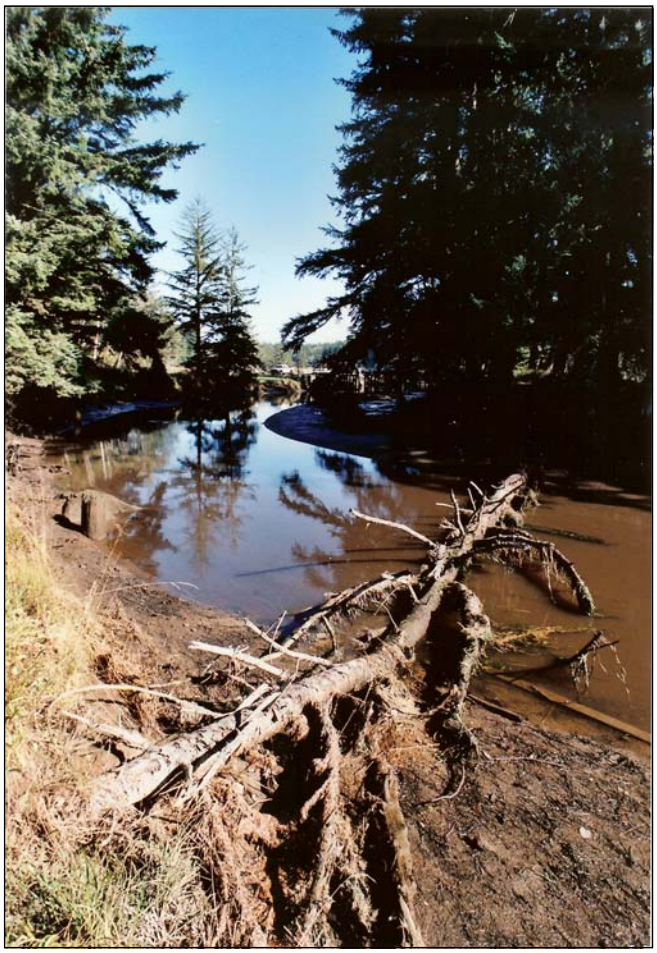
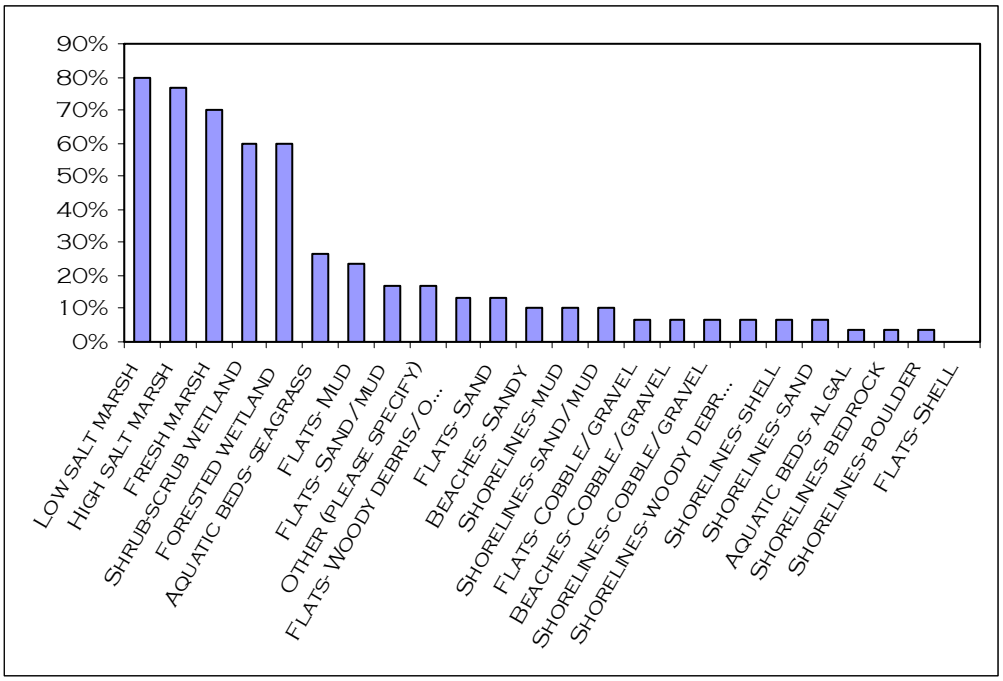
South Slough
National Estuarine Research Reserve

Pacific Northwest Estuarine Wetland Restoration Information Gaps Survey



Restoration Advisory Group meeting
July 10-12, 2007
South Slough Interpretive Center
Charleston Oregon

1) What habitat types are the focus of the habitat restoration activities with which you've been involved?



Low salt marsh	80.00%	24
High salt marsh	76.67%	23
Fresh marsh	70.00%	21
Shrub-scrub wetland	60.00%	18
Forested wetland	60.00%	18
Aquatic beds- seagrass	26.67%	8
Flats- Mud	23.33%	7
Flats- Sand/mud	16.67%	5
Other (please specify)	16.67%	5
Flats- Woody debris/org	13.33%	4
Flats- Sand	13.33%	4
Beaches- Sandy	10.00%	3
Shorelines- mud	10.00%	3
Shorelines- sand/mud	10.00%	3
Flats- Cobble/gravel	6.67%	2
Beaches- Cobble/gravel	6.67%	2
Shorelines- cobble/gravel	6.67%	2
Shorelines- woody debris/org	6.67%	2
Shorelines- shell	6.67%	2
Shorelines- sand	6.67%	2
Aquatic beds- algal	3.33%	1
Shorelines- bedrock	3.33%	1
Shorelines- boulder	3.33%	1
Flats- Shell	0.00%	0

Other (please specify)

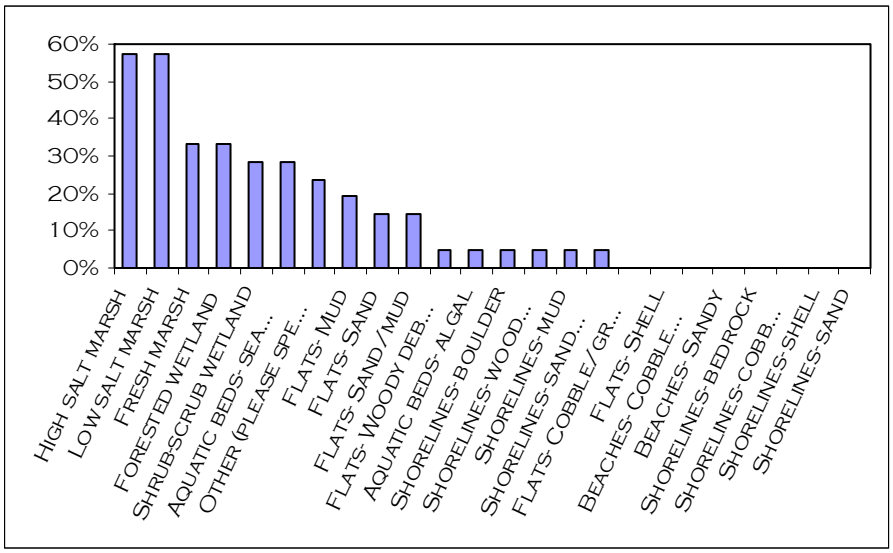
- Freshwater & tidal streams
- all of the above
- -shallow subtidal -tidal channel -pannes and ponds
- slough channels
- tidally influenced streams and river channels. Tide gate replacement

Answered	30
Skipped	1

2) Why have these these habitat types been the focus of your habitat restoration activities?

- My work has recently focused on scrub-shrub and forested wetlands (tidal swamps) because these types have been disproportionately impacted by agricultural activities and they are a "missing link" in the chain of habitats from ocean to headwaters. Also, tidal swamps are not often the target of restoration, because they are not widely recognized (either as part of the original system, or as restorable sites). My work also includes tidal marshes because they the most widely recognized tidal wetland habitats, and they constitute a large part of the estuarine wetland landscape. When organizations want to do a tidal wetland restoration project, they usually focus on a former tidal marsh, because these sites are easily recognized as restorable (due to obvious diking, tide gates, etc.).
- There are clear and expedient actions that reestablish these systems that result in increased goods and services to NOAA trust species. These systems have been destroyed or degraded in a way that is apparent and easy to assess. NOAA Restoration Center supports Olympia Oyster restoration in Puget Sound
- These are the estuarine wetland habitats that were most significantly altered where we work
- We have been working in the Salmon River estuary for a number of years, which is part of the Cascade Head Scenic Research Area. The management plan calls for restoring the salt marsh.
- Importance for spawning and rearing habitats for salmonids
- our organization works on biodiversity conservation, and we are doing an analysis to establish a framework for prioritizing coastal biodiversity conservation work as well as guiding monitoring of strategies (including habitat restoration)
- As in-kind mitigation for impacted wetlands.
- 1. these types are identified as having been degraded or lost at sites compared to historic condition. 2. these are the kinds of projects that proponents have brought in for funding.
- Opportunity and institutional interest associated with mitigation.
- Opportunities for restoration, due primarily to landowner willingness, but also valuable location of the sites.
- Land of interest to local community
- Wetland permitting requirements; some for land management efforts to improve habitat quality
- consulting on: 1.restoration of estuarine ecosystem processes 2 shoreline management issues e.g. erosion, coastal flooding
- The greatest opportunity for projects occurs in these areas.
- Because they are easier to tackle and my focus is freshwater fisheries.
- Opportunities for restoration are most frequent, and these systems have been damaged
- Important and degraded habitats that require the most urgent need.
- Known as juvenile salmon habitat
- These habitat types reflect the kinds of habitats that are adversely affected by development actions in western Oregon and that have suffered chronic degradation over time. Therefore, they often become goals in mitigation and restoration actions.
- Research opportunities related to my long-term interest in wetland systems, their development and functioning.
- funding availability
- Restoration has focused on restoring species that occupies intertidal eelgrass habitat.
- Ownership. Partnered projects with watershed councils / landowners.
- They are the habitat types we own.
- The marsh habitats have experienced significant historical losses and are a priority for the recovery of salmon and water birds. The flats have been invaded by Spartina anglica, and we want to control/eradicate the infestation.
- Focus of restoring tidal wetland mosaics, that are particularly important for estuarine rearing of juvenile Pacific salmon.
- Because they are present on the site.
- Willing Landowners
- Due to losses related to anthropogenic stressors and subsequent interest among NGOs and agencies to restore.
- These areas prioritized for restoration within urbanized areas.

3) What habitat types are the focus of compensatory mitigation activities with which you've been involved?



High salt marsh	57.14%	12
Low salt marsh	57.14%	12
Fresh marsh	33.33%	7
Forested wetland	33.33%	7
Shrub-scrub wetland	28.57%	6
Aquatic beds- seagrass	28.57%	6
Other (please specify)	23.81%	5
Flats- Mud	19.05%	4
Flats- Sand	14.29%	3
Flats- Sand/mud	14.29%	3
Flats- Woody debris/organic	4.76%	1
Aquatic beds- algal	4.76%	1
Shorelines- boulder	4.76%	1
Shorelines- woody debris/organic	4.76%	1
Shorelines- mud	4.76%	1
Shorelines- sand/mud	4.76%	1
Flats- Cobble/gravel	0.00%	0
Flats- Shell	0.00%	0
Beaches- Cobble/gravel	0.00%	0
Beaches- Sandy	0.00%	0
Shorelines- bedrock	0.00%	0
Shorelines- cobble/gravel	0.00%	0
Shorelines- shell	0.00%	0
Shorelines- sand	0.00%	0

Other (please specify)
Do not work on mitigation projects

These habitat types reflect the kinds of habitats that are adversely affected by development actions in western Oregon and that have suffered chronic degradation over time. Therefore, they often become goals in mitigation and restoration actions.

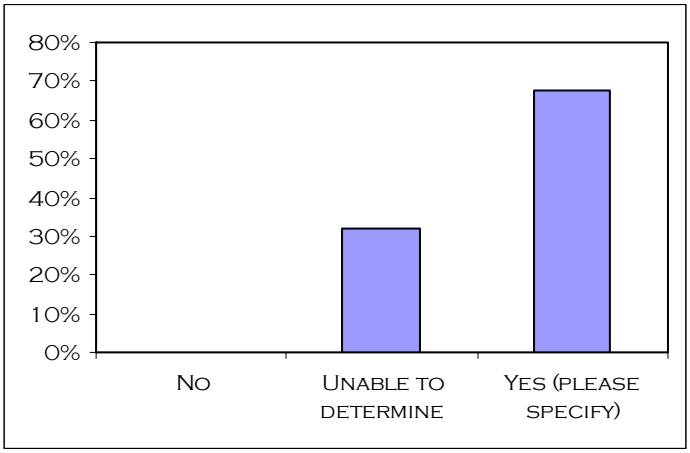
Answered	21
Skipped	10

4) Why have these habitat types been the focus of your compensatory mitigation activities?

- Same reasons as #2 above.
- My mitigation activities are primarily in major ports. These habitats are the component of the historic habitat structure that are missing, and whose replacement will hypothetically achieve the highest restoration of function.
- These seemed to be the habitats that were the easiest for the "mitigator" to create
- In-kind for impacted lands.
- Opportunity and institutional interest associated with mitigation.
- They were common areas for development and associated impacts.
- as 2
- Project opportunity again.
- Because they are smaller, easier projects to tackle. The methods are more tested and easier to justify funding with. There is more of a history of these types of projects and examples of some successful ones.
- Often affected by development activities
- They represent key habitat elements necessary to maintain hydrogeomorphic and ecological processes that sustain native biota in estuaries.
- N/A
- Because these types are either impacted by removal-fill activities and require "in-kind" compensatory mitigation, or they are restored or enhanced for "out-of-kind", i.e., freshwater impacts mitigated by restoration or enhancement of estuarine (brackish or freshwater), compensatory wetland mitigation purposes.
- N/A
- [We are typically not involved in compensatory mitigation activities]
- Because it's all DSL was interested in.
- Willing Landowners
- Due to ongoing pressures from public transportation systems including docks and ferries on nearshore eelgrass beds.
- They were the types that were damaged by ODOT and WSDOT activities.

Answered	19
Skipped	12

5) Are there habitat types not being restored that should be? If so, what are they?



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- Small creek mouths are often overlooked. Management of sediment supply through bulkhead removal and conservation is critical to beach function.
- Forested intertidal wetlands- e.g., spruce swamps
- Breached dike mitigation/compensation wetlands.
- Non-tidal riverine sand and mud flats
- tidal channel systems -especially high order deep tidal channels within marshes deltaic distributary channels
- We need a greater focus on scrub-shrub, forested, tidally-influenced freshwater floodplains, and floodplains generally. We also need some additional effort in pocket estuaries.
- kelp tidal forested swamps
- forested tidal wetlands
- Tidal swamp has been given too little attention as is one of the estuarine habitat types that has suffered most historically.
- I believe that most efforts in compensatory mitigation are either mis-directed or inadequate and few cover the many types of systems listed.
- expanded juvenile coho salmon habitat in estuarine areas is critically needed and provides immediate benefits
- Nearly all estuarine habitat types have sustained habitat degradation and loss and thus would qualify for restoration.
- Scrub-shrub and forested tidal wetlands.
- Freshwater tidal forested communities.
- tidal scrub shrub tidal forest swamp non-tidal river delta floodplain
- Scrub-shrub and forested wetlands.
- ANY of the non-vegetated flats!
- flats!
- Spruce Swamps
- More nearshore beach restoration is needed to reduce erosion, provide vegetation, shade, organic matter.

Answered	28
Skipped	3

6) Why do you think these habitats are being overlooked?

- As described in #2 above, tidal swamps are not often the target of restoration, because they are not widely recognized (either as part of the original system, or as restorable sites). The low awareness of these habitat types is partly due to the fact that they were heavily modified in the early history of settlement. Trees were removed early due to easy log transport opportunities along the adjacent rivers. The sites are high enough that only minimal diking (or no diking) was necessary to nearly eliminate tidal influence, so clear indicators of hydrologic modification are absent. Drainage ditches were dug and restrictive culverts placed early on, eliminating tidal exchange and radically altering channel morphology. Most tidal swamps were probably gone by the early 1900's, though some tidal swamps continued to be cleared, drained and culverted through the mid-1900s. To locate actual intact tidal swamps or restorable tidal swamps, onsite observation is needed. The field work has to occur at specific times (e.g. a wintertime spring tide series and possibly also during a summer minus tide), to confirm that these sites are tidally influenced and to determine the nature of the hydrologic modifications. It takes good elevation survey work and tide gauging to estimate the potential tidal inundation regime after restoration at these sites, so it's harder to prove that they're suitable restoration targets.

6) (Continued from previous page)

- Small parcel property ownership combined with conflicting human-centered uses makes small creek and bluff-to-beach restoration difficult. Assessments of bluff function are just coming on line to prioritize work.
- There are so few left that I don't think there's much common awareness of their original extent and function
- Mitigation/compensation credit sufficient for simple dike breaching, but maximization of functional condition is possible, but no added incentive for mitigation sponsor.
- Large rivers probably have been too altered hydrologically to make this feasible without major infrastructure change.
- Some habitat types are rarer (e.g. forested wetlands) and therefore more difficult to find opportunities to restore. However, I am not aware of any specifics habitat types that are necessarily being overlook.
- these are 'forgotten landscapes' largely obliterated 100-150 years ago
- Practical difficulties in developing projects. Multiple landowners, political obstacles.
- kelp is not a high priority. TFS are too difficult and largely privately owned
- almost none are left in the region
- The time frame in which it takes to recover and the processes that are required to initiate are daunting. But we have seen ample evidence where large wood placed in high marsh provides a nurse log for hemlock, cedar, and spruce to establish as they did historically from old growth blow downs that fell out onto the open tideland.
- Basic lack of knowledge of their value and functions as well as their distribution and condition.
- only recently has the significance of such areas to juvenile coho rearing become widely appreciated
- Restoration techniques in estuaries are not completely understood beyond the removal of tide control structures, there has been too little importance placed on estuaries in general, and most coastal restoration has focused on upriver salmon function, not estuaries.
- It may not be that they are overlooked, but it may be that restoring forested plant communities has a higher risk (or lower likelihood of success) or takes a longer time for success-however defined-than, for instance, breaching a berm/dike to restore tidal influences (thus natural processes). Having said that, I just worked on restoration of a forested community in freshwater tidal habitat in the N. Fork Siuslaw.
- N/A
- largely missing from landscape so few reference sites and little record of their function, size or role. They have unique geomorphic characteristics that are generally destroyed when converted to ag lands so active restoration would require knowing how to recreate those geomorphic features. Passive restoration will require decades or centuries to recreate the geomorphology.
- They are considered less productive than emergent wetlands, there's no preference among types of wetlands, and lack of restoration opportunity.
- Not perceived as being as functional and publicly valuable as vegetated ecosystems.
- Continued Cattle and Hay production
- They may not have been prioritized as major habitats, they may be under private ownership.

Answered	21
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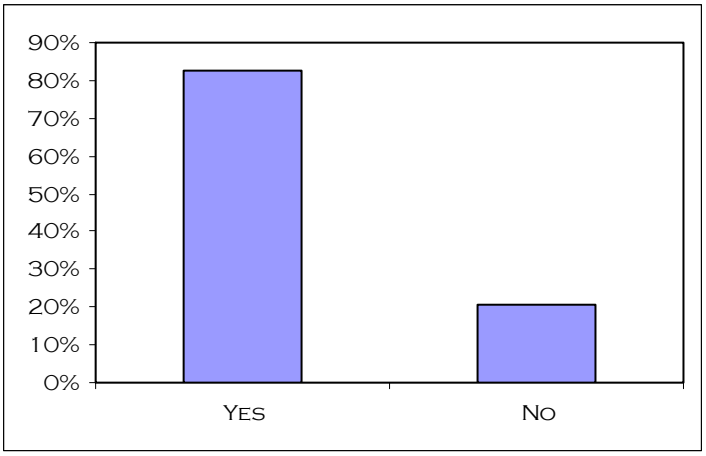
7) Do you collect data from your estuarine wetland restoration project sites) to determine whether project goals are being met (effectiveness monitoring)?



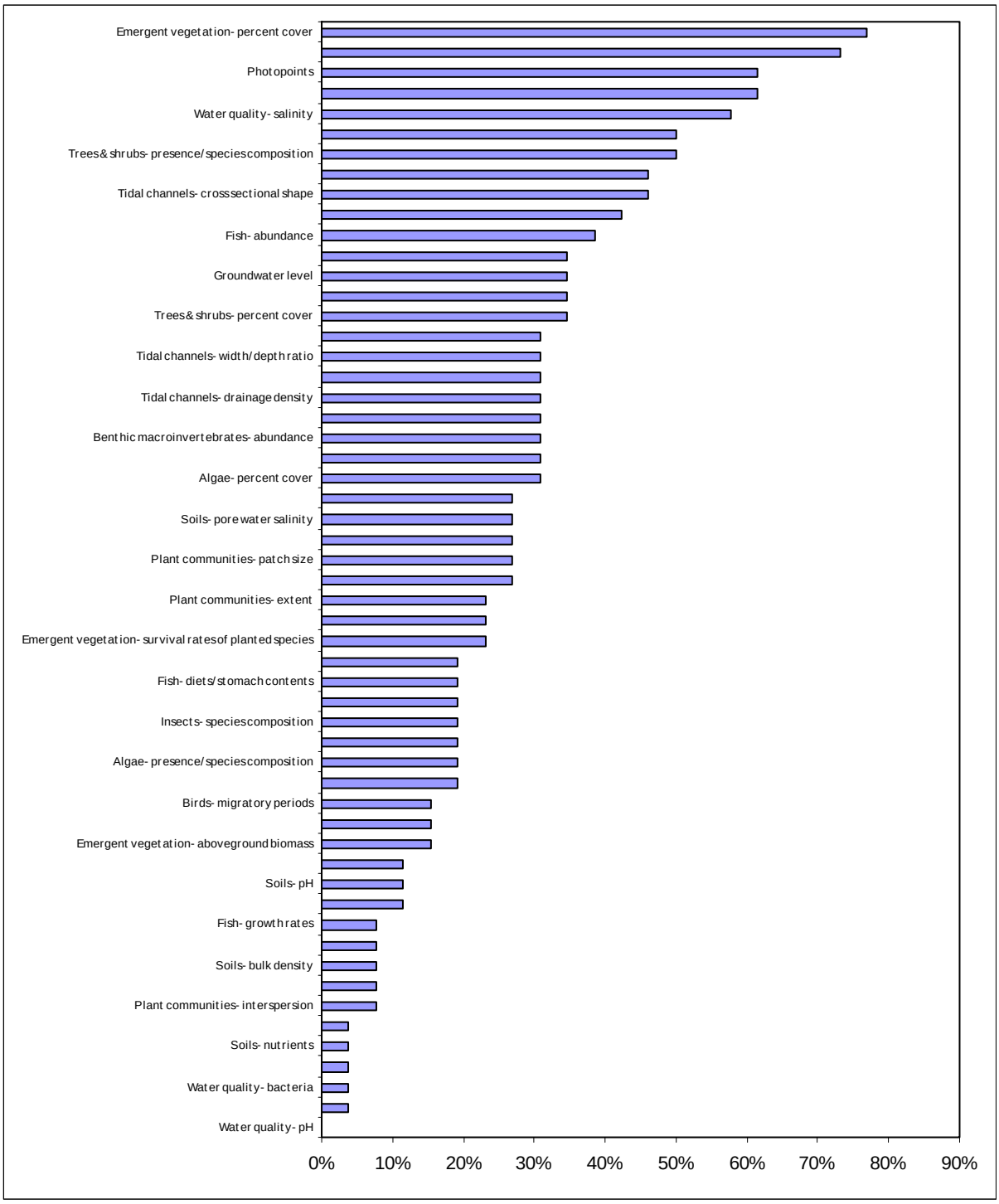
Answered	29
Skipped	2

8) If you do collect effectiveness monitoring data at your project sites, what monitoring parameters do you typically use? (Please refer to the information below and the graph on the following page)

Other (please specify)

- Amphibians
- Seasonal bird (species, sex, age) use behavior(breeding, feeding, migration, etc.) by habitat type (forest, scrub-shrub, emergent, mudflat).
- eelgrass bed cover, Olympia oyster growth and survival rates
- Not all of these parameters are collected at every site. Vegetation is always included but tidal channel measurements, water temperature, and soil parameters are not always included.
- This question could really be broken out per specific compensatory wetland mitigation types or concepts. The monitoring parameters are very project specific. For instance, restoring a forested plant community has, generally for our purposes, distinct success criterion or monitoring parameters than breaching a dike (one obviously requires specific vegetation success criteria, the other requires tidal influence/acre-but not necessarily vegetation monitoring). We have, in general(!), tended to focus on restoring natural processes rather than to speculate on what the future site condition, i.e., %cover of vascular plants, etc., will look like.
- Most data collected by project partners
- large wood abundance and characteristics
- Submerged Aquatic Vegetation - stem height/density
- Submerged Aquatic Vegetation - percent cover

8) If you do collect effectiveness monitoring data at your project sites, what monitoring parameters do you typically use?

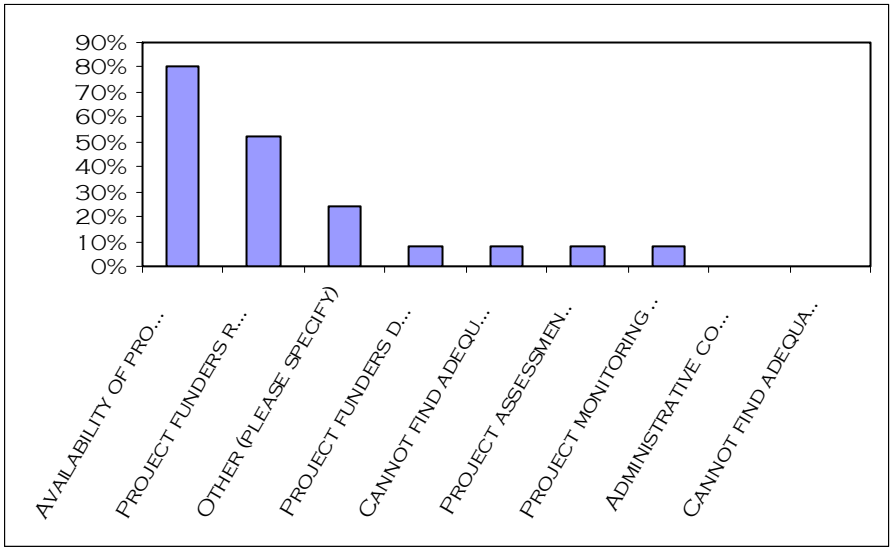


Answered	26
Skipped	5

8) (Continued from previous page)

Emergent vegetation- percent cover	76.92%	20
Emergent vegetation- presence/species composition	73.08%	19
Wetland surface- elevation	61.54%	16
Photopoints	61.54%	16
Water quality- salinity	57.69%	15
Trees & shrubs- presence/species composition	50.00%	13
Tidal channels- length	50.00%	13
Tidal channels- cross sectional shape	46.15%	12
Fish- species composition	46.15%	12
Wetland surface- frequency of tidal flooding	42.31%	11
Fish- abundance	38.46%	10
Trees & shrubs- percent cover	34.62%	9
Trees & shrubs- survival rate of planted species	34.62%	9
Groundwater level	34.62%	9
Water quality- temperature	34.62%	9
Algae- percent cover	30.77%	8
Wetland surface- sediment accretion/erosion	30.77%	8
Benthic macroinvertebrates- abundance	30.77%	8
Benthic macroinvertebrates- species composition	30.77%	8
Tidal channels- drainage density	30.77%	8
Tidal channels- sinuosity	30.77%	8
Tidal channels- width/depth ratio	30.77%	8
Other (please specify)	30.77%	8
Trees & shrubs- basal area	26.92%	7
Plant communities- patch size	26.92%	7
Soils- organic matter	26.92%	7
Soils- pore water salinity	26.92%	7
Tidal channels- order	26.92%	7
Emergent vegetation- survival rates of planted species	23.08%	6
Trees & shrubs- stem density	23.08%	6
Plant communities- extent	23.08%	6
Emergent vegetation- stem height/density	19.23%	5
Algae- presence/species composition	19.23%	5
Soils- texture	19.23%	5
Insects- species composition	19.23%	5
Tidal channels- flow rates	19.23%	5
Fish- diets/stomach contents	19.23%	5
Fish- habitat use	19.23%	5
Emergent vegetation- aboveground biomass	15.38%	4
Insects- abundance	15.38%	4
Birds- migratory periods	15.38%	4
Water quality- dissolved oxygen	11.54%	3
Soils- pH	11.54%	3
Fish- residence times	11.54%	3
Plant communities- interspersion	7.69%	2
Water quality- turbidity	7.69%	2
Soils- bulk density	7.69%	2
Tidal channels- bifurcation ratio	7.69%	2
Fish- growth rates	7.69%	2
Water quality- nutrients	3.85%	1
Water quality- bacteria	3.85%	1
Soils- redox potential	3.85%	1
Soils- nutrients	3.85%	1
Birds- nesting/fledging	3.85%	1

9) If you do not collect effectiveness monitoring data at your project sites, or are unable to collect as much data as you feel should be collected, please indicate why.



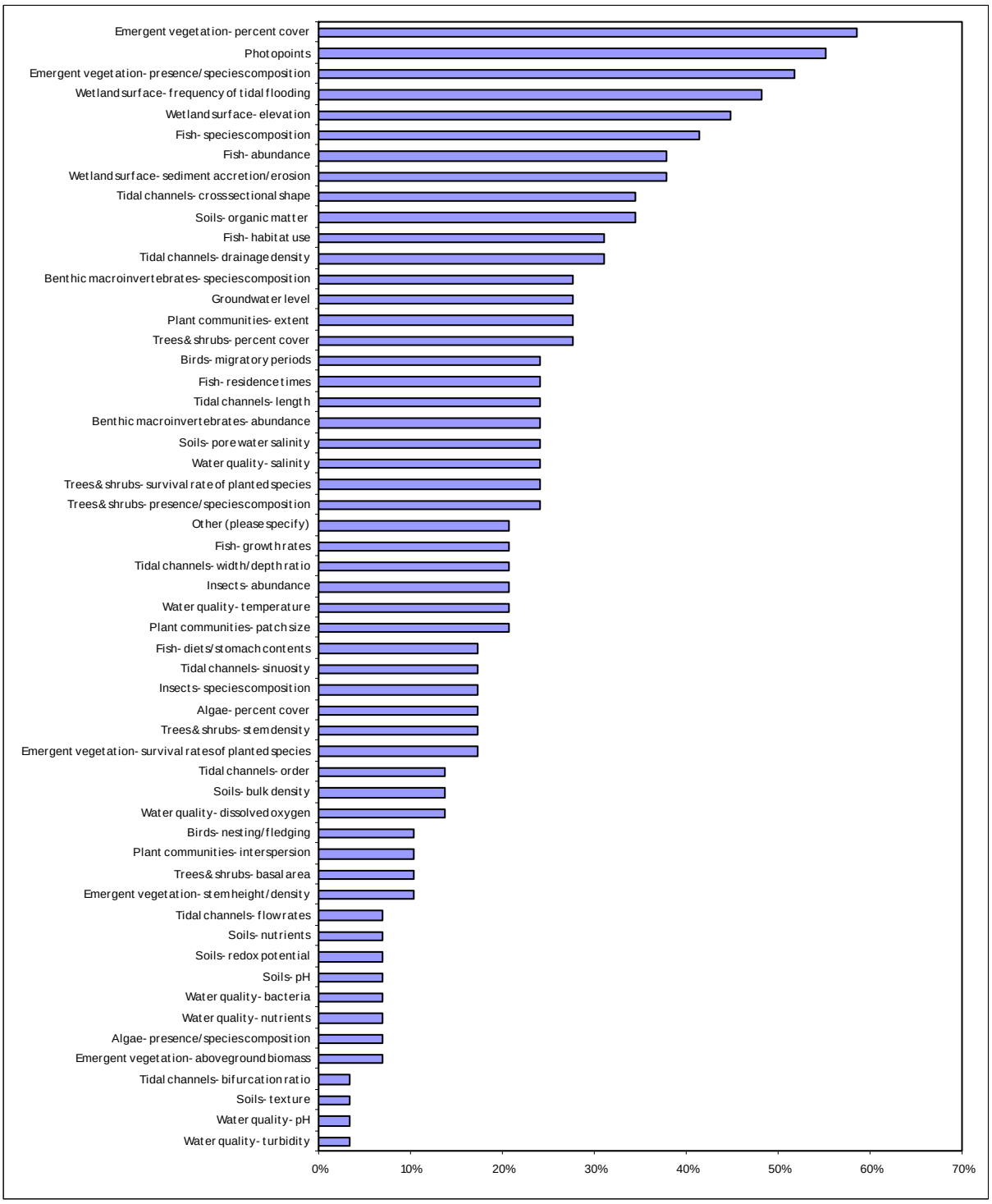
Answered	25
Skipped	6

Program or grant funds are insufficient	80.00%	20
Funders require monitoring but do not provide adequate funding	52.00%	13
Other (please specify)	24.00%	6
Project funders do not require project monitoring	8.00%	2
Cannot find adequately trained monitoring personnel	8.00%	2
Project assessments are based on best professional judgement	8.00%	2
Project monitoring is not a high priority for our organization	8.00%	2
Administrative constraints on hiring monitoring personnel	0.00%	0
Cannot find adequate guidance for project monitoring	0.00%	0

Other (please specify)

- Restoration project not yet approved -- planning stage only now.
- My work has a research focus and isn't associated with particular projects.
- lack of archival institution that can make use of long term monitoring data to advance restoration practice
- Inadequacy of my own knowledge
- Some compensatory mitigation sites require effectiveness monitoring, some only require implementation monitoring. For instance, transplanting of eelgrass requires effectiveness monitoring, breaching a berm may not require effectiveness monitoring-it really depends on the project objectives.
- In projects I have been involved with, it has not been possible to monitor all the variables that would be useful to understand why vegetation structure changes (usually, vegetation is monitored). Sediment/soil characteristics, even visual assessment of these characteristics would be helpful but we have been limited in the number of people who have experience reading sediments - especially in brackish areas.

10) What are the top five to ten monitoring parameters you think should routinely be used for project effectiveness monitoring?



10) (Continued from previous page)

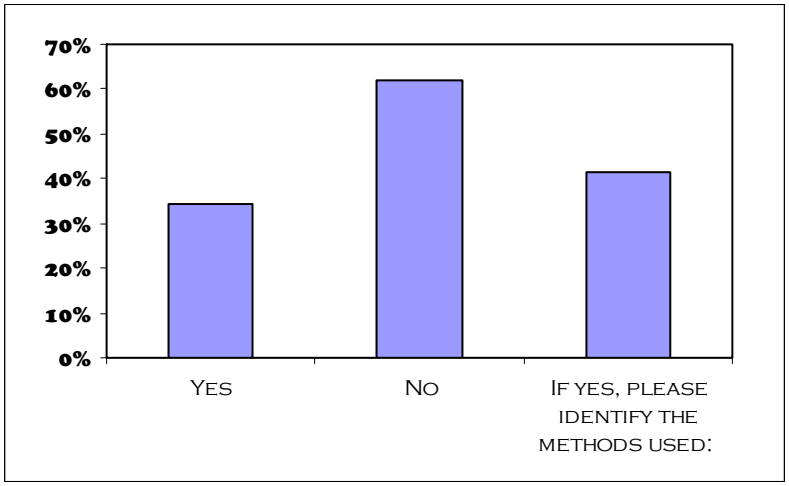
Emergent vegetation- percent cover	58.62%	17
Photopoints	55.17%	16
Emergent vegetation- presence/species composition	51.72%	15
Wetland surface- frequency of tidal flooding	48.28%	14
Wetland surface- elevation	44.83%	13
Fish- species composition	41.38%	12
Wetland surface- sediment accretion/erosion	37.93%	11
Fish- abundance	37.93%	11
Soils- organic matter	34.48%	10
Tidal channels- cross sectional shape	34.48%	10
Tidal channels- drainage density	31.03%	9
Fish- habitat use	31.03%	9
Trees & shrubs- percent cover	27.59%	8
Plant communities- extent	27.59%	8
Groundwater level	27.59%	8
Benthic macroinvertebrates- species composition	27.59%	8
Trees & shrubs- presence/species composition	24.14%	7
Trees & shrubs- survival rate of planted species	24.14%	7
Water quality- salinity	24.14%	7
Soils- pore water salinity	24.14%	7
Benthic macroinvertebrates- abundance	24.14%	7
Tidal channels- length	24.14%	7
Fish- residence times	24.14%	7
Birds- migratory periods	24.14%	7
Plant communities- patch size	20.69%	6
Water quality- temperature	20.69%	6
Insects- abundance	20.69%	6
Tidal channels- width/depth ratio	20.69%	6
Fish- growth rates	20.69%	6
Other (please specify)	20.69%	6
Emergent vegetation- survival rates of planted species	17.24%	5
Trees & shrubs- stem density	17.24%	5
Algae- percent cover	17.24%	5
Insects- species composition	17.24%	5
Tidal channels- sinuosity	17.24%	5
Fish- diets/stomach contents	17.24%	5
Water quality- dissolved oxygen	13.79%	4
Soils- bulk density	13.79%	4
Tidal channels- order	13.79%	4
Emergent vegetation- stem height/density	10.34%	3
Trees & shrubs- basal area	10.34%	3
Plant communities- interspersion	10.34%	3
Birds- nesting/fledging	10.34%	3
Emergent vegetation- aboveground biomass	6.90%	2
Algae- presence/species composition	6.90%	2
Water quality- nutrients	6.90%	2
Water quality- bacteria	6.90%	2
Soils- pH	6.90%	2
Soils- redox potential	6.90%	2
Soils- nutrients	6.90%	2
Tidal channels- flow rates	6.90%	2
Water quality- turbidity	3.45%	1
Water quality- pH	3.45%	1
Soils- texture	3.45%	1
Tidal channels- bifurcation ratio	3.45%	1

10) (Continued from previous page)

Other (please specify)

- Tidal channel planform geometry generally (from high resolution air photos) Winter waterfowl habitat use
- Specific parameters should coincide with the goals for the project.
- Seasonality of tidal inundation is an important parameter -- but not a direct measurement. It's derived from either longterm tide gauging or modeling ot tide levels, combined with site elevation survey. This is a comment, not another parameter... To keep the number of parameters down to 10, I'm relying on the fact that data on vegetation percent cover automatically generates data on species presence and species composition; data on channel cross-sectional shape can be used to calculate width:depth ratio; and data on frequency of flooding can't be obtained without elevation survey (so the latter incorporates the former).
- Too general a question depends upon project.
- THe monitoring needed depends on the purpose of the restoration project. To understand the full impact of the restoration project, however, other variables outside those that were the focus of the restoration should be monitored so that information needed for adaptive management is available.
- THIS QUESTION CANNOT BE ANSWERED WITHOUT REFERENCE TO A SPECIFIC HABITAT TYPE (E.G. CAN'T SPECIFY EMERGENT OR FORESTED....)

11) Do you use established wetland functional assessment protocols (e.g., Hydrogeomorphic Method) to guide restoration planning or to evaluate project effectiveness?



If yes, please identify the methods used:

- We helped develop the Coastal Oregon Tidal Fringe Wetlands Regional Guide.
- HGM Guidebook for Oregon Tidal Wetlands
- Used OWEB funds for training and development of protocal.
- Puget Sound Habitat Monitoring Protocols (modified) Columbia River EstuaryHAbitat Restoration Protocols (draft)
- hydrodynamic modeling
- estuarine habitat assessment protocol
- Somewhat use HGM, Johnson-O'Neil, HEP, etc. but rely mostly on performance standards.
- I do not use them as I consider them ineffective in meaningful assesment
- We are trying to restore the estuary primarily by removing dikes and infrastructure.
- I do not believe that HGM provides adequate quantitative data that is required to determine success. It can be used for an interesting comparison, but I would not use it to determine successs of a compensatory mitigation project.
- HGM
- Roegner et al. Monitoring Protocols for Salmon Habitat Restoration Projects in the Lower Columbia River and Estuary

Answered	29
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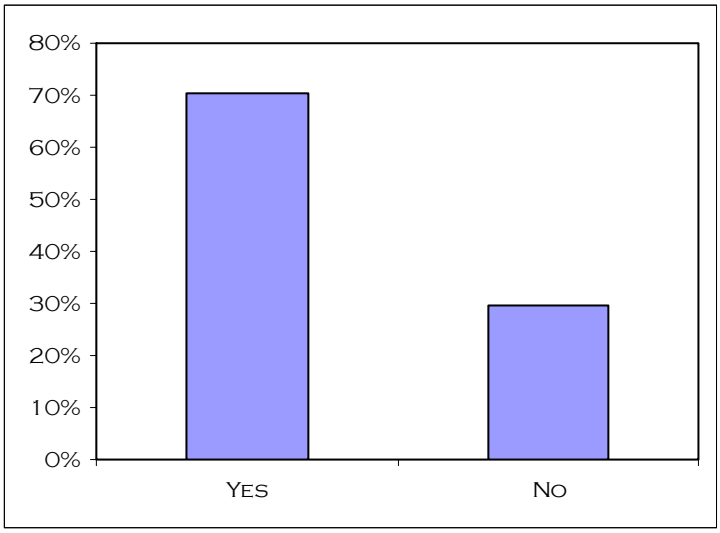
12) Do you collect data at project sites for reasons other than to determine whether project goals are being met?



Answered	27
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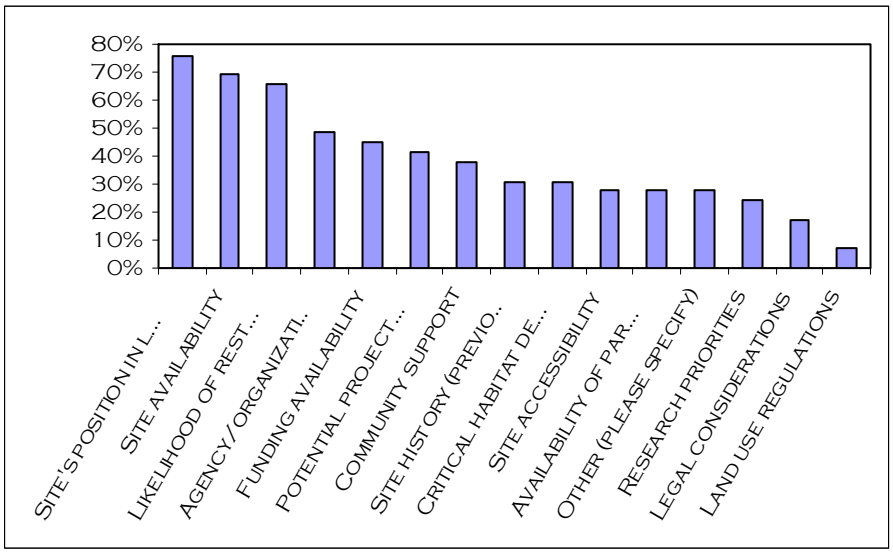
If yes, please specify the type of monitoring and what questions/hypotheses are being addressed.

- Restoration science: methods for addressing diked tidal wetland subsidence; tidal channel creation, restoration and enhancement; non-tidal channel creation/restoration; fish habitat restoration
- Vegetation monitoring to monitor the potential impacts of groundwater withdrawals on wetland/ upland morphology near sand dune lakes.
- to determine the outcome of specific restoration treatments, and identify variability of outcome accross site gradients. We are increasing collecting qualitative 'data' to track observations and work of multiple 'stewards'.
- We use monitoring as a tool for local education and community involvement
- I prefer measures of wetland condition rather than function. I feel that the information is more easily communicated and compared among systems.
- see list of questions in SF Bay tidal wetland restoration design guidelines document
- Basic research on marsh geomorphology, controls on vegetation distribution, methods to control exotic vegetation, effects of sea-level rise on vegetation communities.
- Examining cumulative effects of multiple projects on an ecosystem Adaptive management
- We collect habitat use by wildlife data but do not measure the data against performance standards.
- What is the rate of recovery
- To incorporate into larger research databases of similar type projects.
- for refining future designs
- I also conduct research into tidal wetland ecology which involves monitoring many of the same parameters listed above. I do it for several purposes: To increase scientific understanding of the relationships between structural and biological characteristics of tidal wetlands; to refine my monitoring recommendations by confirming what monitoring parameters best reflect the trajectory of restoration; and to help improve future restoration design.
- experimental projects are testing alternative treatments. Currently invasive plant and large wood experiments in progress.
- baseline landscape-scale monitoring--what are the locations and extents of estuarine habitats and what are their characteristics in different locations?
- Research that addresses causal mechanisms behind basic monitoring metrics.
- Project goals have been very vague on the projects I have worked on. For the most part, any remote monitoring such as aeiral photography or sidescan sonar has been considered extra, but I consider it primary.
- 1) Cumulative effects of multiple restoration projects. 2) Effects of overwater structures on eelgrass growth/density.

13) In prioritizing sites for estuarine wetland restoration actions, what selection criteria other than habitat type do you use?



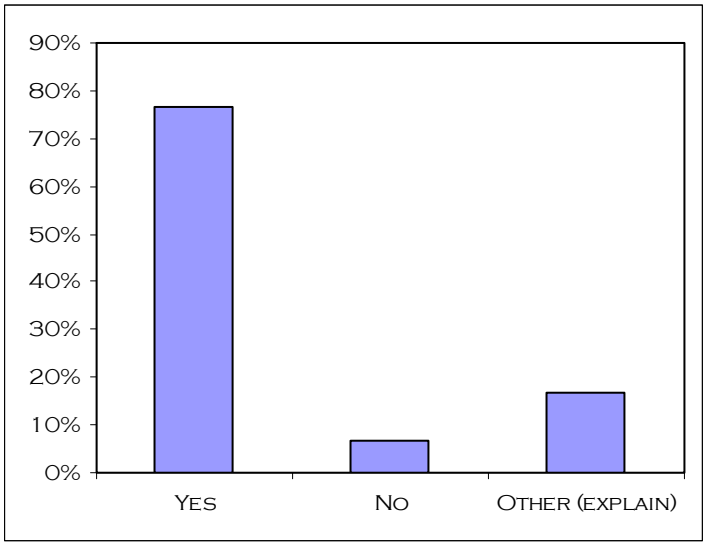
Answered	29
Skipped	2

Other (please specify)

- NOAA has criteria of evaluation that include community participation, future protection of restoration investment, capabilities of project proponent, visibility of the restoration action, and further defines restoration success by preferring actions that result in self-sustaining ecological benefits, and projects which support a diversity of species.
- Meeting multiple biodiversity objectives
- integrity of natural processes that support development of habitat functions.
- Likelihood of being able to restore habitat forming and sustaining processes, e.g., completely removing dikes to allow tidal and riverine flooding.
- level of distrubance, probablility of success, degree in change in function and area
- In my work, initial prioritization has generally been based on ecological criteria (some of which are marked above -- see my estuary assessment chapter for the full process). Choice of specific action sites is then informed by the other criteria you list above.
- Size of site and connectivity to other high-priority sites, preferably following a regional or local wetland conservation plan.
- I am not usually involved in selecting restoration sites.

Site's position in landscape	75.86%	22
Site availability	68.97%	20
Likelihood of restoration success	65.52%	19
Agency/organization priorities	48.28%	14
Funding availability	44.83%	13
Potential project cost	41.38%	12
Community support	37.93%	11
Site history (previous land uses)	31.03%	9
Critical habitat designations/ESA	31.03%	9
Site accessibility	27.59%	8
Availability of partners	27.59%	8
Other (please specify)	27.59%	8
Research priorities	24.14%	7
Legal considerations	17.24%	5
Land use regulations	6.90%	2

14) Do you routinely use reference sites in restoration project planning and/or evaluation?

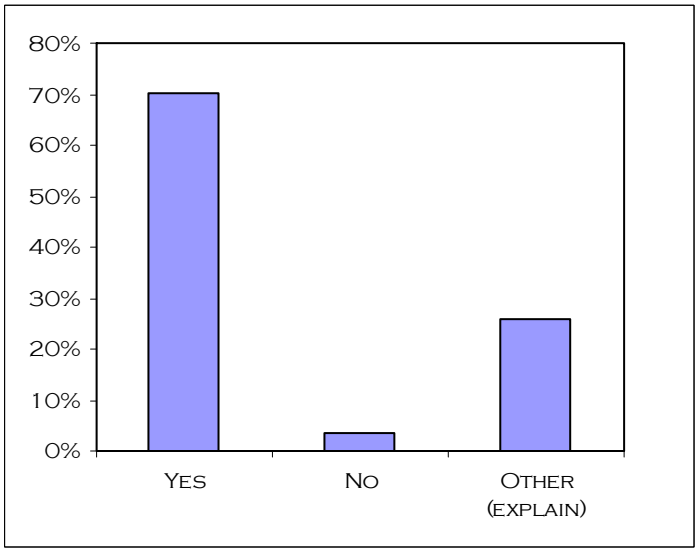


Yes	76.67%	23
No	6.67%	2
Other (explain)	16.67%	5
Answered		30
Skipped		1

Other (explain)

- I would if I knew where to find appropriate sites.
- Not individually paired sites, but rather the series of dozens of reference sites from which data were collected for the Oregon HGM Tidal Guidebook
- sometimes look at reference sites. Not very systimatic.
- We use estimations of reference conditions.
- Don't use reference sites routinely, but whenver possible. It is often difficult to find valid reference sites, especially along an estuarine gradient, and, of course, money to monitor reference sites is scarce.

15) If you use reference sites, are you able to find sites from which you can collect useful data?

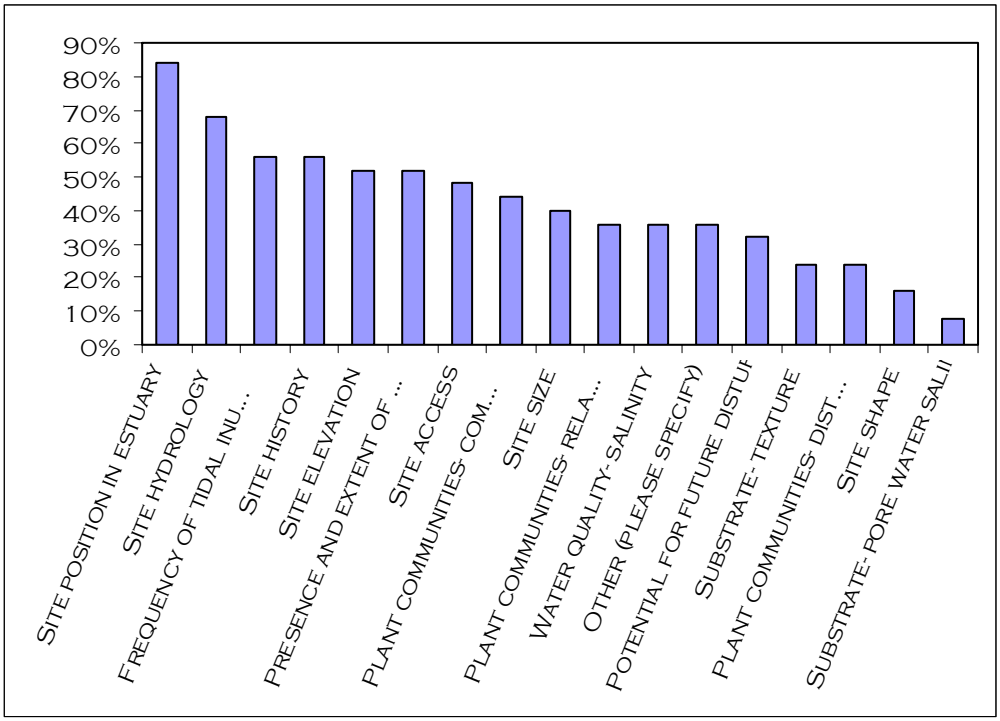


Answered	27
Skipped	4

Other (explain)

- Depends on the wetland habitat type. Little information available on forested and scrub/shrub wetlands.
- It varies, and largely depends on the proximity of the mitigation site to a relatively undisturbed area in the same hgm class and soil type. We use regional data sets based on a number of reference sites in most cases.
- The majority of reference sites that I have seen people use may not have adequate application to the site that is being restored or enhanced.
- Habitat are altered by land management, we attempt to replicate reference conditions within the current social, political, and economic realities that exist.and economic realities that exist.
- Within-system reference site exists, but it may be different than restoration site in terms of sediments, salinity, location, etc.

16) If you use reference sites, what criteria do you use in site selection?



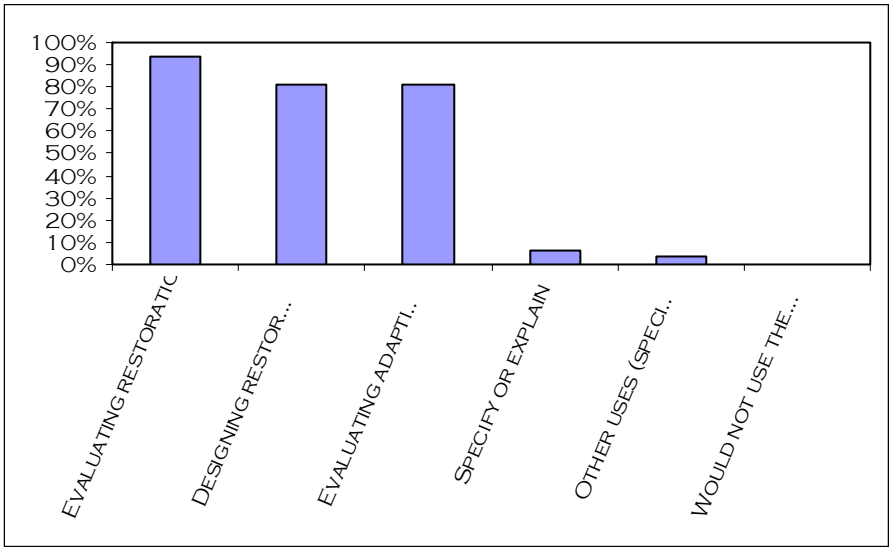
Site position in estuary	84.00%	21
Site hydrology	68.00%	17
Frequency of tidal inundation	56.00%	14
Site history	56.00%	14
Site elevation	52.00%	13
Presence and extent of tidal channels	52.00%	13
Site access	48.00%	12
Plant communities- composition	44.00%	11
Site size	40.00%	10
Plant communities- relative condition	36.00%	9
Water quality- salinity	36.00%	9
Other (please specify)	36.00%	9
Potential for future disturbances	32.00%	8
Substrate- texture	24.00%	6
Plant communities- distribution	24.00%	6
Site shape	16.00%	4
Substrate- pore water salinity	8.00%	2

Other (please specify)

- Typically don't have resources for formal reference site selection, but use subjective observation of presumed patterns at available sites.
- Whether data are already available for the site from other studies
- Similarity to the restoration--hydrogeomorphically and location
- I use a large suite of sites in the Skagit River Delta and I use landscape allometry to generate predictive models of landform geometry. I also use the whole remaining tidal marshes to generate predictive models of vegetation distribution.
- HGM class (river source or marine source; high marsh or low marsh or mudflat; fresh, brackish, marine; low disturbance; etc)
- Relatively close proximity and similarity to project site.
- animal species present in tidal flats
- direct comparability with restoration site attributes.
- Site proximity to restoration site

Answered	25
Skipped	6

17) If long term data sets quantifying one or more estuarine wetland attributes (e.g., vegetation, soils, invertebrate communities, tidal channels...etc.) were made available from a network of reference sites representing a variety of estuarine wetland habitat types in the Pacific Northwest, would you use them for...



Answered	31
Skipped	0

Evaluating restoration projects	93.55%	29
Designing restoration projects	80.65%	25
Evaluating adaptive management options	80.65%	25
Specify or explain	6.45%	2
Other uses (specify below)	3.23%	1
Would not use them (explain below)	0.00%	0

Specify or explain

- the duration of monitoring (i.e. the long term part), would only add value for parameters where variation over time is of interest. This is not something I have thought through.
- Research on basic estuarine ecology

18) What do you think are the most common and important questions that, if answered, would improve your ability to prioritize coastal habitat restoration project site selection more effectively?

- What was the historic extent of tidally-influenced wetlands? What was the composition and distribution of pre-settlement vegetation in the tidal wetlands of the upper estuary (current 1:24k GLO mapping lacks resolution in these areas). How should the possibility of geologic change (sea level rise, major seismic events and associated land subsidence) affect our tidal wetland restoration and conservation priorities?
- change analysis that identifies the distribution of lost ecosystem services in the landscape. Understanding adjacency effects, where restoration of habitat A adjacent to existing habitat B increases the benefits of habitat A restoration as compared to where habitat B is absent. Increase analysis of off-site scale dependent effects of restoration and what thresholds may exist such that a certain aggregate area of restoration triggers recovery of off site ecosystem processes. Determining how site characteristics affect outcome of restoration actions through consistent measurement of multiple restoration projects over time.

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- What habitats are in most need of restoration or enhancement in a given watershed?
- 1. What is the likely trajectory of potential restoration actions compared to reference sites? 2. What are the limiting factors to achieve specific goals based on readily measurable wetland attributes.
- How will sea level rise affect current habitat distribution, function, and dependent species, and how will SLR alter our ability to restore habitats to some level of ecological viability?
- My projects are driven by compensatory mitigation requirements of clients, so my most important questions (at the onset) are related to the governing agencies and their priorities for site selection.
- What is the extent and character of wetland losses across the landscape. how does proximity to existing habitat types or functions enhance or diminish the functional gain from restoration? what real estate parcels are potentially available for restoration activity? What management measures provide the greatest diversity of functional benefit.
- 1. Which landowners are willing to consider restoration. 2. What combinations of marshes and other habitats at a landscape level support the most fish and wildlife numbers and diversity
- What types of projects/habitats get the most "bang for the buck" when it come to benefiting watershed health?
- How do various species (salmon, waterfowl, shorebirds, etc) use habitat--specific aspects of habitat, such as tidal channels, marsh surfaces, mudflats, eelgrass? How do they move between different parts of the landscape? How does this pattern of habitat use affect energy budgets, growth, survivorship? How does natural disturbance (floods, storms) affect patterns of habitat use. How will climate change affect all of the above.
- Better information on functional performance of restored systems from various restoration strategies
- Where is the greatest need and is that property available for restoration/enhancement.
- more fully understanding fish use and growth potential in the variety of different sites
- In combination: 1)A set of reestablished reference sites representing the a full spectrum of estuarine habitat types that are routinely monitored via standard protocols and reporting formats for a broad suite of parameters and data sets/reports are made available for download via a geodatabases; and 2) Watershed level analyses of priority areas for restoration and recovery.
- True measures of functionality
- 1) what are the potentialities for restoration in a particular area (e.g., Humboldt Bay area); 2) which are the most 'ready' sites (access, owner support, funding availability) that meet high priority goals for the area
- What restoration is needed at any particular site to restore estuary function? What sites are more important to conduct restoration at given global warming concerns?
- Which habitat type, per "watershed", has been most adversely impacted?
- What is the capacity for restoration at the site? What are the future land management actions that may influence the site?
- In what ways are estuarine controlling factors vulnerable to climate change impacts? What actions will have greatest effect on increasing system adaptability or functional resilience to CC? (e.g. how would different dike removal locations affect sediment delivery/capture?) How do cumulative restoration actions in an estuary affect the system's function and its resilience to CC? What are the lower food web dynamics - relative importance of riverine vs. tidal marsh vs. algal sources of detritus, benthic vs. pelagic sources? Are there signs of anthropogenic changes in nutrient regimes that are affecting the base of the food web? What are the time scales for restoration actions to become fully functional?

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- impacts of climate change on estuaries -importance of habitat diversity to estuarine functioning
- What does the estuarine landscape need?
- Size of site and connectivity to other high-priority sites, preferably following a regional or local wetland conservation plan.
- What lands are currently in active management, and which ones are not. Also a layer of sites that have mutliple landowners.
- datasets on ecosystem function, e.g. sites of "high quality" due to presence of rare or endemic plant species or communities, rare wildlife, intact habitats, unpolluted conditions, etc. Stressors data are much more frequent in publicly available spatial data (GIS) than functions. frequency distributions of habitat types: historical and present sea level rise from climate change
- I think that more info is needed on the sediment characteristics that will allow restoration actions to succeed is needed. Also, info about how to create those characteristics when they do not exist is needed.

19) What do you think are the most common and important questions that, if answered, would improve your ability to design/engineer coastal habitat restoration projects more effectively?

- What were the physical characteristics of undisturbed tidal wetlands, particularly the types that are now rare (scrub-shrub and forested tidal wetlands)? Physical characteristics include site elevation relative to tidal range (tidal inundation regime), particularly seasonal variation in that regime; salinity of surface water; magnitude of freshwater inputs; tidal channel density, width:depth ratio, sinuosity, order and bifurcation ratio; soil organic matter content, texture, porewater salinity, bulk density and nutrient status. How "restorable" are upper estuary tidal wetlands, given basin-wide hydrologic change? What can we do to speed the restoration of tidal channel networks? (i.e., what is most effective -- channel initiation, channel excavation, passive restoration,etc.?) How does this vary by tidal wetland habitat type, landscape position, etc.? If engineering (initiation, excavation etc.) is needed, what design parameters are appropriate for Oregon wetlands in different landscape positions? What are the different effects of dike breaching vs. dike removal? How long will it take for subsided sites to restore to their original elevations, given today's sedimentation regime? How does this vary by restoration practice (dike removal vs. dike breach; channel excavation vs. passive channel development)? How does this vary by landscape setting, degree of subsidence, basin? What is the relatively importance of freshwater flow vs. tidal flow in structuring tidal channel systems? How does this vary by landscape position and estuary zone?
- Increase analysis of soil/sediment charactetistics and correlation of those parameters to ecosystem services. Increase analysis of off-site scale dependent effects of restoration and what thresholds may exist such that a certain aggregate area of restoration triggers recovery of off site ecosystem processes. Better understanding of controls exerted on system function by soil/sediment condition.
- What's the difference in site hydrology and associated nutrient exchange, sediment dynamics, plant community recruitment, and fish use in restoring diked wetlands using complete dike removal versus breaching the dike in a few locations? Likewise, what's the difference in site hydrology and associated nutrient exchange, sediment dynamics, plant community recruitment, and fish use in restoring a diked wetland with no constructed tidal channels versus a fully constructed tidal channel network?
- Detailed and accurate topographic and elevation data. What is the reference condition? What plant species are appropriate? How can invasive species, such as reed canary grass be controlled, or prevented from colonizing?
- 1. Is there a vertical control network that we can use to link monitoring and site designs. 2. See

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responses to Q18.

- see sea level rise issue raised above
- What hydrological restoration designs and construction techniques have proven effective (in terms of sustained re-naturalization of biological and hyrdological systems) in similar conditions?
- how does short term vector of change indicate long term outcome of restoration actions. how do short term soil/sediment parameters predict long term ecosystem function. what assessments indicate the presence/absence or level of function of those processes critical to maintain habitat function. What are cost effective species specific approaches for establishing suitable surfaces for natural regeneration of vegetation or for propagaing species where natural dispersal is comporomised?
- What designs will allow the most rapid maturation of newly established tidal marshes
- Is there a database that catalogues all past coastal habitat restoration projects and their overall success/effectiveness?
- Is it cost effective to create new wetlands? (Both salt water and freshwater.)
- see tidal wetland design guidelines
- Same answer as in question 18, but we need to create predictive models of tidal channel geometry and vegetation distribution, as well as animal movement and use of habitat.
- Generally better data on factors that control the distribution and abudnance of key vegetation habitat types. Eg, elevation, temperature, water tolerances, salinity range, etc.
- Where are the case records of site prep, management, and ensuing estuarine habitat responses collectively available? Where is the collective history of trial and error with lessons learned? Where are the shapefiles, databases, and geodatabases that are designed to act as a common library for all mitigation and restoration practitioners? How do we link quickly and seamlessly into spatial raster imagery and othe spatial data at adequate resolution to evaluate and manage our sites over time. How do we link our data into such a system as we collect it?
- A system of about 10 reference sites distributed along the PNW coast each with a documented history and data set demonstrating recovery from profound disturbance
- physical (geomorphic and hydrologic) relationships in properly functioning sites
- What aspects of sediment delivery, that we now encounter in coastal watersheds, are important in designing effective restoration projects in estuaries? What are the site goal(s) in estuaries as they currently exist given historic and future land use?
- How can we most effectively mimic natural processes without having to over design or over engineer them?
- How to design projects in a manner that increases resilience of controlling factors to CC (e.g. will increasing tidal freshwater prism increase the system's resistance to upstream salt wedge migration?; If much of river sediment is being firehosed out to deep water due to dike system, are there ways to enhance sediment capture in marsh habitats? Are there better locations or designs for dike removal projects that will result in greater sediment capture?) Should we excavate channels during restoration or allow natural evolution of geomorphology? What are the system-scale effects of a dike project (e.g. how are salinity/sediment/hydraulic conditions affected outside the project footprint)? Do different types of estuarine habitats require active revegetation? Are there some that seldom require active revegetation? Is LWD important to geomorphic development in estuaries and project sites? Is LWD important to fish and bird use of estuarine habitats?
- comparison of costs/benefits of dike breach vs. removal -active vs. passive approach to reversing subsidence
- How can I minimize or avoid "designing" and "engineering" restoration projects?
- Predictive effects
- plant species-elevation relationships sea level rise from climate change relative effectiveness of hydrological reconnection methods: dike removal, dike breaching, tide gate, culvert, at creating channel network.

20) What do you think are the most common and important questions that, if answered, would improve your ability to evaluate/monitor coastal habitat restoration projects more effectively?

- Most of the same questions as in #19, especially the first one. The reference data used for design are also used for evaluation. If we understand processes that form tidal wetlands, we will be much better able to evaluate whether we are successfully restoring those processes.
- Simplification of benthic invertebrate analyses that would reduce per sample costs by using indicies or indicator species. multivariate analysis of multiple ecosystem function surrogates to evaluate the realtive importance of different soil parameters as predictors of key ecosystem functions.
- Why don't more restoration grant programs support effectiveness monitoring at useful and realistic funding levels?
- How long does it take for a wetland to achieve natural conditions?
- 1. Vertical control network (see Q19). 2. What is the relationship of physical habitat measures to biological productivity?
- What are the best indicators of a specific restored system's health? Project owner's funds must be used efficiently in the monitoring phase through selection of fewer, essential indicators. This, in turn, results in longer term, fully funded monitoring regimes and increases the potential for collaborative adaptive management.
- What parameters correlate well with with complex and self-regulating functional recovery? What parameters indicate functional recovery trends that are not subject to year-to-year variation. How can invertebrate monitoring be simiplified to reduce per sample costs while providing ecologically meaninful information.
- Which species or thresholds for biogeochemical processes are most predictive of long term project success
- What are the outcomes we are looking for from a restoration project, and what are the best ways to evaluate success?
- Which of the many measures are the best to monitor effectiveness of wetland restoration?
- Funding for monitoring is the bottleneck, not information.
- a better resolution of the key controlling factors vs vegetation tolerances. Could reduce number of paramters. Better understanding of time for full development of a stable system.
- Where is the overarching oversight needed to organize researchers and managers into using common protocols and standardized data management systems? How can we get researchers to listen to managers when we tell them what tools are missing in the toolbox and then to help us develop them instead of taking our ideas, developing what they think we need, and then handing us back something that often misses the original target?
- 1) what is the post-project geomorphic stability; 2) how have important species responded; 3) have multiple goals been met (e.g., reduced flooding of pasturelands, improved estuarine aquatic habitat)?
- What are the most important parameters to monitor per habitat restoration or enahcement type? I believe that the questions will differ per type of "restoration"
- What elements are most critical to monitor to determine success / failure, and for how long?
- What parameters will alert me to a project's fate in the face of rising sea levels? How do I measure resilience to change? Is there a quick way to measure pore-water salinity? Is there an affordable way to monitor inorganic and organic accretion rates? How do we measure ecological function or infer it from structure? What reference sites/data are available? Long-term data sets? Is there a way to coordinate regional aerial photo/IR photo efforts to make site-specific photo acquisition more affordable? How do we store and manage long-term data sets? Is there a way

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to coordinate/share regional modeling expertise?
- what are the most important attributes to monitor in PNW estuaries?
- What is the desired outcome of the restoration?
- What do we want to see?
- Background variability in the system, intraannual and interannual.
- I think that distinguishing between site characteristics that can be measured remotely and those that need to be either ground truthed or measured directly in the field is important. Many characteristics about distribution of vegetation and sediment types, sediment temps, water temps, can be measured remotely and remote monitoring will provide data at a more appropriate scale. Sampling for higher resolution data as direct data or as ground truth data can then be designed based on the remotely sensed data.

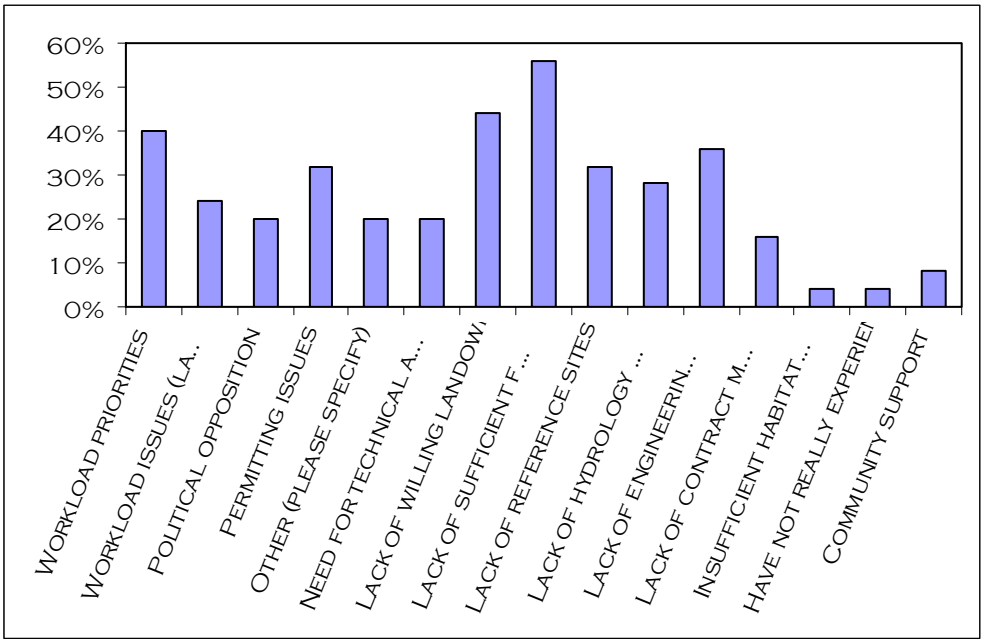
Answered 24
Skipped 7

21) In general, what information do you need to improve your ability to complete high quality estuarine wetland restoration projects?

- Continuous synoptic aggregation and redistribution of scientific literature on a heirarchy of restoration topics to reduce the need for independant literature review for each action.
- WE need more tidal hydrologists to provide site/project specific guidance.
- Elevation data, vegetation data
- 1. Vertical control network. 2. Readily available and usable tidal elevation modeling
- Reference site best management practices; design and construction elements, initial rates of naturalization, long term indicators of systems strength (both bio and hydro).
- Develop sustained (but not necessarily substantial) funding sources that can effectivel catalyze long-term habitat site stewardship? Develop a mechanism for transfering non-quantitative information on best practices and procedures between practitioners. Develop best methods and certificated training for earthwork and revegetation work for habitat restoration.
- Need indicators that are cheap, practical, accurate, and highly predictive.
- Access to information on similar projects, as well as information of how to obtain planting success in the midst of heavy animal disturbance (deer, elk, beaver).
- See answer to question 19 above.
- geomorphic predictions of habitat change at the estuary scale over time frames of ~100 years
- I need funding more than information.
- see 19 and 20
- I need to know how to get my agency to prioritize positions dedicated to collecting and assess monitoring data with the goal of putting the results into useable formats that can be turned around and used by mitigation and restoration practitioners.
- funding aimed at cost-effective projects with an emphasis on utilizing local expertise
- A list of willing volunteer land owners who would be willing to conduct restoration on their lands.
- See above responses. Reference sites and long-term data sets. Knowledge of how estuarine controlling factors are vulnerable to climate change and the mechanisms that are most effective at reducing vulnerability. Greater modeling ability.
- -how to move forward in the face of uncertainty
- A more landscape-scale perspective.
- Social buy in
- Long-term vision that includes substantial funding for monitoring and adaptive management.
- Access to remote sensing data (aerial photo, side-scan, multibeam, lidar, etc.)

Answered 22
Skipped 9

22) In your experience, what obtacles, if any, have impeded your ability to implement high quality estuarine wetland restoration projects?



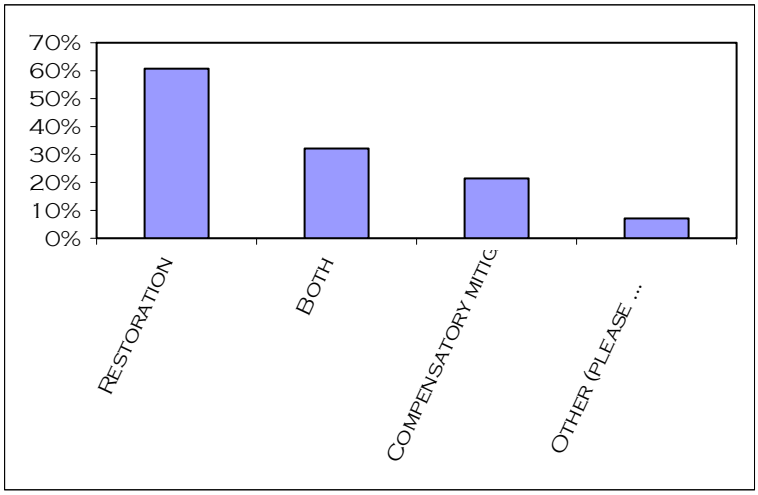
Workload priorities	40.00%	10
Workload issues	24.00%	6
Political opposition	20.00%	5
Permitting issues	32.00%	8
Other (please specify)	20.00%	5
Need for technical assistance	20.00%	5
Lack willing landowners	44.00%	11
Lack sufficient funding	56.00%	14
Lack reference sites	32.00%	8
Lack hydrology expertise	28.00%	7
Lack engineering/modeling expertise	36.00%	9
Lack contract management experience	16.00%	4
Insufficient habitat maps	4.00%	1
Have not experienced any obstacles	4.00%	1
Community support	8.00%	2

Anwered	25
Skipped	6

Other (please specify)

- lack of learning from previous projects or from similar projects completed by other practitioners; no feedback loop. Conflicting land use (industrial ports).
- lack of rigorous/accountable planning and design methodology - 'wiki design' by stakeholder and science advisory groups. - confusion over the difference between restoration as scientific research and restoration as applied science. Sciencism, including the emphasis on uncertainty rather than what we know how to do can be self defeating
- Knowledge and time
- I've had very satisfying experiences to date with restoration, and I believe the results have been good quality. But, improvements could always be made, and there's a lot of potential out there. It would be nice to have all the above bases covered (pie-in-skying).
- Lack of tidal geomorphology expertise.

23) What kinds of estuarine wetland projects do you work on?



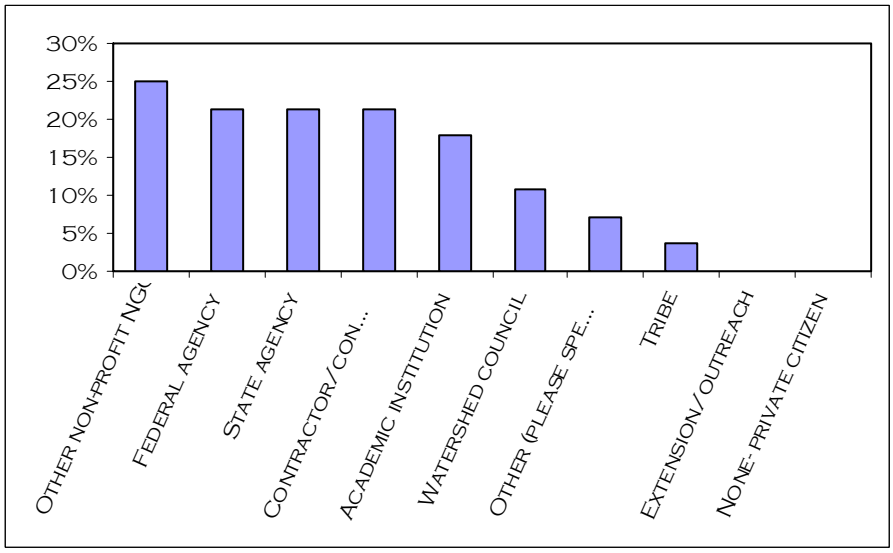
Restoration	60.71%	17
Both	32.14%	9
Compensatory mitigation	21.43%	6
Other (please specify)	7.14%	2

Other (please specify)

- assessment & prioritization of key activities required to protect & restore estuarine habitats for biodiversity, and methods for evaluating restoration and protection activities
- Research

Answered	28
Skipped	3

24) What kind of organization(s) are you most closely associated with?



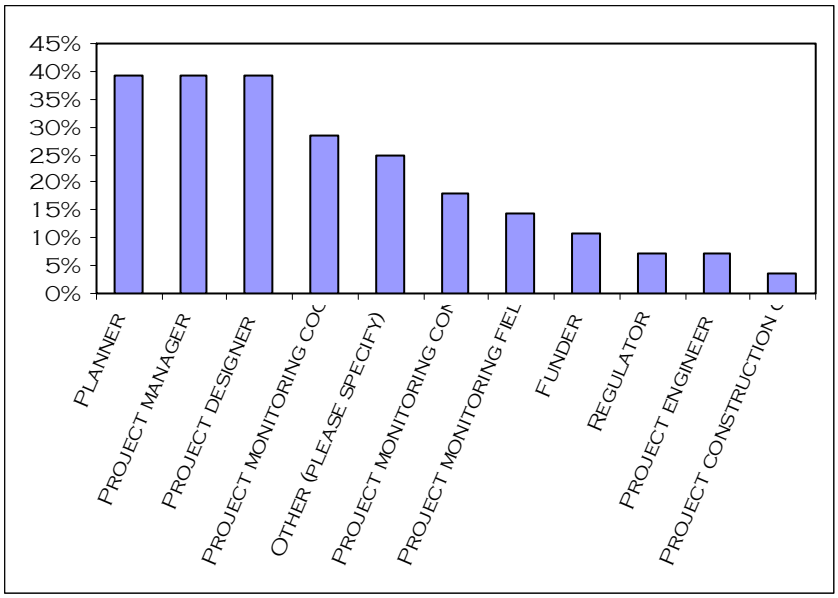
Other non-profit NGO	25.00%	7
Federal agency	21.43%	6
State agency	21.43%	6
Contractor/consulting firm	21.43%	6
Academic institution	17.86%	5
Watershed council	10.71%	3
Other (please specify)	7.14%	2
Tribe	3.57%	1
Extension/outreach	0.00%	0
None- private citizen	0.00%	0

Other (please specify)

- non-profit research
- Soil and Water Conservation District

Answered	28
Skipped	3

25) Which of the following descriptions most closely match your role in estuarine wetland restoration and/or compensatory mitigation projects?



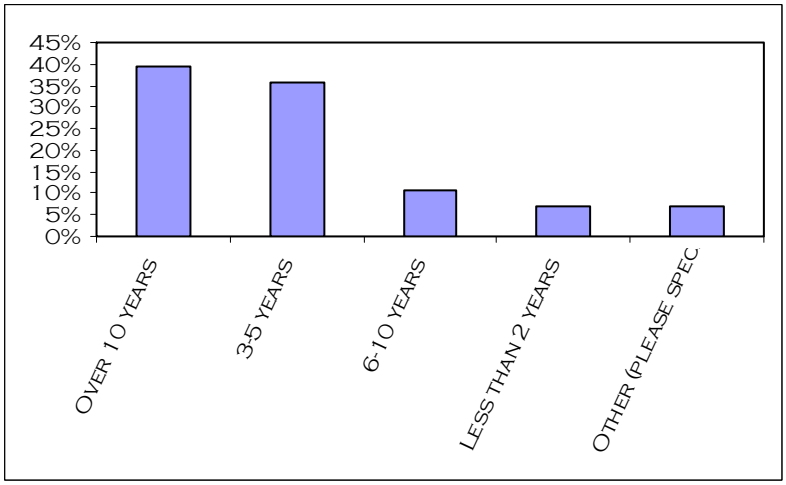
Answered	28
Skipped	3

Planner	39.29%	11
Project manager	39.29%	11
Project designer	39.29%	11
Project monitoring coordinator	28.57%	8
Other (please specify)	25.00%	7
Project monitoring contractor	17.86%	5
Project monitoring technician	14.29%	4
Funder	10.71%	3
Regulator	7.14%	2
Project engineer	7.14%	2
Project construction contractor	3.57%	1

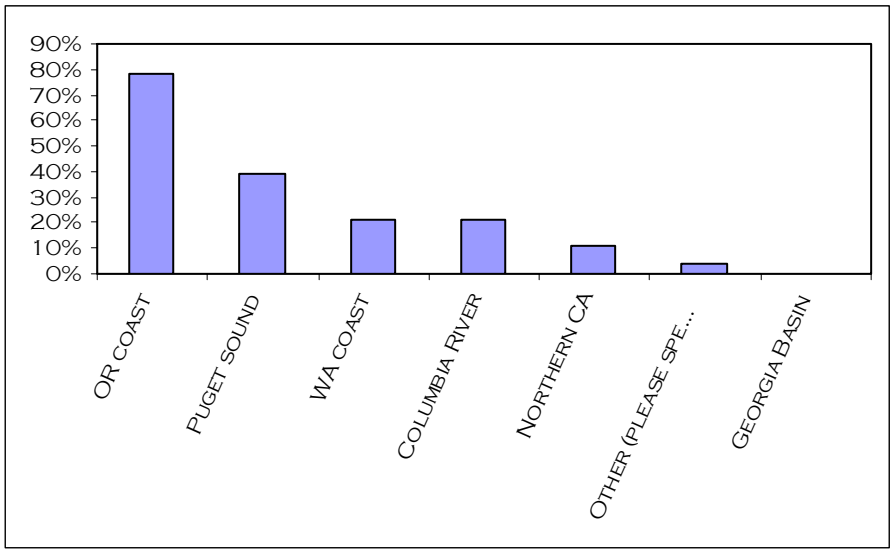
Other (please specify)

- Prepare grant proposals to obtain funding.
- organization scientist
- Scientist charged with evaluating effectiveness of policy and regulation.
- Research Scientist
- Researher
- researcher
- Data analyst

26) About how many years have you been working with any aspect of estuarine wetland restoration and/ or compensatory mitigation projects?



27) In what region(s) have you been working on estuarine wetland restoration and/or compensatory mitigation projects?



Answered	28
Skipped	3

Oregon coast	78.57%	22	**Other**
Puget Sound	39.29%	11	Hudson River
Washtington coast	21.43%	6	
Columbia River	21.43%	6	
Northern California	10.71%	3	
Other (please specify)	3.57%	1	
Georgia Basin	0.00%	0	

28) What did you think of the format and/or content of this survey? Please comment on how it could be could be improved in the future.

- Very good. Lots of thought went into this!
- Good and easy to use.
- overall I am very excited to learn about the results. And those results will better define the effectiveness of the survey than anything I can say!
- Mostly liked it. Very straightforward and user friendly. Some of the choices should have been framed or worded more precisely.
- Good format and content
- Good set of questions.
- Nicely done
- Good.
- very good
- Answers to some of the questions depend specifically on the type of habitat restoration or enhancement.
- Reasonable; keep time required to complete ~5 - 10 minutes!
- Overall great effort. Could not however answer the question on most important parameters, without separating the habitat types (to solve this you could merge all of the vegetation types into one, e.g. vegetation percent cover, vegetation stem density). Also would have been useful to separate the kind of roles one plays in restoration up front, and then to track different respondents to different questions; i.e. I had to leave the questions about restoration implementation blank because although I have my opinions and vicarious experiences I really just monitor restoration projects.
- It would have helped to know what the goals were...could perhaps tailor answers better. Hard survey to construct, I'm sure.

Notes

Notes