

**SUPPORTING STATEMENT B
FOR PAPERWORK REDUCTION ACT SUBMISSION**

**National Double-Crested Cormorant Survey
OMB Control Number 1018-New**

Collections of Information Employing Statistical Methods

The agency should be prepared to justify its decision not to use statistical methods in any case where such methods might reduce burden or improve accuracy of results. When the question "Does this ICR contain surveys, censuses, or employ statistical methods?" is checked "Yes," the following documentation should be included in Supporting Statement B to the extent that it applies to the methods proposed:

1. Describe (including a numerical estimate) the potential respondent universe and any sampling or other respondent selection method to be used. Data on the number of entities (e.g., establishments, State and local government units, households, or persons) in the universe covered by the collection and in the corresponding sample are to be provided in tabular form for the universe as a whole and for each of the strata in the proposed sample. Indicate expected response rates for the collection as a whole. If the collection had been conducted previously, include the actual response rate achieved during the last collection.

A total of 1,016 cormorant colonies, using the procedures outlined in section 2, were selected to be surveyed in 2024. We are expecting that a combination of Federal, Tribal, and/or State biologists will complete all 1,016 surveys and submit data from these surveys with an expected response rate of 100%.

2. Describe the procedures for the collection of information including:

- * Statistical methodology for stratification and sample selection,**
- * Estimation procedure,**
- * Degree of accuracy needed for the purpose described in the justification,**
- * Unusual problems requiring specialized sampling procedures, and**
- * Any use of periodic (less frequent than annual) data collection cycles to reduce burden.**

A stratified random design will be used for monitoring in 2024 to estimate the number of breeding DCCO in each population. A count of nests will be done at each colony selected for sampling. The number of breeding birds will be estimated as two times the estimated number of nests. The sampling frame is defined by the historic colony sites. The database of historic colony sites was reviewed by biologists in each state and updated during summer and fall 2023. After review, some colony sites were removed from the sampling frame because they were deemed duplicate sites in the database or were no longer considered suitable for DCCO nesting.

The number of strata and their boundaries should be allowed to change over time to accommodate changes in the number of colonies and distribution of colony sizes in the

population. Stratification for the 2024 sample is being done using the R package 'SamplingStrata' (Barcoroli 2014) and stratification is based on the DCCO nest count at individual colonies when they were last surveyed. Other auxiliary information (e.g., state, coastal versus interior sites, land ownership, physical characteristics of a colony) can be used to inform stratification but will not be included in the 2024 sample draw. Given a desired level of precision, the SamplingStrata package can determine the best stratification for a population frame at the minimum cost. The cost to sample individual colonies was not provided, thus it was assumed that the cost to survey was the same across colonies. If the cost to sample colonies is all the same, optimum stratification and sample size is based on the value of the target variable (the size of each colony in 2024), auxiliary variable(s) (count at each colony when last surveyed), and the desired precision constraint.

Ideally, auxiliary information used to inform stratification (colony size during last survey) is highly correlated with the target variable (colony size at time of sample). This correlation will be inexact because colonies are dynamic over time and change size. The size of colonies in 2024 is of course unknown and the value was simulated to add uncertainty to the stratification procedure (see Adding Uncertainty in next section).

In addition, some colonies will be surveyed in 2024 regardless of the sample selection. These purposively sampled colonies will be included in a 'Take All Strata.' In other words, the probability of their inclusion in the sample is 1. They are not part of the random sample but their counts, and variance among their counts, is essentially just added to the estimated counts and estimated variance from the random sample to obtain population level estimates.

Lacking other information on colony size in 2024, stratifying the sample based on the last known colony size seems most efficient. However, the relationship between last known colony size and colony size during subsequent years of sampling will be imperfect. This uncertainty needs to be accounted for during design or the recommended sampling effort will be too low to reach the desired precision. Using historic colony size data from the Pacific Flyway (other populations lacked enough historic data), a discrete time Markov chain model (DTMC) was created to estimate how colonies change size over time. Colonies were first placed in size bins, with bins based on a simple breakdown using general observation of a frequency diagram. The R package 'markovchain' (Spedicato et al. 2015) was then used to estimate the transition probability of a colony from one size bin to another between years.

Transition probabilities over periods greater than a single year can be found by using matrix multiplication. These probabilities were used to simulate uncertainty in the target variable for each colony using random assignment to the same or a different stratum based on the probabilities from the DTMC transition matrix. Once a simulated stratum was selected for a colony the expected count was assigned from a uniform random draw within the boundaries of the stratum. For example, if a colony was in stratum 1 (count of 0–10) based on a nest count in 2023, it was assigned to a new stratum based on a weighted random draw, with weights based on the estimated transition probabilities from stratum 1 to each of the other strata.

This approach to accounting for uncertainty will result in different assignments to strata and different values for a colony during each execution. This results in a slightly different stratification scheme and sample size each time the random strata assignments and the SamplingStrata procedure is run. To ensure that the procedure didn't suggest an unnecessarily small or large sample size, the entire procedure (random assignment and value assignment plus stratification using SamplingStrata) was first executed 50 times and a median sample size calculated. The procedure was run again until a randomly drawn sample size was within ± 10 of this median sample size. The distribution of sample sizes among strata from the 50 runs was also examined and compared to the chosen sample to ensure that the chosen sample and stratification was similar to the distribution among strata of the 50 runs.

Sample Selection and Estimation

Desired precision for the abundance estimate for each population was having a coefficient of variation equal to or less than 20%. Because sampling probabilities are known it is relatively straightforward to estimate abundance using a Horvitz-Thompson estimator. Data can also be analyzed using the R 'survey' package.

Survey schedule

In the 2020 FEIS, the Service made the commitment to monitor cormorant populations and produce a report every five years that provides analyses from population monitoring and other status information. This was determined to be the appropriate time scale for monitoring populations in order to inform management decisions.

Citations

Barcoroli, G. 2014. SamplingStrata: An R package for the optimization of stratified sampling. Journal of Statistical Software 61:1–24.

Spedicato, G.A., et al. 2015. The markovchain package: a package for easily handling discrete Markov chains in R. Available online: https://cran.microsoft.com/snapshot/2022-02-07/web/packages/markovchain/vignettes/an_introduction_to_markovchain_package.pdf

3. Describe methods to maximize response rates and to deal with issues of non-response. The accuracy and reliability of information collected must be shown to be adequate for intended uses. For collections based on sampling, a special justification must be provided for any collection that will not yield "reliable" data that can be generalized to the universe studied.

As discussed in Section 1, we expect the response rate to be 100% for the colonies selected since we worked closely with partners to develop a plan to survey all selected colonies. We expect some colonies selected for sampling to no longer be active so those colonies will not be surveyed, and we will update the cormorant colony list

accordingly so they will not be included in future surveys.

4. Describe any tests of procedures or methods to be undertaken. Testing is encouraged as an effective means of refining collections of information to minimize burden and improve utility. Tests must be approved if they call for answers to identical questions from 10 or more respondents. A proposed test or set of tests may be submitted for approval separately or in combination with the main collection of information.

No tests of procedures or methods are planned for the survey. The procedures and methods used for the survey were developed by the cross-flyway monitoring team in coordination with the Service. Future survey procedures and methods may be refined based on what we learn from this initial coordinated survey effort.

5. Provide the names and telephone numbers of individuals consulted on statistical aspects of the design and the name of the agency unit, contractor(s), grantee(s), or other person(s) who will actually collect and/or analyze the information for the agency.

Mark Seamans, Wildlife Biologist, U.S. Fish and Wildlife Service, Division of Migratory Bird Management, phone: (303) 275-2388

Jeff Hostettler, Research Biologist, U.S. Geological Survey, Northeast Region, phone: (301) 497-5500

Mike Wells, Wildlife Biologist, U.S. Fish and Wildlife Service, Region 3 Migratory Bird Program, email: michael_wells@fws.gov