**Delta Smelt Scoping Team Meeting (12.17.19)**

**Attendees:** Chuck Hanson, Erica Fleishman, Erin Cole, Frances Brewster, Larry Brown, Nobel Hendrix, Patrick Coulston, Sam Luoma, Scott Hamilton, Shaara Ainsley

**Action Items**

- Bruce – send Fall Outflow Study Update presentation and model candidates to members (complete)
- Bruce – check with DWR to determine which data sets relating to outflow and salinity are available; this data would be used to test the effects of two different outflow scenarios on salinity under the model used for the Fall Outflow Study
- Bruce – reference BiOp to outline definition of actions related to above hypothesis and send to members for feedback
- All – finalize actions and agree on data sets for inclusion in the above hypothesis by end of January 2020
- Bruce – follow up with members on collecting feedback on Preface Statements for Entrainment Studies 1 and 2 (either as an agenda item during January meeting or a separate call) and send Scott's feedback on the preface to the preface

**Discussion**

- Fall Outflow Study Update
    - Initial objectives:
        - Identify environmental conditions that are associated with detection (probability of capture) and occupancy (probability of presence) of delta smelt.
        - Test mechanistic hypotheses about attributes of habitat or the gradient of habitat quality for delta smelt.
    - Funding for initial study expired; subsequent funding required additional, complimentary objectives, which include:
        - Translate results of occupancy models.
        - Collaboratively explore how the results might inform assessment of the potential effects of management actions.
        - Model potential effects, if appropriate.
        - Inform future data collection.
    - Scope:
        - Computational and project capacity limited the feasible number of occupancy models.
        - The complexity of each model must be bounded.
        - We aimed to assess the fit of models that are of greatest interest to the scientific and management communities.
    - Ability to meet target dates relies on all partners' availability and timely collaboration.
    - Study focuses on mechanisms
        - Use knowledge and intuition to narrow set of possible variables and models.
        - Apply environmental drivers to detection and occupancy.
        - Identify years, months, and environmental conditions along a gradient of ability to explain variation in the data.
    - Utilized a patch occupancy model to determine whether a species was present in a particular area. Two possible states under this model:
        - Presence of the species infers the patch is occupied.

        - A patch is vacant if there is lack of a presence of species under the assumption of perfect detection. However, imperfect detection is a likely occurrence as the patch was occupied but species was not there when it was sampled.
    - Multiple samples are necessary to estimate both occupancy state and detection probability.
    - Delta was broken up into 15 sub-regions and analyzed monthly from September through December.
    - Considered:
        - Whether occupancy state is a function of covariates, the values of which may vary among regions or months.
        - Probability of detection, conditional on presence, for a given sample, region, and month.
        - Whether probability of detection for a given sample, region, and month is a function of covariates, the values of which are taken at the time of sampling.
    - Data workflow was categorized into two categories: occupancy covariates and detection covariates. For each, data was kept if all data existed for a given month and station (and trawl for detection covariates).
    - Data details:
        - Model loops through months for which data are available within years and sub-regions.
        - Fits occupancy and probability of detection as a function of covariates.
        - 1571 months x sub-regions (patches).
        - 10,046 fall midwater trawls (samples).
    - Statistical estimation included the Bayesian estimation with Hamiltonian Monte Carlo, implemented in Stan in which:
        - Coefficients were estimated as probability distributions.
        - Relation of covariates to occupancy, detection were assessed.
        - Evaluation data with posterior predictive distributions and leave-one-out (loo; cross validation method).
    - Relative accuracy of twelve models were estimated by:
        - Model comparison via Widely Acceptable Information Criterion (WAIC).
        - Model averaging via stacking weights.
        - Fitting each model separately and make a prediction for each data point.
        - Combining model predictions with weights that minimize the mean squared error to the observed data.
        - Assessing conditions under which different models are more or less accurate (e.g., region, month, relative precipitation).
    - WAIC values of these models lead to Models 3, 9, and 12 being selected.
    - Model 3
        - Measures occupancy relations based on Turbidity (Secchi depth) and the presence of predation and competitors.
        - Indicated occupancy rates in 2014 were higher in the western sub-regions of the Delta.
        - Sample start time, fork length, and volume were found to be contributing factors to occupancy.
    - Model 9
        - Measures occupancy relations based on salinity and temperature.
        - Indicated occupancy rates in 2014 were higher in the eastern sub-regions of the Delta.
        - Turbidity, fork length, and volume were found to be contributing factors to occupancy.
    - Model 12
        - Measures occupancy relations based on Turbidity (Secchi depth) and predation.
        - Indicated occupancy rates in 2014 were higher in the western sub-regions of the Delta.
        - Sample start time and volume were found to be contributing factors to occupancy.
    - Models were weighted via stacking method to calculate what combination of models most closely predicts the data. Results are as follows:

        - Model 9: 0.66
        - Model 3: 0.33
        - Model 12: 0.00
    - Models 3 and 9 were found to fit better in different spatial and temporal boundaries.
    - Next steps
        - Assess what other hypotheses CAMT would like to analyze.
        - Consider realistic changes in management.
        - Assess potential to represent management actions via covariates for which data are adequate.
        - Use models to make projections given management-driven changes in values of covariates.
        - Working within the range of values observed in the past reduces uncertainty.
        - Use of relative rather than absolute projections for management evaluation reduces uncertainty.
    - Comments
        - Salinity and outflow related impacts are significant considerations from a management perspective.
        - It would be good to acknowledge why this study was conducted the way it was given constraints of available information.
        - Policy makers have not said they want degree of confidence, they want to know how confident we are. If it is not precise, we just tell them that and they can decide whether to make a decision.
        - The central Delta has a large dynamic range of salinity and temperature. Research has been completed that indicates high flow years with low temperature and salinity drives smelt there.
        - Reprioritizing prey variable under models 3 and 9 would mean redoing modeling as Cache Slough does not have that data. This may not be feasible but worthy of consideration.
        - A member indicated support for completing this process before attempting to integrate the abundance study into the model as abundance data is sparse and would require additional resources.
        - Redistribution of population does not necessarily equate to improved survival.
            - The model does not assume a zero sum around improving one habitat leading to degradation of another.
        - For fish to survive, they need food.
            - Answering food related hypotheses is not the intent of this model at this point in time. It is a goal of ours but would require additional funding in order to integrate both abundance and prey.
    - Discussion on pursuing an additional hypotheses to determine how differing outflow scenarios effect salinity within sub-regions.
        - Salinity data sets for two alternatives would be very doable. Utilizing data from 1974 and 1980 would be preferred.
        - McWilliams generates continuous data. Could select daily mean for salinity from it for each station location. Certain years, including 1974 and 1980, already have that data.
        - Pursuing this hypothesis would have management relevance and is discreet in nature.
        - This group will need to decide how actions are defined, including whether they include gates and what years. A data set can be developed after that but requires checking with McWilliams.
        - Let's see what is available before determining years and going from there. We will also review the BiOp in order to outline the actions and send to everyone for feedback. Look to define and decide on data sets by early January.

- Preface Statements for Entrainment Studies 1 and 2
    - This agenda item was postponed and will either be discussed at the January meeting or as a separate call.