Pacific
Marine
& Estuarine
Fish Habitat Partnership

SUMMIT REPORT

A Summit to Advance Juvenile Fish Habitat in West Coast Estuaries

JANUARY 14-15, 2014

Executive Summary

On January 14–15, 2014, a total of 61 federal, state, and local government, tribal sovereign nation, nonprofit organization and other representatives met at Cedarbrook Lodge in Seattle, Washington for a Pacific Marine and Estuarine Partnership-sponsored summit to advance knowledge of juvenile fish use of West Coast estuarine habitats and elements of three West Coast fish habitat assessments:

- **PMEP Nursery Habitat Assessment**, focusing on juvenile fish nursery functions in estuaries.
- **The National Fish Habitat Plan (NFHP) National Estuary Assessment**, focusing on threats to habitats of recreationally and commercially important fish stocks.
- **Nearshore Forage Fish Assessment**, focusing on habitat-related changes over time in distribution and abundance of nine species of forage fish inhabiting estuary and nearshore habitats.

Specifically, the group sought to achieve consensus on the selection of a list of focal estuarine-dependent fish and shellfish species; identify key data and research gaps relative to these species; achieve consensus on how best to assimilate existing fish data and habitat assessments, and discuss core elements of each assessment.

Panel discussions focused on inventorying and classifying estuaries along the West Coast as well as key threats and limiting factors for juvenile fish and shellfish in estuarine habitats.

All attendees participated in five breakout sessions to:

- Address the list of focal species for the PMEP Nursery Assessment;
- Discuss the importance and methodology of inventorying and classifying West Coast estuaries and make suggestions for specific estuaries to include in a West Coast-wide nursery assessment;
- Discuss data that currently exists for proposed focal species and their habitats as well as describe key elements that should be considered for a West Coast-wide data call for all three assessments;
- Discuss the approach PMEP should use to consider key threats/stressors/limiting factors for juvenile fish and shellfish in estuaries;
- Describe how partners could collaborate to compile and link to existing data sets on juvenile fish use of West Coast estuarine habitats;
- Discuss variations in protocols and different sampling efforts, how these could be standardized, and how these influence West Coast assessment outcomes; and

Discuss key science and data gaps relative to juvenile fish and shellfish use of estuaries and their habitats.

Table of Contents

Focal Fish Species for the Three West Coast Fish Habitat Assessments

Summit attendees were asked to review the draft list of focal fish and invertebrate species for the three West Coast fish habitat assessments (Table 1), and articulate which species, including some that may not be on the draft lists, would best represent the role and importance of estuary habitats to West Coast fish and shellfish.

Initial criteria used to select the species for each draft list included:

- **PMEP Nursery Habitat Assessment**—species with extensive estuary rearing during juvenile life stages, occurring over a broad geographic range.
- **The National Fish Habitat Plan (NFHP) National Estuary Assessment**—species from other two assessments, plus additional recreationally and abundant species known to use estuary habitats across a broad geographic range.
- **Nearshore Forage Fish Assessment**—small, short-lived, pelagic planktivorous fish.

I. WHAT SPECIES WOULD BEST REPRESENT THE ROLE AND IMPORTANCE OF ESTUARY HABITATS TO WEST COAST FISH AND SHELLFISH?

- Use an assemblage approach appropriate to biogeography rather than single species. Examples— anadromous fish, pelagic marine, benthic marine, benthic invertebrate, eelgrass, and non-native assemblages. For each of the three assessments, an additional column could be added to the focal species list that identifies the assemblage each fish/shellfish belongs to, with the goal of ensuring all assemblages are represented.
- Southern California species were underrepresented.
- The suite of focal species should change as one moves up/down the coast.
- Invertebrates are, in general, underrepresented.
- The list of species should be based on available data, presence, landscapes, representatives of more than economically important species, keystone species, and species representing different trophic levels. Assessments would then consider threats to these species. If data availability is the driver, data gaps should be highlighted to inform future research activities.
- The NFHP assessment should include non-native species and species that may be having negative impacts on native species.

- Assessment implementers should consider defining the term, "historical," and include data from the 1960s.

Specific Comments—PMEP Assessment

Summit attendees suggested adding the following species (the justification for adding the species, if provided, is included in parenthesis after the name of the species):

- Bay goby (they have an obligate estuarine life history stage)
- Staghorn sculpin (they have an obligate estuarine life history stage)
- Striped bass (extensive use in San Francisco Bay) and whitebait smelt
- Bay shrimp (spends early life history in estuaries)
- Ghost shrimp
- Burrowing shrimp
- Coastal cutthroat
- Littleneck clams
- Gaper clams
- Lingcod (move from NFHP assessment to PMEP assessment)
- Greenlings (move from NFHP assessment to PMEP assessment)
- black rockfish (move from NFHP assessment to PMEP assessment)
- gunnels (move from NFHP assessment to PMEP assessment)
- Green sturgeon
- peamouth chub (represents a lower salinity gradient than others on the lists)
- Lamprey (cultural importance, and connectivity between fresh and saltwater habitats)
- Pacific cod, or others that were once present, but whose populations have dropped
- Northern anchovy
- Surf smelt
- Delta smelt
- threespine stickleback
- sand lance
- eulachon
- Olympic oysters (sensitive indicator of estuary conditions)
- *Corophium* spp.
- Underrepresented Southern California species (leopard shark, bat ray, diamond turbot, sea bass, other perch)

<u>Consider removing the following species:</u>

- The two rockfish (uncertain if they have an obligate estuarine life history stage)

TABLE 1. PROPOSED LIST OF SPECIES FOR WEST COAST FISH HABITAT ASSESSMENTS.

COMMON NAME	Scientific name	PMEP Nursery	Forage Fish	NFHP
DUNGENESS CRAB	*Cancer magister*	X		X
GREEN STURGEON	*Acipenser medirostris*	X		X
STEELHEAD	*Oncorhynchus mykiss*	X		X
COHO SALMON	*Oncorhynchus kisutch*	X		X
CHINOOK SALMON	*Oncorhynchus tshawytscha*	X		X
CHUM SALMON	*Oncorhynchus keta*	X		X
BROWN ROCKFISH	*Sebastes auriculatus*	X		X
SHINER PERCH	*Cymatogaster aggregata*	X		X
CALIFORNIA HALIBUT	*Paralichthys californicus*	X		X
ENGLISH SOLE	*Parophrys vetulus*	X		X
STARRY FLOUNDER	*Platichthys stellatus*	X		X
SPECKLED SANDDAB	*Citharichthys stigmaeus*	X		X
PACIFIC SANDDAB	*Citharichthys sordidus*	X		X
TOPSMELT	*Atherinops affinis*	X	X	X
PACIFIC HERRING	*Clupea pallasi*	X	X	X
AMERICAN SHAD	*Alosa sapidissima*		X	X
DEEPBODY ANCHOVY	*Anchoa compressa*		X	X
SLOUGH ANCHOVY	*Anchoa delicatissima*		X	X
NORTHERN ANCHOVY	*Engraulis mordax*		X	X
THREADFIN SHAD	*Dorosoma petenense*		X	X
SURF SMELT	*Hypomesus pretiosus*		X	X
LONGFIN SMELT	*Spirinchus thaleichthys*		X	X
EULACHON	*Thaleichthys pacificus*		X	X
DELTA SMELT	*Hypomesus transpacificus*		X	X
NIGHT SMELT	*Spirinchus starksi*		X	X
JACKSMELT	*Atherinopsis californiensis*		X	X
CALIFORNIA GRUNION	*Leuresthes tenuis*		X	X
CALIFORNIA KILLIFISH	*Fundulus parvipinnis*		X	X
THREESPINE STICKLEBACK	*Gasterosteus aculeatus*		X	X
PACIFIC SAND LANCE	*Ammodytes hexapterus*		X	X
OLYMPIA OYSTER	*Ostreola conchaphila*			X
BLUE MUSSEL	*Mytilus spp*			X
PACIFIC LITTLENECK CLAM	*Protothaca staminea*			X
BAY SHRIMP	*Crangon franciscorum*			X
LEOPARD SHARK	*Triakis semifasciata*			X
COASTAL CUTTHROAT TROUT	*Oncorhynchus clarkii clarkii*			X
BAY PIPEFISH	*Syngnathus leptorhynchus*			X

COMMON NAME	Scientific name	PMEP Nursery	Forage Fish	NFHP
COPPER ROCKFISH	*Sebastes caurinus*			X
GRASS ROCKFISH	*Sebastes rastrelliger*			X
LINGCOD	*Ophiodon elongates*			X
PACIFIC STAGHORN SCULPIN	*Leptocottus armatus*			X
KELP PERCH	*Brachyistius frenatus*			X
BAY GOBY	*Lepidogobius lepidus*			X
WHITE SEABASS	*Atractoscion nobilis*			X
SPOTTED SANDBASS	*Paralabrax maculatofasciatus*			X
DIAMOND TURBOT	*Hypsopsetta guttulata*			X

- Topsmelt (there was a suggestion that there might be better representative than this species), steelhead, brown rockfish (question regarding extensive estuary rearing)
- Non-native species or put them in a separate category (American shad and threadfin shad)
    - If develop a non-native category, need to include other species (e.g., striped bass, clams, zebra mussels), with purpose of evaluating threat to native habitat/species.
    - If removing invasive species, then remove shad.
- White sturgeon
- Speckled and Pacific Sanddab

NFHP Assessment

Consider adding the following species:

- River lamprey
- Tidewater goby
- six- and seven-gilled sharks

Nearshore Forage Fish Assessment

Consider adding the following species:

- Shiner perch.

Importance and Methodology of Inventorying and Classifying West Coast Estuaries

The Nature Conservancy contractors gave a presentation on the processes they used to initiate steps to create a comprehensive inventory and classification of West Coast confluences (Appendix 2C). Their proposed process inventories all West Coast confluences, classifies each with a common scheme, assigns polygons for each, and ultimately creates a confluence geodatabase that provides standardization across three states, is simple, can be classified using imagery, and is hierarchical/modular. Initial feedback from summit attendees included the following:

II. WHAT IS THE PURPOSE OF A UNIFYING CLASSIFICATION SYSTEM, AND WHICH PROPOSED CLASSIFICATION SCHEME WORKS BEST TO MEET THAT NEED?

- Utility for inventorying and classifying West Coast estuaries
    - The classification system should become a common framework:
        - to guide restoration and management
        - to make comparisons
        - to make strategic investments
        - to develop management plans for different estuaries
        - to inventory estuaries for occurrence of species
        - that creates a common language that promotes discussion among regions
        - that allows for landscape-level scale planning
        - that estimates the effects of climate change
        - that facilitates access to searchable data
        - to implement habitat conservation actions based on species or assemblages of species, many of which are transitory with large geographic ranges
        - that captures the lowest common denominator
    - Underlying all of this is a social management strategy – we must define the questions driving this – where, when, and why we do stewardship. What comparisons are you trying to make? What questions are you trying to resolve? Defining those stewardship/social/political questions will help drive the classification systems used.
    - We have to find a system that hierarchically nests—a stratified structure that allows nesting capability to deal with scale.

- If we are going to be consistent, each of the states have to adopt the same approach, and the classification system needs to be comprehensive across the three states. Do we want to compare restoration potential in the Big Sur to the Duwamish? How do we use the classification? These kinds of decisions affect the comparability of the data.
- The system must be flexible to address new questions in the future.
- How can classifications capture the dynamic nature of estuaries?
- What is the diversity of habitats across this geography, and how do fish and shellfish species use these habitat types?
- These maps will be used in Oregon to potentially update the estuary management plans in Oregon communities – existing habitat maps were made in the late 70s from aerial photography taken in the early 70s. Use LIDAR and new data to create new estuary habitat maps to inform management plans.
- Overriding purpose is to tie various schemes across coast together to foster tech transfer, communications, and coordination across geographies. Hopefully, eventually ties to national and international approaches.
- Some regional prioritization may be an appropriate use of this system, but caution about getting down to the project or action level. Other detailed sets that other estuaries already have will not be replaced. This will give us all a common framework for discussion/communication across areas.
- Purpose is less important than the fact that CMECS is what is already moving forward at the federal level and has already become the federal standard.

- <u>Coastal and Marine Ecological Classification Standard (CMECS)</u>
  - Because the West Coast needs a system that incorporates existing classification systems into a common scheme, CMECS should be crosswalked with other classification systems in existence (e.g., NWI, ShoreZone).
  - CMECS is meant to be a "work in progress" and adaptable. Oregon recently provided feedback on physiographic setting, etc. – next version of CMECS may incorporate these and other changes.
  - Polygons in database can be "internal" – related to level 1 and level 2 geoforms; another attribute could be a physiographic setting.

- <u>Other classification systems</u>
  - Review the wildlife habitat classifications completed in 2001 and 2002 in California, Oregon and Washington (Johnson and O'Neil 2001).
    - Review the revision to Oregon system completed in ~2010. Oregon is one of the first to use CMECS – federally mandated.

- Large estuarine systems
  - Scale
    - Because restoration occurs at the site scale, Puget Sound and San Francisco Bay should be considered on a smaller scale – lagoon, embayment bay, or river. If Puget Sound and SF Bay already have good classification systems, let's use them.
    - Integrating the wildlife aspect was challenging (Humboldt Bay) – multiple levels of scale. It is hierarchical. Important to get large scale information correct, then scale down. Obtained detailed imagery and ground truthing and created habitat maps. Within each habitat, local experts analyzed biota (local species, threats and stressors analysis – within habitat type), then placed that on the landscape. This resulted in being able to describe habitats most affected.
    - Columbia River - Ecoregion based on EPA – 2nd scale – 3rd scale is hydrogeomorphic reach to look at river flow as well as geology – it's a small true estuary with large freshwater component.
    - Look at the scale the fish perceives.
    - We can ask biogeographic kinds of questions – different scale of inference and utility for making comparisons than local scales.
    - Snohomish River system: species that occur in habitat types would serve as a general reference point across Puget Sound and across several scales. What you couldn't do with that information is say, "You should remove that dike." Those kinds of decisions have an array of site management constraints. PMEP can provide underlying biological relationships across the West Coast.
    - For a future refinement of CMECS, consider the "watershed approach" to estuaries—perhaps a numerical system to capture the different nestings.

- Exceedance
  - Oregon – created a polygon based on contour lines to capture the valley floor – within that, using NOAA exceedance values to differentiate between areas that are tidally influenced at least once every two years – also have sub-polygons that have different GIS layers (one for biotic component, one for substrate, one for geoform).
  - NOAA exceedance line – 50 percent exceedance line – anything that falls within that area is submerged at least once every two years. Use that to define tidal lands, which is more accurate than NWI. Areas defined as non-tidally influenced in NWI that really are tidally influenced. Anything above that is considered shorelands.
  - Sea Lever Rise (SLR) and moving targets – is there a way to benchmark relative SLR? Simple elevation models. Flexibility to incorporate local decisions.

III. HOW CAN WE BEST DEFINE THE EXTENT OF ESTUARINE POLYGONS (INLAND, OFFSHORE, LATERAL)?

Summit attendees provided several parameters that should be considered when defining estuaries, including hydrology, exceedance values, tidal inundation/extent of tidal influence, lateral extent (floodplain), and habitats and wetland communities.

Estuary definition:

- Hydrology should be the controlling factor (flow and tidal influence)—will define salinity zones – marine to upstream.
- Exceedance
  - Extent of estuary would be up to 27 ppt for plume offshore; with the upland extent being the exceedance value (which defines the fresh water-tidally influenced area). (As a subzone within the estuary mapping area, the salinity zone ends at 0.5 psu.)
  - Creating exceedance value for entire OR coast would not be too labor intensive – field work and ground truthing based on LIDAR has led to a model that can be applied to other estuaries.
  - Exceedance values would also define an estuary's lateral extent.
  - To get exceedance values, the amount of data and ground-truthing in highly modified systems (to get to the historical situation*) might be of concern (maybe use 10 M DEM for LIDAR instead of a finer scale) to get done in a 2-year time frame for entire tri-state area. But for WA and OR, a great deal of work for mapping in estuaries has been done, including on the LIDAR data to interpret changes, e.g. from diking etc.
- Tidal inundation— The estuary should be defined by the extent of the tidal influence, because it is a clear definition and can be used across the whole coast. Tidal influenced vs. freshwater/saltwater mix; if tidal freshwater is part of the estuary, need polygon to represent that. Extreme high tide should be the definition.
- Lateral extent of estuary—How much of the flood plain is included?
- For the purposes of the fish, habitat-forming processes throughout the entire area of tidal influence are what count.
- The offshore limit of the estuary is defined by mean high water at the mouth.

Other factors to consider:

- Look at SFEI work available soon.

- First create a scientific definition, but then focus the restoration on a policy decision.
- Should estuarine habitat or wetland communities be used to define estuaries (e.g., NWI) from the lateral definition?
- Include a QA/QC step to see whether the classification system works.
- Should there be a scientific definition of an estuary that can be used throughout the area, and then get into the political aspects later? The problem with a broad definition is that it includes too many factors.
- The estuarine plume is an important, but remains undefined at this point.
- How do we define the "upper" extent of the estuary? Salinity intrusion, tidal intrusion… NWI used tidal intrusion. Does this depend on season? E.g., upper extent in mid-winter may be lower than summer. If we want to include all "nursery habitat," then inclusion of all tidally influenced is better than salinity intrusion, e.g., Surge Plain in Grays Harbor.
- In Puget Sound, historical data is available. Bathymetry data is available for some areas, but in most places will need to rely on NWI classification (issue is water depth; shallow water [aquatic vegetation beds] vs. "open water" [deep).

IV. HOW SHOULD SAN FRANCISCO BAY AND PUGET SOUND BE SUBDIVIDED TO MEET ASSESSMENT NEEDS?

- Many other systems too would be subdivided to meet assessment needs: e.g., larger systems with protected embayments, such as Willapa Bay.
- Subdivisions within larger systems are needed; support dissecting these subunits to the degree it is practical and possible. There will be a common classification that will tend to fall out in these larger systems.
- Common language within the system is important.
- Nested hierarchical structure—Refer to Puget Sound and how it has been subdivided—Use PSNERP classification scheme, plus some modifications. Look to the San Francisco Estuary Project or the Bay Delta project (CALFED) for their classification scheme. SF Bay, Suisun/Central/South/San Pablo Bays within SF, confluences and habitat types within each subembayment.
- Cross walk best available data.
- Identify based on "one confluence" between marine and freshwater, but another layer that breaks down the system further into unnamed polygons based on habitat type within the single system.

- Develop a standardized process to populate habitat type polygons across states.

V. WHAT ELSE SHOULD BE CONSIDERED?

- CMECS
  - General level of comfort with CMECS, but don't lose the importance of more detailed information or the need to assure the scalability of information.
  - CMECS ignores the watershed. Is this important to consider if we're looking at threats like run-off?
  - If other classification systems are being considered, other than CMEC, we should spend more time learning about them.
- Context
  - The purpose of this assessment is to classify natural communities in estuaries.
  - Comparing one disparate system to the other might be easier working with assemblages.
  - Make sure we're not comparing a system that has a small plume versus one that has a large plume – this will help us make appropriate comparisons and be a good tool for our understanding of processes and drivers.
  - Are there anthropogenic impacts?
- Approach
  - How to map: single line from Canada to Mexico; add all "events" (confluences) onto that line. Each intersection has coordinates (like a highway map; e.g. river x is at shoreline mile 1456.4…).
  - Assessment will get us to habitat association, but not necessarily to "why" fish are there.
  - Compile known studies in estuaries beyond presence/abundance.
  - Suggest scaling up a notch so that you can group estuaries (geographically, based on cluster analysis, giving it a hierarchal system). This is suggested because biological communities in southern CA are different than biological communities in NW Washington and because you may have threats that are unique to geographic areas. Or group estuaries based on biogeomorphic categories (e.g., Glacial estuaries would

be grouped together), which is still somewhat geographic.

VI. WHAT ESTUARIES SHOULD BE INCLUDED IN A WEST COAST-WIDE JUVENILE FISH HABITAT ASSESSMENT?

- **All functional estuaries** should be included, i.e. any estuary with a mixing zone should be considered; lower limits should be considered…
- **Scale**—Need to define what scale to include or not include.
- **Functional attributes**—Fish passage, tidal influence, hydrologic units or littoral drift or some kind of size grouping, types of certain functional attributes. One might not classify eelgrass beds in the Puget Sound as an estuary, but would classify eelgrass beds at the mouth of a riverine system.
- **Access**—At high tide, fish can access small river inputs, but not at low tide—these are still important.
- **Connectivity**—make sure it is being addressed, if there's shift in fish distributions over time.
- **Restoration potential**—if historically there was a confluence, and it has been cut-off by development, so there currently is no fish passage (culvert removal, etc.).
- **Define estuary footprint**.
- Big Sur Coast: for PMEP nursery assessment can drop many of the small streams (e.g., those that drop off the cliff or that only include wave wash across beach) where there's no "mixing" to constitute an estuary; based on gradient at the coast.
- Keep the complete list, but refine the number of confluences you include based on focus of assessment (i.e., questions).
- Need **ground truthing** of estuaries based on function (talk to experts that have worked in those systems).
- Whether or not there is data on fish will determine which estuaries we look at (both current and historic data), however you could still use it in the classification system.
    - You could still create a model that predicts what fish are in an estuary where there isn't fish data, but it might not be as strong.

VII. WHAT DATA IS AVAILABLE FOR THOSE ESTUARIES AND SPECIES?

- Distribution of coastal cutthroat trout.
- Monitoring data from watershed groups, consulting companies.
- California Department of Fish and Wildlife (and other state agencies) have years of data.
- Studies that monitor a set of estuaries over a set period of time.
- Quality species data is available at the estuary level, but not at a coast-wide level (look into Marine Ecosystems Analysis (MESA))
- Relative abundance, presence/absence, occupancy of fish and shellfish.
- Life history.
- Estuary systems.
- Habitat types within estuaries (What habitats are functional and resilient?).
- Key threats.
- Habitat use—Timing of entry into estuaries, length of residency, what are fish eating? How fast are they growing while in the estuary?

Key Contacts:

- Pacific lamprey coastwide data (and other spp.)
    - Damon Goodman (USFWS, Arcata)
- Coastal Cutthroat Trout
    - Coastal cutthroat trout added to PMEP juvenile–PSMFC. References - 2 pages from Kitty Griswold (PSMFC)
- Habitat GIS data, fish data, HSU data
    - Bill Pinnix (Arcata USFWS)
    - UC Santa Barbara gap analysis on habitat types
    - Emmett salinity report: Habitat use in individual estuaries
- Fish data for California
    - Vicky Frey (Eureka CDFW)
    - Steve Goldman (CDFW), supervises all geo analysts
    - Humboldt Bay, Mike Wallace Cal Dept. Fisheries, coho, threespine stickleback,
- SF Bay
    - SFEI, UC Davis (Jim Hobbs), CDFW (R. Baxter, Kathy Hieb)
- Mapping
    - MLPA (UCSB marine map)
    - ODFW spatial data
    - Tom Miewald (North Pacific LCC and USFWS)
- Species surveys
    - SWRCB benthic invertebrate surveys (SFEI, SCCWRP)

    - Scott Heppell (OSU) Yaquina sampling, multiple species
    - For salmonid data and green sturgeon data focus on SWFSC and NWFSC
- Historical
    - National archives of aerial photography – evaluate changes over time and potential for restoration (coastal records project)
    - Historical thesis by U of O on Coos Bay coastal cutthroat.
    - Check with Bob Emmett on necessity of collecting early data (1970s). Send web link to Bob's report out to the assessment teams, and to science and data team and PMEP summit participants, to see what kind of data is needed to augment it.
    - Southern California Coastal Water Research Program (SCWWRP) for California
    - San Francisco Estuary Institute (SFEI) for California
    - Central Coast Wetlands Group (CCWG) for California
- General ecological information
    - Ecological information from Coos estuary (Partnership for Coastal Watersheds) (source: C. Cornu)
    - Report data (and metadata) including grey literature when appropriate.
    - EPA - data on WC estuaries (e.g., from National Estuaries Programs)
    - Janet Webster, librarian at MHSC: Data on estuaries from reports, dissertations, etc. accessed through Geo Commons (online GIS tool)
    - NERRs and NEPs.
    - Southern CA Bight (SCCWRP) and MLML
    - Data sets: Coos Bay BLM, ELMR, SF Bay Creosote Report (sfbaysubtidal.org)
    - UC Press, Ecosystems of CA. in press. Chapter on estuaries could be useful.

- Invertebrates
    - Henry Lee & Debbie Reusser: nearshore marine invertebrates and vulnerability to climate change
- Watershed groups
    - CDFW (K. Shaffer)
    - SFEI (R. Grossinger)
    - USFWS (Bill Pinnix)
    - ODFW
    - WDFW
    - SCCWRP
    - OCMP
    - CA State Coastal Conservancy (Moira McEnepsy)
    - EPA Emap
    - EPA national aquatic resource surveys
    - NOAA CSC
    - UCSB
    - MLML

    - UCD (Jim Hobbs)
    - Western WA University (Anacortes, WA)
    - SWFSC
    - NWFSC
- Salmon
    - ODFW has kept up Reimer's sampling (index site, S. Coast: Jose Jarrin-Marin; PhD, OSU; Gonzallo Costillo, PhD, OSU; Bob Ellis, data with Tillamook Estuary Partnership, Dan Bottom /Si Simenstad (Salmon River), Stan van de Wetering, Siletz, Yaquina estuarine use, habitat associations.
    - Lack of long time juvenile salmon data– need long term data sets, life cycle basins… ODFW has had long term estuarine monitoring. Maybe sampling due to restoration projects (Tillamook, Salmon River, Sixes, Coos Bay). Which sites would be pick for long term monitoring? 80/81 Columbia River sampling program– demersal and pelagic data. CRDDP Columbia River data development program (ask Laurie Whitecamp).
    - Steve Lindley mentioned that NMFS SWFSC has already done a phased data call 1) what data are available for each estuary, and 2) collected and compiled the data for steelhead, coho? And other salmon? For California, and beyond?
- Shellfish
    - Dungeness from Rumrill, presence, abundance, distribution and sizes, genders, every 2 months last 7 years. Have original data sets as well as compiled into technical reports.
    - Clams– pacific little neck clams– ODFW shellfish program (comparable surveys through WA and CA DFG).
    - Olympia oysters– Steve, Dick– 3 bays (Netarts, Yaquina, Coos Bay): some abundance info shoreline in Coos Bay, CA, WA has similar info (TNC has already captured this in coastal and marine assessments done by TNC). Multiple academic theses associated with this species.
- Juvenile fish
    - NOAA NWFS, ELMR, 1991, Bob Emmett information as corrected by Rumrill.
- Non-native and invasive species
    - Non-native, striped bass, shad, pacific oysters, European green crab, tunicate (Henry Lee, EPA , Newport, PICES data base…has compendium of invasives),burrowing isopod, purple varnish clam, – nursery species, wakame, japonica, *Spartina* , banded killer fish (warm water), large mouth, small mouth bass, New Zealand mudsnails, quagga mussels. (John Chapman, OSU, Hatfield, Newport, Greg Ruiz, Smithsonian, lives part time Portland, PSU institute on invasive species and policy, assessments throughout NW, Mark Sytsma, PSU.
    - Laurie Whitecamp has NOAA data on shad in Columbia, Rogue, Umpqua
- Rockfish

    - Assessment, Susan Schlosser, CA Sea Grant: quantitative assessment of rock fish recruitment into estuaries in N. CA, Oregon
    - Ali Dauble masters OSU, ODFW—Newport.
- Traditional Ecological Knowledge
    - Smith River Rancheria, Megan Rocca, 97 company-- consultant with tribe, just held traditional knowledge workshop in Portland last month.
    - *Ecotrust* has best traditional ecological knowledge data –methodology (Charles Steinback)– pacific lamprey in Columbia, Howard Crombie with Umpqua, Don Ivy, Coquille, John Erlandson, U of O anthropologist. Mary Mahaffy, NP LLC, recently funded traditional knowledge information pilot projects.
- Instream flows and water rights
    - ODFW, Tim Hardin
- Oregon systems
    - Columbia, Coos, Salmon, Tillamook, Nestucca, Siletz, Yaquina, Alsea, Siuslaw, Coquille
- EPA data on WC estuaries
    - Jim Howard, EPA
    - Todd Sandell: Grays Harbor
- National Estuaries Programs
    - Lisa Phipps, Tillamook NEP
    - Cheryl Brown
- Other
    - Identify estuaries that have a lot of data associated with them (NMFS-D. Bottom)

VIII. WHAT SHOULD THE DATA CALL FOR ALL THREE WEST COAST ASSESSMENTS INCLUDE?

- **Guidance for Collecting Data**
    - Describe each of the 3 assessments and specific questions each will address scope and analytical methods (as context for data requested). Get an informed start on what data is out there (i.e., query some sources that you already know) and then do the call to a larger group, down the road, with a very specific request.
    - Two stage approach: (1) ask what entities have based on standard form they fill out via online survey - Initial query for metadata; (2) we review responses and decide which data sets we want (and which we don't want). Develop a list of ~10 contacts for the first wave, then ask those folks for additional contacts. Target certain people (regional experts), for certain data, to answer certain questions. It should be an iterative process, versus a single call for three different assessments.

- Have a scheme for organization: who has been contacted, what data do they have, and what is the timeline for when the data might be useable?
- Criteria: what to include—Gear type, site level characteristics, fish species, what type of data (presence/absence, abundance, CPUE, density), life history recorded, size range recorded),georeferenced, date/time/year, start and end dates, who collected, QA/QC, tide height, water depth, existing format, length/weight, why the study was conducted, limitations of data (consistent or not, incidental collections)
- Are they willing to share their data? Is it in the public domain? Can it be published? Sharing of data might be an issue if it hasn't been published. Knowing how it's going to be used will be important.
- Could be useful to have a preferred format if they have time to organize themselves.
- Keep communication with what PMEP is planning to do with the data, any products.
- If they have species beyond the focal species do we still collect it, or delete?
- Use expert opinion to determine what data exists and to do the actual assessment, versus a broad call to a bunch of people.
- In the data request, we should let the audience know the data that we already have (i.e., data from the first NFHP assessment).
- Determine if you have a common format, determine if you would like it in raw or summarized format, and determine who is doing the data compilation.
- Create a website portal to deposit data in a streamlined way.
- Data ownership: have an answer on whether they can be included on authorship with any publications.
- Make funds available to convert paper data to electronic data

- **Types of data to collect**
  - **Fish data**—georeferenced for species on assessment lists (except salmon); presence/absence by life history stage; abundance over time, life history information, size class, sampling time frame, sampling methodology for metadata, sampling effort.
  - **Habitat data** (georeferenced)—bathymetry, substrate, vegetation; freshwater inflow, degree of exchange with the ocean; salinity; distribution of artificial substrate; tide gates.
  - **Stressors** (may be secondary)—impairment of freshwater inflow, road crossing/train crossings at mouth, Rumrill presentation list- TNC work and national datasets, coastwide publically available data. Will need stressor information at multiple levels (stressors to estuary and stressors to habitat types within an estuary)
  - **Other data** that exists besides juvenile fish: vegetation, bathymetry, etc. that might be useful down the line or help with the habitat classification.
  - Presence or absence (CPUE) data.

- **Traditional Ecological Knowledge**—Potential for application of traditional ecological knowledge. Source of information we don't traditionally think about.
- **Gaps**—Identify voids to fill.

Threats, Stressors and Limiting Factors

IX. WHAT APPROACH SHOULD PMEP USE TO CONSIDER KEY THREATS/STRESSORS/LIMITING FACTORS?

A. How can we capitalize work that has been done in other places?

B. How can we best assess key threats, and what process should we use to do that? How should we think about it?

Look at other models/examples

- Everglades (focus on mechanisms, identify vision)
- PSNERP
- Chesapeake Bay
- IEA
- Halpern
- Gulf of Maine
- Great Lakes
- Environmental Management article (Van Cleve)
- SE Alaska, where there have been fewer impacts as points of comparisons with systems in Washington, Oregon, and California (and a future opportunity with the AK FHP) – living examples of an unstressed system that could be considered benchmarks
- Illustrated ecoregional view of the landscape features and ocean environment that affect salmon migration (Xanthippe Augerot, Atlas of Pacific Salmon (great example!)

Coordination:

- Improve collaboration between PMEP Assessment and CCIEA (CC conceptual models may be starting place for PMEP).

Conceptual models:

- Simple, clear, focused; get you to desired endpoints (re: nursery function).
- Four conceptual models based on four classes of estuaries (sound, riverine, lagoon, embayment) – SF Bay Subtidal Goals, PSNERP.
- Inform processes/elements for focus, which informs data we need (conceptual model vs. framework?).
- Use CM to help identify framework.

- Use CM to ID stressors for different systems.

Consider:

- Inputs
  - Have both broad scale and finer scale data.
  - Evaluate hydrology.
  - Use expert opinion.
  - Historic data (stressors, e.g.), local data, data gaps.
  - Plate tectonics.
  - Incorporate socioeconomic info to enhance relevance.
  - Use prior publications to compile threats information and tell the story.
  - Indicator species, as they may be better indicators of threats.
  - Processes that species rely on, rather than list of spp.
  - Identify pressures by system so you can link issues – consider surrogates.
  - Diversity (w/in and across sites) - Portfolios of habitats: Bristol Bay sockeye, where the high genetic diversity of the sockeye populations reflect the high diversity of habitat types in the larger system. Focus on diversity of estuarine habitats, how to measure it, enhance it, monitor trends.
  - ID which threats you want to monitor and do associated monitoring.

- Outputs
  - Organize information- info needs, attributes, comprehensive biological monitoring; organize by regional stressors, then assign species targets to the stressor.
  - Classify habitats.

Create:

- A framework of estuaries to assess upstream factors affecting individual estuaries.
- A reference condition for each estuary to avoid missing a key threat to an estuary because it isn't a threat to a species.
- A matrix of species/guilds and stressors - rank stressors for the targets.
- Gap analysis.
- Understanding the history of stresses can also be important. It may be those historic threats or new ones that are most important to address.
- In addition to studying the diversity characteristics of habitat types, we need to understand the diversity of life history strategies within species and among species to guide restoration.
- A set of key assumptions and principles as a baseline, and build out from there, and then evaluate why the assumptions do or do not work.
- A standardized system for illustrating stressors (similar to IEA) using the minimal or lowest level of stress intensity as the baseline condition (not the maximum).

- A water quality map using 303d data for multiple watersheds.
- An analytical framework in space and time.
- A suite of applicable stressors, understand the range of scale & intensity of their impacts.
- A proxy for importance and/or condition of an estuary may be to value "big complex places that aren't too trashed."
    - Aerial extent (in a historical perspective).
    - Connectivity (access).
    - Complexity (how many habitat types).

Approaches:

- Develop a set of stressor classes, map them, and then tie to species.
- Start with species, look at the threats affecting them, & make comparisons among species.
- Compare across types of estuaries.
- Create a set of estuaries and list of focal species, identify the land use and land cover, then identify the threats based on the land use for each estuary.
- Think of "opportunities" for fish to use the full range of diversity and ecological processes in the estuarine habitats for which they are dependent.
- Look at changes of the effects (e.g., pollution based threats) over time, rank them for a particular estuary, and assign it an historical rank.
- Recognize regional differences; organize by regional stressors then assign species targets to the stressors.
- Use target groups or assemblages to bin with stressors.
- Don't let what data you have drive the priorities.
- Follow the process that IEA uses for their California Current program: issue identification, scoping – maybe less focus on analysis.

X. WHAT KEY SCIENCE AND DATA GAPS EXIST RELATIVE TO FISH USE OF ESTUARIES?

- Habitats
    - Habitats that juvenile species are using, where those habitats are, and the quality of the habitats.
    - Most species data is presence absence, how do we make the connection to habitats, and how important those habitats are to the species?
    - Shellfish habitats.

- Small estuaries may require special attention in the aggregate. Some work is beginning in CA.
- In Oregon estuaries, less is known about nearshore community, e.g., relationship between estuary and nearshore habitats.
- Habitat use by non-salmonids/different species.
- Areas and habitat types where comprehensive monitoring and inventorying can be done for comparison.
- How habitat condition affects use and survival in the estuaries.
- Associating presence in the estuary with specific habitats or ecosystem services.
- Lack of comprehensive assemblage data across natural and anthropogenic gradient—flow, habitat, tidal, land water, food, hatchery.
- Habitat function vs. habitat association.
- Tidal prism, bathymetry, habitat types within estuaries.
- Links between watershed condition and the functional integrity of the associated estuary.
- Physical attributes of estuary when fish are present (this should be described by conceptual models for each estuary type)
- Freshwater and sediment inputs: timing and amount of input, how much is diverted, function of inputs.
- Estuary type/size and habitat types within estuaries over time (historically vs present)
- How nursery function is affected by shoreline armoring (what processes are changed by armoring)
- To what extent do populations allow diversity or wide ranges in tolerance for some conditions associated with estuaries?
- Water quality and quantity data in estuaries being classified and mapped. Range of tolerances to water quality.

- <u>Stressors</u>
  - Effects of stressors on focal species (e.g., are they sub-lethal?).
  - Invasive species.
  - Climate change.

- Threshold values for variables associated with stressors: How do we define a normal reference condition and gauge the relative impact of a given datum?

- Life History of Fish and Shellfish
  - How does a particular life stage (e.g., estuarine use by juvenile) affect reproduction or other later life stages?
  - Basic assessment of population abundance and distribution of forage fish within estuaries.
  - Recruitment dynamics, sub-populations, other basic ecological issues for species.
  - Data gaps exist for nearly everything other than salmon and Dungeness crab, relatively speaking. Gaps exist for pelagic fishes life histories in estuaries, especially juveniles. There is some work being done on lamprey.
  - Vulnerabilities of key species could also drive data quest, especially with changing climate.
  - Fish use in small systems.
  - Temporal variation is skewed to the spring—very little winter sampling, e.g., missing lamprey going upstream and downstream.
  - The role abundant fish or other species play, e.g., stickleback and shiner perch in the system.
  - Diversity in life history for a given species (or stock), and how that affects their use of the estuaries.
  - Connection between a species' use of the estuary and its fitness for ocean survival, i.e., the contribution the estuary makes to survivorship.
  - Otolith chemistry has been developed for only a few species.
  - How does residence time affect the species dependence on estuaries?
  - Life history of long-lived fish and the contribution of the pre-reproductive life stages (e.g., rockfish).
  - Seasonal movement of species in and out of estuaries.
  - Distributions within sites and the associated variables that define that distribution.
  - Change in fish presence, abundance, diversity over time (historically vs present) – to inform processes and function desired; Look at less altered systems with reference sites.
  - Fish species interactions in estuaries and impacts of hatcheries.

- How common patterns are that have been discovered in a case study basis . . . i.e., how geographically common is the nursery role (or any pattern for that matter) for any given example, e.g., steelhead.

XI. WHAT KEY SCIENCE AND DATA GAPS EXIST RELATIVE TO THREATS/LIMITING FACTORS/KEY STRESSORS?

Climate change:

- Effects on physical habitats and processes, and how that affects nursery function for fishes (where, when, how they use an estuary).
- Ability of habitats to "transgress" inland with sea level rise.
- Ability of species to expand ranges in response to sea level rise and climate change.

Biological:

- Invasive species.

Physical:

- Reduction in flow and change in flow pattern.
- Dredging, filling and armoring of nearshore and impacts to sand.
- Ocean acidification, DO, temperature, salinity, contaminants.
- Water quality data across smaller estuaries (nutrients, pesticides).

Resiliency:

- Resilience for other species besides salmon.
- Interactions between stressors, cumulative effects.
- What are the thresholds for the different stressors?
- Highlight key estuaries that are resilient now - compare into the future.

Scale:

- Complete data across estuaries and across the full range of stressors.

Habitats:

- Determine habitat quality using EPA-type rapid assessment methods done in OR and WA.
- LIDAR imagery determine West Coast gaps.
- Geological information about accretion, relative to sea level rise is a gap. Uplift information may be good in OR, but missing in other places.
- Indicator bird species as a proxy indicator of habitat quality.

Misc:

- Stratify by estuary the approach for capturing threats data.

Collaboration

XII. HOW COULD PARTNERS COLLABORATE TO COMPILE AND LINK TO EXISTING DATA SETS ON JUVENILE FISH USE OF WEST COAST ESTUARINE HABITATS, AND THE LOCATIONS AND CONDITIONS OF THOSE HABITATS?

- Data Synthesis and Analysis
    - Evaluate species habitat relationships within a certain estuary type that is data rich (e.g., Specific estuaries within in Puget Sound), develop a relationship with an individual in the data rich estuaries, and extrapolate to places where you don't have as much data. After you extrapolate, ground-truth to make sure those relationships hold-up in reality.
    - Determine what data you already have in data rich estuaries, and then make a call to assemble data where it's missing. A targeted call for specific datasets that would provide comparable information.
    - Focus on stressor and biological response relationships. This could expand the use of existing datasets. Could look to universities where some of these studies may have occurred.
    - Look at synthesis documents first. Potentially look at research permits?
    - Synthesis – in a structured framework – may be much more important than compiling data.
- Communication
    - Provide potential partners with detailed information about project objectives and what they might get out of the project, in order to foster buy-in.
    - Contract Tribes with data via CMSP effort (traditional ecological knowledge).
    - Important to get senior management on board with collaboration.
    - PMEP needs an outreach strategy for key influential data holders and their supervisors before data is requested. What the data will be used for, what are the benefits of sharing, tribal cooperation. Incentives for holders of smaller datasets in individual estuaries.

- Need to communicate, be inclusive and not do numerous data calls if possible. Review what's out there.
- Be really clear on what is wanted from the collaborators. Know what you're asking for and respect ownership and help where possible. How can it also help them? Ask clear questions, capture the metadata and let them know how it'll be used.
- Identify partners with access to data and distribute effort across those partners.
- Person-to-person contact and follow through.
- Clear and simple process for accepting data.

- Data Sharing
  - West Coast Data Portal (WCGA).
  - Data sharing problematic between agencies often times. Agreements may allow for non-sharing in some instances.
  - Need to ID individuals who can get to the data. Respected folks.
  - Inventory existing efforts to synthesize juvenile fish data.
  - Provide a venue for presenting and reviewing the results of analyses.
  - Identify and bolster the mechanisms that support synthesis. (Is it funding, a coordinating body, contractual deliverables, opportunities to publish)
  - Build off existing database efforts rather than creating a new one (e.g., WCGA, LCCs).
  - Use technologies that support collaboration across scientists and managers (not only GIS staff).

Protocols

XIII. HOW WILL VARIATIONS IN PROTOCOLS AND DIFFERENT SAMPLING EFFORTS INFLUENCE WEST COAST ASSESSMENT OUTCOMES?

- Limits the data that can be compared across systems and stressors, and may lead you to think something isn't there, when it is (increases your likelihood of a Type 2 error).
- Different surveys will result in differing datasets, e.g., Seasonality needs to be considered.
- Limit analyses and inferences to "lowest common denominator" data sets.
- You can often apply certain analytical techniques to make combining the datasets statistically viable.
- Habitat suitability maps from PSMFC for EFH may be useful in some instances. Some groundfish modeling has been done.
- Metadata is critical—Need to know the reason the data was collected, methodology, and QA/QC. Should use a metadata standard. ID key metadata needs. How do we deal with historic information – those without metadata, reports on paper, etc.? May be able to categorize information up front so that it is more comparable.
    - Must have location and date and gear to be useful— Gear type differences; in estuaries: fyke trapping and beach seining, in deeper water: trawling. If you're starting a new sampling regime, what's the best gear to use?
- Consider gathering traditional knowledge, anecdotal information, information from those retiring, tribal sources. Could be a follow up to the State of the Knowledge report.
- Common sampling protocols can be used—this could be a good output of this effort—a tool box.
    - Develop data standards and field protocols to provide consistency in the data going forward.
    - Standardize conceptual frameworks for conveying estuary use by juveniles.
    - Develop qualitative indicators and alternative metrics that can be reliably reported when data will not support a more robust conclusion.
    - Trim the list of species reported on to those for which existing data are found to be adequate to support meaningful conclusions.

XIV. HOW CAN THESE DIFFERENT RESULTS BE STANDARDIZED?

- Stressor data: For comparing large versus small estuaries (e.g., Flow or contaminants), you could standardize per unit size (allometrics). You could standardized stressor for species type (i.e., biological thresholds).
- Normalized data—See Eli Holmes work.
- MARSS modeling analysis.
- Regional assessments or sub-assessments may address some of the standardization issues.
- PNAP protocols—are they comparable for estuary and nearshore? Can they be applied here?
- Hierarchical data: +/-, data robustness concerns and area covered, ecological niche models can be developed from smaller datasets. Time series requires much more data that +/-.
- What standardization is required in these analyses?
- Need to map out how the data will be used so we can prioritize data acquisition. +/- is easier to get than abundance data. Less processing required for +/- for instance.
- Sometimes we will only be able to get "information" that is anecdotal compared to data that is more formally compiled. Some of this information may be turned into spatial data. Could send out a fill in blanks spreadsheet for +/- of species in estuaries and habitats. And if data is published, what is the citation? Should first look through the well-known compilations before requesting duplicate information.
- Depending on the question—analyses may be limited to "lower quality" data (e.g., presence/absence) across range—even though "higher quality" data (e.g., life-history specific abundances) may be available in parts.

Appendix 1. Summit Participants

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Appendix 2. Summit Presentations

All PMEP presentations can be found on the PMEP Summit webpage portion of the PMEP website.

A. Pacific Marine and Estuarine Fish Habitat Partnership—Advancing Juvenile Fish Habitat in Estuarine and Nearshore Marine Environments (*Presenter: K. Schaeffer*)

B. The Pacific Coast Fish Habitat Assessments and the Estuary Summit (*Presenter: C. Greene*)

C. West Coast Estuary Inventory to Support Three West Coast Assessments (*Presenter: W. Heady*)

D. Diversity and Overview of Pacific Coast Estuaries (*Presenter: S. Rumrill*)

E. CMECS (*L. Mattison*)

F. Role of Estuary Habitats in Life History and Productivity of Coho and Chinook (*Presenter: K. Jones*)

G. Large-scale Perspective to Pressures Within and Across West Coast Estuaries (*Presenter: K. Andrews*)

H. Threats and Limiting Factors in Pacific Coast Estuaries (*Presenter: K. Fresh*)

I. Information About Known Threats or Limiting Factors for Juvenile Fish in Estuaries (*Presenter: D. Bottom*)

J. West Coast Fish Habitat Assessment Key Questions (*Presenter: L. DeBruyckere*)

Appendix 3. Supporting Summit Documents

All supporting documents can be found on the PMEP Summit webpage portion of the PMEP website.

A. PREZI Presentation on the Three West Coast Fish Habitat Assessments

B. Draft List of Fish Species for West Coast Assessments

C. PMEP Annual Report

D. One-page Summary of Estuary Inventory Process

E. One-page Summary of CMECS

F. Maps of Oregon, Washington, and California Estuaries

G. Comment Form