OUTCOMES MEMORANDUM

TO: CAMT Members

FROM: Bruce DiGennaro

DATE: 1/17/20

RE: December 12, 2019 CAMT Meeting #85

Attendees: Brad Cavallo, Brycen Swart, Carl Wilcox, Dan Olson, Darcy Austin, Deanna Sereno, Erica Fleishman, Erik Loboschefsky, Frances Brewster, Louise Conrad, Nobel Hendrix, Rene Henery, Sam Luoma, Scott Peterson, Shaara Ainsley, Shawn Acuna, Stephanie Fong, Steven Culberson,

Action Items:

1. Bruce – Distribute link of current website to CAMT for member feedback
2. Bruce, Frances, Sam – Develop February CSAMP agenda that includes:

   - SDM for Delta Smelt
   - Coordinated Salmon Science Plan
   - CAMT 2020 Workplan and funding
   - Plans for 2020 Delta Smelt actions
   - Steelhead comprehensive monitoring program

3. All - Consider establishing sub-groups to flesh out specific needs of CAMT 2020 Workplan associated with "Possible Focused Discussions", especially seasonal outflow.
4. Bruce - Add proposed timeframe for completing various aspects of the Workplan
5. CAMT Co-Chairs - Follow up with CDFW and USFW regarding their participation efforts for scope potential future predictive modeling tools for Delta Smelt management actions.
6. All – Provide Bruce with suggested feedback and edits on CAMT Technical Studies Protocols
7. Bruce - Distribute Steelhead Comprehensive Monitoring Program materials via Carl to CAMT

Discussion Highlights:

1. Agenda and Updates

- CSAMP Website
   - Currently ensuring documents link up appropriately and other finishing touches before launching.
   - Bruce to share current version with members for review.
- Delta Smelt Entrainment reports:
   - Working with Lenny to finalize Studies 1 and 2.
   - Smelt scoping team is working on preface statements which will ultimately be included in report (statements will be reviewed by CAMT).
- SWC November 7 long-fin smelt symposium:
   - 75 attendees.
   - Recording will be posted online, to be determined if presentations will be.
- SWC February 2020 symposium being considered:
   - Suggestions on topics and formats welcomed.

- o Members requested State Water Contractors include as many distribution lists as possible to advertise February symposium.

2. Outcomes and Action Items from 11/19 CAMT Meeting

- Delta Smelt Conditions Report
    - o Received support to develop a report annually and to focus on presenting data without interpretation.
    - o Specific requests:
        - Add graphs showing trends, Delta Smelt distributions and data on aquatic veg.
        - Consider a separate, companion report for interpretation. See specific recs on slides.
        - Comments from Linda, IEP, others will be reviewed incorporated.
    - o Louise will come back in February for an update.
- SDM for Delta Smelt: continuing to integrate this work with Delta Smelt Science Plan.
- Technical Reports: agreement on establishment of protocols and procedures to improve management of technical reports.
- Workplan
    - o Recognize capacity constraints – focus on supporting ongoing technical work as highest priority.
    - o Revisit original management questions (are they still relevant?). Take stock before deciding on future initiatives.
    - o Defer to agency discussions for direction on BiOp support.
- Outstanding action items
    - o Consider and plan for modeling support needs for SDM activity – should know better what we need in a month or so.
    - o Clarify CSSP geographic scope (e.g. southern and western boundary) and objectives. Salmon Subcommittee has requested to wait until interview synthesis has completed and discussed at January 9 Subcommittee before recommending a geographic scope.
    - o Additional biological support needed for SDM work. DFW and Science Program are being explored, as well as other possibilities. Should have better idea of what needs are in coming weeks
- Other Updates
    - o A member suggested that Itag salmon tagging should be integrated into the CSSP effort.
    - o Bruce to consider what of steelhead-specific work via Carl can be brought to CSAMP.

3. CAMT Outflow Study

- Initial objectives:
    - o Identify environmental conditions that are associated with detection (probability of capture) and occupancy (probability of presence) of delta smelt.
    - o 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:
    - o Translate results of occupancy models.
    - o Collaboratively explore how the results might inform assessment of the potential effects of management actions.
    - o Model potential effects, if appropriate.
    - o Inform future data collection.

- Scope:
  - Computational and project capacity limited the feasible number of occupancy models.
  - The complexity of each model must be bounded.
  - Investigators 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.
- Model estimate for each region and month:
  - Delta was broken up into 15 sub-regions and analyzed monthly from September through December.
  - Designated the occupancy state as a binary variable.
  - 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.

- o Fitting each model separately and make a prediction for each data point.
  - o Combining model predictions with weights that minimize the mean squared error to the observed data.
  - o 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
  - o Measures occupancy relations based on Turbidity (Secchi depth) and the presence of predation and competitors.
  - o Indicated occupancy rates in 2014 were higher in the western sub-regions of the Delta.
  - o Sample start time, fork length, and volume were found to be contributing factors to occupancy.
- Model 9
  - o Measures occupancy relations based on salinity and temperature.
  - o Indicated occupancy rates in 2014 were higher in the eastern sub-regions of the Delta.
  - o Turbidity, fork length, and volume were found to be contributing factors to occupancy.
- Model 12
  - o Measures occupancy relations based on Turbidity (Secchi depth) and predation.
  - o Indicated occupancy rates in 2014 were higher in the western sub-regions of the Delta.
  - o 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:
  - o Model 9: 0.66
  - o Model 3: 0.33
  - o Model 12: 0.00
- Models 3 and 9 were found to fit better in different spatial and temporal boundaries.
- Next steps
  - o Assess what other hypotheses CAMT would like to analyze.
  - o Consider realistic changes in management.
  - o Assess potential to represent management actions via covariates for which data are adequate.
  - o Use models to make projections given management-driven changes in values of covariates.
  - o Working within the range of values observed in the past reduces uncertainty.
  - o Use of relative rather than absolute projections for management evaluation reduces uncertainty.
  - o Can project how predation metric will change as occupancy changes due to management actions.
- Member questions/comments and responses
  - o Did you address the changing nature of covariates and detection probabilities? Has detection probability changed greatly over the years?
    - There is not a hypothesis to assess whether the relationship between an environmental variable and detection has changed. We assumed the fundamental relationship between detection and covariant like turbidity has not changed. Also assumed the biological relationship has not changed over time.
  - o We have prey data going back to the 1970's. What's wrong with that data?

- The data needed for this modeling has to encapsulate the four month period between September and December for each sub-region – historical data meeting those requirements only goes back 10-15 years.
    - Multiple model verification of hypotheses is what CAMT should be striving for. X2 is a good indicator in many respects, but not necessarily for salinity.
    - Will you summarize your findings? Is more analysis needed prior to the release of the summary?
        - A manuscript will be developed and submitted to peer reviewed journal. We will prioritize additional requests for modeling if there is a "must have". Our current contract mandates another iteration with CAMT to see how management is influenced. The intent of the project was to have this be a collaborative process.
    - If CAMT is in the process of planning its work for 2020, we need to continue to balance continuing existing processes with improving data collection methods. It is not necessarily an either or. There is value in capturing and distributing what we have done. Would be major service explaining where there are limitations around available data.
    - DSST is pretty taxed – are they available to engage in these discussions? Another round of litigation is imminent – will they be able to speak freely about different hypotheses?
        - All we can do is hope we can speak freely. A DSST meeting is scheduled for later today and this topic will be discussed then. They can report back to us on anticipated ability to offer up additional hypotheses. A conscious decision will need to be made around when we go forward with publishing data collected.
        - Just because there is litigation does not mean science stops.
        - The last round of litigation took air out of the room. This is something to keep an eye on and further discuss when we move into developing and publishing findings.

4. **February 5th Policy Group Meeting**
- Agenda items to include:
    - SDM for Delta Smelt
    - Coordinated Salmon Science Plan
    - CAMT 2020 Workplan and funding
    - Plans for 2020 Delta Smelt actions
        - To be determined who would be giving portion of presentation of planned 2020 activities
    - Steelhead comprehensive monitoring program
- Potential topics for May 23rd Policy Group Meeting:
    - Consider means to integrate CSAMP and IEP needs (e.g. co-hosting meetings)
    - Hatchery salmon (CAMT would get that presentation in January):
    - SWC symposium on long fin smelt
    - Prelim data on Fall xX
    - Actions to be taken regarding BiOp, implementation strategies

5. **CAMT 2020 Workplan**
- Policy Liaison Input
    - Support for prioritizing ongoing studies and taking stock in current CAMT focus

- o Present a summary of progress on CAMT management questions at the future PG meeting, including a summary of current outflow information.
  - o Not seeing entrainment work as high priority – maybe look at salmon entrainment
  - o Outflow and habitat restoration are key management items deserving attention.
  - o Would like to see outflow information pulled together and presented.
  - o What habitat restoration is most impactful? What's our overall strategy/were should investments be made?
  - o Delta Smelt propagation and steelhead management are also important emerging issues with high uncertainty.
- Workplan Categories
  - o In-Progress Activities (largely fully funded)
    - Entrainment Studies (Adult Delta Smelt): expected to be completed soon
    - Fall Outflow: expected to be completed soon
    - SDM for Delta Smelt: will continue throughout 2020
    - Salmon Rearing Habitat in the Delta
    - Coordinated Salmon Science Plan for the Delta: will continue throughout 2020
    - WRLCM Workshops
  - o Retrospective Review and Assessment
    - Review CAMT initiatives to assess where gaps may still exist, what has been successful, what the current key management questions are and how we structure science around those.
    - Plan for summary presentation at the May Policy Group meeting (5/13), including summary on seasonal outflow.
  - o Continuation of ongoing discussions
    - Delta Smelt Science Plan Implementation (DSSP) – coordination with Float MAST and Float PWT
    - Resiliency Strategy Actions (Smelt and Salmon) and Other Salmon Actions
    - New BiOps
    - USBR Prize Competition – Topic to be determined.
    - Prop 1 funded studies
    - Ongoing Delta monitoring program reviews
  - o Additional Focused Discussions
    - Seasonal outflow – summary of what we know (May Policy Group meeting)
    - Habitat restoration – barriers and priorities
      - IAMIT report
      - Long-term funding for monitoring
      - Monitoring approach
    - Steelhead monitoring and protection – funding
    - Salmon entrainment – Salmon Subcommittee?
    - Delta Smelt propagation
- Member feedback
  - o Outflow is not being addressed in SDM and is likely a review paper we need to commission.
  - o CAMT will need to go through each topic under "Additional Focused Discussions" one at a time to determine their respective status. Outflow. Consider forming subgroups to assess the status of these topics.

- o CAMT will need to determine to what extent it is influenced by the Voluntary Agreements.
- o Agencies will need to determine how CAMT can assist in implementation of the BiOps.
- o Regarding "Ongoing Delta monitoring program reviews", ISB has approved IEP pilot monitoring program and trying to institutionalize long term monitoring.
- o "Continuation of ongoing discussions" and "Additional Focused Discussions" should be included in the Workplan but need more definition, including specifics around CAMT's role and when they would occur.

6. **Enriching Decision-support Predictions for Delta Smelt Management Actions**

- Delta Smelt Science plan recommends an integrated process-based tool to predict the effects of annual flow-related management actions and changing ambient conditions on Delta Smelt. This will require several years and dedicated resources. The first step is a detailed approach and proposal to set appropriate expectations, timelines and resource needs.
- Quantitative predictions on the effects of management actions on Delta Smelt are needed.
  - o Actions may benefit a life stage or vital rate.
  - o Benefits may be localized.
  - o Population effect dependent on other factors.
  - o Rose et al. Individual Based Model (IBM) has potential utility for managers.
  - o Other progress since IBM work initiated:
    - Developments in hydrodynamic modeling/particle tracking.
    - Common use of 3D modeling to support decision making.
    - Primary and secondary productivity modeling more advanced.
    - New research on Delta Smelt.
    - Detailed information on growth, movement and condition of ~1000 fish.
- Progress to Date
  - o Under auspices of science plan 'beta test' proposal to Delta Science Program submitted June 2019.
    - Expert Workgroup to develop viable options for model development.
    - Options to be refined through discussion with managers, e.g., CAMT, and other modelers and experts, e.g., IMSC.
    - Any further development dependent on options and interest.
  - o Proposal reviewed, refined and approved.
  - o Contracting almost complete.
- Outline of Scope
  - o Expert Workgroup:
    - CAMT Co-Chairs to follow up with CDFW and USFW regarding their participation in a Delta Smelt Management Actions working group tasked with developing viable options for model development.
    - Identify 2-3 agency experts working through CAMT.
    - Plan workgroup meeting – 2 days (March 2020?).
    - Develop Draft White Paper describing options for developing enhanced decision – support.
  - o Refining Options:

- ▪ Discuss white paper with others, e.g., CAMT, members of Integrated Modeling Steering Committee (April-May).
- ▪ Refine options and potential next steps.
- Expected Outcome
  - o White Paper describing pathway(s) to development of a decision support tool (May-June 2020):
    - ▪ Approximate timeline/resource needs.
    - ▪ Decisions that could be informed/potential uses.
    - ▪ Outline of next steps for development of full 'scope of work'.
  - o Potential Further Step (not covered by DSP funding):
    - ▪ Detailed plan for development of decision support tool – interim/final utility, longer-term refinement/maintenance.
    - ▪ Resource needs – time, money, skills, personnel.
    - ▪ A clear picture of what it will take and what it could deliver.

7. **CAMT Technical Study Protocols**
   - CAMT agreed to take review of these protocols offline.
   - Bruce will follow up with members for deadline for review.
   - Member feedback and corresponding revisions will be discussed at next CAMT meeting.