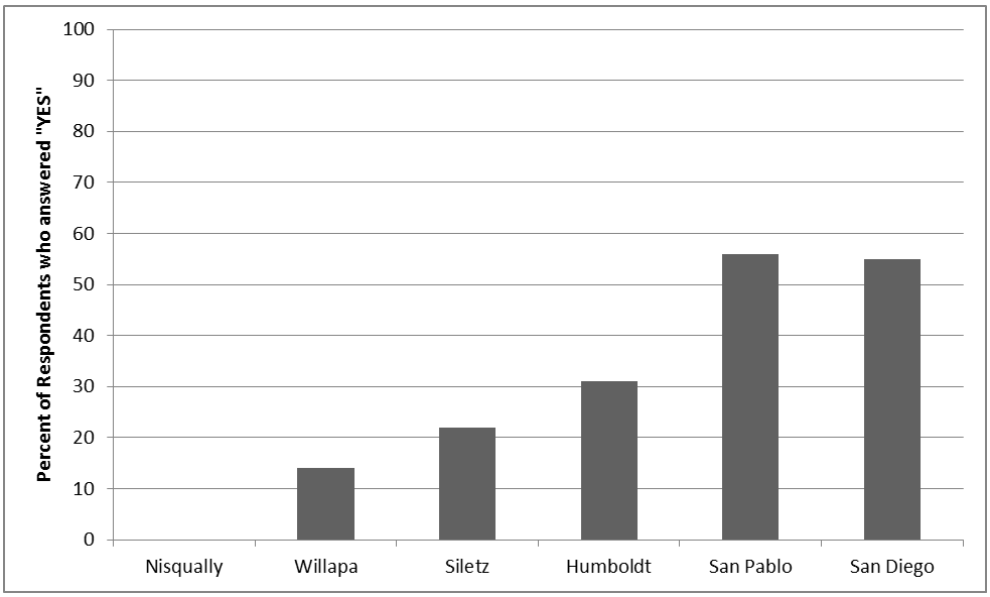
Workshop pre-survey Questions and Answers:

1. What is your job affiliation?



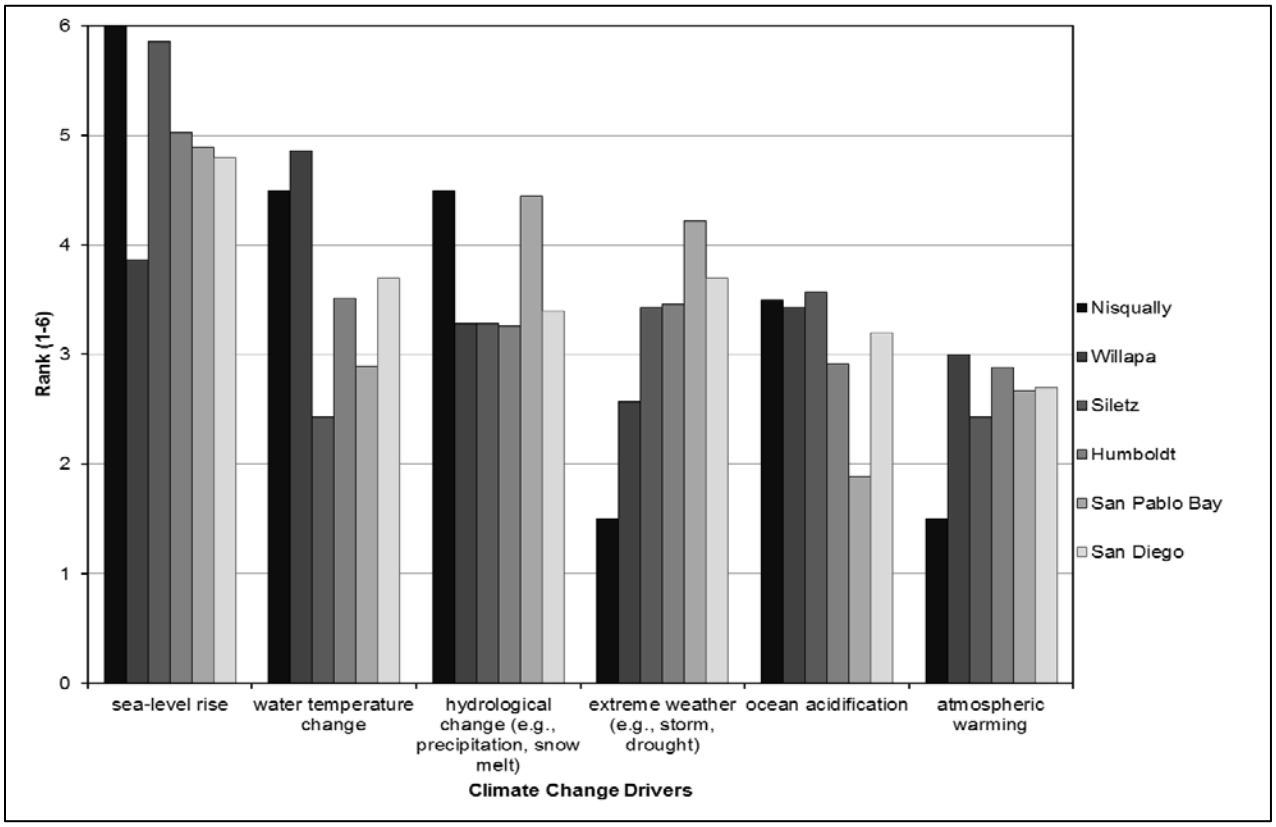
All the workshops were held at U.S. Fish & Wildlife Service National Wildlife Refuges and therefore were biased to federal employees and their partners.

2. Have you had any formal training in climate change science?



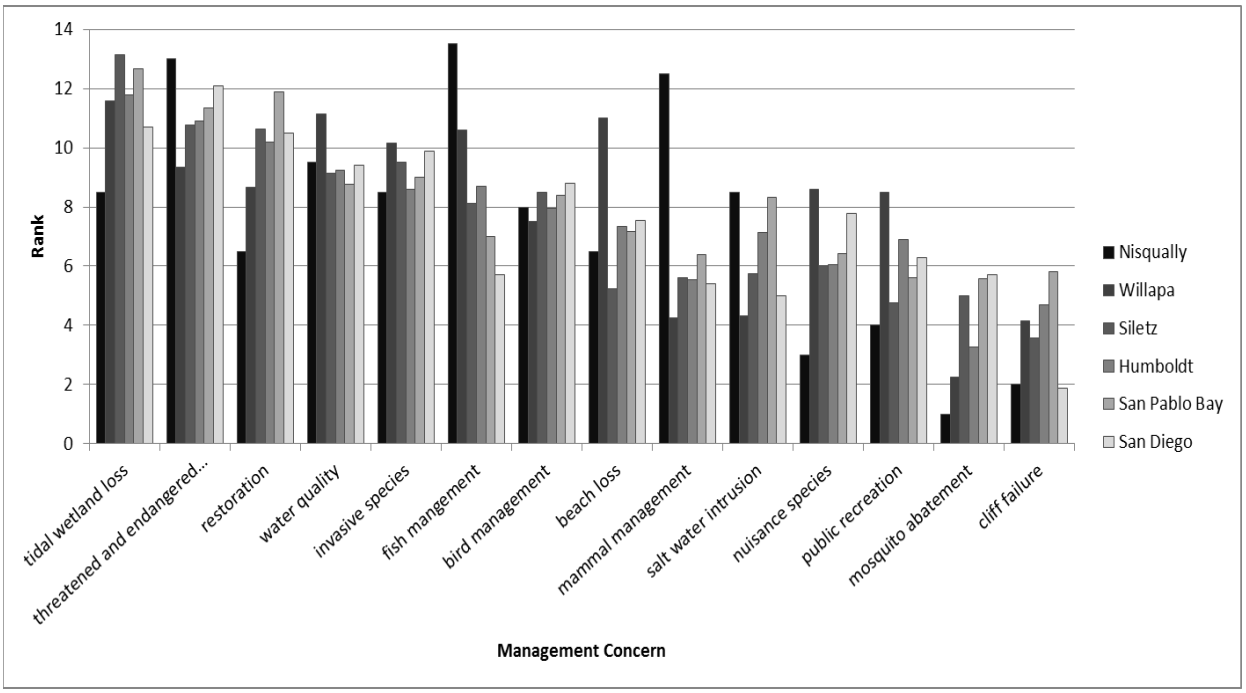
Very few participants said they had formal training in climate change science which illustrates this as an outreach and education need for resource managers and their partners. San Pablo Bay and Sand Diego NWRs had the highest percentage of people who had some formal training in climate change science, but those workshops still had almost 50% of participants with no training in climate change science.

3. What climate change drivers will affect your estuary the most (1= low, 6 = high)



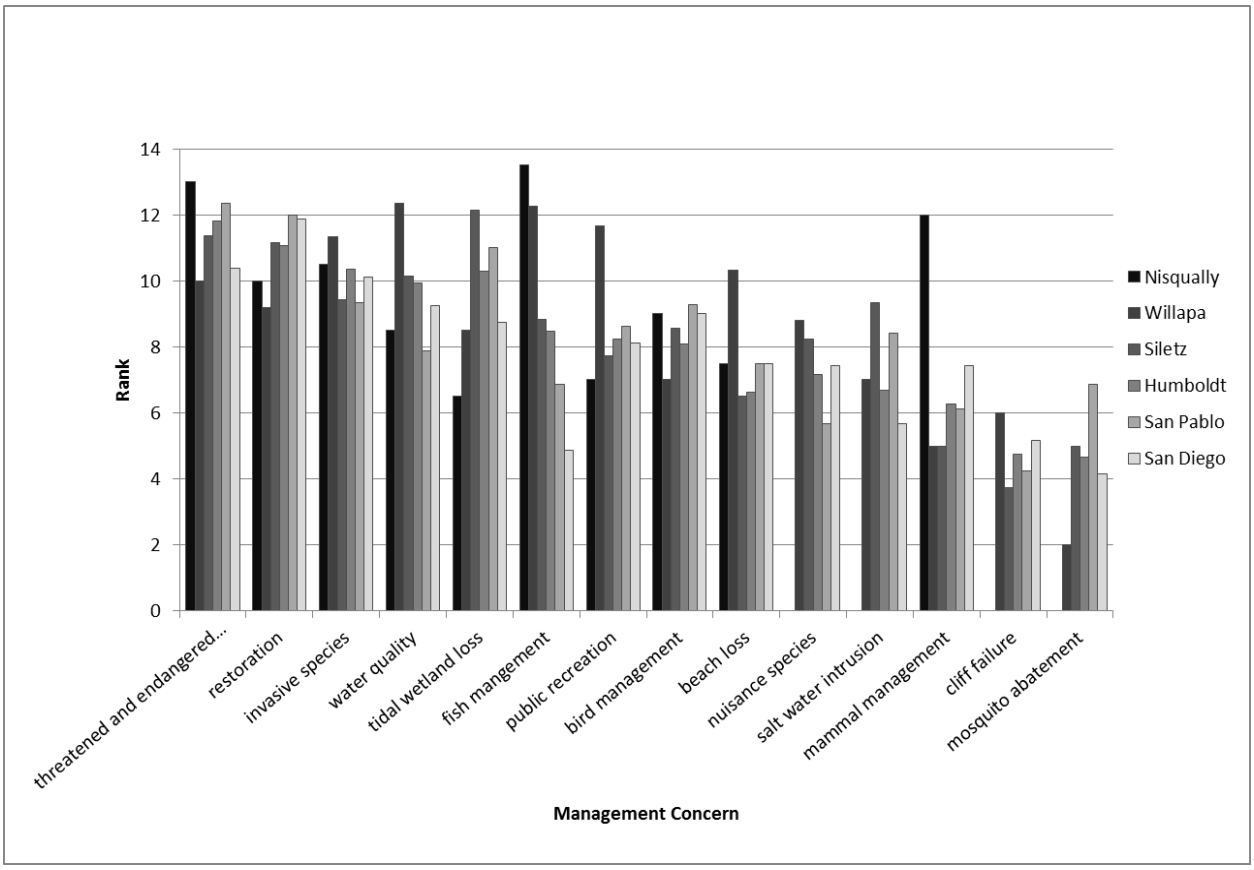
All participants surveyed ranked sea-level rise as the climate change driver they thought would affect their estuary the most. Willapa Bay was the exception which ranked changes in water temperature as more important, probably due to the importance of the shellfish industry for participants. Other changes such as water temperature, hydrological changes, and extreme weather were ranked differently depending on the workshop location along the Pacific coast.

4. What is your greatest management concern? (Low =1, 14 = High)



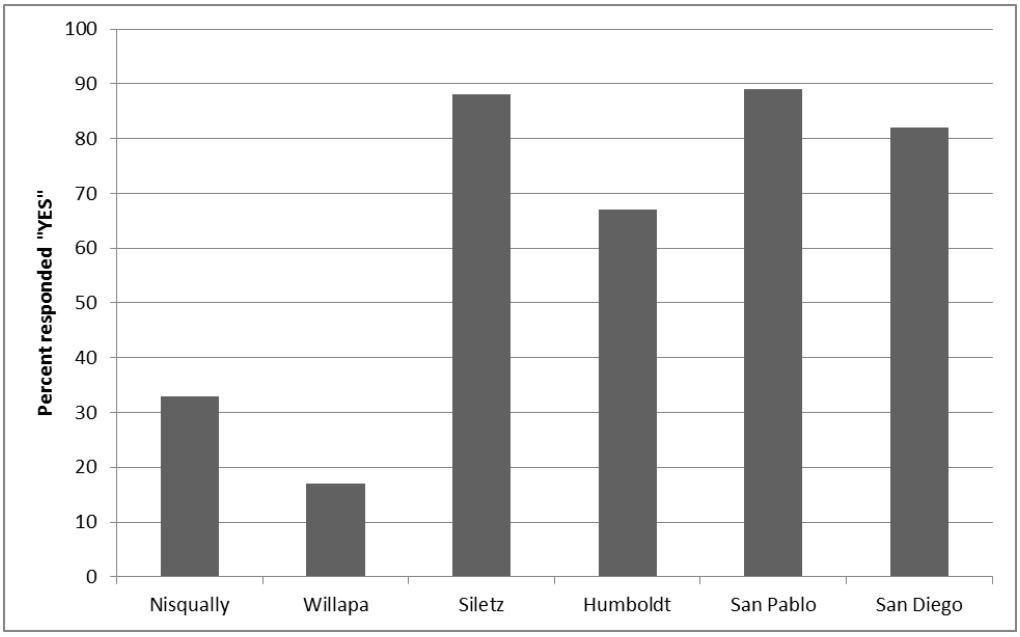
Participants had many management concerns, which varied slightly between sites. Tidal wetland loss and threatened and endangered species were important at all sites presumably due to the workshop locations being focused around U.S. Fish & Wildlife Service Refuges and the extent of tidal wetlands loss and restoration efforts along the Pacific coast.

5. What do you spend the most resources (time and budget) on?



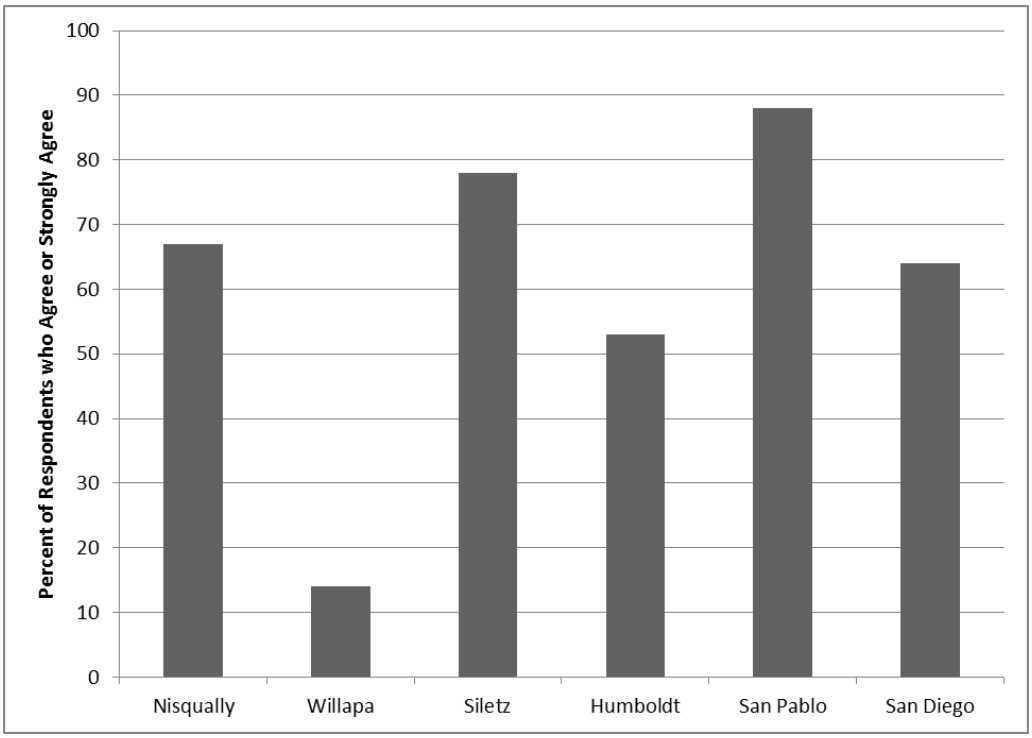
Restoration and management of species (threatened and endangered, invasive, fish, mammals) ranked high for how managers were allocating their resources (e.g., time and money) across most sites. Areas in the Pacific Northwest were more focused on fish management and water quality, whereas endangered species, tidal wetlands loss and restoration, and mammal management were a higher concern in mid-southern California.

6. Are you familiar with the California and North Pacific Landscape Conservation Cooperatives (LCCs)?



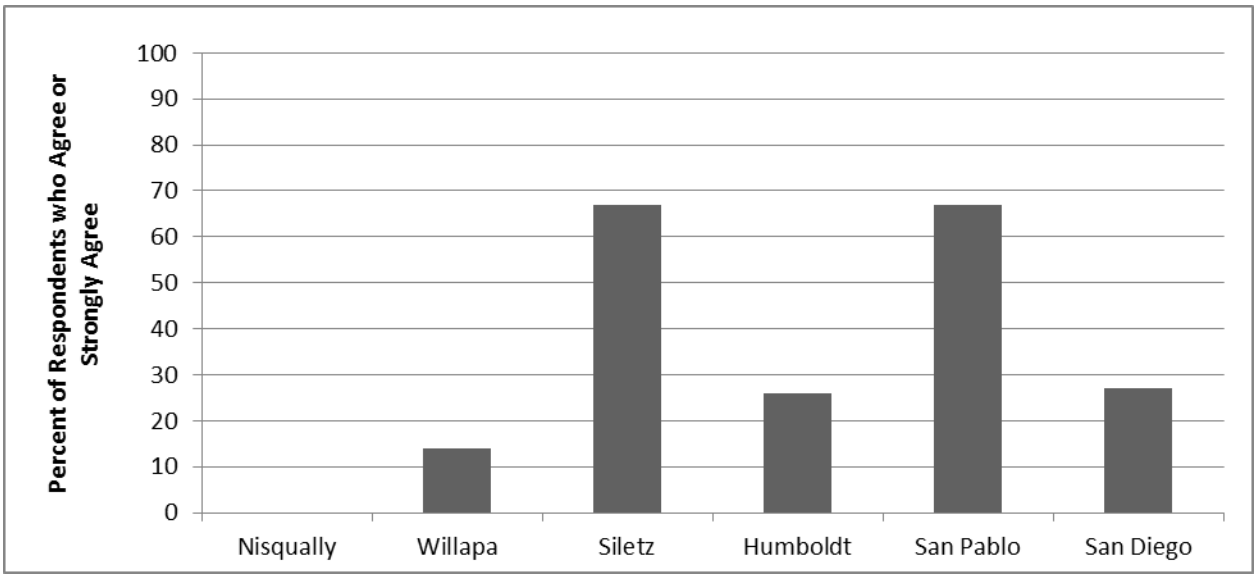
Most workshop locations were familiar with LCCs with the exception of Nisqually and Willapa.

7. Are you aware of projects funded by the California and/or North Pacific Landscape Conservation Cooperative?



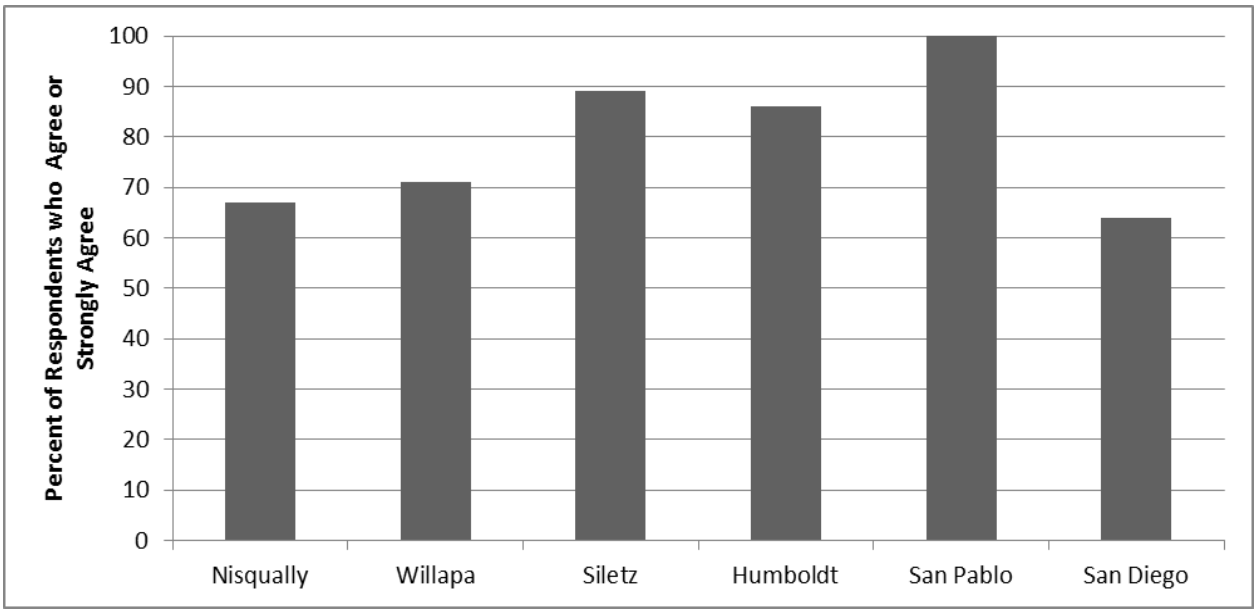
Interestingly at the Nisqually NWR workshop, participants were more aware of projected funded by the LCCs then the LCC role or mission. But, in general people were more familiar with the LCCs then specific projects funded by the LCCs.

8. I have used information provided by the California and/or North Pacific Landscape Conservation Cooperative (LCC)?



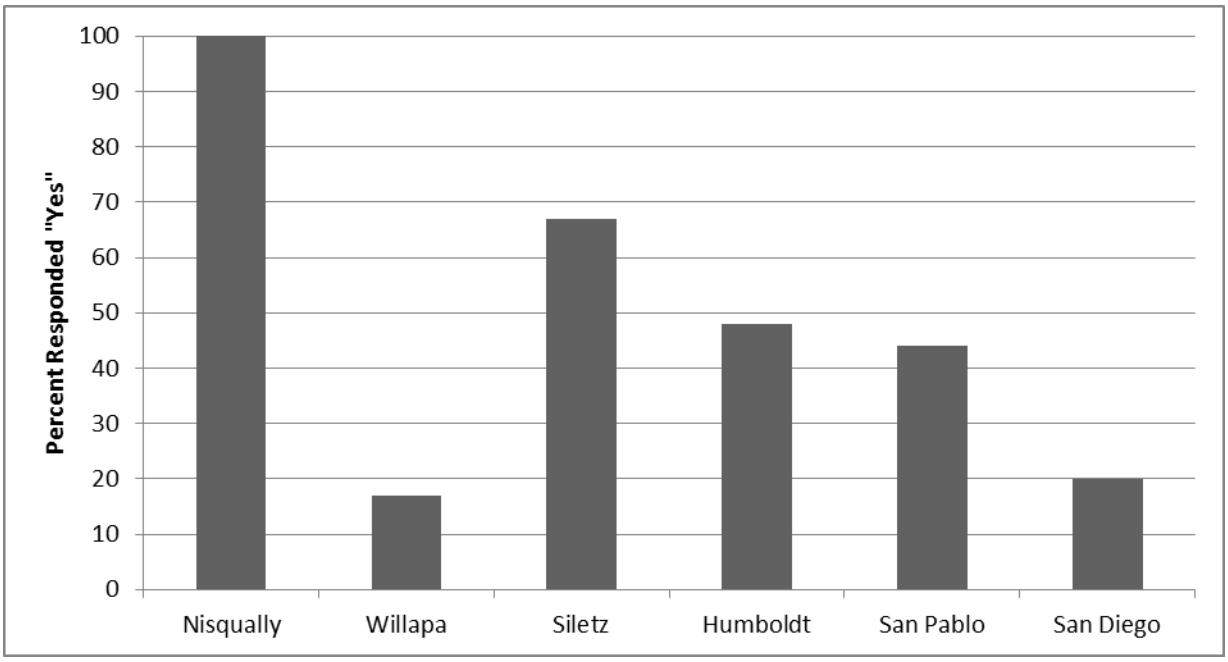
Two workshops had over 50% of participants say they have used information provided by the LCCs. But, four workshop participants had <30% of participants say they have used information provided by the LCCs.

9. I am interested in working more closely with the California and/or North Pacific Landscape Conservation Cooperative.



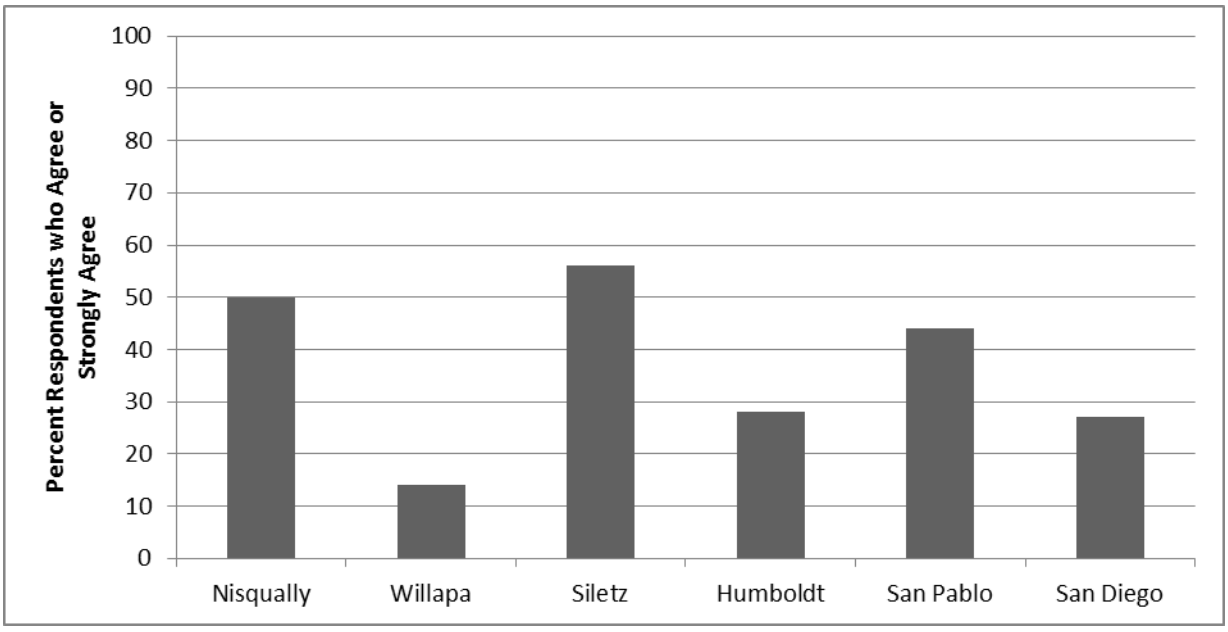
Most participants at all workshop locations are interested in working the LCCs.

10. Are you familiar with the Northwest and/or Southwest Climate Science Centers (NW CSS/ SWCSC)?



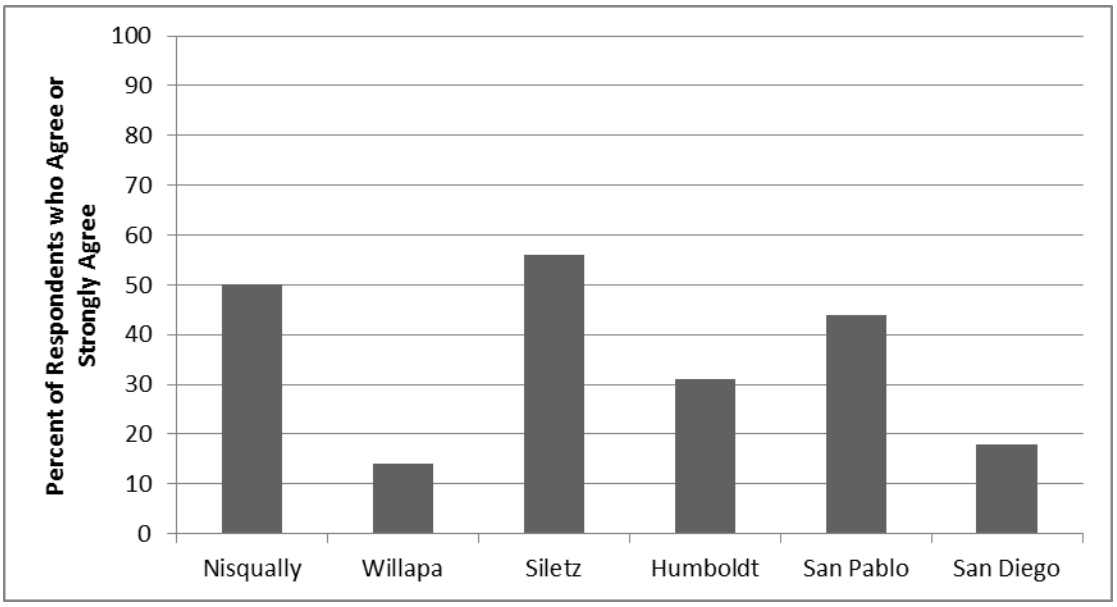
In general, participants were familiar with the Climate Science Centers, with the exception of Willapa and San Diego.

11. I am aware of projects funded by the Northwest and/or Southwest Climate Science Centers.



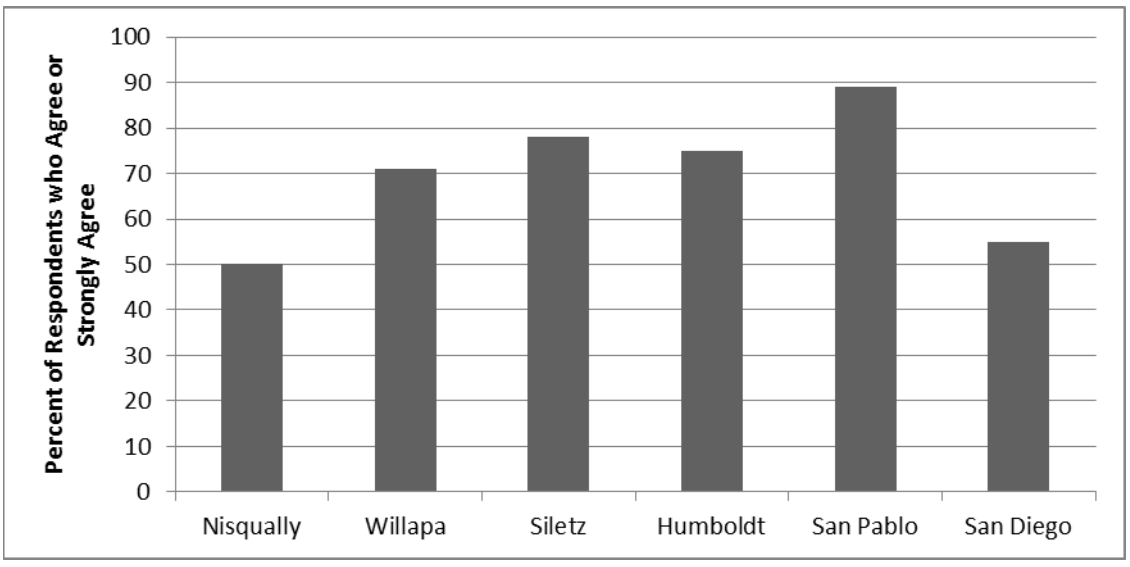
Before the workshops participants were less aware of projects funded by the Climate Science Center, but it was highlighted during the workshops that much of the work presented for their wetlands was funded by the Climate Science Centers.

12. I have used information provided by the Northwest and/or Southwest Climate Science Centers.



In general, if participants were aware of Climate Science Center projects they also used information provided by them.

13. I am interested in working more closely with the Northwest and/or Southwest Climate Science Centers.

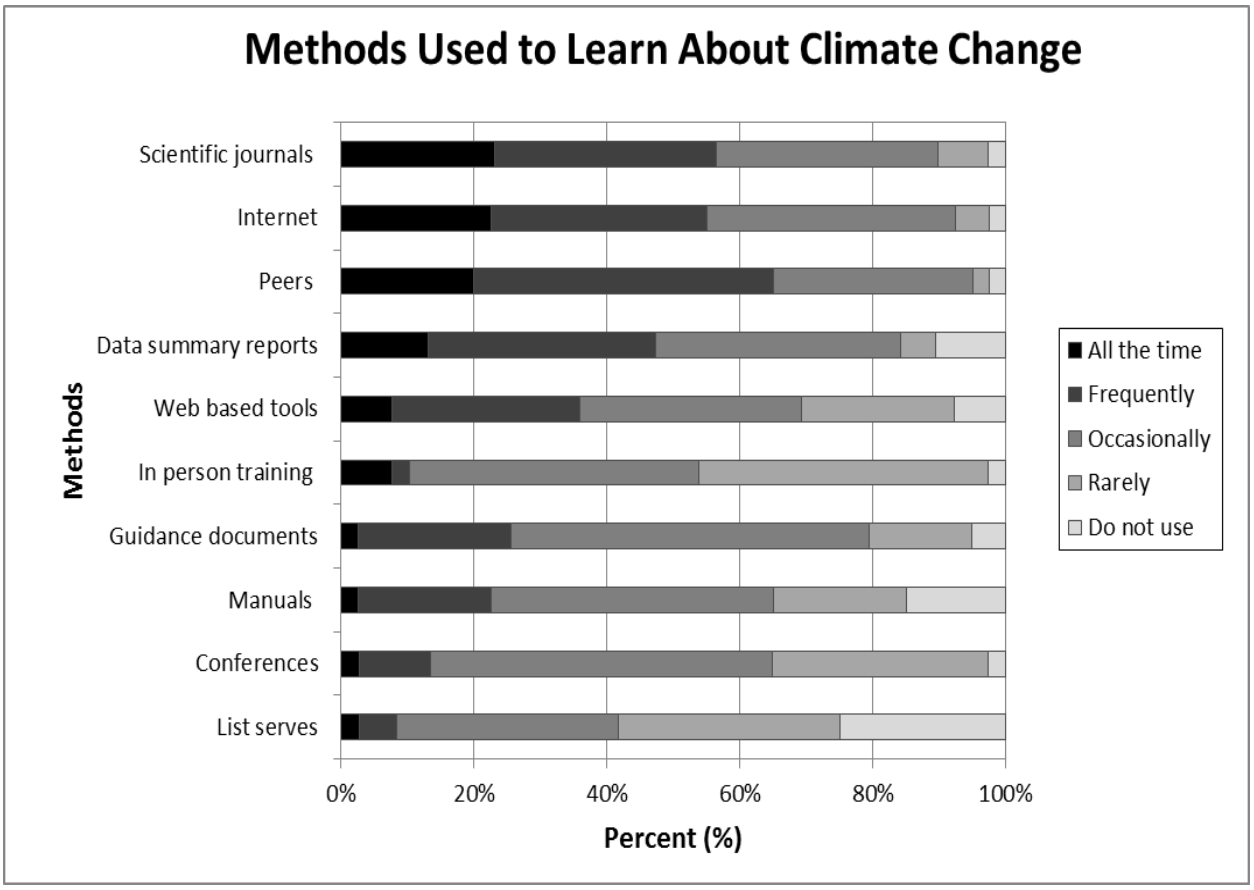


Over 50% of participants at all workshop sites were interested in working more closely with the Climate Science Centers.

Post-survey Questions and Answers:

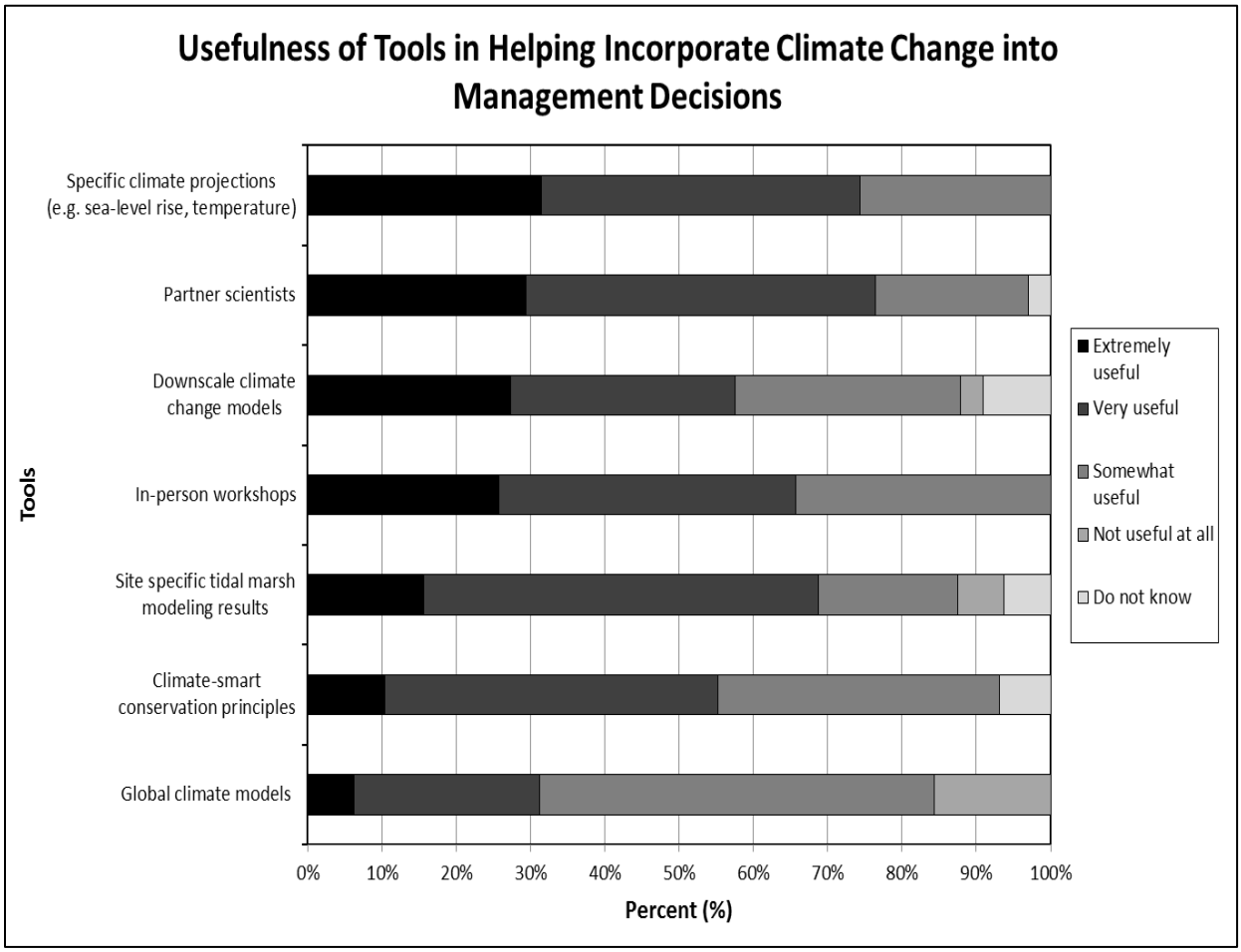
During the post-survey, when asked to rate the methods used to learn about climate change science, across all sites respondents ranked peers and scientific journals as used most frequently, with the internet and data summary reports ranked as the second and third most frequently used method. When asked to rate the usefulness of available tools in helping to incorporate climate change into management decisions, respondents across all sites rated workshops and specific climate projections as the most useful, with partner scientists also rated as a useful tool.

1. Rate the frequency with which you use these methods to learn more about climate change.



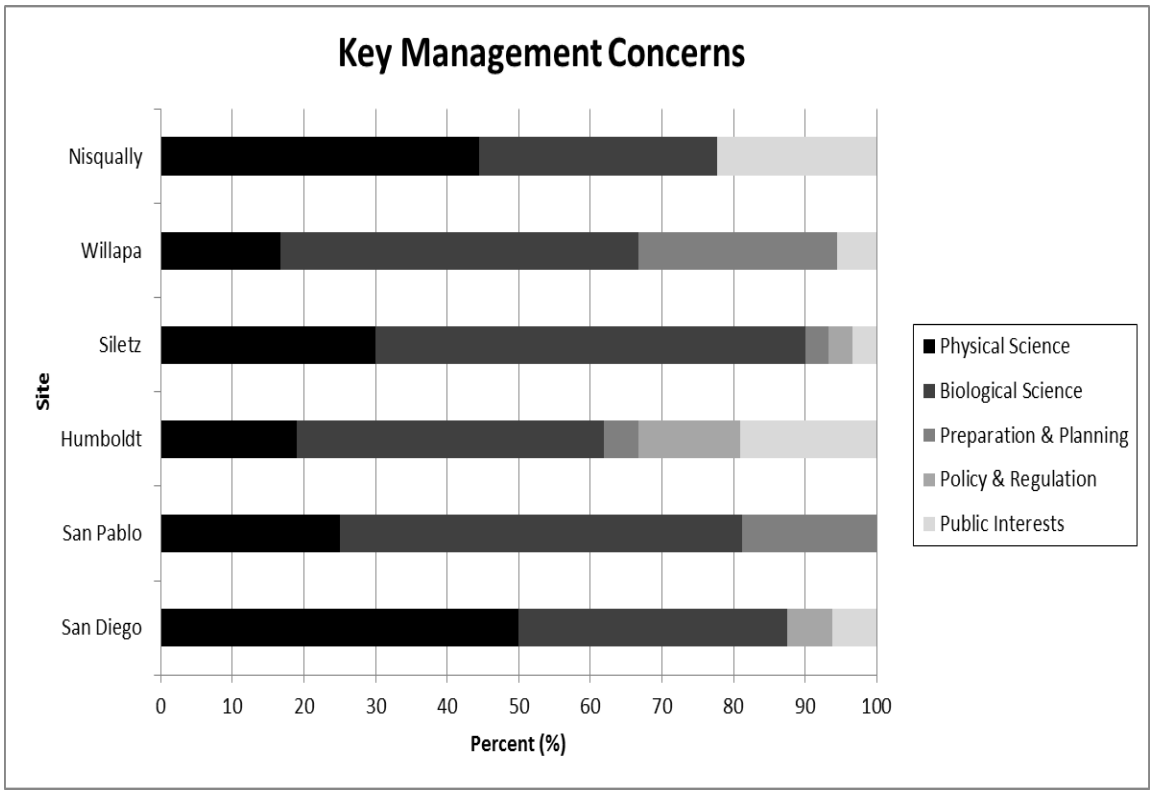
The Internet, peers, and scientific journals were the top three sources where participants "all the time" and "frequently" get their climate change information. Guidance documents, manuals, conferences, and list serves were used "rarely" or "not at all" by the highest percentage of participants.

2. Rate the usefulness of the following tools in helping incorporate climate change into management decisions.



Participants responded that in-person workshops and partner scientists are a useful tool to help incorporate climate change information into their management decisions. Also site specific climate projections (e.g., sea-level rise, temperature etc.) and downscaled climate change models were ranked as "extremely" and "very useful".

3. What are you key management concerns and science needs?



Respondents were given the opportunity to provide short answers about their greatest management concerns and those were binned into five topical concerns. Site specific responses are provided in greater detail below. Information about physical science (e.g., sediment dynamics, water availability) was ranked high for many of the workshop locations, with biological science (e.g., species response) as second.

4. Site Specific Results

4.1 Nisqually Workshop

Workshop: October 21-22, 2014, Dupont, WA

Staff from the U.S. Geological Survey, Western Ecological Research Center, San Francisco Bay Estuary Field station's Coastal Ecosystem Response to Climate Change (CERCC) program held a two-day (October 21-22, 2014) workshop in Dupont, WA with a focus on Nisqually NWR and Port Susan NWR results. The workshop was attended by fourteen participants representing eight agencies or groups (Table 13).

A. Participant Pre-Survey

The pre-survey was administered through Survey Monkey (surveymonkey.com) to 34 participants (NPLCC and NWCSC personnel where not asked to take survey), the response rate was 9%.

- Demographics of respondents: The pool of respondents (n=3) was made up of U.S. Fish and Wildlife Service (33%), Tribal government (33%), and state agency (33%). Zero of the respondents had formal training in climate change science. One respondent had a bachelor's degree, the other two had a graduate degrees.
- When asked "Which of these climate change drivers do you think will affect your estuary most?"
    - All respondents (100%) ranked sea-level rise as their highest concern.
    - Hydrologic change or water temperature change were ranked either second or third by all respondents (Figure 3).
    - When rankings were averaged, ranking (from highest to lowest) was: sea-level rise, hydrologic change (same average ranking as water temperature change), water temperature change, ocean acidification, atmospheric warming, and extreme weather (Figure 3).
- When asked to rank management concerns, fish management was ranked highest followed by threatened and endangered species and mammal management. Complete findings are summarized in Figure 4.

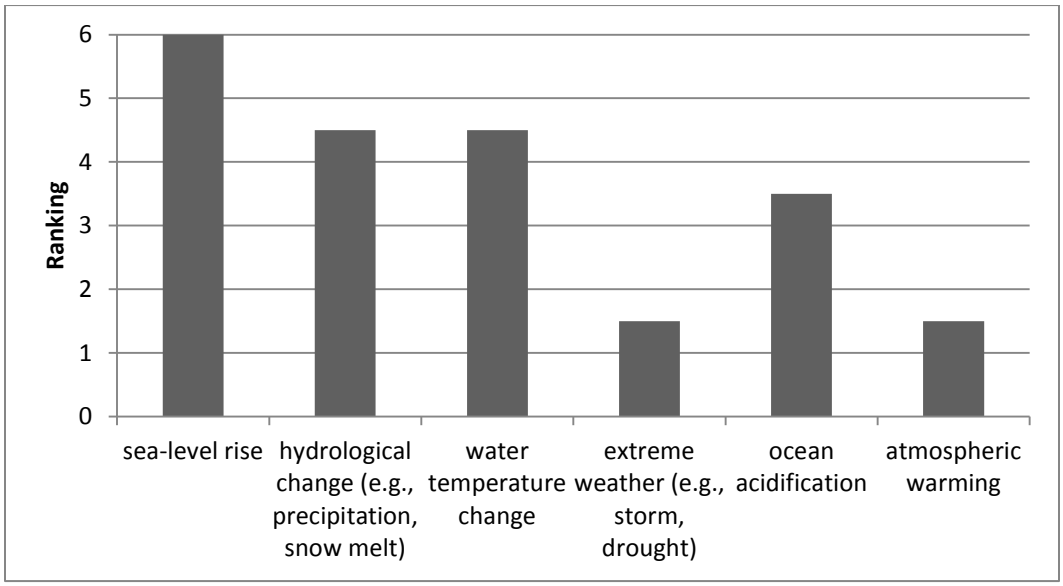


Figure 3. Averaged rankings from respondents on what climate change drivers they think will most affect the Nisqually estuary. 0=low, 6=high.

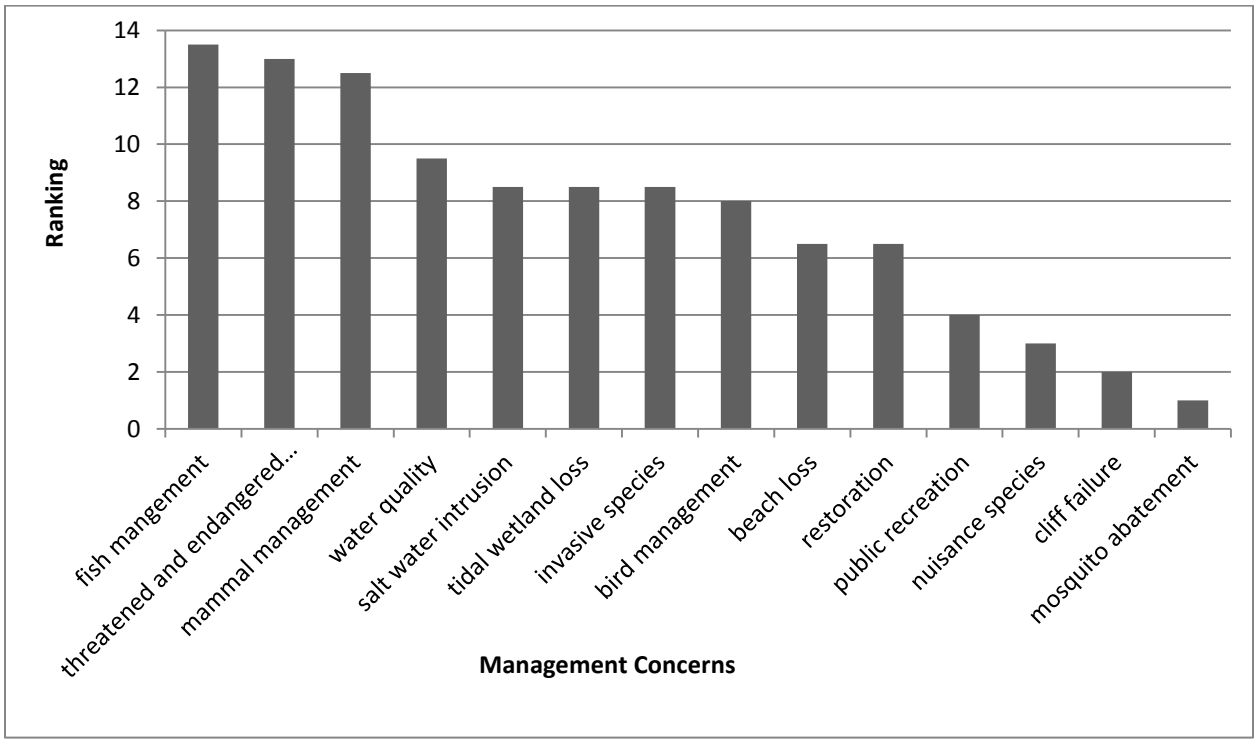


Figure 4. Participants were asked to rank their management concerns for Nisqually estuary. Method was a multiple choice prompt and participants were asked to rank the following categories. Graph represents average ranking with higher numbers equaling a larger management concern

B. Workshop Exercises

During the workshop participants worked through exercises to identify what they are currently managing, key natural or cultural resources, vulnerabilities to their estuary and science-management needs. All participants said they manage estuarine habitats, which include tidal wetlands and nearshore ecosystems.

Map group exercises from Nisqually estuary workshop

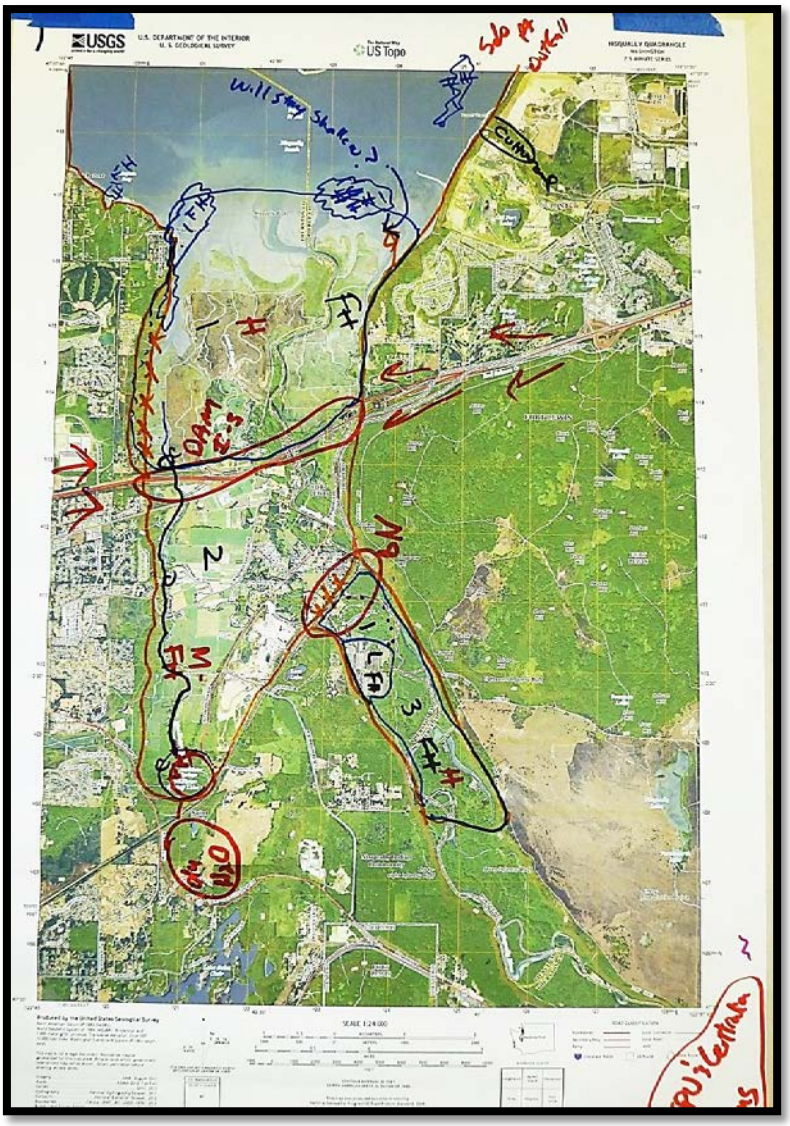


Figure 5. Team 1: Nisqually estuary full map – The entire Nisqually River delta was highlighted as important. I-5 is currently a barrier to upslope marsh migration, and severely limits the ability of climate adaptation efforts. Cultural resource, including salmon are extremely important and vulnerable to sea-level rise

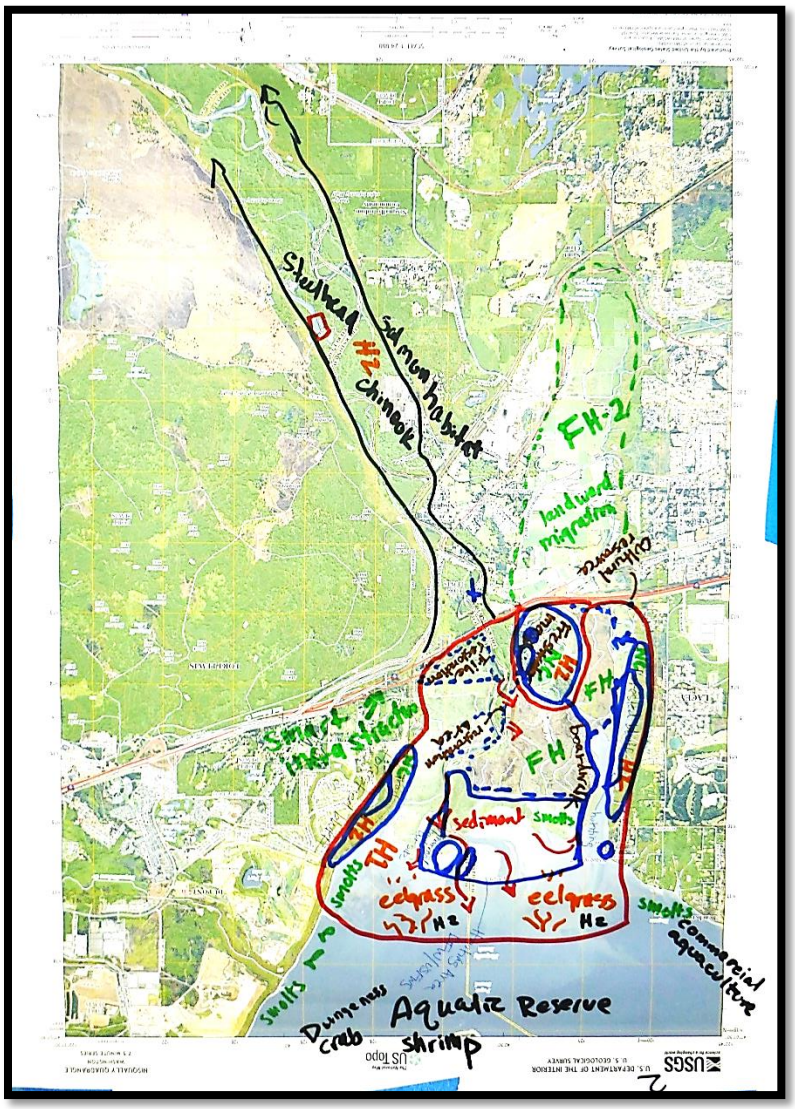


Figure 6. Team 2: Nisqually estuary full map –. Fisheries resource and supporting ecosystems were a main focus. I-5 is a barriers that limits connectivity for wildlife, limits upland marsh migration, and reduces sediment transport from the watershed.

Identified science-management needs

Physical	Biological	Modeling	Preparation & Planning	Resources	Policy & Regulation	Other
Estuary morphological changes	Climate change impacts on Eelgrass	Storm impacts	Adaptation strategy development	Funding for purchase of adjacent lands		Infrastructure as barrier
SLR data	Interaction of water flow, sediment, and salmon	Sedimentation models	Gap analysis	Time and staffing resources for planning		Site specific Dam impacts
Climate change impacts on ocean	Habitat and restoration	Estuary mapping	Landscape planning			
Sediment delivery and dynamics	Upslope migration, adjacent lands					
Spit stability						
Sediment input from Nisqualliy River						

C. Post-Survey

The post-survey was administered at the workshop to participants at the end of the day, paper copies were distributed and collected.

- Demographics of respondents: the pool of respondents (n=4) was made up of Tribal government (25%), Nisqually Reach Nature Center (25%), Nisqually River Council (25%), and Nisqually River Foundation (25%).

Multiple choice questions

- When asked to rate the usefulness of methods used to learn about climate change respondents web-based tools (25%) and peers (25%) were the most frequently used (Table 1).
- When asked to rate the usefulness of available tools in helping to incorporate climate change into management decisions, the majority of respondents rated specific climate projections (75%) as 'extremely useful' (Table 2).

Short answer questions

- When asked about key management concerns, respondents mentioned: climate change effects on estuarine habitat (25%), salmon (50%), adapting to increased human population (50%), and sea-level rise (25%).
- When asked what type of information is needed to incorporate climate change into management, the respondents mentioned: improved local/fine-scale data and models appropriate to Nisqually (50%), sea-level rise information (25%), long term ocean climate data (25%), estuary morphological data (25%), and quantification of potential impacts (25%).
- When asked what the main challenges are to incorporate climate change into management, respondents mentioned: sustainable funding sources (50%), improved information (50%), social and political will (25%), and improved coordination with partners (25%).

Table 1. Nisqually responses (percentage of respondents; n=4) to the prompt, "to rate how often a method is used to learn about climate change ".

	All the time	Frequently	Occasionally	Rarely	Do not use
In person training	0	0	100	0	0
Manuals	0	25	50	25	0
Conferences	0	25	75	0	0
Web based tools	25	25	50	0	0
List serves	0	25	75	0	0
Peers	25	50	25	0	0
Guidance documents	0	25	50	0	25
Internet	0	75	0	25	0
Data summary reports	0	50	25	25	0
Scientific journals	25	25	50	0	0

Table 2. Nisqually responses (percentage of respondents; n=4) to the prompt, "rate the usefulness of available tools in helping to incorporate climate change into management decisions".

	Extremely useful	Very useful	Somewhat useful	Not useful at all	Do not know
Climate-smart conservation principles	0	50	25	0	25
WARMER tidal marsh modeling results	0	75	25	0	0
Global climate models	0	25	75	0	0
Downscale climate change	25	50	0	0	25

models					
Specific climate projections (e.g. sea-level rise, temperature)	75	25	0	0	0
Partner scientists	50	50	0	0	0
In-person workshops	25	25	50	0	0

4.2 Willapa Bay Workshop

Workshop: November 20, 2014, Ilwaco, WA

Staff from the U.S. Geological Survey, Western Ecological Research Center, San Francisco Bay Estuary Field station's Coastal Ecosystem Response to Climate Change (CERCC) program held a one-day (November 20, 2014) workshop in Ilwaco, WA with a focus on Willapa Bay NWR wetland results. The workshop was attended by ten participants representing nine agencies or groups (Table 16).

A. Participant Pre-survey

The pre-survey was administered through Survey Monkey (surveymonkey.com) to 19 participants (NPLCC and NWCSC personnel where not asked to take survey), the response rate was 42% (8 participants).

- Demographics of respondents: the pool of respondents (n=8) was made up of state agency (75%), U.S. Fish and Wildlife Service (13%), and local county group (13%). Six of the respondents had a bachelor's degree; the other two had graduate degrees.
- Twelve percent of the respondents had formal training in climate change science.
- When asked "Which of these climate change drivers do you think will affect your estuary most?"
    - 37% of respondents ranked water temperature change their highest concern
    - Sea-level rise was ranked second by the majority of respondents.

- When rankings were averaged, ranking (from highest to lowest) was: water temperature change, sea-level rise, ocean acidification, hydrologic change, atmospheric warming, and extreme weather (Figure 7).

- When asked to rank management concerns, tidal wetland loss was ranked highest, followed by water quality and beach loss (average ranking). Results summarized in Figure 8.

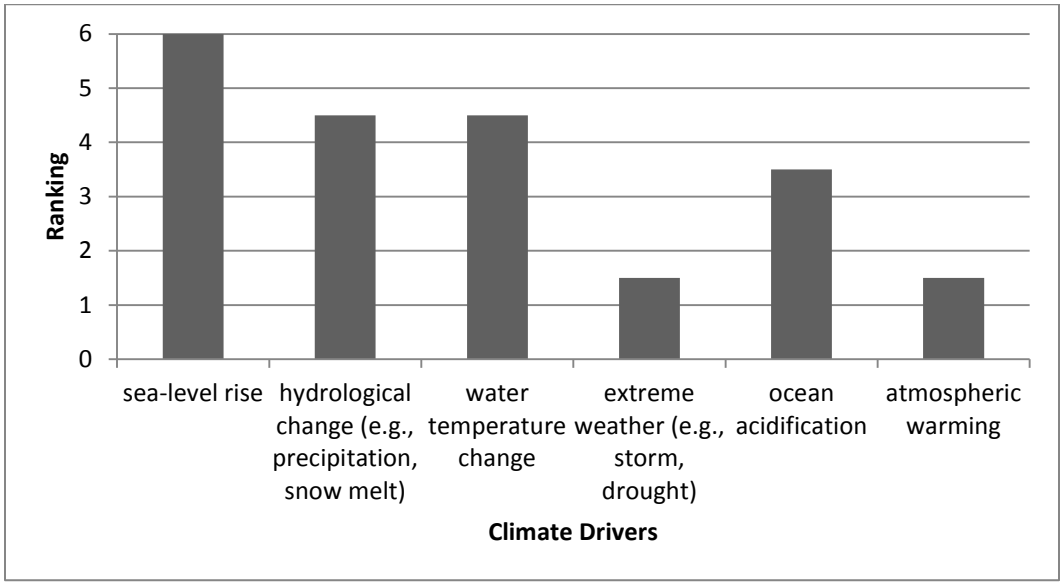


Figure 7. Averaged rankings from respondents on what climate change drivers they think will most affect the Willapa estuary. 0=low, 6=high.

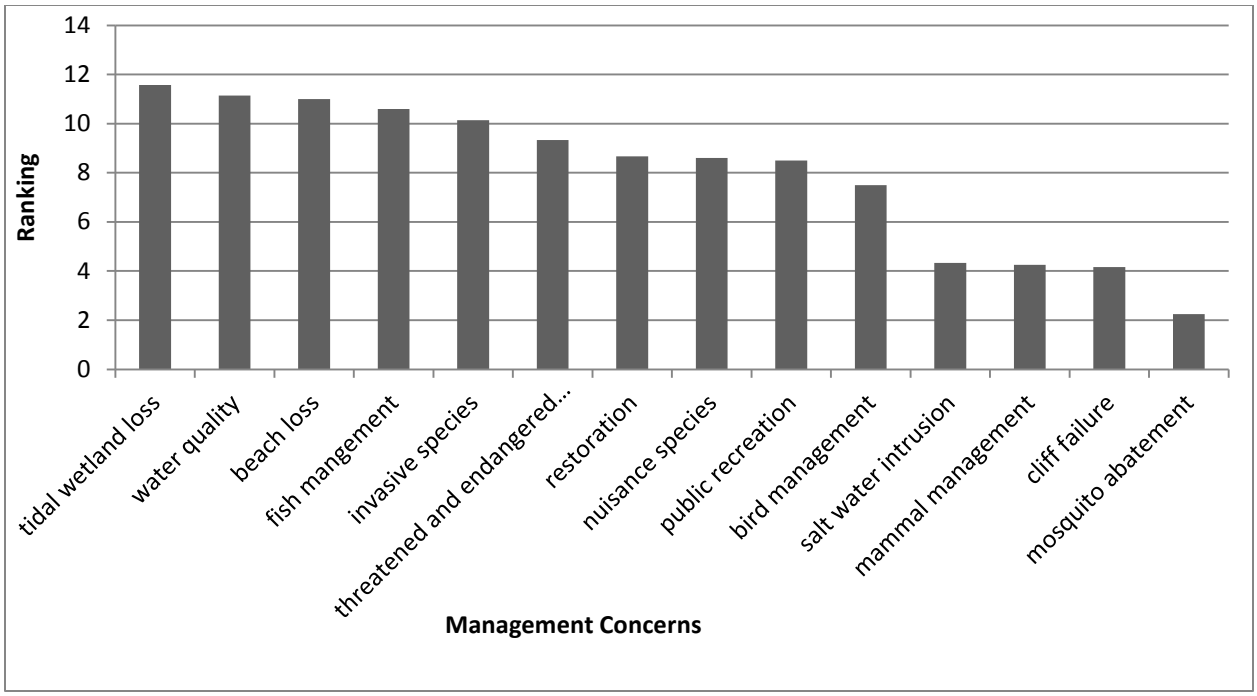


Figure 8. Participants were asked to rank their management concerns for the Willapa estuary. Method was a multiple choice prompt and participants were asked to rank the following categories. Graph represent average ranking with higher numbers equaling a larger management concern.

B. Workshop Exercises

During the workshop participants worked through exercises to identify what they are currently managing, key natural and cultural resources, vulnerabilities to their estuary, and science-management needs.

What type of habitats do you manage?

Uplands	Riparian	Marine	Beaches & Dunes	Wetlands	Other
Forests	Riparian	Intertidal/subtidal	Beaches	Salt marsh	Fish and wildlife
Rangelands		Shellfish habitat			
Farmland					
Temperate forest					
Grasslands					
Prairies					

Workshop map exercises from Willapa Bay estuary

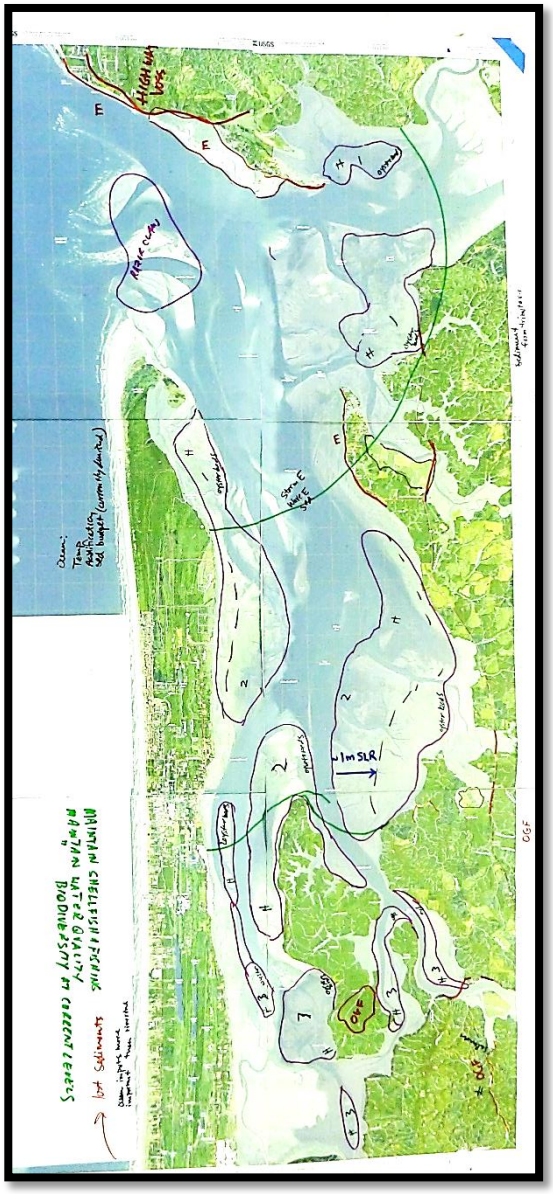


Figure 9. Team 1: Willapa Bay full map – participants identified shellfish growing areas, eelgrass, and transitional mudflats as important resources to maintain in the face of climate change. They also identified the maintnance of current biodiversity and habitat variety as a key management goal.

Figure 10. Team 1: Willapa Bay– razor clam and oyster beds were identified as important resources. Changes in sediment delivery and turbidity were a key management concern and science need.

Figure 11. Team 1: Willapa Bay South – this group focuses on current and future areas for the local shellfish industry.

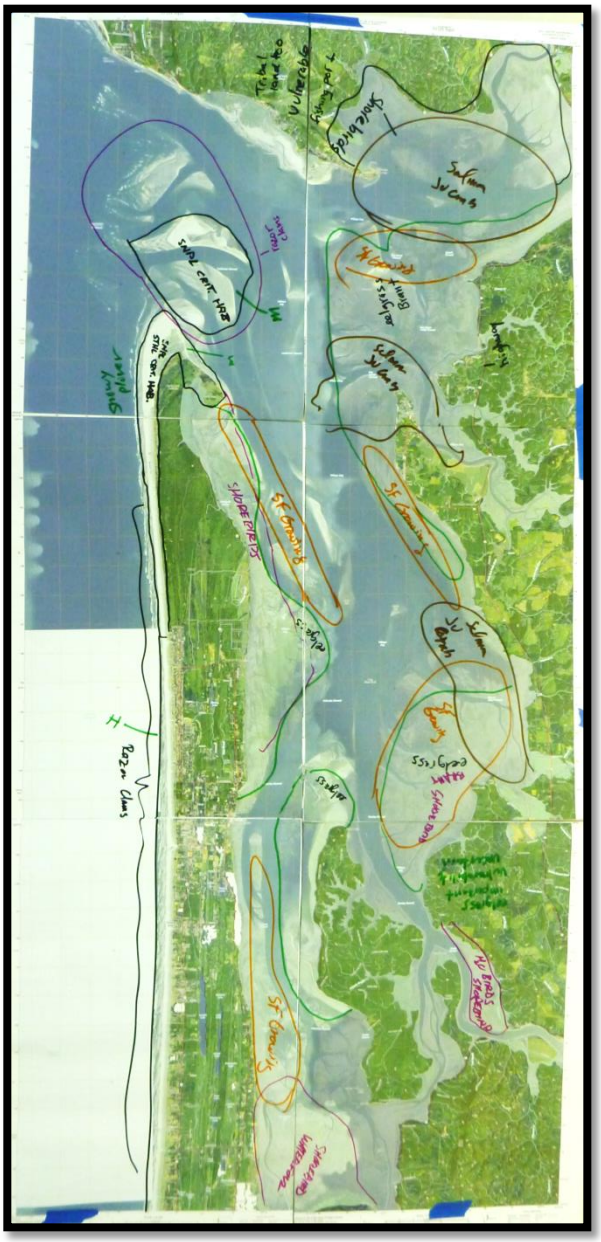


Figure 12. Team 2: Willapa Bay full map – this group identified the diversity of habitats (eelgrass, sandy beaches, tidal wetlands, and mudflats) as a key resource to manage and maintain with climate change. Migratory waterbird foraging areas were considered important and eelgrass habitats for Brant. Also areas were identified for juvenile salmon needs and the shellfish industry.

Figure 13. Team 2: Willapa Bay North – Areas for snowy plover roosting and nesting were identified as important, as well as nearshore ecosystems for juvenile salmon and eelgrass for Brant. Discussions also included concerns over towns located on Willapa Bay that are important local fishing ports and Tribal lands.

Figure 14. Team 2: Willapa Bay south – eelgrass was considered very important by this group but there was a lot of uncertainty about its vulnerability and ability to respond to sea-level rise and changing ocean conditions.

Identified science-management needs:

Physical	Biological	Modeling	Preparation & Planning	Resources	Policy & Regulation	Other
Accretion rates around the bay	CC effects on species	Site specific models	Adaptation strategy			Baseline data
Ocean acidification monitoring	Retain emergent marsh	CC models	Landscape planning to assess affect of timber lands on tributaries and salmon			Social impacts
Freshwater flow into rivers	Marsh restoration					Infrastructure vulnerability
Sediment input and distribution	Restore tidal channels					
Salinity data	Restore fish habitat					
Offshore effects on estuary	Productivity data					
	Spatial distribution and health of eelgrass					

C. Post-survey

The post-survey was administered at the workshop to participants at the end of the day, paper copies where distributed and collected.

- Demographics of respondents: The pool of respondents (n=9) was made up of state agency (44%), non-profit/consultant (23%), local agency (11%), USFWS (11%), and researcher (11%).

Multiple choice questions

- When asked to rate the usefulness of methods used to learn about climate change respondents rated scientific journal (33%), the internet (22%), data summary reports (22%), and peers (11%) as the used 'all the time' (Table 3).
- When asked to rate the usefulness of available tools in helping to incorporate climate change into management decisions, the majority of respondents rated peer scientists (56%) as 'extremely useful' (Table 4).

Short answer questions

- When asked about key management concerns, 67% of respondent's mentioned protection/enhancement/restoration of estuarine habitats, climate impacts/sea-level rise (30%), shellfish populations (22%), ocean acidification (22%), effective adaptation (11%), invasive species/habitat loss (11%), and improve community resilience (11%).
- When asked what type of information is needed to incorporate climate change into management, the respondents (n=8) mentioned: improved local/fine-scale climate change models (75%), climate change effects on species (25%), long term baseline data (25%), knowledge of local areas (n=1), and accurate data (13%)
- When asked what the main challenges are to incorporate climate change into management, respondents mentioned: overall need for new/improved information and concise data (50%), lack of funding (38%), uncertainty of climate predications or interpreting models (25%), lack of public/political support (13%), and limitations from current rules and regulations (13%).

Table 3. Willapa workshop responses (percentage of respondents; n=9) to the prompt, "to rate how often a method is used to learn about climate change ".

	All the time	**Frequently**	**Occasionally**	**Rarely**	**Do not use**
In person training	0	0	11	78	11
Manuals	0	11	22	44	22
Conferences	0	22	33	22	11
Web based tools	0	22	33	22	22
List serves	0	11	22	22	33
Peers	11	33	44	0	11

Guidance documents	0	33	11	22	22
Internet	22	33	33	0	11
Data summary reports	22	33	22	0	22
Scientific journals	33	22	33	0	11

Table 4. Willapa workshop responses (percentage of respondents, n=9) to the prompt, "rate the usefulness of available tools in helping to incorporate climate change into management decisions".

	Extremely useful	**Very useful**	**Somewhat useful**	**Not useful at all**	**Do not know**
Climate-smart conservation principles	11	33	33	0	22
WARMER tidal marsh modeling results	0	56	11	11	22
Global climate models	22	11	44	11	11
Downscale climate change models	33	22	33	0	11
Specific climate projections (e.g. sea-level rise, temperature)	44	33	11	0	11
Partner scientists	56	22	22	0	0
In-person workshops	33	22	44	0	0

4.3 Siletz Bay Workshop

Workshop: November 13, 2014, Newport, OR

Staff from the U.S. Geological Survey, Western Ecological Research Center, San Francisco Bay Estuary Field station's Coastal Ecosystem Response to Climate Change (CERCC) program held a one-day (November 13, 2014) workshop in Newport, OR with a focus on Siletz NWR results. The workshop was attended by fifteen participants representing eleven agencies or groups (Table 17).

A. Participant Pre-Survey

The pre-survey was administered through Survey Monkey (surveymonkey.com) to 42 participants (NPLCC and NWCSC personnel where not asked to take survey), 10 persons took the survey for a response rate of 24%.

- Demographics of respondents: the pool of respondents (10) was made up of non-profit (40%), state agency (30%), consultant (20%), and federal agency (10%). Six of the respondent had a graduate degree, while three had a bachelor's degree, and one person had a high school degree.
- Two of the respondents had formal training in climate change science.
    - When asked "Which of these climate change drivers do you think will affect your estuary most?"
        - 90% of respondents ranked sea-level rise as their highest concern
        - ocean acidification was ranked second
        - When rankings were averaged, ranking (from highest to lowest) was: sea-level rise, ocean acidification, extreme weather, hydrologic change, water temperature change, and atmospheric warming (same average ranking as water temperature change; Figure 15).
    - When asked to rank management concerns, tidal wetlands loss was ranked highest, followed by threatened and endangered species and restoration. Complete findings are summarized in Figure 16.

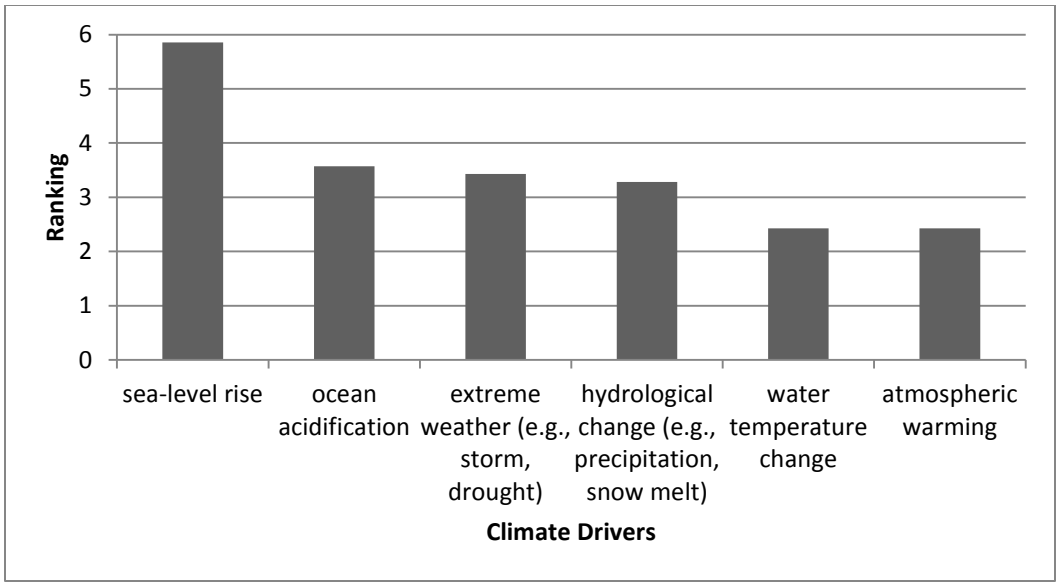


Figure 15. Averaged rankings from respondents on what climate change drivers they think will most affect the Siletz Bay estuary. 0=low, 6=high.

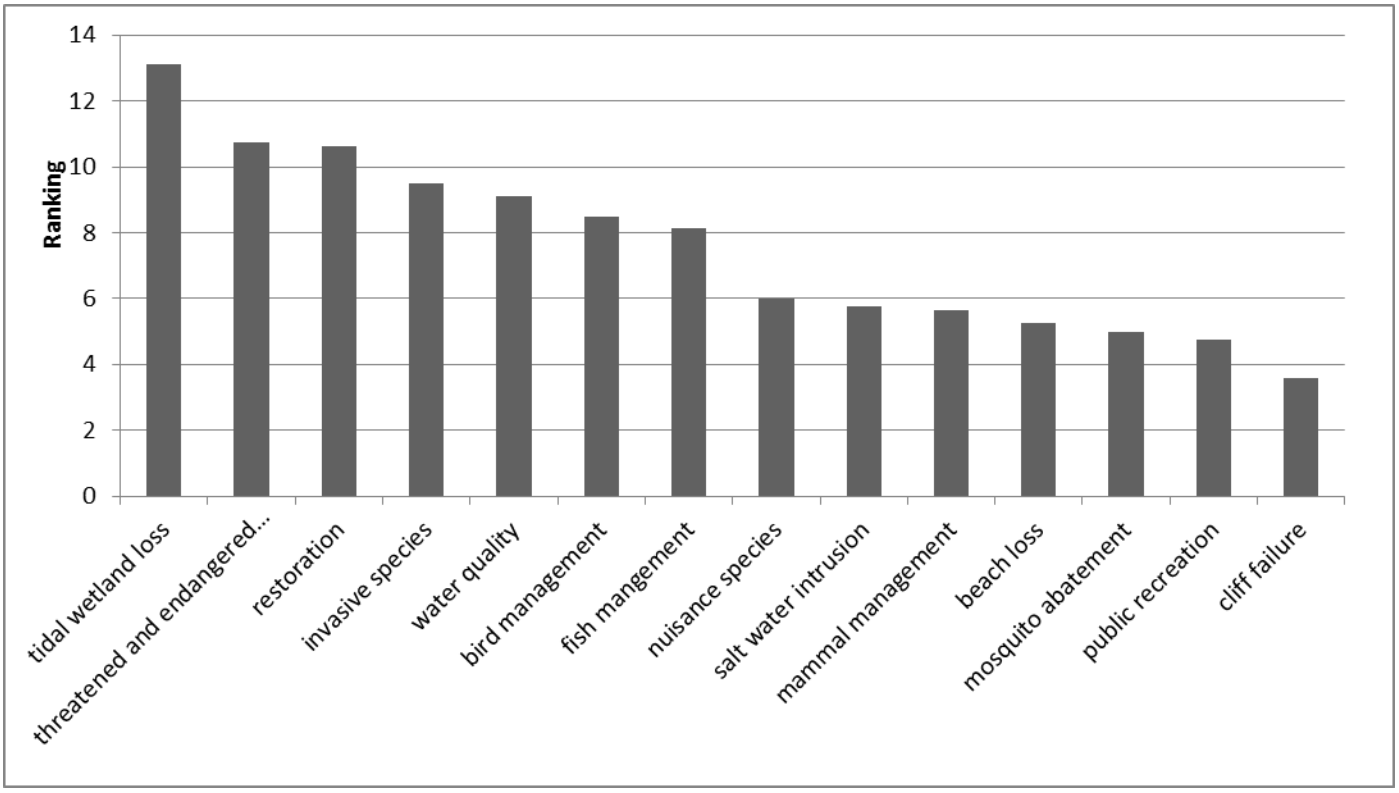


Figure 16. Participants were asked to rank their management concerns for Siletz Bay estuary. Method was a multiple choice prompt and participants were asked to rank the following categories. Graph represent average ranking with higher numbers equaling a larger management concern.

B. Workshop Exercises

During the workshop participants worked through exercises to identify what they are currently managing, key natural and cultural resources, vulnerabilities to their estuary and science-management needs.

What type of habitats do you manage?

Uplands	Riparian	Marine	Beaches & Dunes	Wetlands	Other
Estuarine adjacent uplands	Riverine	Eelgrass		Tidal flats	Coastal watersheds
Scrub-shrub	Floodplains	Intertidal/subtidal		Tidal wetlands	
Prairies	Freshwater	Shellfish habitat		Tidal salt marsh	
Pasture	Lakes	Estuarine		Forested wetlands	
Forests	Headwaters	Off-shore islands		Coastal watersheds	
Migratory bird habitat	Streams	Ocean habitat		Emergent wetlands	
Oak woodlands		Kelp beds		Freshwater wetlands	

Map exercises from Siletz Bay estuary workshop

Figure 17. Team 1: Siletz Bay full map – Participants focused on the riverine systems that enter into the bay as key resources for freshwater flow, sediment delivery, and salmon habitats. They thought that those freshwater sources could be impacted by climate change. Overarching goals for the estuary included to maintain the diversity of the habitats and increase landscape planning by building partnerships for restoration and climate change.

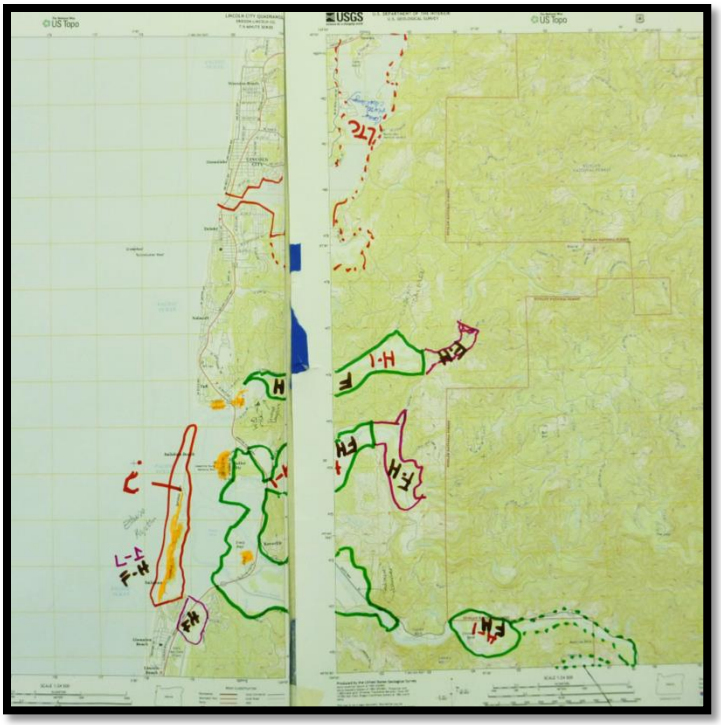


Figure 18. Team 2: Siletz Bay full map –Since the bay is constrained by local topography and mountains there was a lot of discussion about the lack of opportunity for upland migration of habitats. Salt water intrusion into the riverine systems was considered a main concern. The barrier island and outer coast was considered also vulnerable from sea-level rise and storms. Local coastal towns and communities were also identified at risk with sea-level rise.

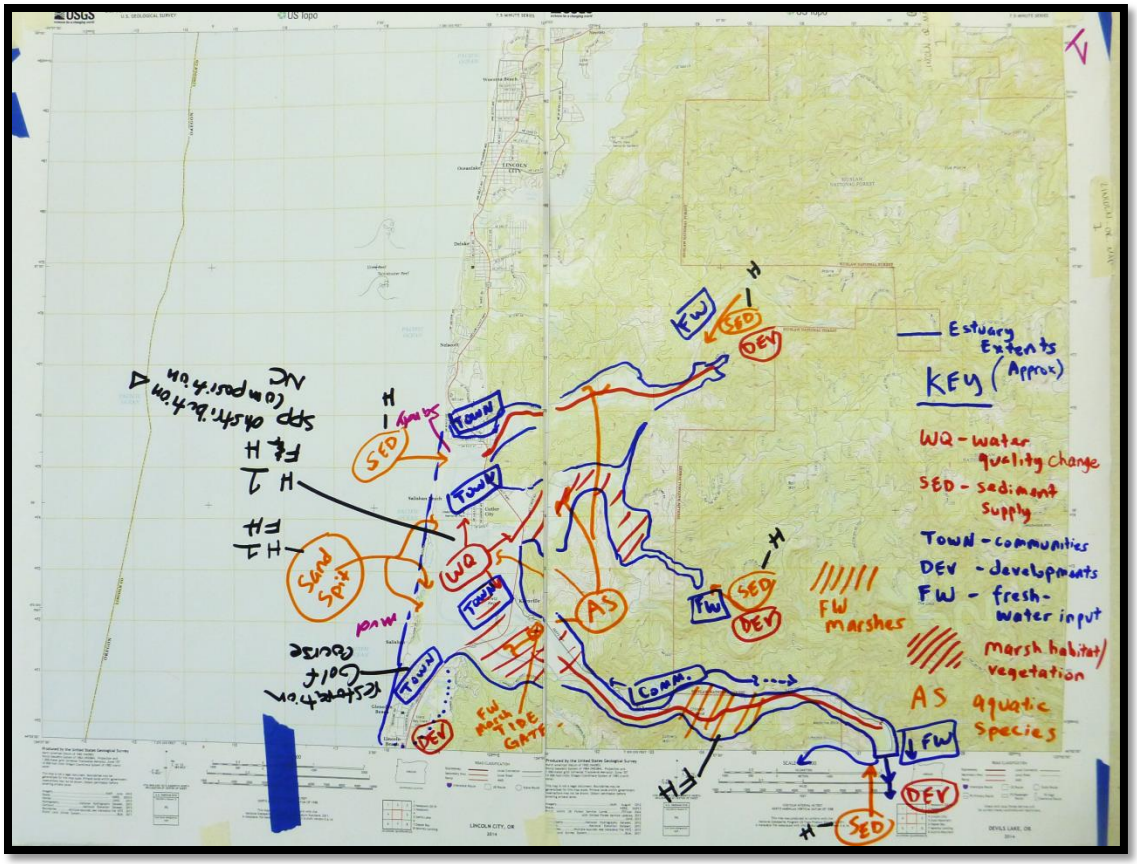


Figure 19. Team 3: Siletz Bay full map –Riverine systems were also identified as key resources and their function as a sediment source. Good water quality for nearshore habitats and aquatic species was equally important to group participants. Also, there was a lot of uncertainty about climate change impacts on species distribution and composition change for their estuary. Local towns were identified as vulnerable from sea-level rise.

Figure 20. Team 4: Siletz Bay full map – this group identified that most areas within the lower estuary would be impacted greatly in the future by sea-level rise due to the constraints of the topography. Again, human communities were identified at risk with sea-level rise. Discussions also occurred about the importance of offshore rocks and their habitats for roosting and migratory waterbirds, but little is known about future impacts.

Identified science-management needs

Physical	Biological	Modeling	Preparation & Planning	Resources	Policy & Regulation	Other
SLR data	CC impacts on mudflats and other habitats	Site specific models	Management guidance, planning structure	Funding		Site specific
Ocean acidification	CC and OA impacts to shellfish	Improve modeling accuracy	Case studies			Culvert effects on sediment transport
Salinity dynamics	Baseline invert and seagrass surveys	Estuary-wide modeling for marsh loss	Prioritization			Adequacy of sediment movement after dike removal
Freshwater dynamics	Secure areas for restoration	Salinity models	Cost/benefit analysis			Coordination of land owners and agencies
Sediment dynamics, accretion rates	Maintaining existing habitats	SLR models	Secure new areas for land acquisition			Infrustructure vulnerability
Landscape data	Migratory birds	Sea surface temperature models				Dam impacts to estuary
LIDAR	Restore tidal function to low lying areas	Improve WARMER models				
Sediment transport differences between natural vs restored areas		Elevation models				
		Natural distaster impacts on estuary				
Mineral deposition variation across NW						

C. Post-survey

The post-survey was administered at the workshop to participants at the end of the day, paper copies where distributed and collected.

- Demographics of respondents: the pool of respondents (n=13) was made up of nonprofit/consultant (38%), state agency (31%), federal agency (15%), Tribe (8%), and local agency (8%).

Multiple choice questions

- When asked to rate the usefulness of methods used to learn about climate change, 21% of respondents ranked peers as used most frequently, with internet, data summary reports, and scientific journals ranked as second most frequently used method (Table 5).
- When asked to rate the usefulness of available tools in helping to incorporate climate change into management decisions, respondents rated specific climate projections as the most useful, and downscale climate change models, partner scientists, and in-person workshops as the second most useful tool (Table 6).

Short answer questions

- When asked about key management concerns, 100% of respondents (12) mentioned protecting and enhancing estuarine habitat (n=12), protecting and maintaining wildlife, fisheries and shellfish populations (42%), climate change effects (e.g. sea-level rise, ocean acidification; 42%), habitat loss (33%), restoration projects (25%), and coastal development (8%).
- When asked what type of information is needed to incorporate climate change into management the respondents (12) mentioned: site specific climate change models (n=6), site specific sea-level rise data/models (n=5), downscaled local data (n=3), climate change effects (e.g. ocean acidification on shellfish; n=3), vulnerability of different habitat types to climate change (n=1), effects/sensitivity of management decisions (n=1).
- When asked what the main challenges are to incorporate climate change into management respondents mentioned: uncertainties in climate change data and modeling (n=4), lack of support/funding and outreach (100%), lack of land area to effectively manage for climate change/surrounding land use (75%), public perception of climate change (75%), long term processes required to include climate change in management/planning regulations and policy (50%), roads/infrastructure/energy development (25%), coordination with agencies, NGO's, non-profits, stakeholders, etc (25%)

Table 5. Siletz responses (percentage of respondents; n=13) to the prompt, "to rate how often a method is used to learn about climate change.

	All the time	Frequently	Occasionally	Rarely	Do not use
In person training	0	7	57	36	0
Manuals	0	29	50	7	14
Conferences	0	0	71	29	0
Web based tools	0	50	14	21	14
List serves	0	7	50	29	14
Peers	21	64	14	0	0
Guidance documents	0	43	36	21	0
Internet	14	43	36	7	0
Data summary reports	14	43	36	0	7
Scientific journals	14	36	43	7	0

Table 6. Siletz responses (percentage of respondents; n=13) to the prompt, "rate the usefulness of available tools in helping to incorporate climate change into management decisions".

	Extremely useful	Very useful	Somewhat useful	Not useful at all	Do not know
Climate-smart conservation principles	0	29	43	0	29
WARMER tidal marsh modeling results	7	36	29	0	29
Global climate models	7	14	71	7	0
Downscale climate change models	29	14	36	0	14
Specific climate projections (e.g. sea-level rise, temperature)	36	43	21	0	0
Partner scientists	29	64	7	0	0
In-person workshops	29	57	14	0	0

4.4 Humboldt Bay Workshop

Workshop: October 2-3, 2014, Arcata, CA

Staff from the U.S. Geological Survey, Western Ecological Research Center, San Francisco Bay Estuary Field station's Coastal Ecosystem Response to Climate Change (CERCC) program along with partners from Oregon State University held a two-day (October 2-3, 2014) workshop in Arcata, CA with a focus on Humboldt NWR results. The workshop was attended by forty-five participants representing twenty-four agencies or groups (Table 16).

A. Participant Pre-Survey

The pre-survey was administered through Survey Monkey (surveymonkey.com) to 44 participants (NPLCC and NWCSC personnel where not asked to take survey) The response rate was 95% (42 participants).

- Demographics of respondents: The pool of respondents (n= 42) was made up of U.S. Fish and Wildlife Service (21%), state agency (19%), consultant (16%), researcher (16%), nonprofit (12%), local agency (9%), state government (5%), and private citizen (2%). Thirty respondents had a graduate degree, while nine had a Bachelor's degree, and two people declined to answer.
- Fifty-seven percent (n=24) of the respondents had formal training in climate change science.
- When asked "Which of these climate change drivers do you think will affect your estuary most?"
    - 52% of the respondents ranked sea-level rise as their highest concern,
    - water temperature change or extreme weather where ranked either second or third by the majority of respondents.
    - When rankings were averaged, ranking (from highest to lowest) was: sea-level rise, water temperature change, extreme weather, hydrologic change, ocean acidification, and atmospheric warming (Figure 13).
- When asked to rank management concerns tidal wetland loss was ranked highest followed by threatened and endangered species and restoration (average ranking). Results are summarized in Figure 22.

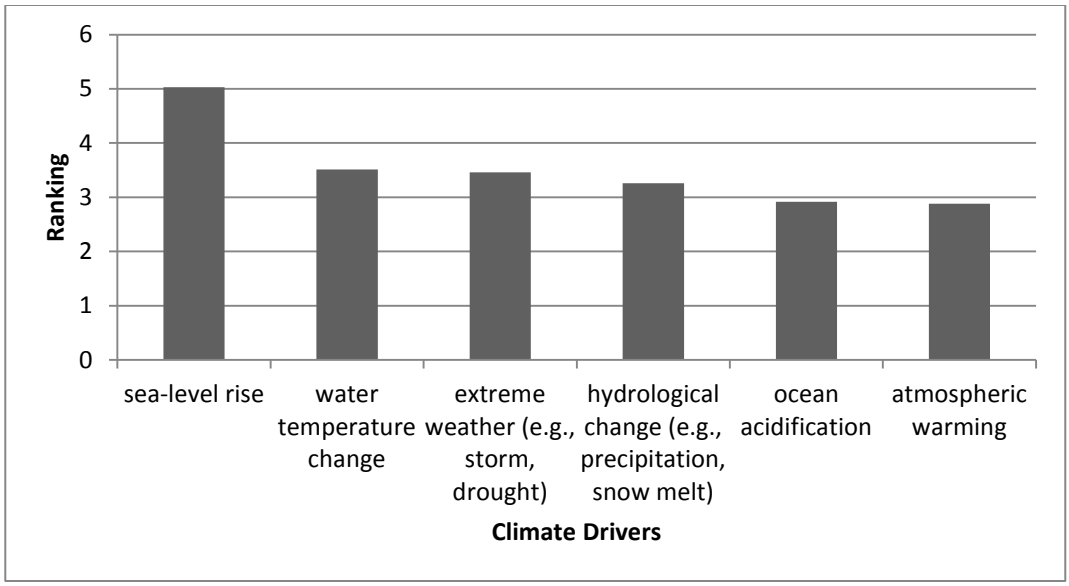


Figure 21. Averaged rankings from respondents on what climate change drivers they think will most affect the Humboldt Bay estuary. 0 = low, 6 = high.

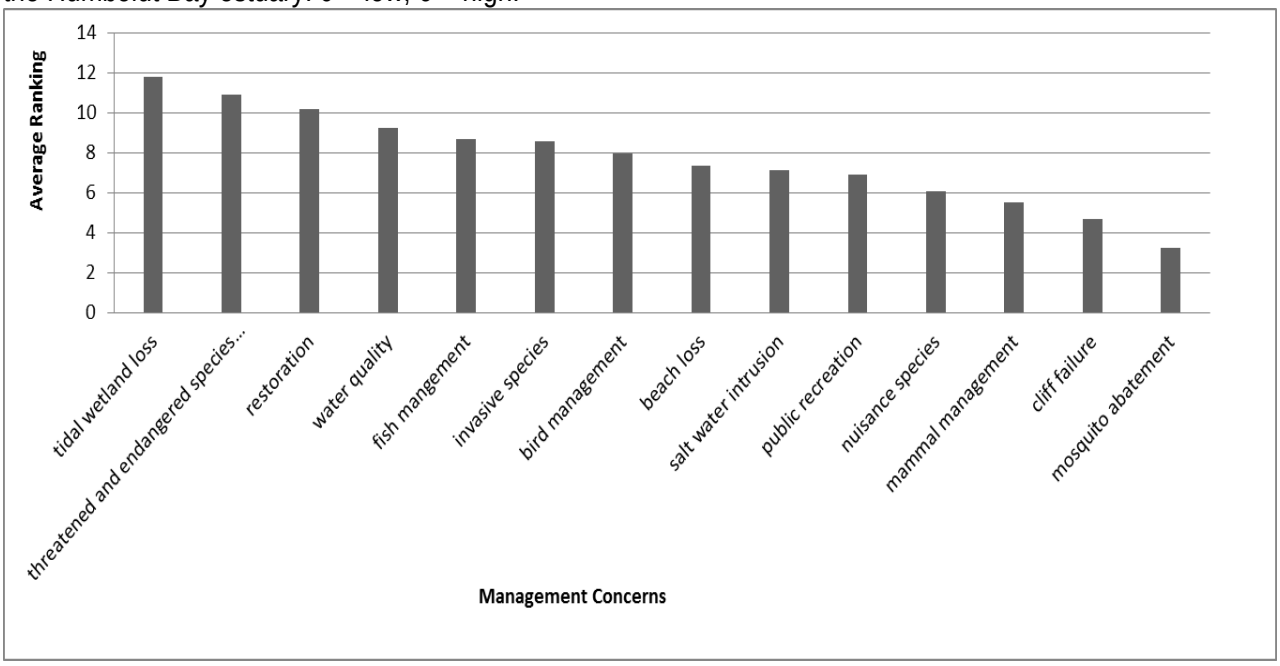


Figure 22. Participants were asked to rank their management concerns for Humboldt Bay. Method was a multiple choice prompt and participants were asked to rank the following categories. Graph represents average ranking with higher numbers equaling a larger management concern.

B. Workshop Exercises

During the workshop participants worked through exercises to identify what they are currently managing, key natural and cultural resources, vulnerabilities to their estuary, and science-management needs.

What type of habitats do you manage?

Uplands	Riparian	Marine	Beaches & Dunes	Wetlands	Other
Forests	Headwaters	Near-shore marine	Dunes	Tidal wetlands	Vertebrate species
Prairies	Freshwater	Intertidal		Tidal salt marsh	T&E species
Oak woodlands	Riparian	Marine fish habitat		Estuarine wetlands	
Private lands					

Map exercises from Humboldt Bay estuary workshop

Figure 23. Team 1: Humboldt Bay full map – the team identified main tributaries and river system as key resources and areas of uncertainty in terms of changes in freshwater flow, sediment source, fish management. Eelgrass and the outer spit were also identified as important.

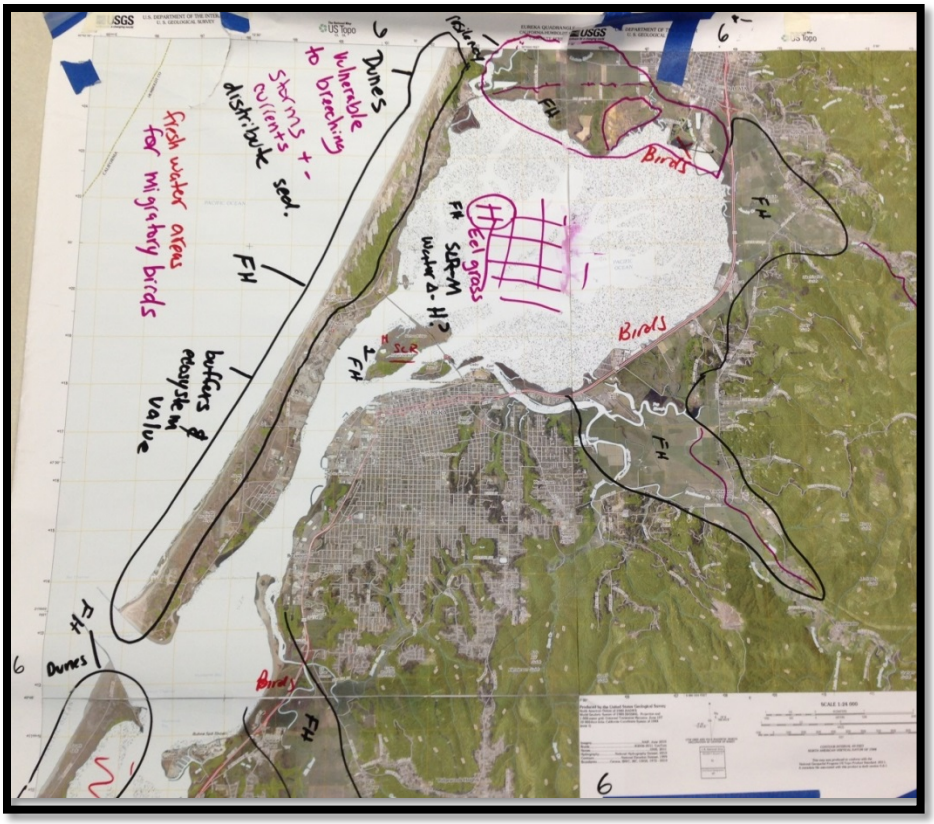


Figure 24. Team 1: Humboldt Bay North – the outer coast dune system and spit were identified as key resources which little known about their climate change vulnerabilities. Eelgrass and Refuge properties along with any open space with adjacent agricultural lands were deemed important for long term planning.

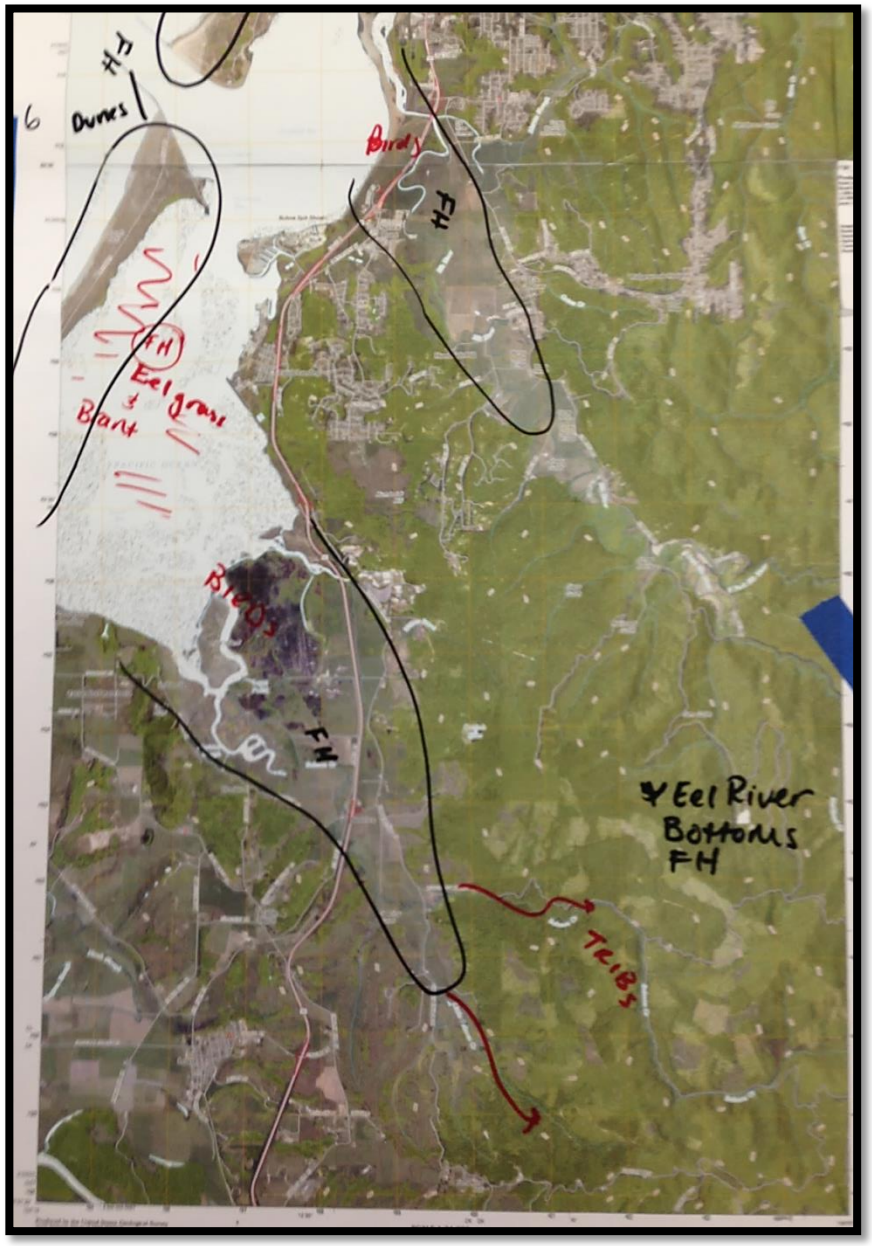


Figure 25. Team 1: Humboldt Bay South – freshwater inputs the bay were determined important along with adjacent open uplands that included agricultural lands. Eelgrass and Brant habitat was also important for this group.

Figure 26. Team 2: Humboldt Bay full map – this team focused on the freshwater input into the estuary, river systems and the opening to the outer ocean. Eelgrass and nearby mudflats were identified as a key resource.

Figure 27. Team 2: Humboldt Bay North - the beach and dune system along with the spit were important areas and have high future importance for protection of the estuary from storms and loss of sediment. Mudflats and eelgrass were also important and would have future high impacts from climate change.

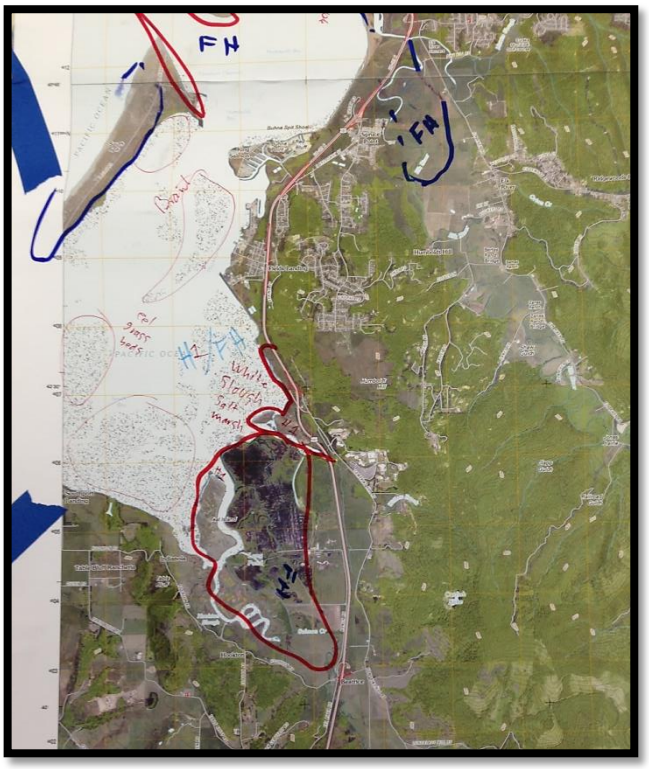


Figure 28. Team 2: Humboldt Bay South - important eelgrass and Brant areas were identified in the south bay. Refuge properties and local riverine systems were also identified as important and key resources with high future value. Low lying riverine areas were identified as high risk from future climate change impacts.

Figure 29. Team 3: Humboldt Bay full map – This group identified the mudflats and riverine sediment sources as key resources. Areas for harbor seals and salmon were also identified as important. The Lamphere Dunes, a unit of Humboldt Bay NWR was identified as important ecosystem to preserve and monitoring for impacts with climate change.

Figure 30. Team 3: Humboldt Bay south – The outer beach and sand spit was identified as important for protection from storm surges and as a migratory birds area. Salmon areas were identified as important and at risk from sea-level rise.

Figure 31.Team 4: Humboldt Bay full map – These participants also identified the fresh water inputs into the estuary as key resources that may be impacted in the future with sea-level rise. Eelgrass was also selected as important for migratory waterfowl. Riverine areas were identified as having high future impacts.

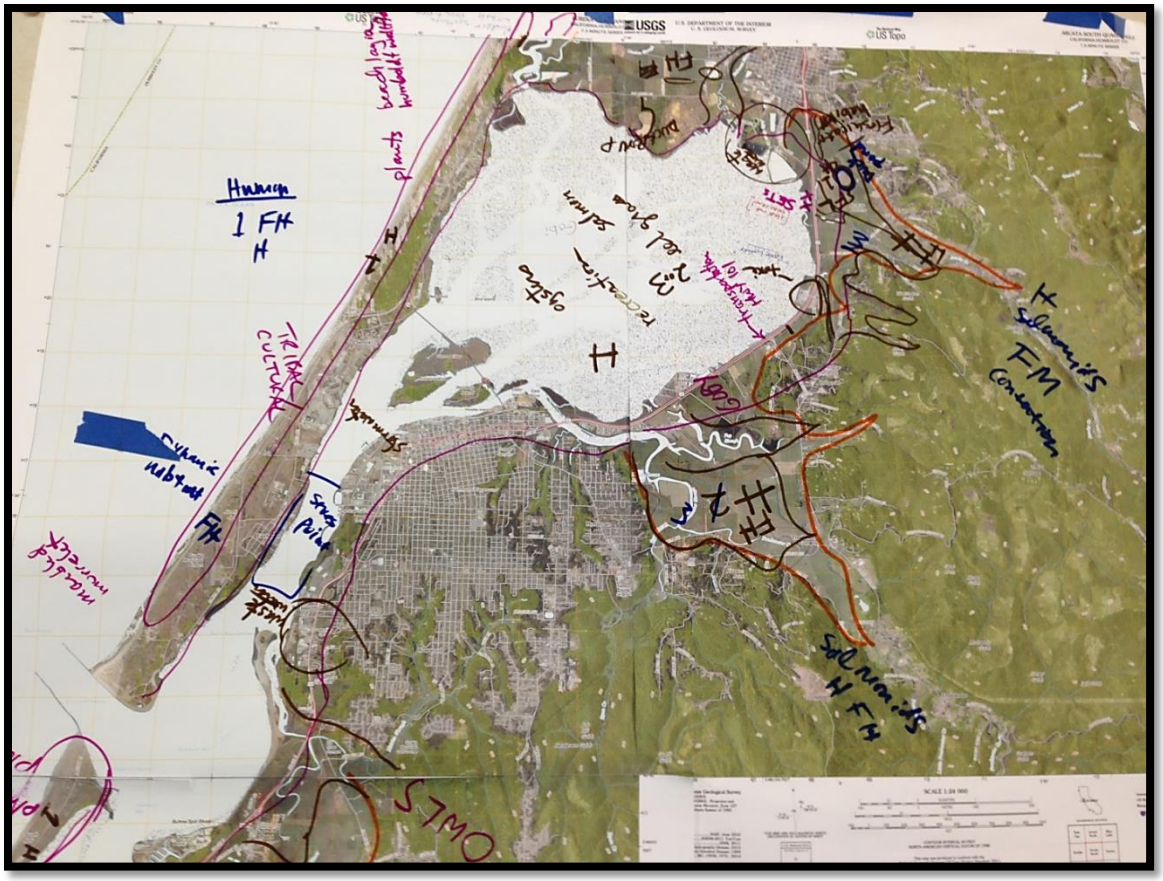


Figure 32. Team 4: Humboldt Bay north – the outer coast san spit and beach was identified as important for wind and wave action and to prevent impacts from storms. This group also identified the sewer treatment plant as vulnerable because of its proximity to the shore line. Also, subsided agriculture areas with earthen levees were also considered vulnerable with sea-level rise, but provide restoration opportunities.

Figure 33. Team 4: Humboldt Bay south – The Refuge headquarters was considered to have low vulnerability in the future. Participants identified areas of importance for owls and salmonids and they thought the future risk of impacts were high for those resources.

Identified science-management needs

Physical data	Biological data	Modeling	Preparation & Planning	Resources	Policy & Regulation	Other
Marsh sediment dynamics, accretin, erosion	CC impacts on habitats	Modeling accuracy	Cost/benefit analysis	Science collaboration	Regulatory restriction with species	Social impacts
Temperature dynamics	Vegetation dynamics in term of inundation tolerance and productivity	Site specific models	Case studies	Data sharing potential	No funding for restoration	Baseline data, elevatin
Salinity dynamics and supply	Nutrient loads in N-Bay vs S-Bay	Vulnerability assessment	Prioritization - acquisition of lands, restoration sites, connectivity, greatest areas of success	Communication and collaboration training	Dialog with Agriculture community needed	Site specific
Rainfall, runoff, flow dynamics	Eelgrass tolerance to changes in the bay	Water temperature, precipitation change	Future strategic local and landscape planning		Outreach to public needed, public awareness	Historic data
Ground water change	Salmonid considerations and change	Future and historic tidelands	Monitoring and detection		Dredging projects	
SLR rates for the bay	Migratory bird stop over - long term viability		Ecosystem based management tips			
Drought impacts	Oyster, aquaculture, eelgrass impacts					
Hydrology surface & ground water	Impacts to T&E species					
Beach, dune change						

C. Post-survey

The post-survey was administered at the workshop to participants at the end of the day, paper copies where distributed and collected.

- Demographics of respondents: The pool of respondents (n=13) was made up of federal agency (39%), non-profit/consultant (31%), state agency (15%), and researcher/local agency (15%).
  Multiple choice questions
- When asked to rate the usefulness of methods used to learn about climate change respondents 54% ranked the Internet as used most frequently with Peers ranked as the second most frequently used method (Table 7).
- When asked to rate the usefulness of available tools in helping to incorporate climate change into management decisions, 100% of respondents rated in-person workshops as the most useful. Partner scientists were rated as the second most useful tool (Table 8).
  Short answer questions
- When asked about key management concerns respondents 92% mentioned: conserving/restoring/maintaining estuarine habitats (46%), sea-level rise (31%), infrastructure vulnerability (31%), threatened and endangered species (15%), dune and forest habitat (13%), soil and water quality (13%)
- When asked what type of information is needed to incorporate climate change into management the respondents 85% mentioned: more/improved baseline information/knowledge and access to it (46%), more certainty in information/models (23%), information on the effects/impacts of climate change (e.g. sediment, temperature, salinity, rainfall, habitat, species; 15%), models scaled to local levels (15%), vulnerability and risks assessment (8%), cost/benefits analysis (8%), coordination between all agencies/stakeholders to plan for climate change (8%).
- When asked what the main challenges are to incorporate climate change into management respondents mentioned: incorporating climate change information into ESA section 7, permitting, planning documents and other policy/regulatory issues (46%), funding/political support (38%), data inconsistency/gaps, uncertainty in projections (31%), lack of knowledge/information on climate change (15%), coordination with other agencies/stakeholders (15%), time (15%), transferring climate change information to staff/stakeholders (6%), prioritizing/ranking of land/restoration (6%), surrounding land ownership (6%).

Table 7. Humboldt responses (percentage of respondents; n=13) to the prompt "to rate how often a method is used to learn about climate change".

	All the time	Frequently	Occasionally	Rarely	Do not use
In person training	0	8	38	31	15
Manuals	0	15	46	31	8
Conferences	0	8	46	31	15
Web based tools	0	23	23	38	15
List serves	8	31	15	15	31
Peers	23	31	38	8	0
Guidance documents	0	38	46	8	0
Internet	31	54	15	0	0
Data summary reports	8	38	15	38	0
Scientific journals	15	23	46	15	0

Table 8. Humboldt responses (percentage of respondents; n=13) to the prompt, "rate the usefulness of available tools in helping to incorporate climate change into management decisions".

	Extremely useful	Very useful	Somewhat useful	Not useful at all	Do not know
Climate-smart conservation principles	15	46	23	0	15
WARMER tidal marsh modeling results	8	38	23	0	31
Global climate models	8	23	62	0	8
Downscale climate change models	15	31	38	0	15
Specific climate projections (e.g. sea-level rise, temperature)	38	54	8	0	0
Partner scientists	62	23	8	0	8
In-person workshops	69	15	8	0	8

4.5 San Pablo Bay Workshop Results

Workshop: September 25, 2014, Petaluma, CA

Staff from the U.S. Geological Survey, Western Ecological Research Center, San Francisco Bay Estuary Field station's Coastal Ecosystem Response to Climate Change (CERCC) program along with partners from Oregon State University held a one-day (September 25, 2014) workshop in Petaluma, CA with a focus on San Pablo Bay NWR results. The workshop was attended by fifteen participants representing eight agencies (Table 16).

A. Participant Pre-survey

The pre-survey was administered through Survey Monkey (surveymonkey.com) to 13 participants (NPLCC and NWCSC personnel where not asked to take survey), 9 persons took the survey for a response rate of 69%.

- Demographics of respondents: the pool of respondents (n=9) was made up of U.S. Fish and Wildlife Service (45%), U.S. Geological Survey (22%), nonprofit (22%), and consultant (11%). Seven respondents had a graduate degree, one had a bachelor's degree, and one had a high school degree.
- Fifty-five percent (n=5) of the respondents had formal training in climate change science.
- When asked "Which of these climate change drivers do you think will affect your estuary most?"
    - 44% of respondents ranked sea-level as their highest concern,
    - hydrologic change or extreme weather were ranked either second or third by the majority of respondents.
    - When rankings were averaged, ranking (from highest to lowest) were: sea-level rise, hydrologic change, extreme weather (same average ranking as hydrologic change), water temperature change, atmospheric warming, and ocean acidification (Figure 34).
- When asked to rank management concerns, tidal wetland loss was ranked highest, followed by threatened and endangered species and restoration. Results are summarized in Figure 35.

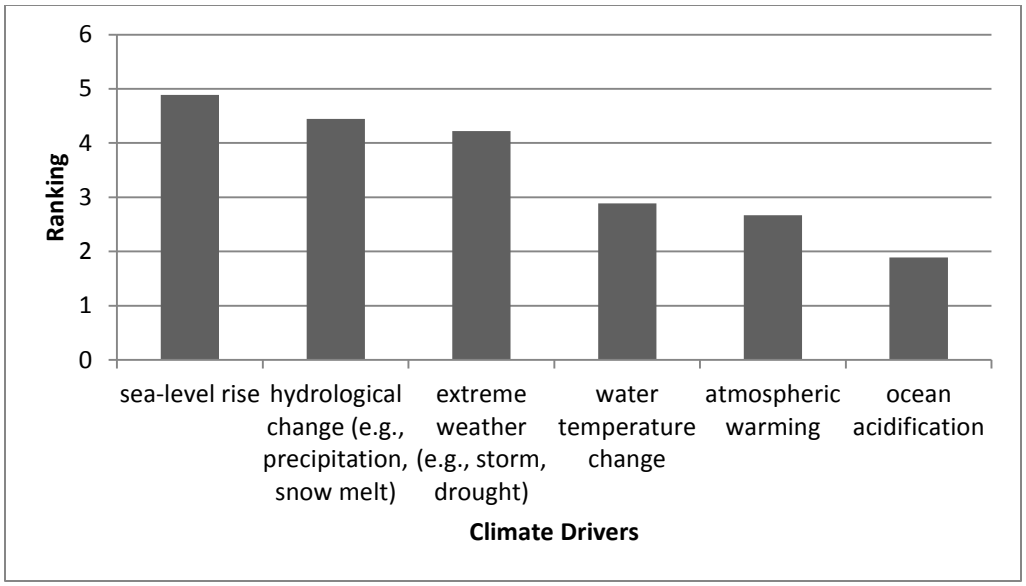


Figure 34. Averaged rankings from respondents on what climate change drivers they think will most affect the San Pablo Bay estuary. 0 = low, 6 = high.

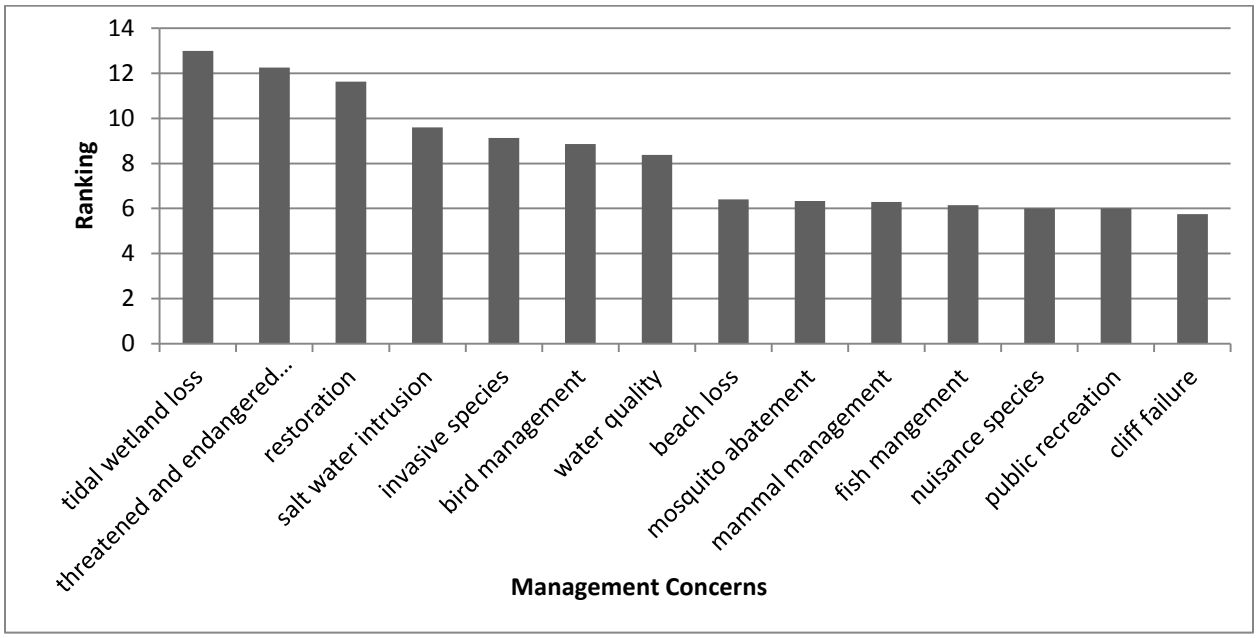


Figure 35. Participants were asked to rank their management concerns for San Pablo Bay estuary. Method was a multiple choice prompt and participants were asked to rank the following categories. Graph represent average ranking with higher numbers equaling a larger management concern.

B. Workshop Exercises

During the workshop participants worked through exercises to identify what they are currently managing, key natural and cultural resources, vulnerabilities to their estuary and science-management needs.

What type of habitats do you manage?

Uplands	Riparian	Marine	Beaches & Dunes	Wetlands	Other
Managed ponds				Tidal wetlands	

Map exercises from San Pablo Bay estuary workshop

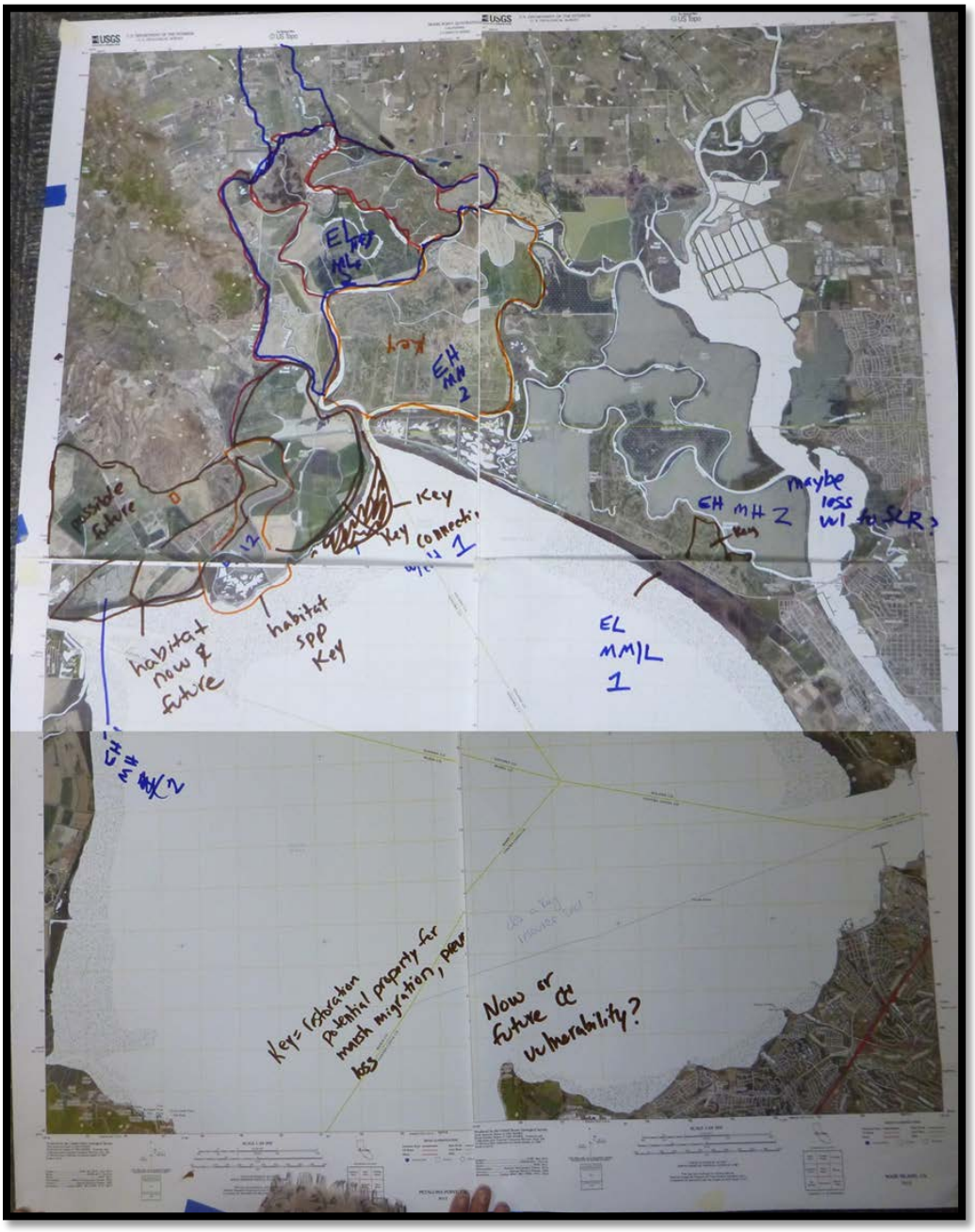


Figure 36. Team 1: San Pablo Bay – Sediment was identified as a key resource. Also restoration sites are currently the best strategy for maintaining marsh in the future. However the understanding of how restorations sites are functioning and will respond to sea-level rise in poorly understood. Upland areas of great importance were identified as future areas of marsh migration and restoration. Endangered species habitats were identified as a key resource.

Figure 37. Team 2: San Pablo Bay– Threatened and endangered species and migratory bird were identified as key ecological attributes for this area. Understanding sediment dynamics and increasing the amount of protected land and connectivity were important themes. Management decisions will influence the species that have benefit from pond restorations. More financial support for monitoring and restoration is needed.

Identified science-management needs

Physical	Biological	Modeling	Preparation & Planning	Resources	Policy & Regulation	Other
Elevation	Marsh processes	CC models general	Management goals	Funding uncertainty		Site specific
Sediment supply	Marsh migration	Modeling accuracy/ validation (eg SETS)	Prioritization			Infrastructure constraints
Inundation/decomposition in brackish vs freshwater (eg Rush Ranch)	Invasive species and SLR		Adaptation strategy			Infrastructure vulnerability
	Predation and upland transition zones		Management guidance			
Restored salt pond sedimentation rate	Restoration outcomes		Land owner planning			
Ecological effects of natural disasters	Vegetation and levee stability					
			Management resilience consideration			
Storm impacts	Strip marsh as tidal wetlands					
Sediment supply/accretion			Case studies			
	Population connectivity		Refuge boundary expansion			
	T&E species source populations		Tidal marsh recovery plan implementation			
	T&E species monitoring					

C. Post-survey

The post-survey was administered at the workshop to participants at the end of the day, paper copies where distributed and collected.

- Demographics of respondents: the pool of respondents (n=5) was made up of federal agency (40%), consultant/other (40%), university (20%).

Multiple choice questions

- When asked to rate the usefulness of methods used to learn about climate change, respondents ranked in person training, web based tools, and peers as most frequently used, and scientific journals and data summary reports ranked as second most frequently used methods (Table 9).
- When asked to rate the usefulness of available tools in helping to incorporate climate change into management decisions, respondents rated downscale climate change models, specific climate projections, and partner scientists as the most useful tools (Table 10).

Short answer questions

- When asked about key management concerns, respondents (n=5) mentioned: tidal wetland habitat (100%), threatened and endangered species (40%), invasive species (40%), sea-level rise restoration design/implementation (40%), vulnerability of coastal wetlands to sea-level rise (20%), and the need for transitional marsh and upland habitats (20%).
- When asked what type of information is needed to incorporate climate change into management the respondents mentioned: guidance to make climate change strategic decisions/actions (80%), improved/more baseline data (60%), downscaled climate change models (40%), improved certainty of models (20%), prioritizing most vulnerable and most adaptable (20%).
- When asked what the main challenges are to incorporate climate change into management respondents (60%) mentioned: incorporating planning/actions now for future conditions (40%), lack of resources/funding/political support (40%), accurately predicting change due to management decisions (20%), regulatory constraints (20%).

Table 9. San Pablo responses (percentage of respondents; n=5) to the prompt, "to rate how often a method is used to learn about climate change ".

	All the time	Frequently	Occasionally	Rarely	Do not use
In person training	40	0	40	20	0
Manuals	20	20	20	20	20
Conferences	20	40	20	20	0
Web based tools	40	0	60	0	0
List serves	20	0	40	40	0
Peers	40	20	40	0	0
Guidance documents	20	20	60	0	0
Internet	20	40	40	0	0
Data summary reports	20	60	20	0	0
Scientific journals	20	60	20	0	0

Table 10. San Pablo responses (percentage of respondents; n=5) to the prompt, "rate the usefulness of available tools in helping to incorporate climate change into management decisions".

	Extremely useful	Very useful	Somewhat useful	Not useful at all	Do not know
Climate-smart conservation principles	0	60	40	0	0
WARMER tidal marsh modeling results	20	40	20	0	20
Global climate models	0	20	60	20	0
Downscale climate change models	20	60	20	0	0
Specific climate projections (e.g. sea-level rise, temperature)	20	60	20	0	0
Partner scientists	20	60	0	0	20
In-person workshops	20	40	40	0	0

4.6 San Diego Bay Estuary Workshop Results

Workshop: December 15, 2014, Imperial Beach, CA

Staff from the U.S. Geological Survey, Western Ecological Research Center, San Francisco Bay Estuary Field station's Coastal Ecosystem Response to Climate Change (CERCC) program along with partners from Oregon State University held a one-day (December 15, 2014) workshop in Imperial Beach, CA with a focus on Tijuana Slough NWR and Tijuana River National Estuarine Research Reserve (TRNERR) results. The workshop was attended by twenty-six participants representing nine agencies or groups (Table 16).

A. Participant Pre-survey

The pre-survey was administered through Survey Monkey (surveymonkey.com) to 48 participants (NPLCC and NWCSC personnel where not asked to take survey), the response rate was 23% (11 participants).

- Demographics of respondents: The pool of respondents (11) was made up of U.S. Fish and Wildlife Service (64%), nonprofit (18%), federal agency (9%), and state agency (9%). Six of respondent had a bachelor's degree; the other five had a graduate degree.
- Fifty-four percent of the respondents had formal training in climate change science.
- When asked "Which of these climate change drivers do you think will affect your estuary most?"
    - 55% of the respondents ranked sea-level highest,
    - extreme weather was ranked second by five of the respondents.
    - When rankings were averaged, ranking (from highest to lowest) was: sea-level rise, water temperature change, extreme weather (same average ranking as water temperature change), hydrologic change, ocean acidification, and atmospheric warming (Figure 38).
- When asked to rank management concerns, threatened and endangered species was ranked highest, followed by tidal wetland loss and restoration. Results are summarized in Figure 39.

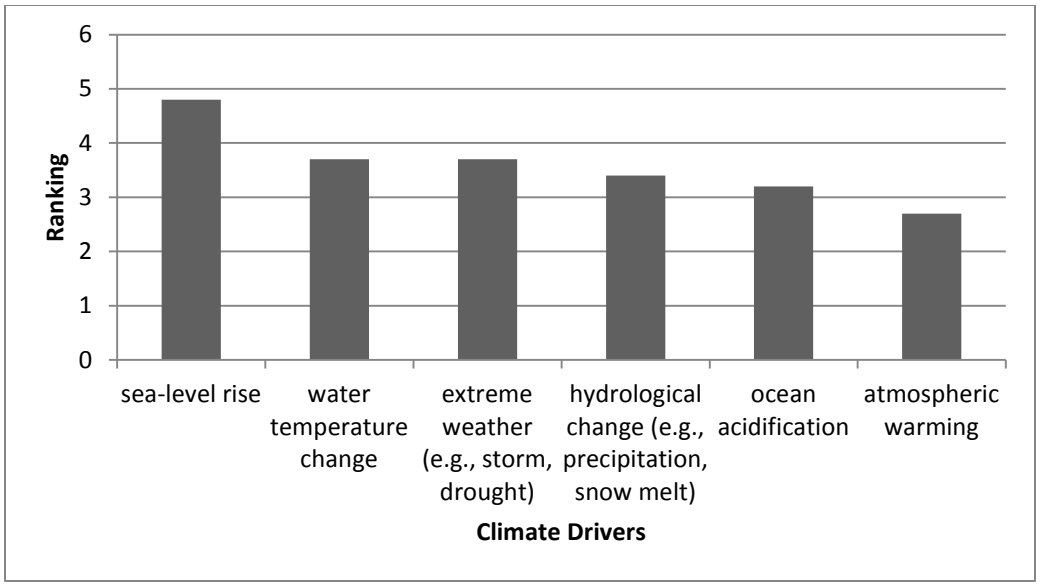


Figure 38. Averaged rankings from respondents on what climate change drivers they think will most affect the San Diego Bay estuary. 0 = low, 6 = high.

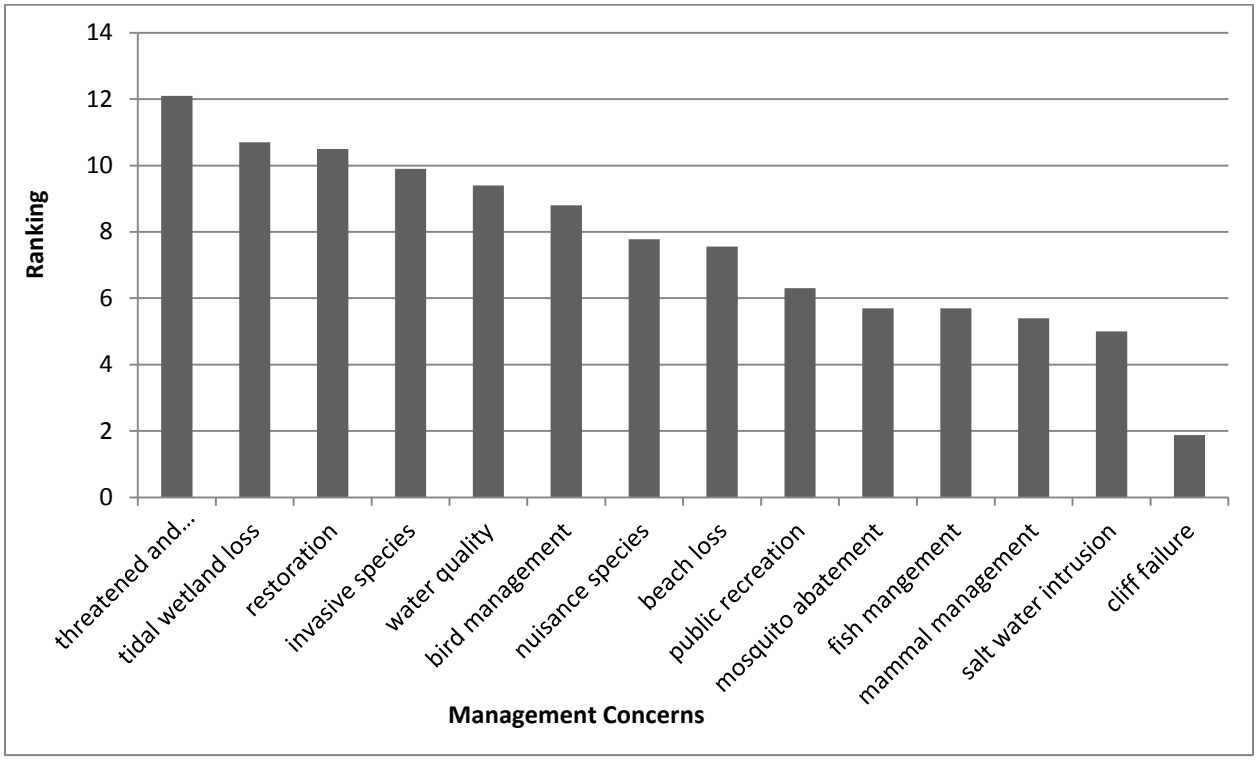


Figure 39. Participants were asked to rank their management concerns for San Diego Bay estuary. Method was a multiple choice prompt and participants were asked to rank the following categories. Graph represent average ranking with higher numbers equaling a larger management concern.

B. Workshop Exercises

During the workshop participants worked through exercises to identify what they are currently managing, key natural and cultural resources, vulnerabilities to their estuary, and science-management needs.

What type of habitats do you manage?

Uplands	Riparian	Marine	Beaches & Dunes	Wetlands	Other
Coastal sage scrub	Riparian	Estuarine		Coastal wetlands	T&E species
Oak woodlands		Intertidal/subtidal		Salt marsh	S. CA habitats
		Bays			
		Eelgrass			

Map exercises from San Diego Bay estuary workshop

Figure 40. Team 1: San Diego Bay full map – this team focused on remaining open space within the estuary and the habitat currently managed for threatened and endangered species and strategies to increase connectivity across habitats.

Figure 41. Team 1: San Diego Bay south – there is a high level of uncertainty about whether the mouth of the Tijuana River will remain open and this was identified as a key science need. Eelgrass, snowy plovers, and light-footed Ridgway's rails were identified as key resources and their associated habitats. Restoration current and future sites were considered important.

Figure 42. Team 2: San Diego Bay full map – Maintaining threatened and endangered species was identified as a priority. Enhancing existing habitats to build climate change resilience was identified as important.

Figure 43. Team 2: San Diego Bay south – Beach dune habitat and wetland habitat is limited and very vulnerable. Maintaining public access is a priority.

Figure 44. Team 3: San Diego Bay full map – This group goals included buffering urban development with natural defense's (living shorelines) and maintaining coastal wetlands. This group identified that resources were limited but of high value to prevent climate change impacts. This group discussed identifying and improving potential migration corridors for wetlands as well as marsh augmentation and the effect of changes in Nitrogen on species. Existing wetlands on the Refuge and NERR were identified as highly vulnerable from climate change. Also salt pond restoration sites were identified as important and highly vulnerable from sea-level rise.

Figure 45.Team 5: San Diego Bay full map – Maintaining endangered species and developing sort and long term strategies and goals was identified as critical. The amount of land is limited but identifying off refuge lands that could support these species is important. Most low lying areas were identified as vulnerable from sea-level rise.

Figure 46. Team 5: San Diego Bay south – a better understanding of the historical ecology of the south arm was viewed as critical. Little is understood about the sediment runoff future projections, freshwater flow amounts, and closing of the mouth events.

Identified science-management needs

Physical	Biological	Modeling	Preparation & Planning	Resources	Policy & Regulation	Other
Elevation surveys, on/off refuge	CC impacts on habitats	Sediment/ accretion models	Adaptation/restoration strategy, short vs long term	Personnel training	Wetland mitigation	Baseline data
Spatial variation in sediment	CC impacts on species, response time	Site specific models	Acqusition of adjacent lands	Time for training	City cooperation	Regional connectivity with Mexico
Episodic event effects	Beach-dependent species adaptation and beach loss	Hydrology	Management time scale determination	Science collaboration	Political support	Site specific
Sediment and hydrology dynamics, sand deposition	Marsh upslope migration	SLR models	CC and project adaptation		Stakeholder collaboration	
Storm frequency	Migratory bird habitat management, military impact	South arm modeling, flow regimes	Planning for bay closure possibility			
Southern dunes and deposition	Fine sediment transfer ecological impact		Project efficacy monitoring			
	Future/current habitat management		Maintain Tijuana River mouth			
	Invasive species					

C. *Post-survey*

The post-survey was administered at the workshop to participants at the end of the day, paper copies where distributed and collected.

- Demographics of respondents: The pool of respondents (n=15) was made up of federal agency (80%), nonprofit (14%), and state agency (6%).

Multiple choice questions

- When asked to rate the usefulness of methods used to learn about climate change, respondents (27%) ranked internet as the method used most frequently, and scientific journals ranked second (20%) (Table 11).
- When asked to rate the usefulness of available tools in helping to incorporate climate change into management decisions, in-person workshops (33%), and partner scientists (20%) , downscale climate change models (20%), specific projections (20%), and WARMER results (20%) were all rated 'most useful' by respondents (% of respondents that rated tool 'most useful' in parentheses) (Table 12).

Short answer questions

- When asked about key management concerns respondents (13) mentioned: coastal/estuarine habitats (30%), predictions of climate change effects (20%), invasive species (20%), threatened and endangered species (13%), water management/quality (13%), impacts of management decisions/actions (6%), conservation within political climate (6%), strategies to address climate change (e.g. sea-level rise; 6%), habitat restoration (6%), human use (6%),
- When asked what type of information is needed to incorporate climate change into management the respondents (n=11) mentioned: more/improved multi-variable base line data sets (36%), downscaled models/analysis/discussion (27%), adaptation strategies and measures of their success/feasibility (18%), rates of change from climate change (9%), species and habitat relationships and impacts from climate change (9%), collaboration and coordination between broad stakeholder groups (9%), wetland mitigation projects (9%), local politics/regulations (n=1), and formal climate change training (9%).
- When asked what the main challenges are to incorporate climate change into management respondents mentioned: uncertainty of data/models/ magnitude of changes (45%), lack of knowledge/local data/models and data availability (36%), funding support (27%), time and scale of

climate change issues (18%), regulatory issues (9%), informing other agencies and stakeholders about climate change (9%), planning current projects with future in mind (9%), urban development constraints (9%), and management slow to make decisions (9%)

Table 11. San Diego responses (percentage of respondents; n=15) to the prompt, "to rate how often a method is used to learn about climate change ".

	All the time	Frequently	Occasionally	Rarely	Do not use
In person training	7	7	40	40	0
Manuals	0	20	53	13	13
Conferences	0	0	47	40	0
Web based tools	7	20	40	27	0
List serves	0	7	20	33	27
Peers	13	46	27	7	0
Guidance documents	0	13	73	13	0
Internet	27	20	47	7	0
Data summary reports	0	27	47	13	7
Scientific journals	20	33	27	13	0

Table 12. San Diego responses (percentage of respondents; n=15) to the prompt, "rate the usefulness of available tools in helping to incorporate climate change into management decisions".

	Extremely useful	Very useful	Somewhat useful	Not useful at all	Do not know
Climate-smart conservation principles	13	40	20	0	13
WARMER tidal marsh modeling results	20	40	13	7	7
Global climate models	0	27	53	7	0
Downscale climate change models	20	33	13	7	20
Specific climate projections (e.g. sea-level rise, temperature)	20	47	27	0	0
Partner scientists	27	33	27	0	0
In-person workshops	33	27	33	0	0

Acknowledgments

The authors would like to thank the U.S. Geological Survey, Western Ecological Research Center and the U. S. Fish and Wildlife Service Refuges for support and the willingness to participate in this project. Research results presented at these workshops were funded by the U.S. Department of the Interior (DOI) Northwest and Southwest Climate Science Centers. We also would like to thank the close cooperation of the refuge staff and other managers that participated in these workshops. The authors would like to thank I. Woo, K. Spragens, and S. De La Cruz, for project assistance.

Appendix I: Workshop Invite Lists

Table 13. List of persons invited to attend Nisqually workshop, bolded names indicate participants that attended one or more days of the workshop. Invite list was developed with consultation of refuge staff.

Nisqually Invite List	
Name	Affiliation
Amit Armstrong	Federal Highway Administration
Bill Kingman	City of DuPont
Betty Bookheim	**Washington Department of Natural Resources**
Birdie (Roberta) Davenport	**Washington Department of Natural Resources**
Brian Combs	South Puget Sound Salmon Enhancement Group
Brian Root	**United States Fish and Wildlife Service**
Christopher Ellings	Nisqually Indian Tribe
City of Lacey	City of Lacey
Curtis Tanner	FWS/ WWO
David Patte	USFWS
David Troutt	**Nisqually Indian Tribe**
Daniel Hull	**Nisqually Reach Nature Center**
Doug Roster	**United States Fish and Wildlife Service**
Glynnis Nakai	**United States Fish and Wildlife Service**
Jessica Bateman	City of Olympia
Joe Kane	Nisqually Land Trust
John Mankowski	**North Pacific Landscape Conservation Cooperative**
Justin Hall	**Nisqually River Foundation**
Lance Winecka	South Puget Sound Salmon Enhancement Group
Lon Wyrick	Thurston County
Michelle Tirhi	Washington Department of Fish and Wildlife
Marian Bailey	**United States Fish and Wildlife Service**

Morgan Greene	Nisqually River Foundation
Stephanie Suter	Puget Sound Partnership
Terry Austin	Joint Base Lewis McChord
Tim Hagan	Pierce County Surface Water Management
Tom Kantz	Pierce County
Treva Coe	Nooksack Indian Tribe
Michael Cox	Environmental Protection Agency
Angela Bonafaci	Environmental Protection Agency
Yongwen Gao	Makah Fisheries Management
Meghan Kearney	North Pacific Landscape Conservation Cooperative

Table 14. List of persons invited to attend Willapa workshop, bolded names indicate participants that attended one or more days of the workshop. Invite list was developed with consultation of refuge staff.

Willapa Invite List	
Name	Affiliation
Bruce Kauffman	WDFW
Catherine Corbett	Lower Columbia Estuary Partnership
Christopher Conklin	Washington Department of Fish and Wildlife
Frank Wolfe	District 2 Commissioner
Steve Rogers	District 1 Commissioner
Dan Ayres	Washington Department of Fish and Wildlife
David Patte	FWS
Denise Lofman	CREST
Eva Kristofik	United States Fish and Wildlife Service
Gary Burns	Shoalwater Bay Tribe
Gus Bisbal	NWCSC
Jackie Ferrier	United States Fish and Wildlife Service
John Mankowski	North Pacific Landscape Conservation Cooperative
Jon Anderson	Washington State University
Kathleen Sayce	Consultant to Frank Wolfe (Pacific County Commission)

Kirsten Feifel	Washington Department of Natural Resources
Lisa Lantz	Washington State Parks
Madeline Ishikawa	CREST
Margaret Varrette	Pacific Coast Shellfish Grower's Association
Mary Mahaffy	North Pacific Landscape Conservation Cooperative
Matt Niles	Washington Department of Natural Resources
Nicole DeCrappeo	United State Geological Survey
William Ritchie	United States Fish and Wildlife Service

Table 15. List of all persons invited to Siletz workshop, bolded names indicate participants that attended one or more days of the workshop. Invite list was developed with consultation of refuge staff.

Siletz Invite List	
Name	Affiliation
Adam Roberts	Oregon Department of Transporation
Andrea Hansen	Oregon Department of Fish & Wildlife
Bobbak Talebi	ECY
Bruce Taylor	Oregon Habitat Joint Venture
Catherine Pruett	Salmon River- Drift Creek Watershed Council
Chris Swenson	Pacific Region Coastal Program
Christina Folger	US EPA
Craig Cornu	SSNERR
Curt Mycut	Ducks Unlimited
Curtis Loeb	ESA Consultants
Curtis Loeb	ESA
Darlene Siegel	ESA Consultants
Darlene Siegel	ESA Associates
David Patte	United States Fish and Wildlife Service
Debbie Pickering	Nature Conservancy
Divison of State Lands	Division of State Lands

Eric Murz	United States Fish and Wildlife Service
Ester Lev	Wetlands Conservancy
Fran Recht	Mid-Coast Watershed Council
Glenn Guntenspergen	USGS
Henry Lee III	EPA
Jack Doyle	Lincoln City Audubon
Jason Kirchner	Oregon Department of Fish & Wildlife
Jean Carter	Nature Conservancy
Jeffrey Weber	Oregon Coastal Management Program
John Bragg	National Estuarin Research Reserve - South Slough
John Mankowski	North Pacific Landscape Conservation Cooperative
John Spangler	Oregon Department of Fish & Wildlife
Joy Vaughan	Oregon Department of Fish & Wildlife
Laura Brophy	Estuary Technical Group, Institute for Applied Ecology
Lisa Phipps	Tillamook Estuaries Partnership
Mary Mahaffy	North Pacific Landscape Conservation Cooperative
Matt Spangler	Oregon Coastal Management Program
Nicole DeCrappeo	Northwest Climate Science Center
Paul Englemeyer	Wetlands Conservancy
Rebecca Chuck	U.S. Fish and Wildlife Service
Rebecca Chuck	United States Fish and Wildlife Service
Rebecca Flitcroft	USDA Forest Service, PNW Research Station
Richard Townsend	City of Lincoln City
Roy Lowe	USFWS
Shawn Stephensen	USFWS
Stan Van De Wetering	Confederated Tribes of the Siletz Indians
Steve Rumrill	Oregon Department of Fish and Wildlife
Tony Stein	Oregon Parks and Recreation Department
Wayne Hoffman	MidCoast Watershed Council

Table 16. List of all persons invited to Humboldt workshop, bolded names indicate participants that attended one or more days of the workshop. Invite list was developed with consultation of refuge staff.

Humboldt Invite List	
Name	Affiliation
Adona White	Regional Water Quality Control Board
Aldaron Laird	Humboldt Bay Municipal Water District
Alex Horangic	University of Arizona
Alison Meadow	University of Arizona - Center for Climate Adaptation Science and Solutions
Andrea Pickart	United States Fish and Wildlife Service
Annie Eicher	H. T. Harvey & Associates
Becky Price-Hall	Coastal Ecosystems Institute of Northern California
Bob Gearthart	Humboldt State University
Brett Vivyan	GHD
Brian Tissot	Humboldt State University
Chet Ogan	Redwood Region Audubon Society
Chuck Swanson	HSU, City of Arcata
Conor Shea	United States Fish and Wildlife Service
Craig Benson	RCAA
Dan Berman	Humboldt Bay Harbor District
David Fuller	US Bureau of Land Management
Diane Ashton	National Marine Fisheries Service
Eileen Hemphill-Haley	HSU Dept Geology
Eric Nelson	United States Fish and Wildlife Service
Erin Taylor	USDA-NRCS
Greg O'Connell	SHN Consulting Engineers & Geologists; North Coast Chapter of the California Native Plant Society
Hank Seemann	Humboldt County Public Works
James Ray	California Dept. Fish and Wildlife

Jeff Anderson	Northern Hydrology & Engineering
Jennifer Curtis	USGS
Jeremy Svehla	GHD
Jill Demers	Coastal Ecosystems Institute & Humboldt Bay Initiative
Joe Tyburczy	California Sea Grant
Joel Gerwein	State Coastal Conservancy
Julie Neander	City of Arcata Environmental Services
Kelley Garrett	Caltrans
Kelly Malinowski	State Coastal Conservancy
Ken Griggs	United States Fish and Wildlife Service
Lisa Shikany	City of Eureka
Lynn Roberts	United States Fish and Wildlife Service
Marcella Clem	Humboldt County Association of Governments
Mark Andre	City of Arcata
Mary Mahaffy	LCC
Melanie Faust	Coastal Commission
Miles Slattery	City of Eureka
Omar Alshafie	HSU
Oona Smith	Humboldt State University
Paula Golightly	United States Fish and Wildlife Service
Rebecca Fris	LCC
Rebecca Garwood	Cal. Dept. Fish and Wildlife
Rhea Williamson	Humboldt State University
Riley Topolewski	City of Eureka
Robert Holmlund	Winzler and Kelly
Robert Sullivan	California Department of Fish and Wildlife Service
Scott Demers	HT Harvey
Sharon Kahara	Humboldt State University
Shayne Green	North Coast Regional Land Trust
Sherry Constancio	Caltrans

Steve Jackson	USGS
Stephanie Frederickson	CalTrans
Stephen Kullmann	Wiyot Tribe
Steve Kramer	USFWS
Vicki Frey	CDFW
Walt Duffy	Humboldt State Univ/US Geological Survey

Table 17. List of all persons invited to San Pablo workshop, bolded names indicate participants that attended one or more days of the workshop. Invite list was developed with consultation of refuge staff.

San Pablo Invite List	
Name	**Affiliation**
Andrea Graffis	Landscape Conservation Cooperative
Anne Morkill	**United States Fish and Wildlife Service**
Debbie Elliot-Fisk	**University California Davis**
Debra Schlafmann	**Landscape Conservation Cooperative**
Don Brubaker	**United States Fish and Wildlife Service**
Giselle Block	**United States Fish and Wildlife Service**
Joy Albertson	United States Fish and Wildlife Service
Julian Meisler	Sonoma Baylands
Karen Taylor	**California Department of Fish and Wildlife**
Ken Burg	**United States Fish and Wildlife Service**
Kristin Byrd	**United States Geological Survey**
Louis Terrazas	**United States Fish and Wildlife Service**
Matt Brennan	**ESA consulting**
Meg Marriott	**United States Fish and Wildlife Service**
Renee Spenst	**Ducks Unlimited**

Susanne von Rosenberg	**GAIA Consulting**
Winnie Chan	**United StatesFish and Wildlife Service**

Table 18. List of all persons invited to San Diego workshop, bolded names indicate participants that attended one or more days of the workshop. Invite list was developed with consultation of refuge staff.

San Diego Invite List	
Name	**Affiliation**
Alison Anderson	United States Fish and Wildlife Service
Amber Pairis	**California Department of Fish and Wildlife**
Andrew Yuen	**San Diego NWR Complex**
Ben Vallejos	Living Coast Discovery Center
Brian Collins	**United States Fish and Wildlife Service**
Bruce Shaffer	US Navy
Carolyn Lieberman	**United States Fish and Wildlife Service**
Chris Helmer	City of Imperial Beach
Chris Nordby	Southwest Wetlands Interpretive Association
Chris Peregrin	CA State Parks
Clark Winchell	**United States Fish and Wildlife Service**
Dani Boudreau	**Tijuana River NERR**
David Zoutendyk	**United States Fish and Wildlife Service**
Ed Pert	**California Department of Fish and Wildlife**
Eileen Maher	Port of San Diego
Emily Young	San Diego Foundation
Evyan Borgnis	California State Coastal Conservancy
Gjon Hazard	**United States Fish and Wildlife Service**
Greg Gauthier	California State Coastal Conservancy
Hank Levien	City of Imperial Beach
Jaime Hotz	United States Fish and Wildlife Service
Jason Giffen	Port of San Diego

Jeff Crooks	**TRNERR**
Jim Nakagawa	City of Imperial Beach
Jim Peugh	**San Diego Audubon Society**
Julio Lorda	**TRNERR**
Justin McCullough	**TRNERR**
Karen Goebel	**United States Fish and Wildlife Service**
Ken Corey	United States Fish and Wildlife Service
Kristen Goodrich	**TRNERR**
Lisa Stratton	Cheadle Center for Biodiversity & Ecological Restoration
Loni Adams	**California Department of Fish and Wildlife**
Mayda Winter	Southwest Wetlands Interpretive Association
Michelle Cordrey	TJ NERR
Mike McCoy	**Southwest Wetlands Interpretive Association**
Monica Almeida	**TRNERR**
Patrick Gower	**United States Fish and Wildlife Service**
Peter Beck	**United States Fish and Wildlife Service**
R.J. Van Sant	**USACE**
Rebecca Fris	**CALCC**
sandy vissman	**United States Fish and Wildlife Service**
Scott Sobiech	United States Fish and Wildlife Service
Slader Buck	**United States Fish and Wildlife Service**
Stewart Mendel	United States Fish and Wildlife Service
Susan Wynn	**United States Fish and Wildlife Service**
Victoria Touchstone	**San Diego NWR Complex**
Wes Bomyea	collaborates with CALCC
William Miller	**United States Fish and Wildlife Service**
Yidelwo Asbu	County of San Diego

Appendix II: Workshop Agendas

Estuary Climate Change Workshop Agenda
Nisqually National Wildlife Refuge
Visitor Center Auditorium
Olympia, WA 98327
October 21-22, 2014

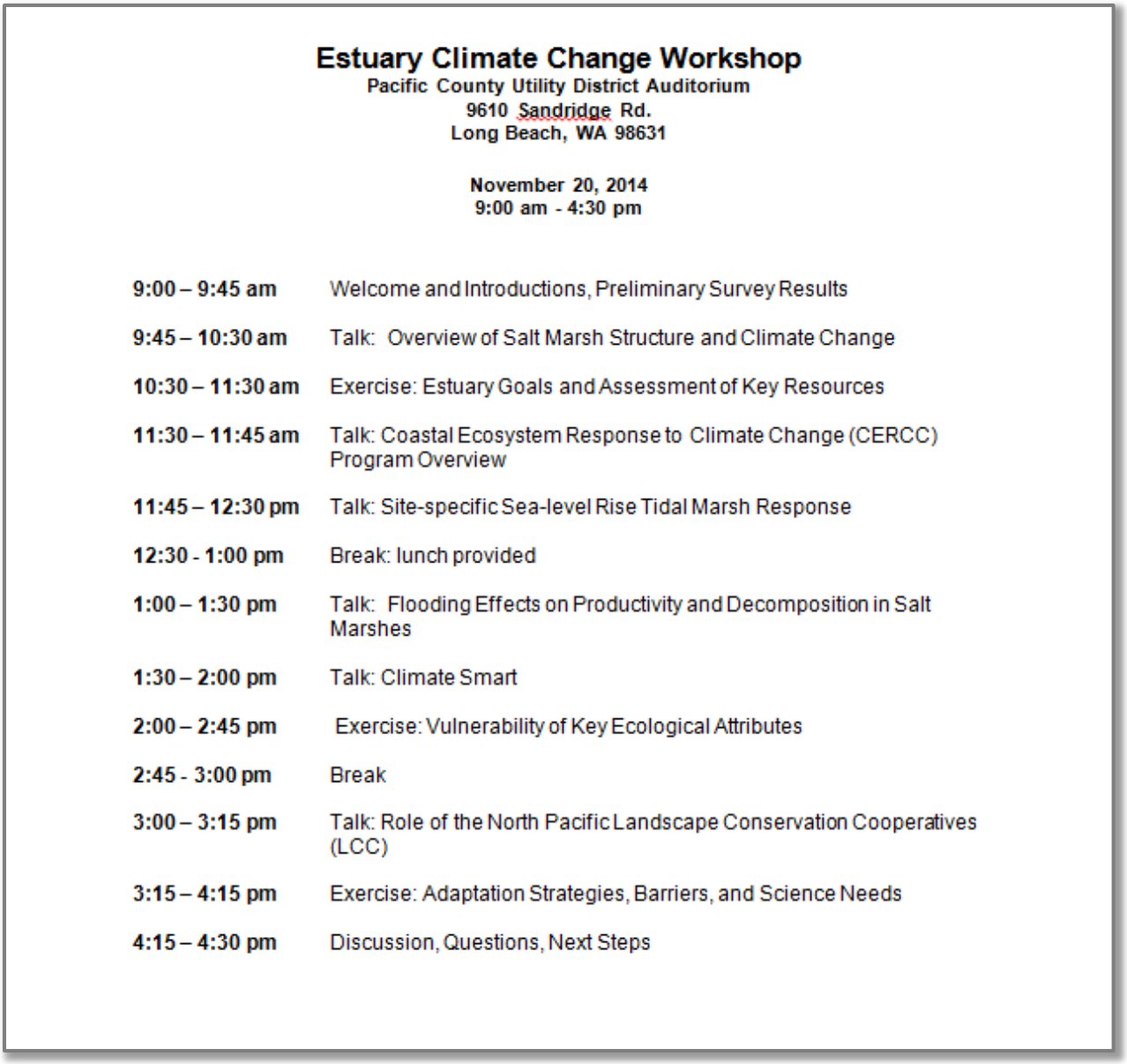
Day 1

10:00 – 10:30 am	Welcome and Introductions, Coffee
10:30 – 11:15 am	Talk: Overview of Salt Marsh Structure and Functioning- Chase Freeman, M.S.
11:15 - 11:45 am	Talk: Climate Smart and Preliminary Survey Results- Kat Powelson, M.S. Student
11:45 - 12:15 pm	Talk: Role of the Landscape Conservation Cooperatives (LCC) - John Mankowski
12:15 – 1:00 pm	Talk: Coastal Ecosystem Response to Climate Change (CERCC) Program Overview - Dr. John Takekawa (lunch provided)
1:00 – 2:00 pm	Talk: Site-specific Sea-level Rise Tidal Marsh Response Models - Chase Freeman, M.S. and Kevin Buffington, Ph.D. Student
2:00 – 2:30 pm	Break
2:30 - 3:30 pm	Exercise: Estuary assessment of key resources and vulnerability
3:30 - 4:00 pm	Discussion, Questions, Next Steps

Day 2

10:00 – 11:00 am	Workshop Recap, Question & Answer
11:00 – 11:45 am	Talk: Nisqually Restoration Update- Isa Woo, M.S.
11:45 - 12:15 pm	Talk: Nisqually Invertebrate Update- Melanie Davis, M.S.
12:15 – 1:45 pm	Exercise: Adaptation strategies, barriers, and science needs (lunch provided)
1:45 - 2:00 pm	Discussion, Questionnaire

Figure 47. Nisqually workshop agenda.



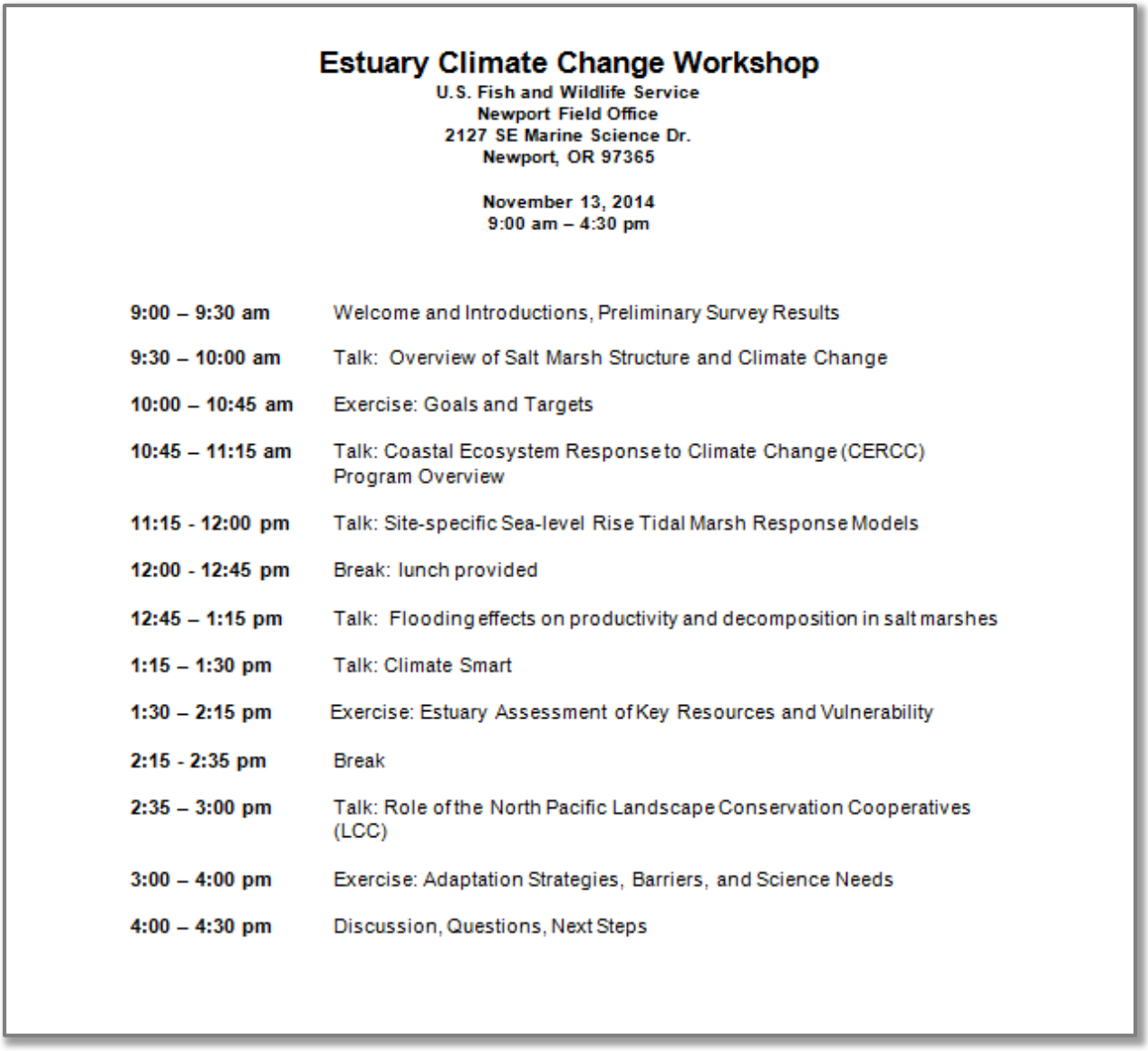
Estuary Climate Change Workshop

Pacific County Utility District Auditorium
9610 Sandridge Rd.
Long Beach, WA 98631

November 20, 2014
9:00 am - 4:30 pm

9:00 – 9:45 am	Welcome and Introductions, Preliminary Survey Results
9:45 – 10:30 am	Talk: Overview of Salt Marsh Structure and Climate Change
10:30 – 11:30 am	Exercise: Estuary Goals and Assessment of Key Resources
11:30 – 11:45 am	Talk: Coastal Ecosystem Response to Climate Change (CERCC) Program Overview
11:45 – 12:30 pm	Talk: Site-specific Sea-level Rise Tidal Marsh Response
12:30 - 1:00 pm	Break: lunch provided
1:00 – 1:30 pm	Talk: Flooding Effects on Productivity and Decomposition in Salt Marshes
1:30 – 2:00 pm	Talk: Climate Smart
2:00 – 2:45 pm	Exercise: Vulnerability of Key Ecological Attributes
2:45 - 3:00 pm	Break
3:00 – 3:15 pm	Talk: Role of the North Pacific Landscape Conservation Cooperatives (LCC)
3:15 – 4:15 pm	Exercise: Adaptation Strategies, Barriers, and Science Needs
4:15 – 4:30 pm	Discussion, Questions, Next Steps

Figure 48. Willapa Bay workshop agenda.



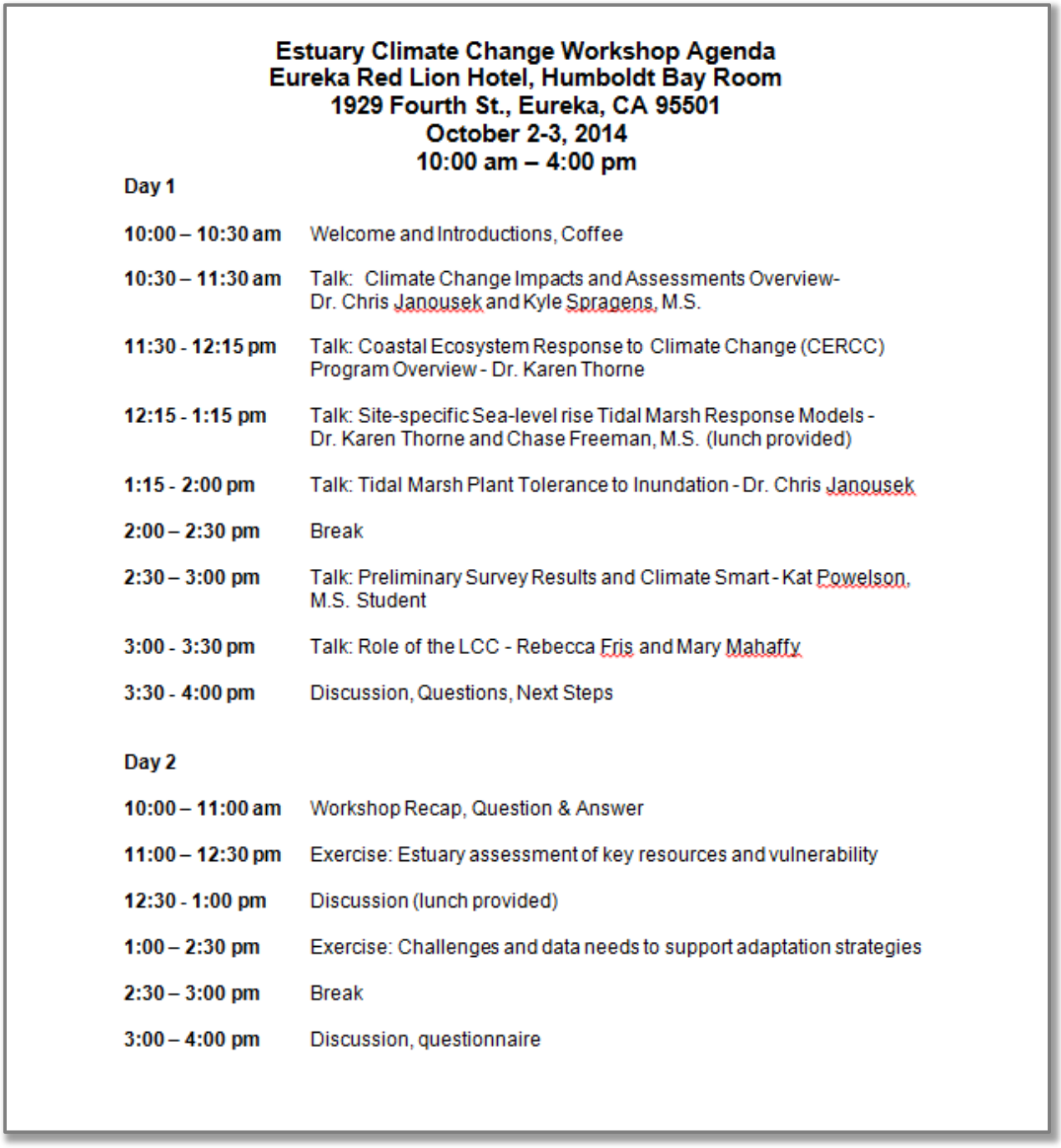
Estuary Climate Change Workshop

U.S. Fish and Wildlife Service
Newport Field Office
2127 SE Marine Science Dr.
Newport, OR 97365

November 13, 2014
9:00 am – 4:30 pm

9:00 – 9:30 am	Welcome and Introductions, Preliminary Survey Results
9:30 – 10:00 am	Talk: Overview of Salt Marsh Structure and Climate Change
10:00 – 10:45 am	Exercise: Goals and Targets
10:45 – 11:15 am	Talk: Coastal Ecosystem Response to Climate Change (CERCC) Program Overview
11:15 - 12:00 pm	Talk: Site-specific Sea-level Rise Tidal Marsh Response Models
12:00 - 12:45 pm	Break: lunch provided
12:45 – 1:15 pm	Talk: Flooding effects on productivity and decomposition in salt marshes
1:15 – 1:30 pm	Talk: Climate Smart
1:30 – 2:15 pm	Exercise: Estuary Assessment of Key Resources and Vulnerability
2:15 - 2:35 pm	Break
2:35 – 3:00 pm	Talk: Role of the North Pacific Landscape Conservation Cooperatives (LCC)
3:00 – 4:00 pm	Exercise: Adaptation Strategies, Barriers, and Science Needs
4:00 – 4:30 pm	Discussion, Questions, Next Steps

Figure 49. Siletz workshop agenda.



Estuary Climate Change Workshop Agenda
Eureka Red Lion Hotel, Humboldt Bay Room
1929 Fourth St., Eureka, CA 95501
October 2-3, 2014
10:00 am – 4:00 pm

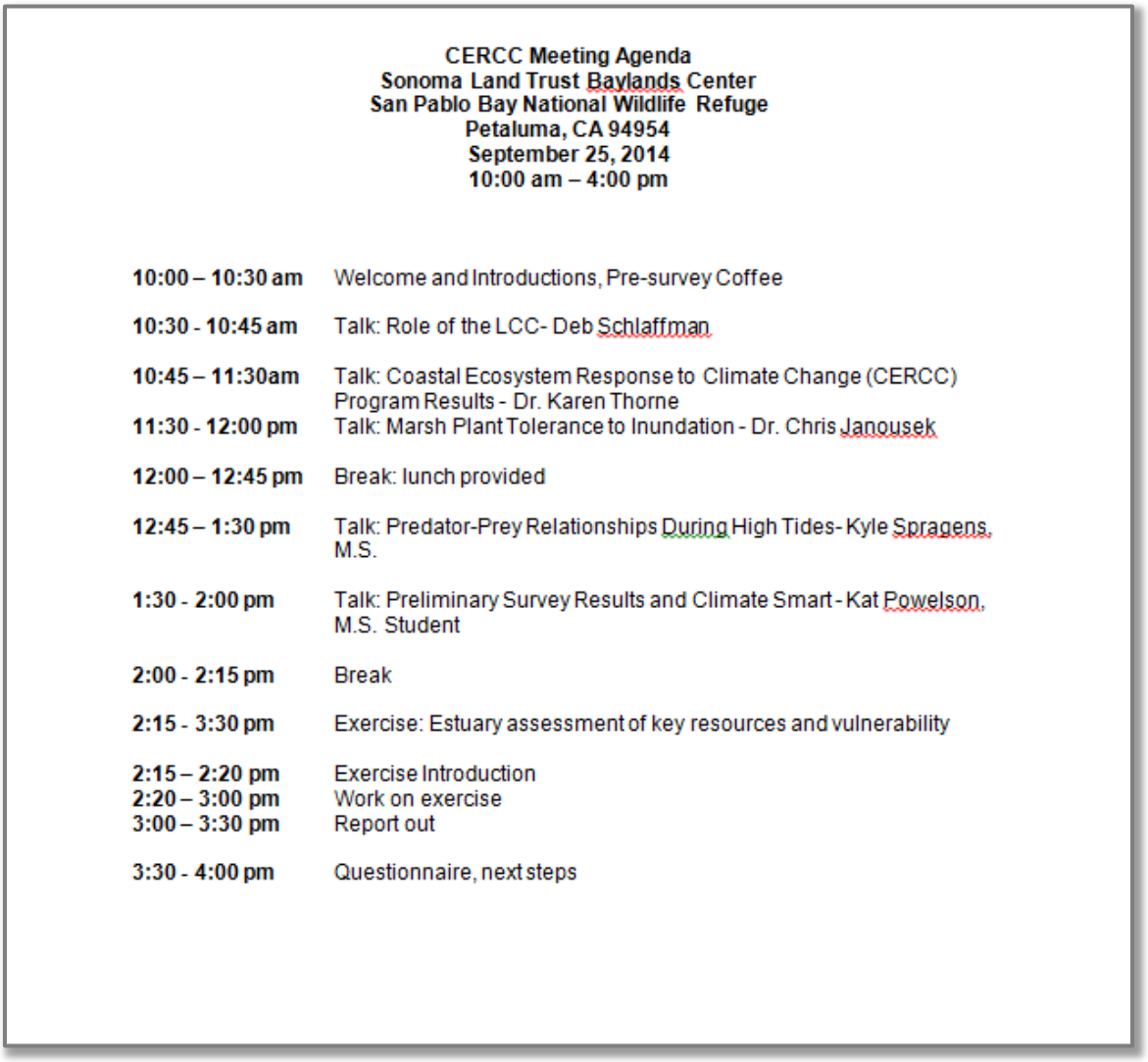
Day 1

10:00 – 10:30 am	Welcome and Introductions, Coffee
10:30 – 11:30 am	Talk: Climate Change Impacts and Assessments Overview- Dr. Chris Janousek and Kyle Spragens, M.S.
11:30 - 12:15 pm	Talk: Coastal Ecosystem Response to Climate Change (CERCC) Program Overview - Dr. Karen Thorne
12:15 - 1:15 pm	Talk: Site-specific Sea-level rise Tidal Marsh Response Models - Dr. Karen Thorne and Chase Freeman, M.S. (lunch provided)
1:15 - 2:00 pm	Talk: Tidal Marsh Plant Tolerance to Inundation - Dr. Chris Janousek
2:00 – 2:30 pm	Break
2:30 – 3:00 pm	Talk: Preliminary Survey Results and Climate Smart - Kat Powelson, M.S. Student
3:00 - 3:30 pm	Talk: Role of the LCC - Rebecca Fris and Mary Mahaffy
3:30 - 4:00 pm	Discussion, Questions, Next Steps

Day 2

10:00 – 11:00 am	Workshop Recap, Question & Answer
11:00 – 12:30 pm	Exercise: Estuary assessment of key resources and vulnerability
12:30 - 1:00 pm	Discussion (lunch provided)
1:00 – 2:30 pm	Exercise: Challenges and data needs to support adaptation strategies
2:30 – 3:00 pm	Break
3:00 – 4:00 pm	Discussion, questionnaire

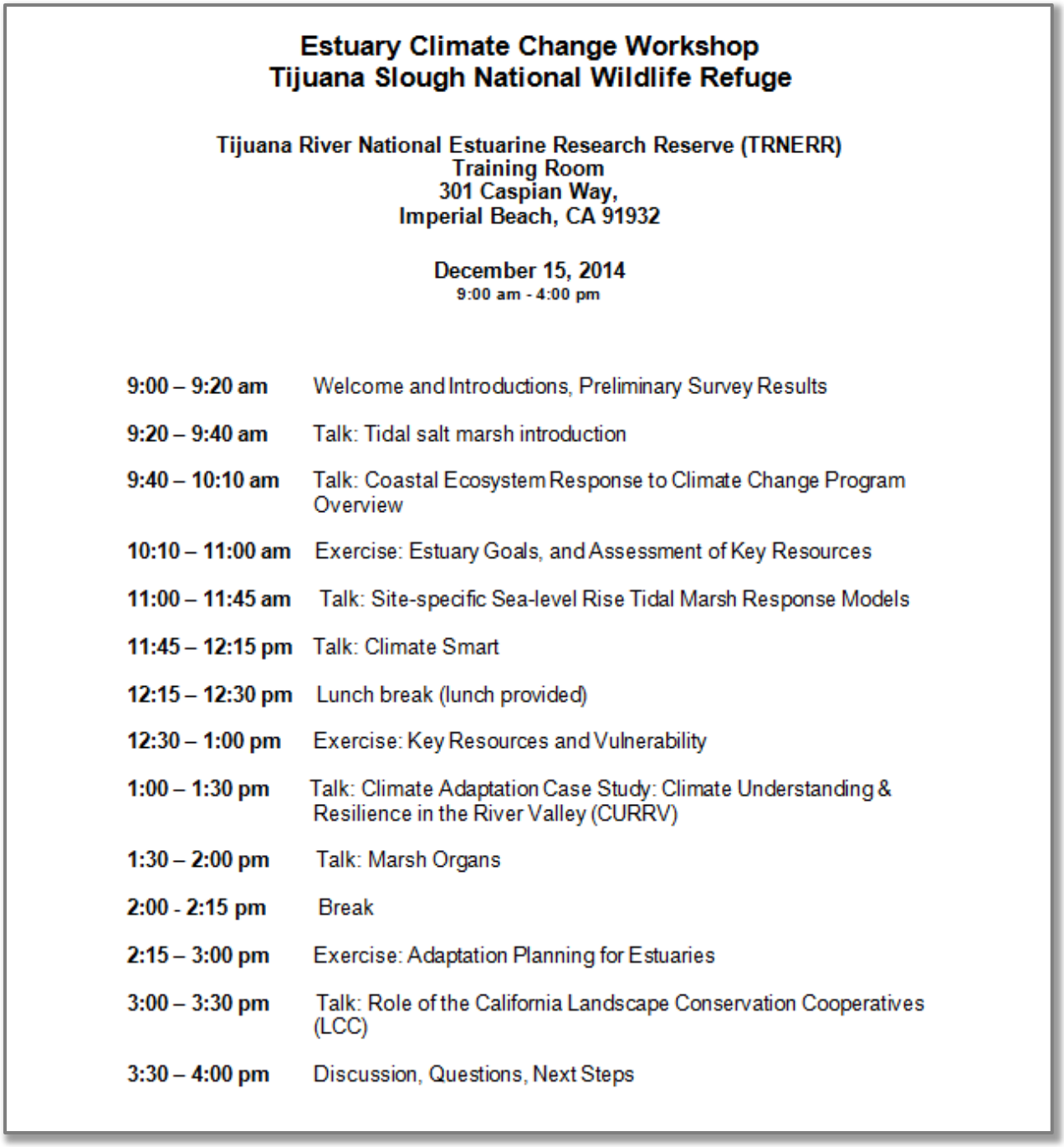
Figure 50. Humboldt Bay workshop agenda.



CERCC Meeting Agenda
Sonoma Land Trust Baylands Center
San Pablo Bay National Wildlife Refuge
Petaluma, CA 94954
September 25, 2014
10:00 am – 4:00 pm

10:00 – 10:30 am	Welcome and Introductions, Pre-survey Coffee
10:30 - 10:45 am	Talk: Role of the LCC- Deb Schlaffman
10:45 – 11:30am	Talk: Coastal Ecosystem Response to Climate Change (CERCC) Program Results - Dr. Karen Thorne
11:30 - 12:00 pm	Talk: Marsh Plant Tolerance to Inundation - Dr. Chris Janousek
12:00 – 12:45 pm	Break: lunch provided
12:45 – 1:30 pm	Talk: Predator-Prey Relationships During High Tides- Kyle Spragens, M.S.
1:30 - 2:00 pm	Talk: Preliminary Survey Results and Climate Smart - Kat Powelson, M.S. Student
2:00 - 2:15 pm	Break
2:15 - 3:30 pm	Exercise: Estuary assessment of key resources and vulnerability
2:15 – 2:20 pm	Exercise Introduction
2:20 – 3:00 pm	Work on exercise
3:00 – 3:30 pm	Report out
3:30 - 4:00 pm	Questionnaire, next steps

Figure 51. San Pablo Bay workshop agenda.



Estuary Climate Change Workshop
Tijuana Slough National Wildlife Refuge

Tijuana River National Estuarine Research Reserve (TRNERR)
Training Room
301 Caspian Way,
Imperial Beach, CA 91932

December 15, 2014
9:00 am - 4:00 pm

9:00 – 9:20 am	Welcome and Introductions, Preliminary Survey Results
9:20 – 9:40 am	Talk: Tidal salt marsh introduction
9:40 – 10:10 am	Talk: Coastal Ecosystem Response to Climate Change Program Overview
10:10 – 11:00 am	Exercise: Estuary Goals, and Assessment of Key Resources
11:00 – 11:45 am	Talk: Site-specific Sea-level Rise Tidal Marsh Response Models
11:45 – 12:15 pm	Talk: Climate Smart
12:15 – 12:30 pm	Lunch break (lunch provided)
12:30 – 1:00 pm	Exercise: Key Resources and Vulnerability
1:00 – 1:30 pm	Talk: Climate Adaptation Case Study: Climate Understanding & Resilience in the River Valley (CURRV)
1:30 – 2:00 pm	Talk: Marsh Organs
2:00 - 2:15 pm	Break
2:15 – 3:00 pm	Exercise: Adaptation Planning for Estuaries
3:00 – 3:30 pm	Talk: Role of the California Landscape Conservation Cooperatives (LCC)
3:30 – 4:00 pm	Discussion, Questions, Next Steps

Figure 52. San Diego workshop agenda.