Independent Science Advisory Panel Technical Memo

Piping Plover Monitoring Program "Discuss and Feedback" -- Report from the Independent Science Advisory Panel

30 January 2022

In recognition and continuation of the technical advisory role and review capability of the Independent Science Advisory Panel (ISAP) to the Missouri River Recovery Program (MRRP -- obligated under the Final Biological Opinion on *Operation of the Missouri River Mainstem Reservoir System* and other environmental commitments and projects), the panel was engaged in a "discuss and feedback" session on 14 November 2022 addressing the state of piping plover monitoring and assessment with the Army Corps of Engineers staff and consultants. The Piping Plover Discuss and Feedback engagement with Independent Science Advisory Panel (ISAP), the Bird Technical Team, and Carl Schwarz provided an opportunity to discuss modifications to the plover monitoring plan. A "hybrid monitoring design" was proposed in 2020 and ISAP has previously submitted comments and suggestions on plover monitoring to the Corps (memo dated 3 January 2020).

ISAP members present for the discussion found it engaging and productive. An engagement of this type, along with a presentation of monitoring data, should occur at least semi-annually starting next year. Questions about changes in the historic sampling program were addressed with edifying input from Technical Team members. Unlike for the Pallid Sturgeon, no charge questions from the Army Corps of Engineers were provided to guide this brief report on adaptive management and monitoring of Piping Plovers. Therefore, this memo is arranged to provide ISAP feedback on four relevant issues -- (1) the context for plover monitoring on the Missouri River, (2) comments on the newly proposed plover monitoring plan, (3) suggestions for moving forward with a formal adaptive management framework for the plover, and (4) thoughts on future discussion topics with the ISAP.

Changes in context of plover monitoring on the Missouri River

The Piping Plover on the Missouri River has been the subject of considerable research. Much is known about the bird's demography, responses to habitat management (including river flows, island creation, and vegetation management), and life history attributes. More recent work has investigated the movement of Great Plains Piping Plovers between the Missouri River and alkali lakes in the Dakotas and Canadian Prairie Provinces. Investigations of plover dispersal in the

upper Great Plains has revealed high rates of interchange of plovers between the river and alkali lakes (Swift et al. 2022), indicating that the extensive Great Plains population functions as a metapopulation. The plover is long-lived and capable of long dispersal events; plover's population structure today likely is similar that that existed before the river was altered with major dams. The understanding of plover population structure and dynamics in the Great Plains leads to several questions that should be addressed in support of Piping Plover management on the Missouri River --

- Are we operating under a false representation of the true system dynamics because current conservation efforts do not fully account for emigration and immigration?
- Should the understanding of plover metapopulation dynamics reshape the management action agenda for the plover on the river?
- Is the current emphasis on creating or expanding sand-bar islands to provide nesting habitat on the river really necessary?
- And should there be a shift in the focus on gathering plover data on the river to a greater focus on plovers in adjacent areas in the alkali lakes region?

Current and proposed plover sampling design

The current plover sampling scheme is an attempt to generate a plover population census, whereby all suitable habitat within the river is sampled. The proposed new sampling design, referred to the "hybrid design," was outlined by Schwarz et al. (2019). It includes the following key points:

1. The design uses the relative standard error (RSE = standard error/estimate) = 0.2 for the number of adults and fledge ratio over all river segments. This is an arbitrary decision but provides a starting point. If target RSE decreases, sample size increases approximately by factor of $1/\sqrt{n}$, i.e., to halve the RSE, need to increase sample size by factor of 4.
2. The sample is stratified first by segment for administrative convenience and "local" control at segment level (i.e., river vs. lake). This stratification is not part of the estimation process.
3. The sample next is stratified within segments into low (L) versus medium/high (M + H) based on historical usage by the birds (or previous years "census" counts).
4. Data collection records the number of map-units and map-unit to map-unit variation for adult counts and productivity in each habitat stratum of each segment.
5. The design uses a Neyman allocation to bin samples to strata (segments and habitat types within segments) to find the minimum RSE for a given sample size, then adjusts total sample size until target precision is obtained (RSE = 0.20 for adult estimate and fledge-ratio).

The ISAP is satisfied that this is a defensible sampling approach with several caveats. Note that the sampling design summarized above is commonly referred to in the statistical literature as double sampling for stratification (Thompson 2012). The proposed sampling design differs from a traditional double-sampling approach in three ways.

First, the plover sampling design assigns sample units to strata based on the previous year's "census" count. Traditional estimators assign phase 1 sample units to strata only after a phase 1 sample is collected. This is not possible on the Missouri River because the phase 1 "census" and the phase 2 search for nests to estimate the number breeding adults and productivity occur simultaneously. A concern with this approach is the relevance of the previous year's "census" count, given that the system is prone to rapid changes in the areal extent and quality of habitat, for example drought one year and wetter than normal conditions the next year.

Second, the proposed plover sampling design deviates from traditional double sampling designs by sampling all sample units in phase 1. Traditional double sample designs take a random sample of units at both phases 1 and 2. Because all map units are proposed to be surveyed in phase 1, the sampling fraction = 1. This design seems more aligned to ratio estimation with stratification (Hankin et al. 2019: section 7.3), which allows for either "separate" or "combined" estimators.

Third, traditional double sampling methods assume that the variables of interest at phase 2 are measured without error. That assumption is partially addressed in the proposed monitoring design by increasing sample size at phase 2 until a RSE <= 0.20 is obtained.

The ISAP's primary concern is how these deviations from traditional two-phase sample designs may affect estimates of the variance components for both the number of breeding adults and adult productivity. Will the variances be significantly underestimated? It may be that as long as errors are minor and the phase 2 estimate is unbiased all will be good and the traditional formulas should apply. The estimates will be slightly less than "true" sampling variance, but by an ignorable amount.

The ISAP observes that clarification is needed on other aspects of the monitoring plan. For example, the stratified random sampling design -- or double sampling for stratification as noted earlier -- is appropriate and defensible, although its justification as optimal is lacking. Among other features, optimal sampling should be efficient, reliable, representative, and flexible. Important considerations include the homogeneity/heterogeneity of the population, sample stratification (selected to minimize within-sample variation), and the size of the sampling unit. Optimal therefore is defined in terms of sampling theory and logistical/financial considerations. Is the design robust to spatial variation in plover distribution along the river, distribution that changes nearly annually? If not, changes in plover habitat, river geomorphology, and other factors could affect implementation of the sampling design (sample size, stratum definitions, etc.).

Put another way, how well do we understand if the number of birds, clutch size, nest success rate, etc. are uniform up and down the river as is assumed? A topic that was not discussed at the November meeting was the identity of the environmental factors (covariates) targeted by data collection in support of adaptive management of plovers and their habitat on the river. It is possible that that essential component of the plover monitoring design has not yet been addressed by the technical team. ESH and flow data are currently collected, but it is possible that other as-yet not-measured environmental factors -- substrate size, vegetation cover/height/etc., and possibly others -- also deserve attention.

Moving towards a formal adaptive management (AM) framework

During the discussion the ISAP reiterated the need to formalize an adaptive management framework for the plover. In particular, there is a need to more closely link the monitoring program and its specific outputs with clearly articulated benchmarks that lead to specific management actions and their adjustment through time. To that end it would be helpful if the data collection aspect of the monitoring scheme were formally written up, describing how it specifically serves adaptive resource management.

The technical team described whether selected biological endpoints were meeting desired compliance levels. However, actual issues in resource management were not discussed. And, approaches for addressing management of the plover population through the collected survey data were not addressed. There is a need for discussions that link plover data and environmental-actor data to management actions in an adaptive framework.

A related aspect of the plover adaptive management process is a need for the ISAP to have regular, proactive engagements with the Corps, addressing what is intended to be done, rather than reactive interactions about what has already been done -- that is, responding to the annual AMCR report. That dialogue requires responses to all of the recommendations in the adaptive management framework, not just a subset of them.

Future discussions

The ISAP observes that the Discuss and Feedback session was highly productive and should occur more frequently. The panel recommends that the following topics be considered for future engagements --

- How and to what extent should the recently generated information on plover dispersal among demographic units in the upper Great Plains be incorporated into management-action decisions on the Missouri River?
- Should the proposed monitoring survey design be altered in response to highly variable plover habitat conditions on the river?
- Are the current benchmarks from the monitoring program -- for example, measures of productivity -- suitable for management planning purposes, or should the emphasis shift to model building and simulation?
- What steps need to be taken to incorporate the Piping Plover and its dynamic habitat into a fully functioning adaptive management framework?

Literature Cited

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