Review and Revision of the Alaska Migratory Bird Council Subsistence Harvest Survey

Final Report

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Summary

For nearly 4.5 years, starting formally in April 2014, we worked closely with the Alaska Migratory Bird Council (AMBCC) to review and revise the migratory bird subsistence harvest survey. For the first 1.5 years, we met with the AMBCC and a Technical Working Group (TWG) to identify stakeholder objectives, document stakeholder use of annual survey data, and to analyze survey performance with respect to objectives and data use. We concluded that the existing design was not meeting stakeholder objectives and we proposed alternative designs as well as special studies to address possible deficiencies in data collection, use, and interpretation (George et al. 2015). In April, 2016, after further work, and recommendations by the TWG (Otis et al. 2016), the AMBCC unanimously chose to limit the survey to five regions, with a focus on 1) total harvest of commonly harvest species, 2) achieving a coefficient of variation (CV, i.e., precision) ≤ 0.25 for the state-wide (i.e., across the five regions) estimate and 3) a CV ≤0.50 for the regional estimates (George et al. 2016). Given this direction from the TWG and a U.S. Fish and Wildlife Service budget of $150,000, we developed a revised design that was implemented in 2016 as a pilot year. The 2016 survey achieved a CV of 0.30 for the statewide estimate and an average regional CV of 0.55; only 2 of the 5 regions achieved a CV of ≤ 0.50. Since our precision objectives were not met, we used the recent 2016 data with an optimal sample allocation calculation designed to achieve the desired statistical precision goals (Otis et al. 2017). These modifications were implemented for the 2017 survey and the resulting CVs generally met our precision goals with a statewide estimate of 0.19 and a regional average CV of 0.39. Only 1 region did not have a CV ≤ 0.50. In 2018, we repeated the optimal allocation analysis using the 2017 data to further refine the sample allocation for the 2018 survey (Otis and Doherty 2018). This modification was accepted by the AMBCC in September 2018. Otis and Doherty (2018) also recommended that a third optimal allocation analysis be performed in 2019 with the pooled data from the 2016-2018 surveys and that the resultant allocation of sampling effort among the regions be fixed for a period of at least five years. With this fixed effort, the systematic sampling protocol can be revisited to facilitate a more even distribution of sampling effort across years among individual communities in each region (i.e., over a period of 5 or 10 years, all communities in a region will be surveyed a similar number of times). This recommendation was also accepted by the AMBCC at the September 2018 meeting. In summary, the harvest survey is nearly exceeding all precision objectives and with the 2019 minor adjustments, we expect the survey to be adequate for at least the next 5 years. Below we include the George et al. 2015, Otis et al. 2016, George et al. 2016, Otis et al. 2017, and Otis and Doherty 2018 reports that document details supporting this summary. For navigation below, these reports are identified with headers.

Review of Subsistence Harvest Survey

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EXECUTIVE SUMMARY

The Alaska Migratory Bird Co-Management Council (AMBCC), which is comprised of representatives from native populations (i.e., the Native Caucus, NC), the Alaska Department of Fish and Game (ADFG), and the US Fish and Wildlife Service (USFWS), developed a subsistence migratory bird harvest survey in 2003. Surveys have been conducted annually since 2004 but recent concerns about the reliability of the estimates and whether the estimates were being used to make management decisions, motivated the decision to conduct a review of the survey design and data collection protocols. In 2014 our team from Colorado State University was contracted to conduct this review and a Technical Working Group (TWG) made up of representatives of the USFWS, ADFG, and NC was assembled to provide project oversight and guidance. This report represents our assessment of the survey and an evaluation of how well it is meeting stakeholder objectives. We also provide suggestions for potential modifications to the survey.

The history of nearly continuous change in survey implementation from the initial recommended survey design to the present recommended design and the associated fluctuation in survey budgets have made evaluating the historical performance of the survey relative to current stakeholder objectives difficult. Therefore, we note that our evaluation was based on data and auxiliary information collected from the 10 years of surveys as implemented**.** In addition, the survey objectives differ among the stakeholders and therefore the performance must be examined with respect to the differing priorities.

Based on input from AMBCC partners, we broadly define 3 categories of potential uses of AMBCC harvest survey estimates by stakeholders: 1) document the nutritional and cultural value of subsistence harvest of the migratory bird resources, 2) use in formal decision making processes (e.g., structured decision making to set harvest regulations), and 3) monitor temporal and spatial trends in harvests of a wide of range of species. The data have been used for 1 and 3, but not for 2. Whether the data would be used in a formal decision making process will rely upon two factors; a structure to incorporate such data, and trust that the data are informative.

All three stakeholder groups agree that harvest estimates of the commonly harvested species (the list of commonly harvested species differed among the groups) is a top priority for the survey. Furthermore, all groups agreed on the target precision for the estimates (Confidence Interval Percentage or CIP ≤ 50%). The groups differ, however, in the preferred geographical scale, and the seasonal timing of estimates. The NC and ADFG place the highest priority on regional estimates whereas the USFWS identified statewide estimates as the most important. The USFWS prefers statewide harvest estimates so these estimates can be integrated into flyway species management plans. ADFG and NC believe that regional harvest estimates are more relevant for management than statewide estimates. ADFG and the NC also accept lower precision for harvest estimates based either on the region (NC) or the level of harvest of a species within a region (ADFG). With respect to seasonal timing, the NC specifies that precise estimates (CIP < 50%) should be available for all four seasons (spring, summer, fall, and winter), ADFG believes that precise estimates should be available for seasons of highest harvest, and USFWS preferred two seasonal estimates (spring-summer, and fall-winter). In relation to these objectives, the current survey design cannot produce statewide estimates and therefore does not meet an annual statewide estimate objective. Without statewide estimates, evaluating the precision of statewide estimates is not possible. With respect to NC and ADFG preference for regional estimates, in the regions that were sampled, 61%

of the regional estimates of annual harvest met the precision guidelines. With respect to regional seasonal estimates the survey does not achieve the desired precision for most of the non-zero harvest estimates.

ADFG and the USFWS identify estimates of rarely harvested species (ADFG) or species of conservation concern (USFWS) as the second priority. ADFG indicated that the precision of the estimates for these species from the general subsistence survey can be lower than the precision for commonly harvested species such that the data provide "qualitative indices of harvest". The USFWS, however, specified that the Confidence Interval Percentage should be ≤ 50% for species of conservation concern. The NC did not specifically address rarely harvested species but their second priority focused on regions of low harvest and specified a CIP < 100% for all species every 3-5 years. The USFWS also specified that estimates should be provided for the spring-summer and fall-winter periods. With the current survey, 71% of the annual regional harvest estimates of rarely harvested species do not meet the precision criteria identified by the USFWS and therefore an even greater proportion of the seasonal estimates will not achieve the desired precision. In addition, issues with misidentification raise additional concerns about the reliability of harvest estimates of rarely harvested species. For rarely harvested species, we conclude that the current survey does not meet the criteria set by the USFWS, but does meet the criteria identified by ADFG.

USFWS identified egg harvest of species for which subsistence egg gathering may have population level impacts or could be used in population management as a top priority, ADFG identified egg harvest estimates as the third priority for the survey. The majority of the egg harvest estimates met the precision criteria set by ADFG (Confidence Interval Percentage ≤ 100%) in the Yukon-Kuskokwim Delta but did not in other regions.

The USFWS identified estimates of hunter participation and persons/households consuming migratory birds taken during for subsistence as their third priority. The current survey was not designed to estimate hunter or household participation and therefore we could not evaluate the performance of the survey for this objective.

Our conclusion is that the current survey design as implemented is not meeting many of the objectives identified by the stakeholders. We suggest three alternative survey designs for consideration and further evaluation: (1) sampling all regions every year (All Regions Statewide Survey Design); (2) restricting the survey to a subset of the regions with the highest harvest (Priority Regions Only Survey Design); and (3) a design in which high priority regions are sampled every year and low priority regions are sampled on a rotating basis (Mixed Priority Statewide Survey Design). No single one of the designs can be expected to achieve all desired objectives equally for all stakeholders. Each design will require tradeoffs in survey objectives. For example, if all regions are sampled every year, we expect that budget considerations would dictate that the intensity of the survey effort within each region would have to be reduced, thereby decreasing the precision of regional estimates. Alternatively, restriction of the survey to only regions with high harvest may risk the loss of community engagement in the AMBCC partnership in the non-surveyed regions.

Data quality is another issue that we address in our evaluation. In cooperation with the TWG, we identified five data quality issues with the current survey: 1) potential errors associated with asking questions about the harvest of sensitive species, 2) memory or recall error, 3) nonresponse error, 4) crippling loss, and 5) species misidentification. There are generally two approaches that can be used to reduce the impact of these errors on reliability of the estimates: 1) data collection protocols can be adjusted to try to minimize the frequency and magnitude of errors or, 2) special studies can be designed to estimate the error and adjust estimates as necessary. A previous review (Naves et al. 2008) of the harvest survey identified some of these same data quality issues and some adjustments to the survey protocol were made to reduce potential bias. However, questions about data quality remain and, to complement the approach of refinement of data collection protocols, we provide suggestions for special studies that might be used to estimate the importance of these potential sources of error and bias. Our initial assessment is that memory/recall error and misidentification error should receive the highest priority among special studies. In addition, nonresponse error might be addressed inexpensively by adding additional questions to the data collection protocol.

Our conclusions about survey performance and suggestions for alternative survey designs and special studies provide the basis for the next phase of our project. We will work with TWG and AMBCC to identify additional analyses and cost evaluations that can be used to inform stakeholder decisions about priorities for designs, protocols, and/or special studies that may be field tested in 2016. Our ultimate goal is to work with stakeholders to develop a sustainable harvest survey that can achieve a satisfactory set of preferred objectives that have been articulated by the AMBCC partners.

INTRODUCTION

In 1997, the Migratory Bird Treaty was amended to allow subsistence hunting during the spring and summer in Alaska. Further, Alaska's indigenous people were given a role in migratory bird conservation with the formation of the Alaska Migratory Bird Co-Management Council (AMBCC), which is comprised of representatives from the US Fish and Wildlife Service (USFWS), Alaska Department of Fish and Game (ADFG) and representatives from Alaska Native communities (i.e., the Native Caucus). One initiative of the AMBCC was the development and implementation of a subsistence migratory bird harvest survey (further details below). The AMBCC developed a harvest survey methodology in 2003 and the first survey was conducted in 2004. Surveys have been conducted annually since 2004, but concerns raised by the USFWS about whether the data were being used to address management questions, species misidentification and other data quality issues led to a reduction in survey effort in 2011. In 2014, our team from Colorado State University was contracted to help with a review of the survey and a Technical Working Group (TWG) made up of representatives of Alaska's native population, ADFG, and the USFWS was assembled (see Appendix A for members) to provide project oversight and guidance. The TWG first met on Sept 22 2014, just prior to the AMBCC semi-annual meeting to gather perspectives and directions for future action. In November, 2014 we surveyed TWG members about their desired geographic scales for harvest estimates and species for which subsistence harvest data should be collected, interest in harvest trends over time, and also to provide documented uses of past survey data. Based on these results, we delivered a progress report to the TWG for review on Jan 13, 2015 (Appendix B). We received valuable feedback (summary in Appendix C) and we met with the TWG again on February 20, 2015 to discuss the report and obtain further perspective and direction. Notes from this meeting are in Appendix D. This draft of the Final Report for Phase I of the review builds on these prior efforts. This report will: 1) review the current survey design and its implementation; 2) synthesize and evaluate current stakeholder objectives and their justifications for uses of the survey data; 3) describe the current use of migratory bird subsistence harvest data by stakeholders; 4) discuss the performance of the survey in achieving the desired objectives by: a) an assessment of the potential impact on data quality of several sources of survey error, b) comparison of harvest estimate precision to desired precision criteria, c) ability of the survey design to produce annual reliable statewide and regional estimates and trends at desired time scales, and 5) provide general descriptions of alternative study designs and ancillary (e.g., data quality) studies that could be considered for further development.

REVIEW OF SURVEY DESIGN AND IMPLEMENTATION

In 2003, an ad hoc committee composed of several experts with experience in design of harvest surveys and knowledge of subsistence harvests provided recommendations for a statewide harvest survey (AMBCC 2003). The report stated that "a statewide survey that employs uniform methods and samples all areas within the same year where subsistence harvest occurs will provide harvest data that are comparable within regions of the state and across years over the entire state." The specific goal of the survey was to estimate annual subsistence harvest of migratory birds: by species, statewide, regionally, and seasonally, with a corollary objective of being able to compare migratory bird species population trends with harvest trends. The recommended survey design specified that 2/3 of the villages in all regions were to be sampled every year. However, this design was never implemented because it quickly became evident that the cost was prohibitive.

In 2004, the first year of the survey, six regions were surveyed. In anticipation of inadequate budgets to implement the original survey design, the AMBCC Harvest Survey Committee adopted a rotational schedule in 2005 with the intent of surveying the Yukon-Kuskokwim (Y-K) Delta every year and the other regions every other year (Naves 2010). In 2005–2007, six or seven regions were sampled annually, but annual selection of regions does not appear to have followed any pre-designed, multi-year rotational scheme. In 2008–2009, a review and revision of the AMBCC Harvest Assessment Program (AMBCC-HAP) was conducted (Naves et al. 2008). In 2009, only two regions were sampled while program efforts were directed to the transition into the revised survey methods.

The revised survey design specified in the Naves (2012) report indicated that ½ the regions should be surveyed in a given year and that communities within regions should be surveyed every 4 years. This design has some attributes of a rotating panel design, which is not uncommon in repeated sample surveys (Kalton 2009). An important deviation from the standard panel design is that 2 regions (Y-K Delta and North Slope) are designated to be sampled each year. The remaining 6 regions are divided into 2 groups (panels) that are to be sampled in alternate years. All subregions within a region are sampled, so they actually represent regional strata (Figure 1). Half of the communities in each subregion are to be surveyed and the communities rotate in alternate panels (communities are not randomly selected). Following this schedule, each community is surveyed every-other year in the Y-K Delta (and North Slope) and every 4 years in the other regions. For our evaluation purposes we consider this to be the 'current design'.

This multi-year rotation scheme was implemented in 2010, with the exception that the Southeast Alaska region was not sampled. In 2011, data quality issues pertaining to rarely taken species were raised in the context of the Yellow-billed Loon (*Gavia adamsii*) process for listing under the Endangered Species Act (ESA). Starting in 2011, sampling efforts were reduced as funds were directed (1) to the current survey review process and (2) to address data needs related to Yellow-billed Loon harvest. From 2011–2013, the number of sampled regions declined from three to one and the selected regions have not followed the rotation scheme.

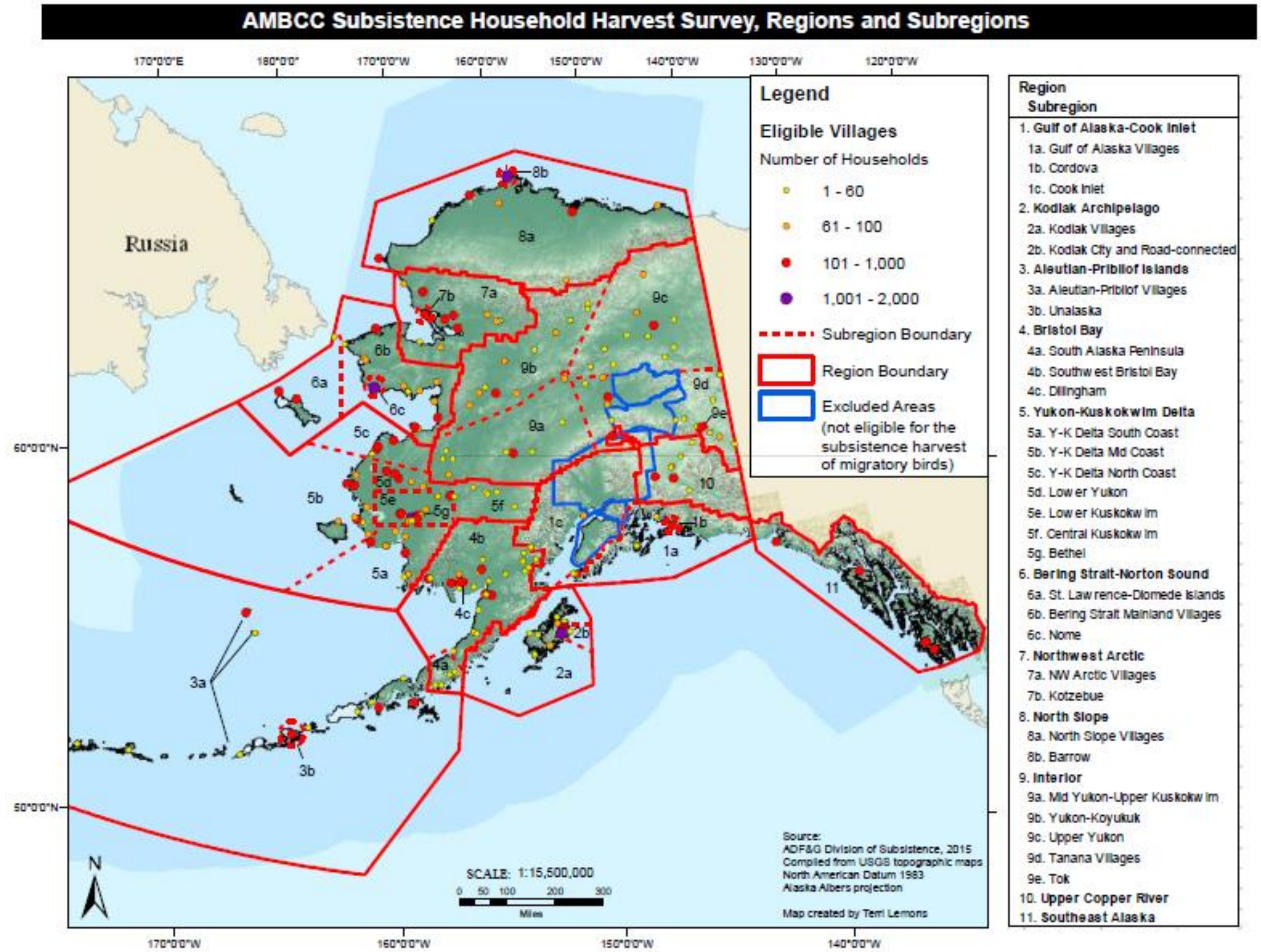

Figure 1. Regions and subregions of the AMBCC migratory bird subsistence harvest survey (from Naves 2010).

STAKEHOLDER SURVEY OBJECTIVES

A primary purpose of the review is to determine whether the subsistence harvest survey is achieving stakeholder objectives. Therefore an essential task was to describe these objectives in precise terms that would permit objective evaluation of survey performance. During the past year we have worked through several exercises with TWG members to articulate their survey priorities and associated justifications for the objectives of their respective organizations. In addition, we asked that the justifications be linked to specific uses for the subsistence harvest data. The unedited prioritized objectives and justifications provided by each of the stakeholders are italicized and presented below. Because these are unedited, readers may notice some inconsistency in formatting.

Native Caucus

Objectives and justifications

Objective 1

1. *For regions with the highest harvest, obtain yearly estimates of all species harvested, and estimate harvest of commonly harvested species with a precision of 50% (CIP) for every season (spring, summer, fall, and winter).*

Justification: The Native representatives of both the Technical Working Group and the AMBCC Harvest Survey Committee agree that regional estimates are of the highest priority. They are much more meaningful to the local communities, which translates to better participation and willingness to provide accurate information. Given the geographic size of the State Alaska and the culturally diverse Alaska Native Tribes that inhabit this area, we believe regional estimates are the most important estimates to the local communities. Direct participation in the surveys by the local communities builds capacity, trust, and buy-in, all of which are important in collecting accurate data, and minimizing error and bias.

Objective

2. *In regions with lower harvest, obtain estimates of all species harvested in each season every 3-5 years with estimates of commonly harvested species with a precision of 100% (CIP).*

Justification: This data will assist in providing documentation and justification for the regulatory proposals that have been tabled due to the fact that the proposals are requesting harvest seasons outside of the spring-summer subsistence harvest season established by the treaty amendment. It isimportant to continue conducting the surveys at some level in order to maintain trust, ownership, and capacity building with the local communities. While we believe that focusing on one species, particularly if it is a bird of conservation concern, or a rarely taken bird, may cause suspicion about the motive for the survey and be less likely to participate, a general survey design consisting of all species can be used to address the harvest of these rarely taken species when conservation concerns arise. Regions with low populations and/or low harvest numbers can be surveyed every 3-5 years. It is important to continue conducting the surveys at some level in order to maintain trust, ownership, and capacity building with the local communities.

Alaska Department of Fish and Game

Objectives

1. ***Bird harvest, commonly-taken species (important subsistence resources)*** *For bird harvest of commonly-taken species, the average precision of harvest estimates should be ≤50% CIP for (a) region(s) where the species is harvested more commonly and in the largest numbers and for (b) annual estimates or estimates for the season(s) of most harvest. For species and regions of secondary importance, the average precision should be ≤100% CIP which are adequate for management decisions.*

Table 1. Examples of commonly-taken species and their main regions and seasons of harvest.

Species	***Region***	***Season of most harvest***
America wigeon	*Yukon-Kuskokwim Delta*	*Fall*
America wigeon	*Interior*	*Spring*
Auklet	*Bering Strait-Norton Sound*	*Spring*
Brant	*Yukon-Kuskokwim Delta, Bering Strait-Norton Sound*	*Spring*
Black scoter	*Yukon-Kuskokwim*	*Spring*
Cackling/Canada goose	*Yukon-Kuskokwim*	*spring, fall*
Common eider	*Bering Strait-Norton Sound*	*spring, fall*
Common eider	*North Slope*	*Spring*
King eider	*Yukon-Kuskokwim*	*Spring*
King eider	*North Slope*	*spring, summer*
Mallard	*Yukon-Kuskokwim*	*spring, fall*
Northern pintail	*Yukon-Kuskokwim*	*Fall*
Northern pintail	*Bering Strait-Norton Sound*	*spring*
Snow goose	*Yukon-Kuskokwim*	*spring*
Snow goose	*Bering Strait-Norton Sound*	*spring, fall*
White-fronted goose	*Yukon-Kuskokwim, North Slope*	*spring*

2. ***Bird harvest, rarely-taken species (some species of conservation concern)*** *A general survey design (addressing all species) can provide "qualitative indices of harvest" for rarely-taken species and inform dedicated studies. We believe, however, that the general survey design should be driven by species of broader management interest. If a focused study is conducted on a rarely-taken species, confidence intervals of harvest estimates for should be ≤50% CIP for (a) region(s) were the species is harvested more commonly and in the largest numbers and for (b) annual estimates or estimates for the season(s) of most harvest. For species and regions of secondary importance, confidence intervals of ≤100% CIP are adequate for management decisions.*

3. ***Egg harvest*** *Most likely, the same survey design cannot address both birds and eggs with the same level of precision. Although it is important to document and somewhat quantify egg harvest, the harvest survey design should prioritize narrower confidence intervals for bird harvest. For those species whose eggs are commonly harvested, confidence intervals should be*

≤100% CIP for the region(s) where the species' eggs are harvested more commonly and in the largest numbers.

Justification

1. Objective: Regional estimates

The prioritization of region estimates by ADF&G (as opposed to statewide estimates) is in part due to uses of regional data and in part due to practical difficulties in obtaining statewide estimates. Alaska is large and diverse compared to other states in the Flyway system. For Alaska, regional estimates are needed to properly assess and respond to management topics considering bird species distribution and population units, spatial variation in harvest patterns, and regional socio-economic and cultural contexts. Some practical difficulties in obtaining statewide estimates include: (a) limited funding, (b) low response rate in mail out surveys that could be a cheaper alternative than in-person surveys for statewide estimates, and (c) regional issues in data collection that may be more easily accounted for in regional surveys (e.g., response rates that vary by region, regional sensitivity to issues related to species of conservation concern).

Data uses of regional estimates:

(a) Promote participation of Native partners in management (regional estimates are more meaningful for Native partners than statewide estimates).

(b) Develop management and conservation actions at the appropriate geographic scale.

(c) Enable management to account for differences in cultural and socio-economic context.

(d) Assess harvest patterns and amounts for different bird population units (e.g., Pacific and mid-continent white-fronted goose; eastern and western tundra swan; Pacific and mid-continent sandhill crane).

(e) Clarify species identification issues in harvest surveys based on species distribution.

(f) Continuation of time series including currently available data. Because of large annual variation in harvest, many years of data are needed to depict usual harvest patterns and harvest trends.

2. Objective: Spring, summer, fall, and winter estimates

Fall and winter harvests account for about 30% of the annual subsistence bird harvests. The HIP survey does not represent fall and winter harvest in rural areas because of low compliance to the duck stamp requirement. . . Also, there are unsolved mismatches in fall-winter (sport) harvest regulations and subsistence practices.

Data uses of fall and winter estimates:
(a) Document and quantify fall and winter subsistence harvests.
(b) Inform discussions on recurrent regulation proposals for fall and winter subsistence hunting.

3. Objective: Include all species in the survey, both commonly- and rarely-taken species

Data for rarely-taken species should continue to be collected in the general survey framework. However, the general survey design should be mostly driven by commonly-taken species. From an implementation perspective, the survey should include all species because people get suspicious of surveys focusing on a *set of species and there are no significant additional costs of including all species as opposed to only a set of species.*

Data uses of rarely-taken species estimates:
(a) Document diversity of bird subsistence harvests.

(b) For rarely-taken species, particular data treatment procedures can be formulated for data collected through a general survey design (e.g., present both reported numbers and harvest estimates, or present only reported numbers and do not generate harvest estimates).

(c) If needed, data on rarely-taken species collected through the general survey are used to design dedicated studies.

(d) If impossible to implement dedicated studies for rarely-taken species of conservation concern because of sensitivity of topics (no consent to conduct dedicated studies or low participation rates), data collected in the general survey provides at least a qualitative documentation of harvest.

4. Objective: Include birds and eggs

There are no significant additional costs of including egg harvest as opposed to only birds, but the survey design should be driven by bird harvest.

Data uses of egg estimates:
(a) Document subsistence uses of eggs.

(b) Worldwide, there is little information on harvests of wild birds egg harvests although harvests may be significant. Alaska has the most comprehensive dataset of egg harvests and should continue to lead efforts in the documentation (qualitative) and quantification of egg harvests.

5. Objective: Conduct Surveys More Frequently in Regions with Highest Bird Amounts

If not surveying all regions every year:

Data uses
(a) Data from regions surveyed more frequently (every year, every-other year) can be used to generate annual region estimates.

(b) Data from regions surveyed infrequently (every 5 years; e.g., Upper Copper River, Gulf of AK-Cook Inlet regions) can be used to document subsistence harvests and help gauging annual variation in harvest amounts.

U.S. Fish and Wildlife

Objectives

1. *Annual, total harvest estimates of migratory bird species that are known to be important to subsistence hunters in Alaska including but not limited to Pacific greater white-fronted geese, cackling Canada Geese, Pacific black brant, common eiders, king eiders, and black scoters. In addition, the survey should include annual estimates of the number of eggs for species for which subsistence egg gathering may have population level impacts (e.g., emperor geese) or be used in*

population management (e.g., Pacific greater white-fronted geese and cackling Canada geese). Annual statewide estimates of migratory birds should be analyzed for two seasonal periods: spring-summer and fall-winter. All estimates should be unbiased with less than 50% CIP. Further, a study should be designed and conducted to evaluate potential bias in estimates due to misidentification, recall, low response rate within a village, status of the species, and village participation.

2. *Annual, total harvest estimates of migratory bird species of conservation concern (e.g., yellow-billed loon, bar-tailed godwit), listed species (e.g., Steller's eider, spectacled eider), and candidate, petitioned, or other species the Service believes population growth may be impacted by subsistence harvest (e.g., emperor geese, bar-tailed godwit). Similar to assessing the effects of subsistence harvest on species considered to have robust populations, understanding how subsistence harvest may impact population abundance and trend for species with small and/or declining populations, or species given special protection is necessary as mandated by the Migratory Bird Treaty Act and Endangered Species Act. Annual statewide estimates of migratory birds should be analyzed for two seasonal periods: spring-summer and fall-winter. All estimates should be unbiased with a less than 50% CIP. Further, a study should be designed and conducted to evaluate potential bias in estimates due to misidentification, memory recall, low response rate within a village, status of the species, and village participation. For example, identification might be poorest for rare species (e.g., yellow-billed loon vs. common loon; marbled vs. Hudsonian vs. bar-tailed godwit) and the incentive to not report is likely highest for closed species (e.g., spectacled eider, Steller's eiders, emperor geese) and their eggs.*

3. *Annual, total estimates of hunter participation and persons/households consuming migratory birds taken during for subsistence. Annual statewide estimates of hunter participation and persons/households should be analyzed for two seasonal periods: spring-summer and fall-winter. All estimates should be unbiased with a less than 50% CIP. Further, a study should be designed and conducted to evaluate potential bias in estimates due to low response rate within a village and village participation.*

Justification

The Service's objectives for the AMBCC subsistence harvest survey were based on: (i) legal mandates under the Migratory Bird Treaty Act and the Endangered Species Act and (ii) how these data will be used in migratory bird management and conservation. Additional detail on the Service's harvest survey priorities follows.

Legal Mandate

The Migratory Bird Treaty Act of 1918, as amended, implements the four bilateral conventions between the United States and Canada, Mexico, Japan, and Russia for the protection and conservation of migratory birds. In 1997, the Letter of Submittal from the Secretary of State to the President of the United States accompanying the Protocol amending the migratory bird convention between the United States and Canada stated:

> *It is the intention of U.S. Fish and Wildlife Service of the Department of the Interior and the Alaska Department of Fish and Game that management information, including traditional knowledge, the number of subsistence hunters and estimates of harvest, will be collected cooperatively for the benefit of management bodies.*

> *Harvest levels of migratory birds in the United States may vary for all users, commensurate with the size of the migratory bird population. Any restrictions in harvest levels of migratory birds necessary for conservation shall be shared equitably between users in Alaska and users in other states, taking into account nutritional needs.*

The Endangered Species Act of 1973, as amended, is the second legal mandate that requires the U.S. Fish and Wildlife Service to assess all factors that could reduce the likelihood of survival and recovery of an ESA-listed species. For any proposed federal action, such as annually authorizing Alaska spring and summer migratory bird subsistence hunting seasons, the Service is required to ensure the hunt will not reduce the likelihood of survival and recovery of Steller's and Spectacled eiders.

Uses of the Data

Alaska subsistence harvest survey data are not currently being used in any formal regulatory decision making processes. The primary reasons for this are related to:

1. *Lack of statistical precision of the estimates;*
2. *Concerns about potential sources of bias in the estimates;*
3. *Unpredictable timing of when data become available;* and,
4. *Lack of species-specific state-wide or population estimates necessary to assess potential effects on migratory bird population status and to evaluate regulation effectiveness.*

Subsistence harvest survey estimates are currently used to assess general patterns over time and among regions, outreach and education, provide employment to rural residents, and foster collaboration among state, federal and Alaska Native groups. However, the four limitations cited above limit both confidence and therefore application of subsistence harvest data.

Potential uses of migratory bird subsistence harvest data to inform harvest management and support migratory bird conservation include:

1. *Documenting subsistence harvest users, egg and bird harvest, and timing of harvest;*
2. *Evaluating trend in subsistence harvest users, egg and bird harvest, and timing of harvest;*
3. *Evaluating harvest equitability among harvest users including among regions or subregions and between subsistence and sport harvest;*
4. *Evaluating effectiveness of regulations and regulation changes for intended purposes;*
5. *Outreach, education and employment opportunities for rural residents;*
6. *Association with population abundance and evaluation of sustained yield;*
7. *Estimating hunter effort and success; and,*
8. *Estimating annual productivity based on age ratios in the harvest.*

The potential uses of the migratory bird subsistence harvest data outlined above depend upon many factors including type, scale, precision, bias, and timing of data availability; and existence of demographic models to assess effects of fall and subsistence harvest on population size. The Service believes the availability of meaningful migratory bird subsistence harvest data will provide incentive to develop more effective harvest strategies and management plans.

Conclusion

The Service has advocated for the collection of statewide, unbiased migratory bird subsistence harvest data to assess effects of spring and summer subsistence hunting on commonly harvested species and evaluate potential effects on abundance and trend of species whose populations are suspected to be, or are known to be in decline or what are protected by the Endangered Species Act. However, a statewide survey may be cost prohibitive. Possibly a subset of the 11 AMBCC regions comprising the majority (e.g., >90%) of the subsistence harvest could be surveyed to help minimize costs. We support evaluating a rigorous, cost effective survey sampling design that most effectively meets the legal mandates and uses of the data. Subsistence harvest estimates at finer spatial scales including region, subregion, and village levels may be more useful for fine scale planning, regulation development, and outreach. However, an assessment of survey costs relative to gains in spatial resolution, precision, and bias are needed to determine relative benefits. Increasing spatial resolution is desirable if it can be achieved in a cost effective manner. However, priority should be at the species-specific state or population level.

Adaptive harvest management (AHM) models currently only exist for the northern pintail, black duck, scaup, and mallard. However, we believe the availability of statewide, unbiased migratory bird subsistence harvest data may prompt development of AHM for commonly harvested subsistence species including brant, cackling Canada geese, white-fronted geese, and scoters. Further, we believe that a survey that keys in on species (e.g., bar-tailed godwit) whose population abundance and trend are less understood, but suspected susceptible to subsistence harvest, may generate critical and necessary outreach to encourage conservation partnerships and decreased take.

HOW HAVE THE DATA BEEN USED?

Responses from TWG members regarding uses of the survey data were gathered from a survey (November 2014; Appendix B) and are summarized below. Based on input from AMBCC partners, we define 3 categories of potential uses of AMBCC harvest survey estimates by stakeholders: 1) document the nutritional and cultural value of subsistence harvest of the migratory bird resources, 2) use in formal decision making processes (e.g., structured decision making to set harvest regulations), and 3) monitor temporal and spatial trends in harvests of a wide of range of species.

Native Caucus

Summaries of AMBCC subsistence harvest survey data have been provided to Alaska Native Organizations and Alaska rural communities (villages) in the form of reports and outreach products since the inception of the survey. In addition, representatives from ADFG and the USFWS have attended numerous meetings of regional migratory bird councils to give presentations and discuss the results of the harvest survey with council members and the public. The regional councils have shared the subsistence harvest information with community members at village meetings and by distributing outreach products. These efforts have addressed the first use of the AMBCC data, documentation of nutritional and cultural values.

Alaska Department of Fish and Game

The Division of Subsistence in the ADFG is responsible for conducting the AMBCC subsistence harvest surveys, checking and compiling the data, and producing harvest estimate reports. Estimates have been summarized at the regional and subregional level; no statewide estimates have been attempted. Harvest estimates are shared with villages, Alaska Native Organizations, state and federal resource management and conservation agencies, the Pacific Flyway Council (PFC), and the public. Data at the household level are confidential and data at the village level are considered sensitive. These efforts have documented subsistence use to the stakeholders.

The State of Alaska is a member of the Pacific Flyway Committee (PFC) and is formally represented by staff members on the Council, Study Committee and the Nongame Technical Committee. State representatives provide technical information to PFC committees on issues of harvest management and regulations and related issues. Subsistence harvest data are routinely submitted during the annual regulation process and are often cited in specific species management plans. Recommendations about subsistence harvest regulations are developed jointly by the AMBCC, and therefore we discuss the use of the data in the formal decision making process when discussing uses of the data by the USFWS. An extensive listing of ADFG reports, publications, and cited references are provided in Appendix B.

Temporal trends in migratory bird harvest (the third category of use defined above) were examined in the Y-K Delta over the period 1985-2005 by the USFWS Division of Migratory Bird Management (Wentworth 2007) and by (Alcorn 2008). These analyses addressed a specific provision of the amendment to the MBTA that requires the take of migratory birds relative to their continental population sizes by subsistence hunters should not change after the implementation of the MBTA amendment.

U.S. Fish and Wildlife Service

In response to the amendment of the MTBA in 1997, the USFWS conducted and commissioned a series of subsistence bird harvest surveys across the state to: 1) determine which regions should be included, and in some regions, which communities should be eligible (e.g., Copper River communities) and, 2) identify harvest patterns that would help define the regulations (Paige and Wolfe 1998). Results of these studies were used to establish regulations such as elimination of bag limits because it was acknowledged that many subsistence hunters shared their harvest with other village members and therefore bag limits would compromise traditional practices. The migratory bird subsistence harvest regulations have not changed since they were first established. The lack of changes in regulations are related to: 1) the broad scope of the regulations: no bag or season limits, no shooting hours (except North Slope) and 2) continuing bird harvest and population monitoring data that have not indicated a compelling need for changes, and 3) failure to achieve consensus among the stakeholders on proposed changes.

Subsistence harvest data have been included in most PFC management plans for species subjected to both subsistence and sport harvest, but none incorporate these estimates into a formal regulatory decision process. According to USFWS, the three primary reasons for this exclusion are: 1) perceived lack of statistical precision of the estimates, 2) concerns about potential sources of bias in the estimates, and 3) adoption of some management plans prior to the implementation of the AMBCC subsistence harvest survey.

An Environmental Assessment (EA) of the proposed regulatory action governing the subsistence harvest is produced annually (USFWS 2015). The primary focus of the EA is waterfowl because ducks and geese constitute the large majority of the harvest. The discussion of Alaska subsistence harvest socioeconomics includes statistics about numbers of hunters and waterfowl species harvest, but these estimates are taken from surveys conducted prior to the initiation of the AMBCC survey and therefore may not reflect current estimates. In the 2015 EA, the section on endangered species does include harvest information from 2010–2013 AMBCC surveys of Steller's Eider (*Polysticta stelleri*), Spectacled Eider (*Somateria fischeri*), and Yellow-billed Loon.

Section 7 of the Endangered Species Act requires an annual Biological Opinion (BO) on the effects of proposed subsistence harvest regulations on endangered species. Reviewed species are Steller's Eider, Spectacled Eider, and Yellow-billed Loon. AMBCC surveys are one of several cited harvest survey efforts. The BO for these species repeatedly expresses significant concerns about unmeasurable bias of survey estimates for all 3 species due to myriad combinations of misidentification, reporting, measurement and recall errors, as well as some concern about sample household selection bias (USFWS 2014). Lack of statistical precision of harvest estimates and trends is assumed due to a combination of both sampling error and actual annual variation in species abundance and hunter effort and no estimates of precision are provided. Ultimately, the harvest estimates in the BO are used somewhat qualitatively, i.e., in terms of orders of magnitude, and within the context of both species population surveys of abundance, trend, and distribution, and additional socioeconomic factors.

The 2013 Supplemental Environmental Impact Statement on the Issuance of Annual Regulations Permitting the Hunting of Migratory Birds includes a specific component for the Alaska subsistence harvest (USFWS 2013). Survey statistics are used extensively in the discussion/evaluation of this activity. In particular, the magnitude of individual species subsistence harvest is cited within the context of the total harvest that occurs during the fall sport harvest season. We note that Alaska fall season harvest estimates are included in the total harvest estimates reported in the national HIP survey.

DATA QUALITY

Groves et al. (2004) discussed the challenges of human survey methodology within the context of "total survey error" that results from measurement, coverage, sampling, nonresponse, and processing errors and state that "all surveys involve some kinds of compromises with the ideal protocol …[and]… in some cases there are only imperfect solutions to survey design problems." We think this statement is a helpful context for discussing the data quality issues of the AMBCC survey. One challenge in our review will be to make the recommendations about the tradeoffs between cost and reduction of survey error. Below we provide a general discussion of several potential sources of bias in the harvest survey estimates and special studies that could inform us about the severity of these biases. Although we treat each issue separately, the potential for issues to magnify or cancel one another out is possible. We provide more detailed explanations of the study protocols in the Recommendations section.

Sensitive Question/Species Status

The general consensus among stakeholders is that placing additional special emphasis on harvest of special status species during the conduct of the general survey may compromise the accuracy of all harvest data and reduce participation rates. Therefore, we suggest that a separate survey with a specialized protocol would be required if there are sufficient concerns about the accuracy of harvest estimates of these species. A standard approach in the human survey design literature for collecting information about very sensitive questions is known as the randomized response design (Warner 1965, Horvitz et al. 1976). In the interview, the respondent may be asked either the sensitive question, or an innocuous question, depending on the outcome of a random process, e.g., a coin flip. The key feature of the technique is that this outcome is unknown to the surveyor and thus he does not know which question the respondent has answered. Therefore, whether a specific individual has engaged in the sensitive behavior cannot be determined. However, an unbiased estimate of the proportion of the sampled population that has engaged in the sensitive behavior can still be obtained. Refer to the Special Studies section for an example wildlife application of the technique which we believe could be adapted for use in the AMBCC survey.

Memory/Recall Error

Memory error is a type of measurement error, in which the survey response (species harvest) deviates from the true harvest due to the individual's inability to accurately recall the harvest events. If the respondents consistently underestimate or overestimate their harvest, then biased estimates result. The severity of the error is probably related to the lag time between the time of harvest and the survey interview. Because of the very long AMBCC 'survey year', i.e., April through October in most regions, memory error may significantly affect the survey data. Naves et al. (2008) acknowledged this problem in their assessment of survey methods by pointing out that lag times ranged from 3 to 7 months. The magnitude of the problem had also been exacerbated by interviewer's failure to adhere to the survey protocol for the timing of survey, which resulted in an average of 71% of the 2004–2006 interviews being conducted with even longer extended periods. In an effort to reduce the potential of memory error by adjusting the timing of interviews, the survey protocol was changed in 2010 to a system with 2 instead of 3 seasonal follow-up interviews, but with the same lag time intervals. An evaluation of survey lag times after this change has not been conducted.

Direct empirical estimates of memory bias from survey data are not possible, since the truth cannot be known. Statisticians have developed techniques such as comparing survey estimates to those obtained by a subsample of individual hunters that are asked to maintain diaries of hunting episodes or are interviewed frequently throughout the season. Most results of studies conducted to evaluate memory bias have concluded that longer recall periods and increased hunting activity by the individual are associated with increased overestimation of harvest (Connelly and Brown 1995; Connelly et al. 2000, Ghosh 1978; Westat Inc. 1989). Refer to the Special Studies section for the description of a special survey study designed to evaluate the magnitude of memory bias in the AMBCC survey.

Nonresponse Bias

We define nonresponse bias as the difference between the true harvest amount of a species in the target population and the expected average value of the estimate from the sample data. In any survey of wildlife harvest there will be some percentage of sampled hunters that choose not to respond. Nonresponse bias occurs if the average harvest of these hunters is consistently different from the average harvest of respondents. The magnitude of the bias is the product of this difference in harvest and the percentage of non-respondents in the survey. In the AMBCC survey design, non-response refers to either (1) entire village(s) opting out of the survey and/or (2) individual household(s) with surveyed village(s) choosing not to participate.

If there are relatively few non-respondents, then the risk of nonresponse bias is reduced, but not necessarily eliminated (Groves et al. 2004). An extreme difference in harvest between respondents and non-respondents could produce a significant bias even if response rates are large. To illustrate this point in the context of the AMBCC survey, consider that >90% of villages selected for sampling since 2010 have agreed to participate, and that the average nonresponse rate for individual households in 2004–2013 was 14%. If we make the assumption that village response rate is independent of the size of the village, then we can do a rough calculation that results in an overall nonresponse rate of 23%, which is considered quite low in the human survey literature. For example, the USFWS HIP survey uses 3 follow-up mailings to non-respondents and still has achieved only ~50% response rate (K. Wilkins, pers. comm.). If the average harvest in 77% of households that responded is the same as in the 23% that did not respond, then there is no non-response bias. However, if the harvest of non-respondents was 2x, 4x, or 10x times greater than the harvest of respondents, then the survey would underestimate the true harvest by 19%, 40%, or 67%, respectively. Alternatively, if the harvest of non-respondents was 0.50x, 0.75x, or 0.90x times less than the harvest of respondents, then the survey would overestimate the true harvest by 13%, 21%, or 26%. These example values would probably be considered extreme differences. But the problem is that, as with all human surveys, the difference between respondents and non-respondents is not observable, i.e., there is no direct way to estimate nonresponse bias. Therefore, we have no empirical way to determine at this point in time if nonresponse bias in the AMBCC survey is a serious problem. Statisticians have devised several bias-adjustment techniques and survey designs that have been used with mixed success, but these involve additional data collection and/or multiple contacts. In general, more emphasis in the implementation of human surveys has been placed on techniques for maximizing response rates and thereby minimizing the risk of significant bias.

Village participation rates

The proportion of villages that have refused to participate in surveyed regions/subregions has decreased slightly from an average of 12% in 2010 to < 5% in 2011 - 2014 (Table 2). If refusals are most often due to a fundamental distrust of government agencies or their justification for collecting personal subsistence harvest data, or a lack of continuity in village leadership, then we would not expect a substantial difference between overall harvest amounts of these villages compared to participating villages (J. Fall, L. Naves; ADFG; pers. comm.). In any case, we do not foresee any practical way to measure differences in harvest between participating and non-participating villages. Admittedly, there are several regions that have been sampled infrequently in recent years, and therefore future participation rates in these regions could differ from past years. If we assume that past village participation rates are indicative of the future, the generally low refusal rates and the likelihood of non-harvest related motivation for non-participation suggest this source of survey error is not a major concern.

Table 2. Village participation rate, AMBCC harvest survey 2010–2014.

Year		Villages in subregion or region	Contacted villages	Villages that agreed to participate in the survey	Village participation rate[1]
2010	Chugach-Cook Inlet region	5	3	2	67%
2010	Kodiak Archipelago region	12	6	6	100%
2010	Yukon-Kuskokwim Delta region	47	24	22	92%
2010	Bering Strait-Norton Sound region	16	9	8	89%
2010	Interior Alaska	43	20	18	90%
2011	Bristol Bay region	27	11	11	100%
2011	Yukon-Kuskokwim Delta region	47	20	19	95%
2011	St. Lawrence-Diomede Is. subregion	3	2	2	100%
2012	Kotzebue subregion	1	1	1	100%
2012	St. Lawrence-Diomede Is. subregion	3	2	2	100%
2013	Yukon-Kuskokwim Delta region	47	23	21	91%
2014	Cordova subregion	1	1	1	100%
2014	Upper Yukon subregion	11	6	6	100%

[1] Village participation rate is number of villages that agreed to participate/number of villages contacted.

Household participation rates

The average proportion of households in villages surveyed since 2010 that have refused to participate in surveys is < 10% (Naves 2015) and it seems reasonable to expect this behavior will continue in the future (with the same caveat mentioned above regarding future participation rates in villages that have been sampled infrequently in the past several years). However, as above explained, even with low nonresponse rates, a large difference in average harvest between non-respondents and respondents can result in potentially important nonresponse bias. A 'double-sampling' technique (Thompson 2013) has been used in human surveys to estimate nonresponse bias. In this technique, a subsample of initial non-respondents is selected and a more intensive effort and/or different contact methods are used to enlist initial non-respondents to eventually participate in the survey. Data from this subsample is then used to represent all non-respondents and to adjust the estimates based on initial respondents. For example, in mail surveys, follow-up contact of non-respondents typically includes telephone calls and/or additional mailings. We believe the additional time, expense, and expected ineffectiveness of impersonal follow-up contact methods make this approach an unworkable alternative for the AMBCC survey. In the Special Studies section we propose 2 alternative approaches that could provide indirect evidence for the potential for serious nonresponse bias due to household participation refusals.

Crippling Loss

The distinction between kill rate and harvest rate is important. Kill rate is the proportion of the population killed by hunters, whereas harvest rate is the proportion of birds killed and retrieved. The difference between these two metrics is crippling, or wounding, loss. Crippling loss can be a large source of bias in harvest estimates. For some objectives, such as estimating the number of calories consumed, harvest rate is the metric of interest. However, for bird population models, kill rate is the metric that is relevant. Anderson and Burnham (1976) estimated the national average crippling loss rate for all waterfowl as 20%, but crippling loss occurs with all hunted species (e.g., 5–33% for bobwhite; Haines et al. 2009). Crippling loss may be higher for sea ducks than for other waterfowl (commonly hunted over decoys) because sea ducks may be shot at longer ranges and may be more apt to escape retrieval (Rothe et al. 2015:426). Crippling loss rates reported by hunters in the HIP survey was 18% for sea ducks and 12% for other ducks (Padding et al. 2006, Moore et al. 2007 cited in Rothe et al. 2015). Crippling loss in the eider hunt at Point Barrow has been estimated as 30%–43% depending on hunting conditions (Thompson and Person 1963, Johnson 1971). Estimating crippling loss is difficult. Crippling loss can be estimated by using telemetry to track the fate of individuals in an area during the hunting season, but studies involving this approach are expensive. A less accurate, (and less costly) approach, is to estimate crippling loss visually, usually from a hidden blind. However, hidden blind studies could lead to mistrust with the hunting public. Strategies to reduce crippling loss include mandatory use of a retriever dog, hunter proficiency tests, shell limits, and including crippled waterfowl as part of a daily limit or report (Van Dyke 1981, Mondain-Monval et al. 2015), but many of these strategies are unlikely to work in the subsistence hunt in Alaska due to the lack of the use of retrievers, and possible public dissatisfaction with heh use of proficiency tests and shell limits. Estimating and overcoming crippling loss is a vexing problem, but recognizing crippling loss as a bias may help keep other potential sources of bias in perspective. We discuss potential study designs to better understand crippling loss under "Special Studies".

Misidentification

Species misidentification can potentially bias harvest estimates (higher or lower) if a species is consistently misidentified as another species. How large a problem this is for the subsistence harvest survey is unknown, but the problem has been recognized (Naves, Pers. Comm.) and efforts have been made to avoid misidentification errors in the field. For instance, harvest survey forms include pictures of species likely to be harvested in sets of regions together with English names. Lists of Native and local names have been compiled in all Alaska Native languages and dialects and are used in the survey to assist in species identification (Naves 2012). Commercial species identification guides (e.g., Dunn and Alderfer 2011) and complementary materials specifically designed for the subsistence harvest survey have been used to assist in species identification (e.g., Naves and Zeller 2013). In addition, data are vetted by ADFG and USFWS biologists and by local individuals that are familiar with harvest patterns in each region (Naves, pers. comm.). Finally, special efforts have been made to reduce misidentification of loon species in harvest surveys (Naves 2015). Despite these efforts, in cases where a rare species is difficult to distinguish from a common species, e.g., Yellow-billed and Common Loons and Bar-tailed (*Limosa lapponica*), Hudsonian Godwits (*Limosa haemastica*), and Marbled Godwits (*Limosa fedoa*), such errors and potential biases may be large.

The USFWS has suggested that Brant harvest has been reported in regions where they do not occur (E. Taylor, pers. comm.). Although Brant breed coastally and only migrate over salt water, Brant records from Interior Alaska could either represent misidentification errors, or possibly correct identification, but incorrect harvest location. Brant harvest was reported from Interior Alaska in 2004 and 2006 but the numbers were small, representing only 0.55% of the total reported Brant harvest. In addition, it could not be determined if the Brant harvest reported from this region represented misidentification error or was simply due to hunters that travelled to coastal areas and correctly identified the birds. Brant were inadvertently included on the harvest survey forms for 1 or 2 interior villages (L. Naves, pers. comm.) which may account for the reports of Brant in interior Alaska. However, if all of the Brant reported from Interior Alaska were misidentified, the numbers still would be relatively small and thus probably do not represent a large bias for this species. We did not attempt additional comparisons between the breeding distribution of harvested species in Alaska and harvest survey reports because of the difficulties of assigning discrepancies to misidentification error. We believe that in situations where misidentification error has been raised as a serious problem for a particular species, it is best addressed by focused studies on the species of interest.

The USFWS reviewed the ADFG 2013 harvest report from the Y-K Delta and identified a number of instances where harvest estimates appeared anomalous or to be outside of values reported previously (E. Taylor, pers. comm.). In several instances, it was suspected that the anomalous values were due to misidentification. ADFG reviewed the data and found no data entry errors. It is possible that the high values reported for harvest of Yellow-billed Loon in the Lower Kuskokwim subregion and Brant eggs in the North Coast subregion were the result of misidentification but without additional information, identifying the cause is impossible. A number of the other seemingly anomalous estimates (e.g., plover egg harvest in the Lower Kuskokwim), are likely a result of extrapolation from a small sample to the total population.

There are a variety of ways that misidentification errors can be reduced. For instance, increased education of both the hunters and the surveyors could reduce misidentification errors on the survey. Greater effort during the survey to correctly identify species harvested can also reduce misidentification. For instance, the recent investigation of misidentification of Yellow-billed Loons on St. Lawrence Island (Naves and Zeller, 2013) provides an excellent template for addressing misidentification error at a local scale and could be implemented in other situations where misidentification has been raised as a potential problem. In this case, surveyors were accompanied by a biologist during home visits to provide assistance with identification issues. In addition, visual surveys of loons were conducted to estimate the proportion of different loon species in the areas where birds were harvested (Naves and Zeller 2013). These efforts, however, cause a significant increase in the costs of the survey.

An alternative approach is to identify the harvested species using a survey that is independent of the household survey. For instance, the HIP survey only asks waterfowl hunters to specify the number of ducks, sea ducks, geese, and Brant that they harvested. The species that are harvested are identified by asking a subset of the hunters to send wings and tails of harvested birds, which then are identified to species by USFWS and state biologists (the "parts survey") (Raftovich et al. 2014). Logistics, cost, technical issues, and potential cultural barriers so far have prevented testing this approach in subsistence bird harvest surveys (L. Naves, Pers. Comm.). Refer to the Special Studies section for description of alternative approaches that could be considered for estimation of misidentification rates.

PRECISION OF HARVEST ESTIMATES

The precision of subsistence harvest estimates is key to their use in management of migratory birds. If the estimates are imprecise, managers are reluctant to use them in harvest strategy or trend estimation models. All AMBCC harvest reports have used CIP as a measure of precision. CIP is used in HIP reports from the USFWS Migratory Bird Program and therefore the precision estimates used in the AMBCC reports are directly comparable to HIP estimates. CIP is estimated as:

$$CIP(X_r) = t_{df,1/\alpha} \times \sqrt{var(X_r)}\frac{1}{X_r}$$

where X_r is the regional harvest estimate, $Var(X_r)$ is the variance of the regional harvest estimate, and $t_{df,1/\alpha}$ is the critical value for the Student's t distribution where α is the significance level and df is the degrees of freedom (Naves 2014). The CIP is closely related to the Coefficient of Variation (CV). For the typical sample sizes in the AMBCC survey, $t_{df,1/\alpha} \cong 2.00$ and $CV(x_r) = \sqrt{var(X_r)}\frac{1}{X_r}$ and therefore $CIP(X_r) \cong 2 \times CV(X_r)$.

Bird Harvest

To examine whether the current survey meets the precision criteria identified by the USFWS, ADFG, and NC, we compiled regional CIP values for 1) commonly harvested species (>2% of total subsistence harvest based on the analysis by R. Oates and L. Naves), 2) species groups used in the AMBCC harvest reports, and 3) species identified by USFWS as species of conservation concern. Although both Yellow-billed Loon and Bar-tailed Godwit are species of concern, we did not include them in our examinations either because of issues regarding species identification (Yellow-billed Loon, Naves and Zeller 2013) or they are not identified at the species level in the harvest surveys (Bar-tailed Godwit). CIP values for each species or species group, region, and year were compiled from AMBCC harvest reports and summarized in Appendix F. In their objectives, the USFWS identified a CV <25% as the goal for the precision for statewide subsistence harvest estimates which is equivalent to a CIP < 50%. Alaska Department of Fish and Game identified a CIP of < 50% for their level of precision in regions where the species is harvested most commonly and in the largest numbers. A CIP < 100% was specified for other regions of secondary importance. Harvest estimates with CIP > 100% (CV > 50%) are generally considered poor for harvest management (confidence interval is approximately 0 to 2 times the harvest estimate). Using the thresholds identified by the NC, ADFG, and USFWS and an upper threshold of 100%, we classified the CIP values into three categories to provide a general assessment of the precision of the estimates. Estimates with CIP ≤50% were considered good, 50 < CIP ≤ 100% were considered moderate, and CIP > 100% were considered poor. Although some stakeholders stated that they wanted the same precision levels for individual season estimates and the total estimate over all seasons, it is important to realize that our assessment of the precision of survey estimates refers only to the TOTAL annual harvest. However, based on an informal assessment of the seasonal estimates in the annual AMBCC survey reports, we can say that a majority of seasonal harvest estimates of individual species are zero, and thus have corresponding CIP values of zero. In order to get some idea of the precision of non-zero seasonal estimates, we extracted estimates for duck and goose species from the 2010 harvest survey report (Naves 2012). The percentage of regional bird and egg species seasonal harvest estimates with CIP < 50% were: Kodiak (19%, 0%), Y-K Delta (58%, 46%), and Interior (29%, 0%). It is our contention that any sample size determination exercises that we may do in the future (based on realistic expectations of future survey budgets) would necessarily involve precision of total annual harvest. Individual season estimates will have less precision than an estimate for the corresponding total, and we do not expect that the desired precision levels could be achieved on a seasonal basis.

Most (66%) of the regional estimates of commonly harvested species had good precision 24% were moderate and 10% were poor (Table 3). Harvest estimates of Species of Conservation Concern (rarely-taken species) had overall poorer precision: 29% of the CIP values were good, 39% moderate, and 33% were poor. The distribution of precision estimates for Species Groups was similar to Commonly Harvested Species. Harvest estimates of individual species generally had good precision for commonly harvested species (Table 4). In general, the proportion of estimates that had good precision declined as the number of birds harvested declined (Commonly Harvested Species are arranged from most to least harvested in Table 4). For Species of Conservation Concern, precision was good for Emperor Geese, which are harvested in relatively large numbers, but poor for Steller's and Spectacled Eiders. Precision of harvest estimates for Species Groups was variable. The majority of the precision estimates were good for ducks and geese (100% and 85%, respectively), but fewer than 50% of the estimates were good for cormorants, murre, scaup, and total seabirds. Precision varied greatly by region, which is likely related to variable harvest amounts among regions (Table 5). More than 50% of the estimates were good in 5 of the 9 regions; only 33%, 38%, and 14% of the estimates were good in the Aleutian-Pribilof Islands, Gulf of Alaska-Cook Inlet, and Upper Copper River regions, respectively, where bird harvest is relatively low. With respect to NC and ADFG preference for regional estimates, in the regions that were sampled, 61% of the regional estimates of annual harvest met the precision guidelines.

Table 3. Percentage of regional bird harvest CIP values that were good (CIP <50%), moderate (50< CIP <100%), and poor (CIP >100%) by species category for AMBCC subsistence harvest data 2004–2011.

		Percent in CIP category		
Species category[1]	N[2]	Good	Moderate	Poor
Commonly Harvested	348	66	24	10
Species of Conservation Concern	49	29	39	33
Species Groups	162	69	20	11

[1]- See Appendix E for list of species or species groups included in each category.

[2]- Number of annual regional harvest totals used in calculating the percentages.

Table 4. Percentage of regional bird harvest CIP values that were good (CIP ≤ 50%), moderate (50% < CIP ≤100%), and poor (CIP > 100%) by species or species group for AMBCC subsistence harvest data 2004–2011. Commonly harvested species are arranged from the most harvested to the least harvested. Species of Conservation Concern and Species Groups are arranged alphabetically.

		Percent in CIP category		
Species or Species Group	**N[1]**	**Good**	**Moderate**	**Poor**
Commonly Harvested Species				
Greater white-fronted Goose	22	95	5	0
Mallard	27	78	11	11
Northern Pintail	27	63	22	15
Cackling/Canada Goose	5	80	0	20
Cackling Goose	18	72	28	0
Lesser Canada Goose	21	81	10	10
King Eider	19	89	11	0
Brant	23	70	26	4
Black Scoter	23	52	35	13
Snow Goose	19	74	26	0
American Wigeon	20	70	30	0
White-winged Scoter	21	67	19	14
Common Eider	18	67	22	11
Long-tailed Duck	24	46	50	4
Canvasback	19	47	32	21
Surf Scoter	18	56	33	11
Species of Conservation Concern				
Emperor Goose	17	65	24	12
Steller's Eider	16	6	38	56
Spectacled Eider	16	13	56	31
Species Groups				
Auklet	3	100	0	0
Cormorant	8	25	13	63
Goldeneye	22	59	27	14
Murre	8	38	25	38
Scaup	24	38	29	33
Swans	24	71	13	17
Teal	22	82	18	0
Total ducks	27	100	0	0
Total geese	27	85	11	4
Total seabirds	21	24	67	10

[1]- Number of annual regional harvest totals used in calculating the percentages.

Table 5. Percentage of regional species harvest CIP values that were good (CIP <50), moderate (50< CIP <100), and poor (CIP >100) by region for AMBCC subsistence harvest data 2004–2011.

		Percent in CIP category		
Region	N[1]	**Good**	**Moderate**	**Poor**
Aleutian-Pribilof Islands	15	33	40	27
Bering Strait-Norton Sound	79	67	18	15
Bristol Bay	90	54	33	12
Gulf of Alaska-Cook Inlet	16	38	44	19
Interior Alaska	53	68	26	6
Kodiak Archipelago	14	50	29	21
North Slope	68	49	29	22
Upper Copper River	22	14	59	27
Yukon-Kuskokwim Delta	15	81	13	5

[1]- Number of annual regional harvest totals used in calculating the percentages.

Egg Harvest

Precision of egg harvest estimates was summarized by species or species group, region, and year (Appendix G). In general, the precision of egg harvest estimates was lower than the estimates of bird harvest. Fifty percent of all regional egg harvest estimates were good, 26 were moderate, and 24 were poor. A large proportion of the egg harvest estimates with good precision came from the Y-K Delta (Table 6). When harvest estimates from the Y-K Delta are excluded, only 29 of the estimates were good, 35 were moderate, and 35 were poor. Thus, most (81%) of the egg harvest estimates from the Y-K Delta were good but other regions where egg harvest was low, most (70%) of the estimates were moderate or poor.

Table 6. Percentage of species egg harvest CIP values that were good (CIP ≤50), moderate (50< CIP ≤100), and poor (CIP >100) by region for AMBCC subsistence harvest data 2004–2011.

		Percent in CIP category		
Region	**N[1]**	**Good**	**Moderate**	**Poor**
Aleutian-Pribilof Islands	3	33		67
Bering Strait-Norton Sound	17	41	35	24
Bristol Bay	22	27	41	32
Gulf of Alaska-Cook Inlet	5	40	40	20
Interior Alaska	5		20	80
Kodiak Archipelago	2	50		50
North Slope	11	18	45	36
Yukon-Kuskokwim Delta	42	81	12	7

[1] Number of annual regional harvest totals used in calculating the percentages.

TREND ANALYSIS

Although AMBCC stakeholders have not placed a high priority on using survey data to estimate temporal changes in species harvest, we conducted a trend analysis for a few species using 2004–2011 survey data from the Y-K Delta. We believe some components of this analysis provide additional insight into the performance of the current survey design in the Y-K Delta region, which has been surveyed most consistently and thoroughly since the start of the AMBCC survey. The analysis also encourages consideration of a longer-term perspective of the potential of a consistent monitoring program to inform management and conservation.

We selected 4 species with different levels of average annual harvest and spatial distribution of harvest. The White-fronted Goose harvest is among the largest (19,000) in the region and occurs throughout a large proportion of the region. The Black Scoter harvest (7,700) is also substantial, and but it is more spatially localized. The Northern Pintail harvest (9,200) is substantial and widely distributed. The Surf Scoter harvest (1,300) is relatively small and more spatially localized.

We used a random effects model analysis (Franklin et al. 2002) to estimate species harvest trends in 2004–2011, and then used results from these analyses to estimate the power of the survey to detect changes in harvest levels given additional years of survey data. Finally, we estimated proportions of the observed variation in annual harvests that were due to sampling error and to the estimated true annual variation in harvest amounts.

None of the estimated species harvest trends suggested a consistent annual increase or decrease in 2004–2011. Based on 8 years of data, the power analyses for the 4 species consistently suggested that the survey would have a reasonably high probability (= 0.75) of detecting harvest trends when the relative annual change in harvest was >15%-20% (Figure 2). However, with a few more years of data (N = 12 years), trends could be detected for changes of 6%-10% in annual harvests, which is a much more plausible range.

Comparison of sampling variation to true annual variation revealed that, for all species, <10% of the variation in a set of annual harvest estimates resulted from sampling variation. This result provides support for the presumption that multiple and variable ecological and socio-economic factors that affect the actual harvest in any given year result in large variation in harvest estimates from year to year, e.g., Fall et al. 2013).

Our trend analysis results are based on a simple linear trend model and we acknowledge that different estimates of trend and variance components could result from using a different model. However, there are a few general points that are relevant to our review. First, results were consistent among all 4 species. Second, sampling variation had a relatively minor impact on the ability of the survey to detect temporal change in harvest. Instead, the most important factor in detecting change is the number of years in which the survey has been conducted.

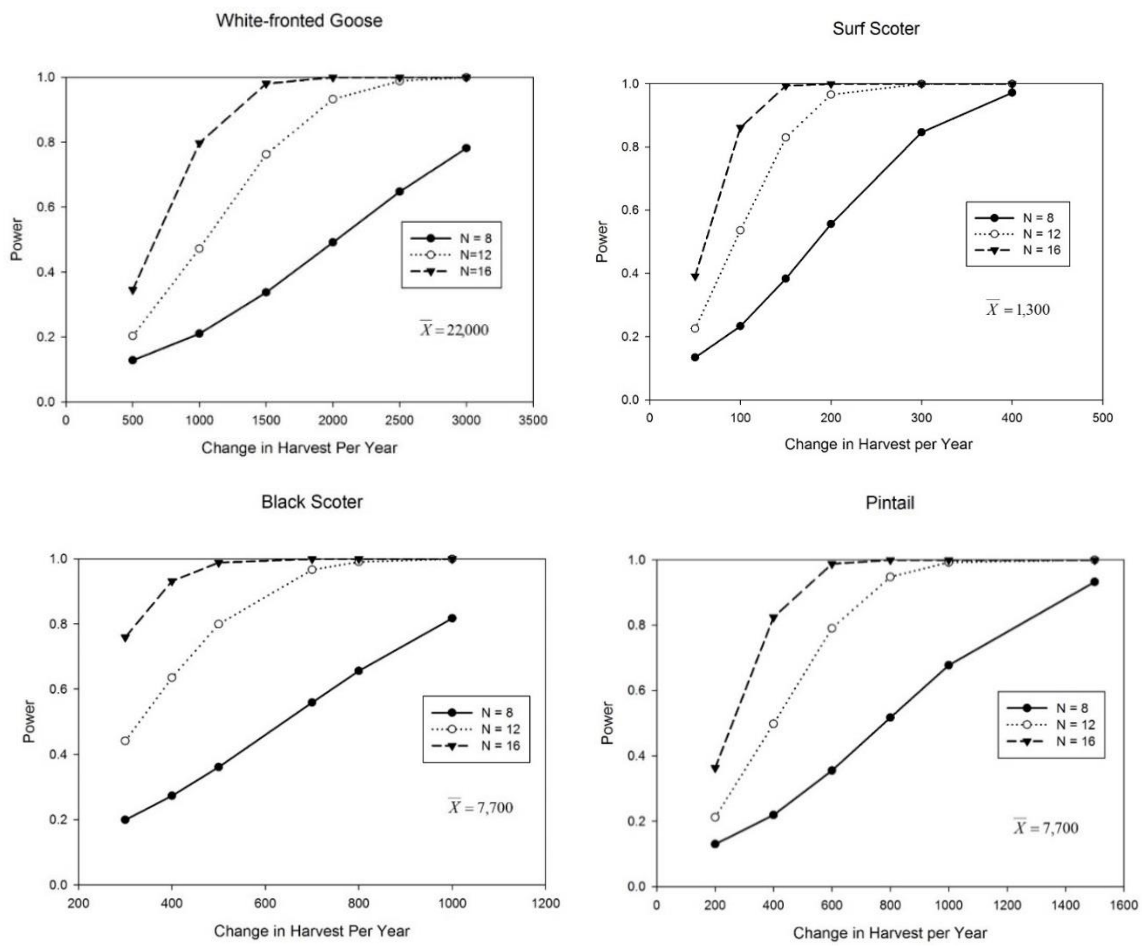

Figure 2. Statistical power (α = 0.10) for detecting a significant trend in harvest of 4 species in the Yukon-Kuskokwim Delta with N years of data. Analysis derived from 2004–2011 AMBCC surveys. $\bar{X}$ = average harvest.

DISCUSSION OF SURVEY PERFORMANCE RELATIVE TO STAKEHOLDER OBJECTIVES

The history of nearly continuous change in survey implementation from the initial recommended survey design (AMBCC 2003) to the present design (Naves 2012) and the associated fluctuation in survey budgets have made it difficult to directly evaluate the historical performance of the survey relative to stakeholder objectives. Therefore, it is important to clarify that our evaluation has to be based on data and auxiliary information collected from the 10 years of surveys as implemented. This reality results in a more piecemeal approach to evaluation. Nevertheless, we believe the information available to us has provided a sufficient foundation for our conclusions and recommendations.

Native Caucus

The first priority was annual estimates of commonly harvested species in the regions with highest harvest. This objective largely met in years when regions with high harvest were surveyed. The Y-K Delta is the region with highest harvest and during the period 2004–2013, it was surveyed in 2004–2011 and 2013 (in 2013 only 5 of 7 subregions were surveyed; Naves 2015). The vast majority (91%) of estimates of commonly harvested species met their precision criterion (CIP ≤ 50%), but the lack of an estimate in 2012 and the absence of surveys in two subregions in 2013 meant that their first priority for the survey was not achieved in those years. Bering Strait-Norton Sound and Bristol Bay, the regions with the second and third most harvest, respectively, have been sampled much less frequently. During the most recent 10-year period (2004–2013), regional estimates were obtained for Bering Strait-Norton Sound and Bristol Bay only 3 and 4 years, respectively. The precision target (CIP ≤ 50%) was achieved for most of the commonly harvested species in both Bering-Strait-Norton Sound (59%) and Bristol Bay (56%) during the years they were surveyed (Appendix F). As mentioned previously, seasonal estimates will have lower precision than the total annual estimate, but the exact loss in precision varies by species and region.

The second objective was to obtain estimates for commonly harvested species every 3–5 years (or 2-3 times in a 10-year period) in regions of lower harvest (no definition of "lower harvest" was provided), with CIP ≤ 100% for each season. This objective was only partially met during the period 2004–2013. Three of the regions were surveyed only once during the 10-year period which does not meet the second objective. In addition, the precision of harvest estimates did not meet their criteria (CIP ≤ 100%) for most (> 50%) of the species in the Aleutian-Pribilof Islands and Interior Alaska.

Alaska Department of Fish and Game

Due to federal budget constraints and the need to assess specific harvest levels for the Yellow-billed Loon on St. Lawrence Island, the subsistence harvest survey was not fully implemented over the previous 10-year period. There has been no coherency from year to year in the number of, and selection strategy for, regions to be sampled (i.e., a rotation schedule for regions). The average number of regions sampled per year since 2010 is three, whereas the intended average number in the standard design is six. We also note that for several of the surveys, the necessary sample sizes for regional estimates could not be achieved. This reality makes it difficult to assess if the current survey design is achieving the desired precision objectives because available budgets have precluded its implementation.

The most representative survey of that design occurred in 2010 when 5 regions were sampled, and therefore we decided results from that year would be informative. We classified the Y-K Delta and Bering Strait-Norton Sound as regions of primary importance and Interior Alaska, Kodiak Archipelago, and Gulf of Alaska-Cook Inlet as regions of secondary importance based on average harvest level. In the Y-K Delta region, estimated precision for most important species generally satisfied the CIP ≤ 50% criterion, as did the estimate for Emperor Goose harvest. The precision for Steller's Eider was moderate in the Y-K Delta (Appendix F). Though the Gulf of Alaska and Bering Strait-Norton Sound regions were surveyed in 2010, regional harvest estimates for individual species were not calculated because of insufficient data (Naves 2012). Precision of harvest estimates for Interior Alaska and the Kodiak Archipelago regions satisfied the 50% CIP criterion for 58% and 44% of the commonly harvested species, respectively. With respect to the desired frequency of sampling regions and communities, it is clear that the intention of sampling ½ the regions in a given year and assuring that communities within regions are surveyed every 4 years has not been achieved.

ADFG identified estimates of egg harvest as their third priority. Furthermore, they acknowledged that it would be difficult to precisely estimate both bird and egg harvest with a single survey. As a result, they relaxed the precision of the egg harvest estimate to CIP < 100%. The precision of the egg harvest estimates met the precision criteria for 93% of the species in the Y-K Delta, 80% of the species in the Gulf of Alaska-Cook Inlet, and 76% of the species in the Bering Strait-Norton Sound but was met for only 20-68% of the species for the rest of the regions (Table 6).

U.S. Fish and Wildlife Service

Our assessment is that the study design as implemented has not achieved the three USFWS survey objectives for two reasons. First, the top priority identified by the USFWS was to produce annual statewide harvest estimates of bird species known to be important to subsistence hunters. Although it is possible to obtain both statewide and regional estimates with the same survey, valid estimates at both scales require that the survey be implemented following a statistically valid protocol at both the regional and statewide level. The main problem with trying to generate statewide annual estimates from the current design is that only a subset of the regions has been sampled annually, and the regions have not been chosen randomly. If regions had been randomly selected within a cluster sampling framework (regions as clusters), extrapolations to statewide estimates would be possible, although the estimates would likely have very poor precision due to large difference in harvest among regions. But in the current design, regions are treated as strata and in any year the majority of strata have not been surveyed. In a given year, it would be possible to generate an estimate for a region that was not surveyed by averaging the estimates from prior years in which the region was surveyed. These averages could then be added to estimates for the surveyed regions to generate a statewide estimate. However, we do not believe this approach would result in reliable annual statewide estimates because it also does not account for large annual variation in harvests. Bird harvest data from the Y-K Delta (1985–2005) (Wentworth 2007) has documented large annual variation in regional harvests (also see section on Trend Estimation). Thus, use of prior years' averages as a substitute for actual annual harvest estimates is inadequate, especially given that some regions have been surveyed only one or two years. Also, if an average was to be used, there are challenges associated with estimating the variance and confidence intervals for the estimates. Use of the average calculated sampling variance from surveyed years would likely severely underestimate the true variance because 1) it assumes that sampling effort (sample size) in a non-surveyed region would be the same as if an actual statewide survey had been conducted, and 2) it does not account for the actual annual variation in harvests.

Secondly, USFWS is concerned about the potential bias in estimates caused by misidentification, recall, and nonresponse errors in the data. Although some amount of error and bias is inherent in any harvest survey, the magnitude of error and biases in the AMBCC survey is unknown. Direct estimation of these types of errors can be attempted by conducting specially designed experimental surveys. Alternatively, or in addition, the focus can be placed on changes in survey protocol, interviewer training, and educational outreach designed to lessen the risks of significant bias and error.

Regarding precision of harvest estimates, our summaries based on the past survey results suggests that precision criteria of CIP ≤ 50% at the regional scale was met 66% of the time for commonly harvested species but only 29% for Species of Conservation Concern. Since no estimates of harvest and precision for statewide estimates are available, we cannot assess this criterion directly.

The USFWS identified estimates of hunter participation and persons/households harvesting and using migratory birds taken for subsistence as their third priority. The current survey was not designed to estimate hunter or household participation and therefore this objective is not met.

DISCUSSION OF SURVEY USES RELATIVE TO STAKEHOLDER JUSTIFICATIONS

Native Caucus

The NC believes that regional estimates are very important to document and protect subsistence uses and to ensure that harvests are sustainable in the long term. The NC also believes regional estimates are critical to maintain the involvement and participation by local communities. The subsistence harvest data have been shared with local communities both in the form of annual reports and in outreach products produced by ADFG, although data are always presented at the regional level. Whether participation and engagement by communities is affected by these outreach products is untested, but our assumption is that they are positively related.

Alaska Department of Fish and Game

ADFG believes that regional harvest estimates are required to adequately assess and respond to possible management actions that should be informed by spatial and temporal harvest patterns while accounting for regional cultural and socio-economic factors. However, they provided no specific examples for how this process has been used since the inception of the AMBCC survey, e.g., a description of how data from a region has been used to inform management actions or address cultural or social issues. Long-term trend data from the Y-K Delta region, which has been surveyed continuously for 8 years, could be used in a more formal context to document emerging regional or subregional trends in harvest amounts and species composition and perhaps compare them to available corresponding indices of species abundance.

We do not dispute the intrinsic value of simply documenting the amount and diversity of the migratory bird and egg harvest. But a more compelling justification for long term regional surveys could be made by directly using these estimates within meaningful management and cultural contexts through formal analyses and management processes.

U.S. Fish and Wildlife Service

The USFWS acknowledges that data are not currently used in any formal regulatory decision process and list 4 reasons: 1) lack of precision, 2) concerns about sources of bias in the estimates, 3) unpredictable timing of availability of estimates, 4) lack of reliable statewide estimates. For most of the commonly harvested species, precision of the harvest estimates at the regional scale is within acceptable limits. However, precision of statewide estimates desired by USFWS is unknown. We agree that there may be legitimate concerns about bias. With respect to the annual timing of available survey results, we suggest that if USFWS proposed an annual species regulation process that would require timely annual statewide harvest estimates, improvements in all phases of the production of final annual reports could be achieved with substantive discussions with all AMBCC partners.

USFWS objectives specify equal precision for both spring-summer and fall-winter seasons. In theory, fall-winter harvests should be documented by the nationwide USFWS HIP survey. However, most subsistence hunters do not purchase duck stamps and therefore are not included in the HIP survey which most likely results in an underestimation of fall-winter subsistence harvests by the HIP. The recent exemption of subsistence users from purchasing duck stamps will likely further reduce the participation of subsistence hunters in the HIP survey. Therefore, we believe it is critical for the AMBCC to continue to conduct fall-winter subsistence harvest surveys.

Several potential uses of harvest survey data by USFWS were given for informing species harvest management and conservation strategies, e.g., estimation of species harvest trends, spatial and temporal distribution of harvest. USFWS also suggested that an annual harvest survey that provides reliable estimates could motivate future development of informed harvest management strategies. However, as they acknowledge, such strategies require several data streams in addition to harvest data, and development of demographic population models and formal decision processes. Development of informed species management strategies requires long-term commitment of significant resources and a high priority designation by migratory bird management community. However, the addition of reliable statewide harvest estimates to current harvest management efforts would represent a valuable contribution. For example, ongoing development of models that support harvest strategies for Brant and Cackling Goose would benefit from incorporation of subsistence and sport harvest estimates, and reliable subsistence harvest estimates will be critical to the recent new initiative for subsistence harvest management of Emperor Goose (E. Taylor, pers. comm.).

ALTERNATIVE SURVEY DESIGNS

This report thus far (1) has described our efforts to clarify survey objectives, priorities, data uses, and justification by the 3 AMBCC partners and (2) has discussed our evaluation of the ability of the current survey design to achieve the objectives articulated by TWG committee members. Our conclusion is that the survey has not achieved many of the objectives identified by the stakeholders. Although the USFWS has used the survey data in a few instances to help inform species management decisions, e.g., Yellow-billed Loon and Emperor Goose, the lack of statewide estimates and data quality concerns have precluded data use in annual formal decision management decision processes. ADFG has acknowledged some concerns with data quality, e.g., memory bias and misidentification. Budget constraints and fluctuating regional priorities have prevented implementation of the intended rotational schedule of regional surveys and adequate sampling effort within some surveyed regions. Therefore, we conclude that it is necessary to achieve consensus among all stakeholders on specific priority objectives of the survey moving forward and to modify attributes of the current harvest survey design and perhaps data collection protocols accordingly.

In this section of our report, we provide brief descriptions of 3 alternative designs for consideration. These designs are based on 1) TWG member input about desired survey objectives and associated justifications (rounds of structured questions submitted to the 3 AMBCC components), 2) analyses we have conducted thus far, and 3) the many helpful discussions we have had with individuals during our four visits to Alaska in the past year and during innumerous teleconference meetings and email communications. Although we do not have precise knowledge of the future survey budget, we believe that even under the most optimistic budget predictions, it will not be possible for the survey to achieve all stakeholders' objectives. Therefore tradeoffs will be necessary. Our philosophy is to develop alternative designs that attempt to capture different sets of priorities and tradeoffs, so the most informed decisions can ultimately be made about the future of the survey. Our intent here is to provide sufficient detail to foster discussion and recommendations that will then guide further statistical and cost analysis required for a more informed comparison among design alternatives.

Design I. All Regions Statewide Survey Design

The critical feature of this design is that all regions are sampled every year. Regions are considered as strata, and because all strata receive some sampling effort, estimation of statewide harvest is straightforward. Sampling effort in each region would likely be proportional to some measure of the harvest of species of most common importance, but we expect that overall sampling effort within a region would be substantially reduced from the current effort allocated to a sampled region in a given year. This reduced regional effort is a result of the fact that the desired precision criterion is specified at the state scale, not the regional scale. Valid regional estimates will still be available, but the tradeoff is that they will have less precision than the statewide estimate. We would expect that random selection of households would be preceded by random selection of subregions and villages, but informed specification of sampling effort at each stage will require consideration of both relative cost and variation among sampling units.

We believe an important criterion in comparison of alternative designs is their relative robustness to changes in overall survey effort and/or in the scheme for allocating sampling effort among regions. For example, we might expect some degree of budget fluctuation from year to year, which in turn will affect sample sizes. In the statewide design, as long as every household has some chance of being included in the sample, no matter how small the sample is, the estimates will still be valid. However, the smaller the sample, the less precise the estimates will be. As another example of design robustness, consider a scenario in which a special concern about the harvest of a species or group of species has arisen in a specific region, and there is consensus that better information is required. A purposeful reallocation of additional effort to the region where this species occurs is easily accommodated, with the tradeoff that reduced sampling effort in other regions will result in less precise estimates.

Design II. Priority Regions Only Survey Design

Regions differ substantially in their average bird and egg harvest amounts and composition of species in the harvest. In this design, criteria would be developed by stakeholders to rank the overall importance of each region's contribution to the survey and then use this ranking to decide on a subset of regions that would be sampled annually. Regions that are not in this subset would not be included in the survey design. This design is motivated by the potential cost-saving option of completely eliminating a set of regions from the survey and using a design similar to Design I for the included regions. The relative cost advantage of this design can be compared to the other designs, but the potential disadvantages of Design II are more difficult to predict. Because the households in the eliminated regions have no chance to be sampled, the harvest estimates would have to be considered as indices of the statewide harvest. As with any index, inferences about temporal changes in harvest would depend on the assumption that the proportion of the statewide harvest represented by the non-surveyed regions remains constant over time. Thus, there is a risk that index estimates could be confounded by future shifts in spatial distribution and composition of the harvest. Also, the loss of outreach, education, and employment opportunities, and lack of harvest documentation in the non-surveyed regions could lead to reduced engagement, support, and cooperation in the migratory bird subsistence harvest co-management process.

Design III. Mixed Priority Statewide Survey Design

This design is similar to that developed in 2008–2009 survey review (Naves 2012) in which high priority regions (Y-K Delta and North Slope) were to be sampled every year and the remaining regions were divided into 2 subsets to be sampled according to a pre-defined annual rotation schedule. We can characterize such a design as having 2 components (strata: 1) regions sampled every year and 2) regions sampled less frequently. In any given year, we would sample all regions in Stratum 1 but only a subset of regions in Stratum 2. With the assumption that the subset of sampled regions in Stratum 2 could be considered representative of all the regions in Stratum 2, valid statewide estimates can be obtained.

Given the set of survey objectives provided to us by TWG members, an initial version of this design would identify 2 or 3 regions of highest priority to be sampled every year (Stratum 1), and the remaining regions (Stratum 2) would be divided into 2–3 clusters to be sampled every second or third year. Regions would be assigned to clusters so that each cluster would be as representative as possible of the entire Stratum 2. Households in each sampled region in a given year would be selected from randomly chosen subregions and villages, similar to the All Region Design.

Allocation of sampling effort to strata and regions would depend on pre-defined priorities. For example, it might be decided that harvest estimates for regions in Stratum 1 should achieve a relatively high level of desired precision and that Stratum 2 regional estimates would necessarily have lower desired precision. Therefore, precision of statewide estimates derived from combining both strata would be a consequence of sample size decisions at the regional scale. Alternatively, if desired precision of statewide estimates was the priority, then the design challenge would be to find the most statistically cost efficient allocation of sampling effort to strata and regions.

An advantage of this design is that it assures sampling of a small set of the highest priority regions every year, most likely at a relatively high sampling rate, and also samples lower priority regions with acceptable frequency. A disadvantage of this design is that it is less robust to changing monitoring priorities and fluctuating budgets because each region is assigned to a fixed stratum and each region in Stratum 2 is assigned to a fixed cluster. Compared to the All Region Design, the Mixed Priority Design cannot accommodate adjustments in assignment of regions to strata and clusters and therefore it requires a higher degree of long-term stability of institutional policies, funding, and management priorities.

SPECIAL STUDIES

The USFWS has identified data quality issues as an impediment to use of the subsistence harvest survey data in management decisions. There are generally two approaches that can be used to reduce the impact of errors and biases on reliability of the estimates: 1) data collection protocols can be adjusted to try to minimize the frequency and magnitude of errors/biases or, 2) special studies can be designed to estimate errors/biases and adjust estimates as necessary. A previous review of the harvest survey (Naves et al. 2008) identified some of these same data quality issues and some adjustments to the survey protocol were then made to reduce potential bias. If the survey is redesigned, further changes to the protocol may be considered for reducing potentially significant data errors/biases. As a complement to this approach, we provide descriptions of several special studies that may be used to quantify and adjust for errors/biases in the harvest estimates.

Sensitive Questions for Special Status Species

The randomized response design has most often been used to estimate the proportion of a target population that has engaged in illegal or unethical social behavior (e.g., illegal drug use, shoplifting, cheating on a test), but we will use an example from the wildlife literature for illustration. Solomon et al. (2007) surveyed 2 communities near a national park in Uganda to evaluate the utility of the design to estimate prevalence of illegal harvest in the park. Survey respondents were first asked to flip a coin and note which side landed up. The interviewer could not see the coin and was not told the result. Then the interviewer placed 2 photos in a bag; one photo depicted a hunter with an illegal, dead animal and the other photo depicted the head side of a coin. The respondent was then given the bag and asked to reach in and get a photo without looking into the bag. Again, the interviewer could not see which photo was chosen. If the individual got the coin photo, he was asked to respond 'yes' if his coin landed on heads and 'no' if it was tails. If he got the illegal hunting photo, he was asked to respond 'yes' if he had engaged in illegal hunting, and 'no' otherwise. The only data collected by the surveyor is the "yes/no" answer of the individual, and the only statistic reported from the survey is the proportion of 'yes' answers. This statistic, together with the known probabilities of a getting a 'heads' in the coin flipping (50) and of getting the illegal hunt photo from the bag (50), can be used to produce an unbiased estimate of the true proportion of the population that engaged in illegal hunting. In this particular study, the investigators conducted a parallel survey in which the respondents were asked directly about illegal hunting. This survey estimated that 2% of the population had engaged in illegal hunting, compared to 39% in the randomized response survey.

More sophisticated applications of the randomized response method are possible, but they involve increasingly complicated protocols. For this design to be successful, the interviewer must be able to communicate very effectively, be skilled in conducting the necessary steps in the process, and be able to gain the trust of the respondent in assuring him that no tricks are involved and that his response is essentially anonymous. The technique also assumes the hunters are aware they harvested a closed species. A special survey designed to estimate the take of species of conservation concern will require adequate investment in interviewer training, as this will be key to the success to the survey, but we suggest that the technique may be a feasible choice for gaining reliable information about sensitive subsistence harvest behavior.

Memory/Recall Error

We suggest consideration of a special study to evaluate the magnitude of memory bias by comparing harvest data from 2 randomly selected samples of households. Harvest data from the 'control' sample would be collected using the standard AMBCC survey in-person interview protocol and data from the 'experimental' sample would be collected from hunting diaries maintained by household members during the harvest season. Success of the study depends on the participation of a sufficiently large number of households that agree to maintain a diary. Prior experience with calendar harvest surveys in Alaska suggests that necessary sample size will be difficult to achieve (J. Fall; ADFG; pers. comm.). We therefore suggest use of a reward incentive to increase participation by households in the experimental sample. After completion and return of the diary at the end of the harvest season, all participating households could be awarded an incentive or perhaps become eligible for a raffle drawing. Private corporations have used incentives to increase participation in surveys conducted in the North Slope of Alaska, and ADFG has also provided incentives in surveys of fishermen (J. Fall; ADFG; pers. comm.). The type and value of the incentive would require further discussion and potential funding and legal issues would also need to be assessed. Our thought at this point is to not consider expending state or federal resources on incentives, but rather to explore the possibility of recruiting corporate sponsors that would provide incentives in the form of gift certificates for hunting/fishing gear. If such a study suggested an important effect of memory bias on harvest estimates, then it might be prudent to 1) replicate the study in an additional year and/or community so robust data can be obtained for application of correction factors to standard survey estimates, or 2) incorporate use of diaries as a regular component of a standard survey protocol.

Nonresponse error/Household participation rates

To assess non-response bias, we recommend two special studies that can be done at little or no additional cost to the survey program. Results from these studies would serve to guide future decisions about the need for further investigation into nonresponse bias.

Nonresponse Study I

In large villages, the current AMBCC survey involves pre-stratification of households into 'harvester' and 'non-harvester' categories based on past hunting activities of individual households, as determined by the surveyor and other local knowledgeable people. The first study would compare past participation rates of individuals in the 2 categories after the completion of the hunting season (L. Naves; ADFG; pers. comm.) to see if pre-assigned 'harvesters' were actually more likely to have participated in the past compared to 'non-harvesters'. Misclassification rates of households into harvest strata that consistently approach 50 or greater would bring into question the cost efficiency of the stratification exercise.

Surveyors and other knowledgeable local people do not always know past or current harvest activities of all households in a village, and therefore pre-stratification at the beginning of the season does not guarantee that, in the months ahead, that households will behave as predicted, e.g., harvester households may eventually not harvest birds if their boat or other gear is broken; if the hunter moves out of the house; if harvesters do not have time to go hunting birds; or if they go hunting, they are successful in harvesting birds (L. Naves, ADFG; pers. comm). An assessment of the available data should ensure representation of communities of different sizes in the potential sample. Alaska subsistence communities vary in size from a few to a few thousand households. The current survey methods call for harvest-level stratification in all communities with 60 or more households. For villages with less than 60 households, sometimes surveyors provide stratification information even if all or most households are surveyed.

Nonresponse Study II

This study requires modification of the current survey protocol. Once a village is selected to be surveyed and a household list (sampling frame) has been developed, a completely random sample of households is selected. The surveyor then visits every selected household and begins the interview by asking 3 questions: 1) "Did your household harvest none, some, or a lot of birds/eggs last year?" 2) "If you were asked to participate in the survey last year, did you agree?", and 3) "Are you willing to participate in the survey this year?" Although the order, exact wording, and descriptions of categories of take will require careful thought, these questions would provide insight into differences between this year's participants and non-participants with respect to last year's hunting success and participation status. A critical assumption in this study is that all households will be willing to answer the initial questions.

Crippling Loss

Field studies can be conducted to directly understand and estimate crippling loss. The two primary field study methods involve (a) the marking birds with use of transmitters to track the fate of individual birds and (b) the use of a hidden blind from where an observer records the outcome of hunter activity (e.g., number of shots, number of hits, number of wounded birds not retrieved). Studies using these methods are usually conducted at a small scale and can be expensive. Hidden blind studies are usually carried out in places of a high concentration of hunters. Crippling loss rates may vary depending on hunting technique and conditions (e.g., eider hunt over ice or open water, hunt from a blind, from a boat while traveling, or by jump shooting; with or without a retriever dog). Therefore generalization of results from small-scale studies to the entire population of hunters and a large diversity of bird species/species groups harvested for subsistence can be questionable. Field studies conducted at an appropriate scale to cover a diversity of subsistence hunting techniques, conditions, and species would be costly but would address a potentially large source of bias in harvest-related mortality.

Indirect information on crippling loss can also be obtained as part of harvest surveys. The HIP survey asks questions about the amount of crippling loss. Likewise, questions about birds wounded but not retrieved could be included in the AMBCC survey. The wording of such questions would require careful consideration because of the potentially sensitive nature of these questions. These questions would generate information similar to that obtained from the HIP survey.

Another option would be to conduct an in-depth literature review and assess whether available information on crippling loss could be reasonably integrated as a correction factor in calculations of harvest estimates for the AMBCC survey. In harvest management and population models, wounding loss is typically considered to be 20% of the total duck kill (Anderson and Burham 1976, Johnson 1971). Although incorporating a constant correction factor is common practice, crippling loss rate probably varies by species, season, and year. For instance, crippling loss rates are usually higher in sea ducks (20–

40%) as compared to other waterfowl. Whether acceptable correction factors could be agreed upon is unknown.

Misidentification

Issues with misidentification of particular species in specific areas are best addressed with focused studies. The study of loon harvest on St. Lawrence Island is a good example of how this approach can address specific species identification issues (Naves and Zeller 2013). The more general problem of misidentification of species on the harvest survey, however, could be addressed by employing an alternative method of identifying birds that are harvested. A random subset of households could be selected to provide additional information on the species harvested. Most native hunters are averse to sending body parts (parts survey) to biologists for identification as is done in the HIP survey but this possibility has not been fully discussed with the NC. It is possible that an incentive, similar to the approach suggested for encouraging hunters to fill out hunting logs, could be used to increase participation in the parts survey. The advantage of using wing and tail feathers is that in addition to species, the sex and age of the bird can often be identified. Estimates of the sex and age of the birds that are harvested can inform decisions about harvest management.

If a parts survey is deemed to be culturally inappropriate, a different method of species identification is needed. One approach would be to ask a subset of hunters to submit pictures of the birds they harvested. If a hunter did not have a camera, cameras could be provided. In order for hunters to feel comfortable, it would be essential that the identity of the individual remains confidential. This approach would require purchasing of some cameras and time for biologists to review the pictures that are received which could add significant cost to the survey. Another approach would be to ask a random subset of households to provide 3-4 body feathers from each bird that they harvest and use genetic methods to identify samples to species. This would have the advantage of providing greater anonymity but costs approximately $40.00/sample and, depending on the sample size, could add significant costs to the survey.

Recommendations

Our initial thoughts are that memory or recall error and misidentification should receive the highest priority. In addition, nonresponse error might be addressed inexpensively by adding additional questions to the data collection protocol.

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APPENDIX A. MEMBERS OF ALASKA SUBSISTENCE HARVEST SURVEY TECHNICAL WORKING GROUP

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APPENDIX B. DRAFT PROGRESS REPORT I

Review and Revision of the Alaska Migratory Bird Co-Management Council Subsistence Harvest Survey

Progress Report I

Summary of Subsistence Harvest Survey Technical Working Group Comments and Proposal for Initial Review of Survey Performance

(DRAFT FOR REVIEW ONLY)

13 January 2015

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EXECUTIVE SUMMARY

Based on the responses to our questions about the survey objectives from the subsistence harvest survey Technical Working Group (TWG) we propose the following approach as a first step in our harvest survey review. We provide additional justification for our approach in the summaries of the responses to each question.

- We will evaluate harvest survey performance at the regional scale for all regions and at the subregional scale for the Yukon-Kuskokwin Delta. We will not examine survey performance at the statewide scale. We believe that valid statewide estimates are only possible if all regions are surveyed in the same year, and this has not been the case in any year since the AMBCC was initiated.
- We will evaluate harvest estimate reliability for species groups that are commonly harvested (geese, ducks, and seabirds), species that are most important as subsistence resources, species that are harvested in large numbers relative to their population sizes in Alaska, and species of conservation concern that are harvested in significant numbers (Table 1). Reliability will be measured by statistical precision. Estimates will be evaluated for each year since 2003 and will also be summarized across years.
- We will conduct a 'best-case' trend analysis to inform stakeholders about the precision and sensitivity of species-specific regional trend estimates derived from the current survey design.
- We will consult with the Native Caucus TWG members about how we can appropriately evaluate the importance of the harvest survey for community outreach and education and maintenance of cultural traditions.

Introduction

In July 2014, T. Luke George, David Otis, and Paul Doherty from Colorado State University were awarded a contract from the United States Fish and Wildlife Service to (USFWS) to review the Alaska Migratory Bird Subsistence Harvest Survey (hereafter, harvest survey). A Technical Working Group (TWG) of individuals from the Alaska Migratory Bird Co-management Council (AMBCC) Native Caucus (NC), Alaska Department of Fish and Game (ADFG) and the USFWS was formed in August and met for the first time in Anchorage, Alaska on 22 September 2014. All members had experience with the development, implementation, analysis and use of the harvest survey. The TWG was established to provide guidance for the survey harvest review and to facilitate communication with the AMBCC. At this meeting it was decided that we would follow up on our discussion by asking TWG members to respond to several questions related to key attributes of the survey design and objectives. In addition, we would ask each TWG member to provide citations of reports, publications, and any additional documentation of uses of the harvest survey data. This report provides a summary of the responses to those questions, a compilation of documented uses of the survey, and our recommendations for initial analyses in the review of the harvest survey.

Summary of Responses

We received individual responses from three TWG members (Mike Pederson, Molly Chythlook, and Dan Rosenberg), a combined response from two members of ADFG (James Fall and Liliana Naves) and a collective response from the USFWS (Eric Taylor, Ted Swem, Richard Lanctot, Khristi Wilkins, and Todd Sanders).

Question 1. What scale (village, subregion, region, state) is it most and least important to have reliable estimates in order to achieve the survey goals of sustaining harvest traditions and bird populations?

At least one of the responses ranked each scale as the highest priority. Both Molly Chythlook and Mike Pederson identified regional estimates as the highest priority. Dan Rosenberg suggested that for regions with the most abundant bird populations and highest harvest, subregional estimates would be of highest priority, and that in regions with relatively small harvest, regional estimates would be sufficient. James Fall and Liliana Naves suggested that statewide estimates were desirable because they could be integrated into the national Harvest Information Program (HIP) estimates and provide information relevant to the Flyway councils. They also stated that at estimates at a level below the state (region or subregion) are needed to respond appropriately to state management issues at a meaningful scale. The USFWS identified statewide estimates as the highest priority followed by regional, and subregional estimates.

Most of the respondents provided additional thoughts on the appropriate scale of analysis. Mike Pederson stated that the Harvest Survey Committee of the AMBCC opposes releasing harvest survey information at the village level. The USFWS pointed out that finer scales of resolution (region or subregion) may be more useful for regulatory decision making but that an assessment of costs relative to a gain in spatial resolution would be needed. They also noted that harvest estimates should achieve a specified level of precision (less than 25 coefficient of variation) to be useful for informing management decisions. Finally, they noted that harvest estimates at the region or subregion level may allow harvest estimates to be used in management of specific bird species or populations of special concern (e.g. cackling goose, white-fronted goose). In addition to the points made by the USFWS, James Fall and Liliana Naves stated that reliable harvest information below the state level was important for a variety of reasons including: 1) reducing problems with species identification, 2) providing a better assessment of spring harvest (which may have greater effects on populations than summer or fall harvest), 3) allowing analysis of harvest relative to Alaska's geographic and cultural traditions, 4) providing information that is meaningful to subsistence users, 5) accounting for differences in response rate among regions, 6) prioritizing survey effort to address evolving management issues, and 7) allowing continuity with long-term surveys in particular regions (e.g. the Yukon-Kuskokwim Delta).

We propose to summarize harvest data at the regional level and at the subregional level for the Yukon-Kuskokwin Delta. Reliability of harvest estimates will be summarized by year and across years (see Methods section). We will not examine harvest at the statewide level. We believe that statewide estimates are problematical because survey data have never been collected at the statewide level in any year and high year-to-year and regional variation makes averaging across years very questionable.

<u>Question 2. For which species or species groups (for example, most harvested, most common, species of conservation concern, culturally significant) is it most and least important to have reliable estimates?</u>

Most respondents stated that species that have traditionally been harvested for subsistence should receive the highest priority. Dan Rosenberg suggested that the most commonly harvested species in each region or subregion should receive priority, including species that have been harvested in the past but are now closed to hunting (emperor goose and spectacled eider). The USFWS suggested that groups of species (e.g. geese, ducks, swans, waterbirds, shorebirds, seabirds, cranes, and owls) and species or populations of greatest importance to subsistence harvest should receive priority. It was their opinion, however, that reliable estimates of harvest cannot be achieved at finer taxonomic scales (e.g., species and populations). James Fall and Liliana Naves identified three groups of species that should receive highest priority: 1) species that are most important as subsistence resources, 2) species harvested in large numbers relative to their population size in Alaska, and 3) species of conservation concern.

We will analyze harvest data for individual species in the categories identified by James Fall and Liliana Naves as highest priority based on the 2011 review of harvest and population data (Table 1). We will also evaluate harvest survey performance for commonly harvested species groups, i.e., geese, ducks, and seabirds. The number of birds harvested in the other groups identified by the USFWS are either included in other groups (waterbirds) or are harvested in such low numbers that reliable estimates cannot be obtained (cranes and owls).

Table 1. High priority species in the evaluation of current survey performance. Note that some species occur in more than one category.

Harvest Category	Species or species group
Important subsistence resources (> 2 of subsistence harvest)	White-fronted Goose, Mallard, Northern Pintail, Canada/Cackling Goose, King Eider, Brant, Black Scoter, Scaup, Snow Goose, American Wigeon, Murres, White-winged Scoter, Teal, Goldeneyes, and Auklets
Large proportion (>5) of estimated Alaska breeding population harvested by subsistence users.	Canvasback, Brant, Black Scoter, Long-tailed Duck, Surf Scoter, Pelagic Cormorant, and Mallard
Large proportion (>5) of estimated Alaska breeding population harvested by subsistence users. Harvest during fall and winter includes birds from other regions (mixed populations).	King Eider, Steller's Eider, Common Eider
Species of conservation concern that are harvested in significant numbers	Black Scoter, Common Eider, King Eider, Brant, Emperor Goose

Question 3. How important is it to have reliable estimates of annual trend in harvest (very, not very, don't care)?

In general, responses from all stakeholders did not suggest a strong interest in an increased emphasis on harvest trend estimates. USFWS and ADFG were skeptical that the survey could realistically be expected to produce trend estimates that would be sufficiently reliable for use in management strategies. ADFG suggested that harvest trend data could be useful in specific management contexts in which complementary population abundance and distribution data are available, e.g., Cackling Canada geese in the Yukon-Kuskokwim Delta region. ADFG also pointed out that language associated with the MBTA amendment stipulated that the subsistence harvest should not result in significant increases in species harvest relative to their continental population abundance. As previously mentioned, for the majority of regions and the large majority of species, it is unrealistic to expect that reliable trend estimates could be obtained from the current or any foreseeable future survey design. However, there was some interest expressed by USFWS and ADFG in the potential tradeoffs and cost effectiveness of a survey design that focuses on trend estimates for specific species at a regional scale. We propose to conduct a trend analysis that would inform stakeholders about the precision and sensitivity of species-specific regional trend estimates derived from the current survey design.

Question 4. Please provide documentation (for example, meeting notes, published reports, management plans, websites) of how survey data have been used to make management decisions in support of conservation of bird populations and harvest traditions.

Native Caucus

Survey data have been provided to regional management bodies for review since the inception of the AMBCC harvest survey. In addition, representatives from ADFG and the USFWS often attended regional harvest meetings to share the results of harvest survey.

Alaska Department of Fish and Game

The survey process and resulting harvest data represent a tangible and fundamental communication link between the subsistence harvest community and the agencies responsible for subsistence harvest management. Formal estimation of the magnitude of the harvest of birds and eggs serves to document the cultural and economic importance of the resource and also provides for educational and outreach opportunities in rural communities.

The State of Alaska is a member of the Pacific Flyway (PF) and is formally represented by a staff member (Dan Rosenberg) on their Study Committee. State representatives provide technical information to PF managers on issues of harvest management and regulations and related issues. Subsistence harvest data are routinely submitted during the annual regulation process and are often cited in specific species management plans (see USFWS summary for additional information).

An extensive listing of ADFG reports, publications and cited references is provided in Appendix A.

U.S. Fish and Wildlife Service

The 2013 Supplemental Environmental Impact Statement on the Issuance of Annual Regulations Permitting the Hunting of Migratory Birds includes a specific component for the Alaska subsistence harvest. Survey statistics are used extensively in the discussion/evaluation of this activity. In particular, the magnitude of individual species subsistence harvest is cited within the context of the total harvest that occurs during the fall sport harvest season. It is noted that Alaska fall season harvest estimates are included in the total harvest estimates reported in the national Harvest Information Program survey.

Most Pacific Flyway management plans for species subjected to both subsistence and sport harvest include survey estimates, but none incorporate these estimates into a formal regulatory decision process. The three primary reasons given for this exclusion are: 1) lack of statistical precision of the estimates, 2) concerns about potential sources of bias in the estimates, 3) adoption of management plans prior to the implementation of the AMBCC survey.

An Environmental Assessment (EA) of the proposed regulatory action governing the subsistence harvest is produced annually. The primary focus of the EA is waterfowl because ducks and geese constitute the large majority of the harvest. The discussion of Alaska subsistence harvest socioeconomics includes statistics about numbers of harvest participants and waterfowl species harvest, but these estimates are taken from surveys conducted prior to the initiation of the AMBCC survey. The 2015 EA section on endangered species does include harvest information taken from 2010-2013 AMBCC surveys of Steller's Eider, Spectacled Eider, and Yellow-billed Loon.

An annual Biological Opinion (BO) on the effects of proposed subsistence harvest regulations on endangered species is required in accordance with Section 7 of the Endangered Species Act. Reviewed species are Steller's Eider, Spectacled Eider and Yellow-billed Loon. AMBCC surveys are one of several cited harvest survey efforts. The BO repeatedly expresses significant concerns about unmeasurable bias of survey estimates for all 3 species due to myriad combinations of misidentification, reporting, measurement and recall errors, as well as some concern about sample household selection bias. Lack of statistical precision of harvest estimates and trends is assumed due to a combination of both sampling error and actual inter-annual variation in species abundance and hunter effort and no estimates of precision are provided. Ultimately, the harvest estimates are used somewhat qualitatively, i.e., in terms of orders of magnitude, and within the context of both species population surveys of abundance, trend, and distribution, and additional socioeconomic factors, to formulate the final biological opinion.

An extensive listing of USFWS reports, publications and cited references is provided in Appendix A.

Analysis Methods

Annual harvest estimates and coefficients of variation (CV) for each region and species or species group will be compiled from existing AMBCC harvest survey reports. We will examine the distribution of the CVs and create a small number of cutpoints that define categories of relative precision. To provide a quick visual summary of the data, summary table cells will be coded by category. We will examine the reliability of estimates for each species or species group across years by averaging the CV across years and assigning the appropriate category.

The intent of the trend analysis is to partition harvest estimate variance into independent estimates of true annual variation in harvest and sample survey variation, and to then explore how different levels of survey effort are related to the power of the survey to detect temporal changes in species harvest. In consultation with ADFG staff, we expect the best case dataset will be from Yukon-Kuskokwim Delta, which was surveyed for 8 consecutive years (2004-2011). Our intention is to conduct the analysis on 2 species that traditionally are harvested in relatively large numbers. One species would be expected to be harvested throughout a large proportion of the region (e.g., white-fronted goose) and the other would have a more spatially localized harvest (e.g., black scoter). Similarly, we intend to repeat the analysis on 2 species that traditionally are harvested in relatively small numbers. One species would be expected to be harvested throughout a large proportion of the region (e.g., merganser) and the other would have a more spatially localized harvest (e.g., godwit).

Discussion Points

1) We acknowledge that the proposed analysis described herein does not address concerns about the bias of harvest estimates due to factors such as recall bias, misidentification, missing values, etc. We anticipate that these concerns will be addressed in a subsequent stage of our survey evaluation.
2) The report will include our perspectives on survey performance within the context of potential uses of survey data in harvest regulation management, conservation monitoring, and cultural communication. Our perspectives will be informed by previous experience with wildlife agency harvest surveys and interactions to date with the AMBCC and TWG.
3) We understand that the majority of the cost of the survey is devoted to transportation of surveyors to selected communities and households and that there is relatively small cost in collection of harvest data on individual species. Therefore we emphasize that results of our evaluation may impact the distribution of survey effort among regions and communities but not the species that have been traditionally surveyed in each region.

Appendix A. ADFG Response to Question 4 (Documented Use of Survey Data)

Alaska Migratory Bird Subsistence Harvest: Harvest Data Available and their Uses

Table of Contents

1. Alaska Bird Subsistence Harvest Data

Note: includes only studies specifically conducted to assess harvest of birds and eggs (does not include bird data collected in surveys addressing all subsistence resources).

1.1 Goose Management Plan, MBTA Amendment, Development of Harvest Regulations, and Transition to AMBCC Harvest Survey Program (1980–2002)

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Stoval, R. (2000) Subsistence migratory bird harvest survey report for the kodiak island villages 1999-2000. Kodiak National Wildlife Refuge. Unpublished report. Harvest estimates revised 2003.

Webb, D.D. (1999) Subsistence waterfowl harvest survey Galena, Huslia, Nulato, Koyukuk, Kaltag, Hughes, Ruby, 1998. Koyukuk-Nowitna National Wildlife Refuge Complex. U.S. Fish and Wildlife Service, Galena.

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1.2 AMBCC Harvest Survey Program (2004–Present)

1.2.1 AMBCC Annual Harvest Reports

Naves, L.C. (2010a) Alaska migratory bird subsistence harvest estimates, 2004–2007. Alaska Migratory Bird Co-Management Council. Alaska Department of Fish and Game Division of Subsistence Technical Paper 349, Anchorage, USA.

Naves, L.C. (2010b) Alaska migratory bird subsistence harvest estimates, 2008, Alaska Migratory Bird Co-Management Council. Alaska Department of Fish and Game Division of Subsistence, Technical Paper No. 353, Anchorage.

Naves, L.C. (2011) Alaska migratory bird subsistence harvest estimates, 2009, Alaska Migratory Bird Co-Management Council. Technical Paper No. 364. Alaska Department of Fish and Game, Division of Subsistence, Anchorage.

Naves, L.C. (2012) Alaska migratory bird subsistence harvest estimates, 2010. Alaska Migratory Bird Co-Management Council. Alaska Department of Fish and Game Division of Subsistence, Technical Paper 376, Anchorage, USA.

Naves, L.C. (2014a) Alaska subsistence harvests of birds and eggs, 2011. Alaska Migratory Bird Co-Management Council. Technical Paper No. 395. Alaska Department of Fish and Game, Division of Subsistence, Anchorage.

Naves, L.C. (2014b) Alaska subsistence harvest of birds and eggs, 2012. Alaska Migratory Bird Co-Management Council. Technical Paper No. 397. Alaska Department of Fish and Game, Division of Subsistence, Anchorage.

Naves, L.C. (in preparation, pending adoption of harvest estimates). Alaska subsistence harvest of birds and eggs, 2013. Alaska Migratory Bird Co-Management Council. Technical Paper No. NNN. Alaska Department of Fish and Game, Division of Subsistence, Anchorage.

1.2.2 AMBCC Special Projects

Naves, L.C. and T.K. Zeller (2013) Saint Lawrence Island subsistence harvest of birds and eggs, 2011–2012, addressing yellow-billed loon conservation concerns. Alaska Migratory Bird Co-Management Council. Alaska Department of Fish and Game Division of Subsistence Technical Paper 384, Anchorage.

Naves, L.C. (2014c) Subsistence harvest of birds and eggs, Gambell and Savoonga 2002–2010. Alaska Migratory Bird Co-Management Council. Alaska Department of Fish and Game Division of Subsistence, Technical Paper 395, Anchorage, USA.

Rothe T.C., Padding P.I., Naves L.C., and Robertson G.J. (In Press) Harvest of sea ducks in North America: a contemporary summary. pp. 369–415 *in* Savard J.-P.L, Derksen D.V., Esler D., and Eadie J.M. (editors). Ecology and conservation of North American sea ducks. Studies in Avian Biology, Sandercock B.K. (series editor). CRC Press.

1.2.3 AMBCC Harvest Data Outreach and Communication

(2011) AMBCC Survey Resultus Overview: Yukon-Kuskokwim Delta Region, 2004–2009.

(2011) AMBCC Survey Resultus Overview: Bristol Bay Region, 2004–2009.

(2011) AMBCC Survey Resultus Overview: Interior Alaska Region, 2004–2009.

(2014) AMBCC Survey Resultus Overview: Kotzebue, 2012.

(2014) AMBCC Survey Resultus Overview: Cordova (draft), 2014.

1.3 Other Research Conducted by or Commissioned by USFWS Migratory Bird Management

Huntington, H. (2009a) Documentation of subsistence harvest of spectacled eiders and Steller's eiders in western and northern Alaska: a literature review.

Huntington, H. (2009b) Documentation of subsistence harvest of yellow-billed loons in western and northern Alaska.

Omelak, J. (2009) Subsistence uses of yellow-billed loons on St. Lawrence Island. Draft report. Kawerak Natural Resources Subsistence Program.

Zeller, T.K., D.M. Marks, L.H. DeCicco, E.A. Labunski (2011) Loon harvest study St. Lawrence Island, Alaska, 2010. U.S. Fish and Wildlife Service Division of Migratory Bird Management, Anchorage, Alaska, USA.

2. Uses of Harvest Data

2.1 Information Provided to the Pacific Flyway

Fischer, J.B. (2009) Midcontinent greater white-fronted geese in Alaska, 2008 project updates. Unpubl. U.S. Fish and Wildlife Service, Migratory Bird Management, Anchorage.

Marks. D. and Fischer, J.B. (2012) Alaska midcontinent greater white-fronted geese, project updates, 2011–2012 field seasons. U.S. Fish and Wildlife Service, Migratory Bird Management, Anchorage.

Marks. D. and Fischer, J.B. (2013) Midcontinent greater white-fronted geese in Alaska: annual summary of monitoring and research. U.S. Fish and Wildlife Service, Migratory Bird Management, Anchorage.

2.2 Uses Related to the Authorization of the Alaska Spring-Summer Subsistence Hunt

2.2.1 Annual ESA Section 7 Consultation

Note: The Biological Opinions are annual requirement and have been produced since 2004. Ted Sweim (TWG) would be able to provide more info on requirements related to ESA Section 7. This list likely miss some years.

U.S. Fish and Wildlife Service (2009) Biological opinion for 2009 Alaska migratory bird subsistence harvest. U.S. Fish and Wildlife Service, Alaska region. Memorandum 6 April 2009 from the Assistant Regional Director, Fisheries and Ecological Services, Alaska Region to the Assistant Regional Director, Migratory Birds and State Programs, Alaska Region. 36 pp.

U.S. Fish and Wildlife Service (2010a) Intra-agency conference for proposed 2010 Alaska migratory bird spring-summer subsistence hunt, candidate species: yellow-billed loon (*Gavia adamsi*) and Kittlitz's murrelet (*Brachyramphus brevirostris*). U.S. Fish and Wildlife Service, Migratory Bird Management, Anchorage, Alaska, USA.

U.S. Fish and Wildlife Service (2010b) Intra-agency biological assessment for proposed 2010 Alaska migratory bird spring/summer subsistence hunt for threatened species spectacled eider (*Somateria fischeri*) and Steller's eider (*Polysticta stelleri*). Unpublished report by the U.S. Fish and Wildlife Service, Migratory Bird Management, Anchorage. Signed 19 March 2010 and submitted to the Fairbanks Fish and Wildlife Field Office, Endangered Species Branch. 86 pp.

U.S. Fish and Wildlife Service (2010c) Intra-agency biological opinion for managing migratory bird subsistence hunting in Alaska: hunting regulations for the 2010 spring/summer harvest. Consultation with the U.S. Fish and Wildlife Service, Migratory Birds, Anchorage. Prepared by U.S. Fish and Wildlife Service, Fish and Wildlife Field Office, Fairbanks.

U.S. Fish and Wildlife Service (2011) Intra-Service biological opinion for managing migratory bird subsistence hunting in Alaska: hunting regulations for the 2011 spring/summer harvest. Consultation with the U.S. Fish and Wildlife Service, Migratory Bird Management, Anchorage. Prepared by U.S. Fish and Wildlife Service, Fish and Wildlife Field Office, Fairbanks.

U.S. Fish and Wildlife Service (2012) Intra-Service biological opinion for hunting regulations for the 2012 spring/summer harvest. Consultation with the U.S. Fish and Wildlife Service, Migratory Bird Management, Anchorage. Prepared by U.S. Fish and Wildlife Service, Fish and Wildlife Field Office, Fairbanks.

U.S. Fish and Wildlife Service (2014) Intra-Service biological opinion for hunting regulations for the 2014 spring/summer harvest. Consultation with the U.S. Fish and Wildlife Service, Migratory Bird Management, Anchorage. Prepared by U.S. Fish and Wildlife Service, Fish and Wildlife Field Office, Fairbanks.

2.2.2 Environmental Assessment

The Environemtnal Assessment is an annual requirement and have been produced since 2004 based on the harvest information available.

U.S. Fish and Wildlife Service (1980) Final environmental assessment, subsistence hunting of migratory birds in Alaska and Canada [Amendment of Migratory Bird Treaties]. U.S. Fish and Wildlife Service, Anchorage.

U.S. Fish and Wildlife Service (2012) Enviromental assessment: managing migratory bird subsistence hunting in Alaska, hunting regulations for the 2013 spring-summer harvest. U.S. Fish and Wildlife Service, Migratory Bird Management, Anchorage.

U.S. Fish and Wildlife Service (2013) Enviromental assessment: managing migratory bird subsistence hunting in Alaska, hunting regulations for the 2014 spring-summer harvest. U.S. Fish and Wildlife Service, Migratory Bird Management, Anchorage.

U.S. Fish and Wildlife Service (2014) Enviromental assessment: managing migratory bird subsistence hunting in Alaska, hunting regulations for the 2015 spring-summer harvest. U.S. Fish and Wildlife Service, Migratory Bird Management, Anchorage.

2.3 Uses Related to the Authorization of the Alaska Fall Hunt

Consultation for fall, sport hunt may use AMBCC harvest data because HIP doesn't fully portray fall harvest in AK.

2.4 Management, Recovery, Conservation Plans

Alaska Shorebird Group (2008) Alaska shorebird conservation plan. Version II. Alaska Shorebird Group. Anchorage, AK.

U.S. Fish and Wildlife Service (1996) Spectacled eider (*Somateria fischeri*) recovery plan. Published 12 August 1996 by the United States Fish and Wildlife Service. http://ecos.fws.gov/docs/recovery_plan/960812.pdf accessed 11 November 2009. 157 pp.

U.S. Fish and Wildlife Service (2002) Recovery plan for the Alaska breeding population of the Steller's eider. Published 30 September 2002 by the United States Fish and Wildlife Service. http://ecos.fws.gov/docs/recovery_plan/020930b.pdf accessed 11 November 2009. 29 pp.

U.S. Fish and Wildlife Service (2009) Alaska seabird conservation plan. U.S. Fish and Wildlife Service, Migratory Birds Anchorage, Alaska.

2.5 Uses Related to ESA Listing Processes

Note: may be missing some documents.

Earnest, S. (2003) Status assessment and conservation plan for the yellow-billed loon (*Gavia adamsii*). U.S. Geological Survey, Biological Science Report. USGS/BRD/BSR-2003.

Stehn, R.A. and E.J. Taylor (2010) Subsistence harvest of eiders and feasibility of estimating the number of unrecovered birds at Barrow, Alaska. Division of Migratory Bird Management, Waterfowl Management Branch, Anchorage, Alaska, 11 January 2010. 25 pp.

U.S. Fish and Wildlife Service (2009) Twelve-month finding on a petition to list the yellow-billed loon as threatened or endangered. Published 25 March 2009 by the U.S. Fish and Wildlife Service. Federal Register 74 (56): 12931–12968.

U.S. Fish and Wildlife Service (2010) Candidate Notice of Review. Species assessment and listing priority assignment form, yellow-billed loon (*Gavia adamsii*), May 2010.

U.S. Fish and Wildlife Service (2012) Candidate Notice of Review. Species assessment and listing priority assignment form, yellow-billed loon (*Gavia adamsii*), May 2012.

U.S. Fish and Wildlife Service (2014a) Species status assessment report, yellow-billed loon (*Gavia adamsii*). 28 August, 2014. U.S. Fish and Wildlife Service, Fairbanks.

U.S. Fish and Wildlife Service (2014b) 12-Month finding on a petition to list the yellow-billed loon as an endangered or a threatened species. Federal Register Vol. 70, No. 190, pages 59195–59204, 1 October 2014.

2.6 Uses Related to Other Information Needs

Delinger, L.M. and Wohl, K.D. (2001) Harvest of seabirds in Alaska. Pages 3–10 in Delinger, L.M. and Wohl, K.D. (eds) Seabird harvest regimes in the circumpolar nations. Conservation of Arctic Flora and Fauna (CAFF) International Secretariat, Circumpolar Seabird Group. CAFF Technical Report no. 9.

Goldstein, J.H., Thogmartin, W.E., Bagstad, K.J., Dubovsky, J.A., Mattsson, B.J., Semmens, D.J., López-Hoffman, L. and Diffendorfer, J.E. (2014) Replacement cost valuation of Northern pintail (*Anas acuta*) subsistence harvest in Arctic and sub-Arctic North America. Human Dimensions of Wildlife 19(4):347–354.

Tessler, D.F., J.A. Johnson, B.A. Andres, S. Thomas and R.B. Lanctot (2014) A global assessment of the conservation status of the black oystercatcher *Haematopus bachmani*. International Wader Studies 20:83–96.

Wohl, K.D. Nelson, T.L., and Wentworth, C. (1995) Subsistence harvest of seabirds in Alaska. U.S. Fish and Wildlife Service, Division of Migratory Birds, Anchorage. Unpublished report submitted to the circumpolar Seabird Working Group. Program for the Conservation of Arctic Flora and Fauna CAFF.

Wohl, K.D., Wentworth, C., and Dewhurst, D. (2008) Harvest of seabirds in Alaska. Pages 8–19 in Merkel, F. and Barry, T. (eds) Seabird harvest in the Arctic. Conservation of Arctic Flora and Fauna (CAFF) International Secretariat, Circumpolar Seabird Group. CAFF Technical Report no. 16.

Western Hemisphere Shorebird Group Meeting (2011) Shorebird hunting workshop summary and supplemental information. Fourth Western Hemisphere Shorebird Group Meeting, 11–15 August 2011. http://www.shorebirdplan.org/science/assessment-conservation-status-shorebirds/huntingworkshop/

Appendix B. USFWS response to Question 4 (Documented Use of Survey Data)

Final Supplemental Environmental Impact Statement on the Issuance of Annual Regulations Permitting the Hunting of Migratory Birds, 2013

The U.S. Fish and Wildlife Service updated in May 2013 the Environmental Impact Statement on the issuance of annual regulations for hunting of migratory birds. This document is available online at: http://www.fws.gov/migratorybirds/pdfs/FSEIS20Issuance20of20Annual20Regulations20Permitting20the20Hunting20of20Migratory20Birds.pdf

Below is a summary of the document and references to subsistence harvest survey data.

PROPOSED ACTION

The proposed action of the 2013 Final Supplemental Environmental Impact Statement (FSEIS 2013) is to adopt a process for authorizing migratory bird hunting in accordance the Migratory Bird Treaty Act (16 U.S.C. §703-712) and the four bilateral conventions. Regulations allowing the hunting of migratory game birds in the families Anatidae (waterfowl), Columbidae (doves and pigeons), Gruidae (cranes), Scolopacidae (snipe and American woodcock) and Rallidae (rails, coots, gallinules and moorhens) currently are promulgated annually. These 'annual' regulations include framework regulations and special regulations, and take into consideration factors that change from year-to-year, such as abundance and distribution of birds, times of migration, and other factors. In contrast, 'basic' regulations (e.g., those that govern hunting methods, such as the gauge of shotgun that can be used, the number of shells a gun can hold, regulations about possession and transportation of harvested birds, etc.) are promulgated and changed only when a need to do so arises. Therefore, basic regulations are not addressed in FSEIS 2013.

The Service believes that there are seven components of the proposed action for which alternatives can be considered regarding how annual regulations are established for the hunting of migratory birds. The first six components deal with the fall-winter hunting season and include: (1) the schedule and timing of the general regulatory process, (2) frequency of review and adoption of duck regulatory packages, (3) stock-specific harvest strategies, (4) special regulations, (5) management scale for the harvest of migratory birds, and (6) zones and split seasons. In addition, a seventh component of the proposed action concerning the subsistence-hunting regulations process for Alaska is considered, and the impact of cumulative harvest of migratory bird hunting on National Wildlife Refuges also is discussed.

The Service is committed to moving toward establishing increased coordination (coherence) between the harvest, habitat, and human dimension aspects of migratory bird management. The components of the proposed action presented in this assessment are designed to help move migratory bird management in that direction.

4 AFFECTED ENVIRONMENT
4.1 Migratory Birds and Habitats
4.4.3 Swans
4.1.3.3 Harvest
Page 99

Tundra swan

Tundra swans have been subjected to a limited harvest since 1962. All swan-hunting seasons are regulated and monitored by Federal and State wildlife agencies in accordance with Tundra Swan Hunt Plans (Trost et al. 1999; Pacific Flyway Council 2001, unpublished report; Ad hoc Eastern Population Tundra Swan Committee 2007, unpublished report). As specified in the Plans, hunting seasons are limited to specific areas, time periods, and numbers of hunters. Limits are placed on the number of swans that can be harvested in each flyway and within each swan population. Hunters must get a permit for each swan, and are required to report whether a swan was harvested. In addition, hunters in Utah and Nevada must have their swans examined by State biologists to identify the species of swan (i.e., tundra or trumpeter, see below). In recent years, approximately 4,400 tundra swans have been harvested annually in the U.S. during hunting seasons (Table 4.7). Subsistence hunting of tundra swans and eggs also occurs in Alaska, with harvest approximately equal to the fall-winter harvest (U.S. Fish and Wildlife Service 2003a, unpublished report; U.S. Fish and Wildlife Service 2003b, unpublished report; Wentworth 2004; Collins and Trost 2009).

4 AFFECTED ENVIRONMENT
4.1 Migratory Birds and Habitats
4.1.12 Other migratory birds (seabirds, shorebirds, and waterbirds)
4.1.12.3 Harvest
Pages 143–144

[NOTE preceding paragraphs describe pop status of seabirds, waterbirds, and shorebirds]

These non-game species are available for egg-gathering as well as subsistence hunting. An annual statewide survey to estimate subsistence harvest of non-game species in Alaska does not exist. Estimates based on partial survey and anecdotal information suggest that seabirds and shorebirds make up approximately 10 of the subsistence harvest of migratory birds (the remainder being mostly waterfowl). Murre eggs and birds comprise the bulk of the nongame bird harvest. Most species of shorebirds, seabirds, and other waterbirds are taken incidentally and identification is a problem in reporting. However, a model was developed to come up with a statewide estimate surveying the regions in a systematic method over a five-year period (Naves et al. 2008) and methods of implementing such a survey are currently being evaluated.

6. ENVIRONMENTAL CONSEQUENCES
6.1 General effects of regulations
6.1.10 Regulations and socioeconomic environment
6.1.10.1 Individuals
Pages 183–186

Subsistence Hunters

Today in Alaska, subsistence harvests of migratory birds occur primarily in rural areas where fishing and hunting are major components of the regional economy. Most rural communities are supported by traditional mixed cash and subsistence economies, wherein families support themselves through some combination of employment for wages, commercial fishing and trapping, and subsistence activities (Lonner 1980; Petterson et al. 1988). Often, subsistence harvest activity is limited to a few individuals in the community or family who share the products of hunting, fishing and gathering with others. Due to the Environmental Consequences tradition of sharing, the number of households using birds typically is greater than those taking birds. In areas where migratory bird harvest is greatest, approximately 60 of households harvest migratory birds and up to 86 of households use the migratory bird resource.

Many traditional subsistence ways of life have changed with existing technology. Now cash is necessary to purchase modern equipment to hunt, fish, and gather. Migratory bird take is only one of the traditional subsistence activities that produce wild foods (Lonner 1980; Petterson et al. 1988).

Historically, little documentation existed regarding the subsistence harvest of migratory birds in Alaska, especially outside of the Y-K Delta area, because of the difficulty in obtaining data. Estimates of annual subsistence harvest in limited areas of Alaska for the 1960s–1970s consisted of 239,740 migratory birds, of which 125,900 (53) were ducks, 105,120 (44) were geese, 5,700 (2) were swans, 1,300 (~0.5) were cranes, and 1,720 (~0.7) were seabirds. In addition, approximately 50,600 eggs of migratory birds were taken annually (U.S. Department of the Interior 1980). These figures compare to a national fall-winter harvest of about 1.7 million geese and 15.1 million ducks for the 1978–79 season. Thus, during that year, subsistence harvest constituted only a very small percentage of the overall harvest that occurred.

In areas eligible for migratory bird subsistence in Alaska, an estimated combined average of 236,000 migratory birds was reported taken annually for subsistence from the early/mid-1990s through 2000 (U.S. Fish and Wildlife Service 2003c). Based on annual fluctuations in areas where multi-year data are available, the harvest may have ranged from 200,000 to 250,000 birds, depending on the year. This harvest estimate is based on data from about 75 of the total population and 149 of the 166 communities in areas eligible for subsistence. Subsistence harvest figures from the North Slope communities of Barrow, Pt. Hope, Pt. Lay, and Wainwright (total population 6,131), the city of Kodiak (population 12,973), and several small communities in interior Alaska (total population 1,564), are not available so were not included in this analysis. In the late 1980s, subsistence harvests from Barrow, Wainwright, and Pt. Lay averaged 13,600 migratory birds, with a range from 11,000–17,000 birds (5,000–6,300 geese and 6,000–10,600 ducks; Braund 1993a; 1993b).

Of the combined reported subsistence harvest estimate of 226,000 migratory birds, approximately 160,000 birds (71) were taken in the spring-summer and 66,000 birds (29) were taken in the fall (U.S. Fish and Wildlife Service, unpublished data, Anchorage, AK). An unknown portion of the fall subsistence harvest occurs in August, before the fall-winter non-subsistence hunt begins. Of the reported combined migratory bird harvest, 82,300 (36) were geese, 108,700 (48) were ducks, 7,500 (3) were tundra swans, 6,000 (3) were sandhill cranes, and 21,500 (10) were seabirds and shorebirds (U.S. Fish and Wildlife Service, unpublished data, Anchorage, AK).

Species composition of harvest differed somewhat between spring-summer and fall. Of the combined spring-summer harvest estimate of 160,000 birds, 40 were geese, 44 were ducks, 3 were tundra swans, 3 were sandhill cranes, and 10 were seabirds and shorebirds. Of the combined fall harvest estimate of 66,000 birds, 28 were geese, 59 were ducks, 3 were tundra swans, 3 were sandhill cranes, and 7 were seabirds and shorebirds. This suggests that geese are more important in the spring/summer harvest, and duck harvests are more important in the fall. However, based on numbers alone, almost twice as many ducks are taken in spring-summer than in fall.

Because geese weigh approximately three times as much as ducks (an average of three pounds usable meat compared with an average of one pound), their contribution by weight to the subsistence diet is much greater than ducks. Similarly, swans and cranes contribute eleven pounds and seven pounds of usable meat, respectively. Thus, the spring-summer harvest contributes >70 of the total subsistence migratory bird diet, by weight, due to relatively more geese being taken (Wentworth and Wong 2001).

The area of Alaska with the highest migratory bird harvests (1992/95–2000) was the Y-K Delta. Of the statewide migratory bird harvest taken in subsistence eligible areas, an estimated 99,000 (44) birds were taken on the Y-K Delta. The Y-K Delta harvest also accounts for over half (53) of the geese and 40 of the ducks reported (U.S. Fish and Wildlife Service, unpublished data, Anchorage, AK). Bristol Bay and the Bering Strait mainland were next highest in total harvests, accounting for 25,000 birds each, followed by the Northwest Arctic Alaska region at 23,000 birds. Of the 21,500 reported Alaska seabirds and shorebirds harvested, most were taken on St. Lawrence Island (86).

The estimated harvest of migratory bird eggs in subsistence-eligible areas in Alaska averaged 109,000 between 1992/95 and 2000. Of this number, most eggs (82) were taken from seabirds, primarily gulls and murres, and 14 were from waterfowl (U.S. Fish and Wildlife Service, unpublished data, Anchorage, AK). The Y-K Delta had the highest harvests of waterfowl eggs, accounting for 58 of the statewide estimate. Bristol Bay, Bering Strait, St. Lawrence Island, and the Northwest Arctic took most of the seabird eggs.

The intensity of migratory bird and egg harvest efforts varies regionally in Alaska. For migratory birds (1992/95–2000), the three top areas in terms of per capita migratory bird harvest were the Siberian Yupik communities of Gambell and Savoonga on St. Lawrence Island, the small communities of Kodiak Island (Akhiok, Karluk, Larsen Bay, Old Harbor, Ouzinke, and Port Lions), and the 38 Central Yupik communities of the Y-K Delta. St. Lawrence and Little Diomede Islands had the highest per capita egg harvests, which included almost all common murre eggs (U.S. Fish and Wildlife Service, unpublished data, Anchorage, AK).

A harvest survey of 192 rural villages was conducted in 2008 (Naves 2010). The total reported number of migratory birds taken for subsistence was 150,756 birds, 70 of which were taken in the spring, 15 in the summer and approximately 15 in the fall. Of the reported combined bird harvest, 65,291 (43.3) were ducks, 76,311 (50.6) were geese, 3,990 (2.6) were tundra swans, 2,642 (1.8) were sandhill cranes, and 2,522 (1.7) were seabirds and shorebirds (Naves, 2010).

To place subsistence harvest in perspective, the 2008 Alaska subsistence harvest estimates can be compared with national HIP estimates. The 2008 HIP estimate for ducks was 13.7 million (including seaducks). Alaska's HIP estimate, which is included in the national estimate, was 68,300 ducks in 2008 (Raftovich et al. 2009). The 2008 Alaska subsistence harvest estimate of ducks was 65,291 (only 10 of the Alaska HIP estimate came from hunters living in the subsistence-eligible areas, so there is little overlap between these two figures). The Alaska subsistence harvest of ducks, therefore, amounts to less than 1 of the total national HIP estimate (Naves, 2010).

Total national harvest of geese, according to HIP estimates, was 3.8 million in 2008 (including brant). The Alaska HIP estimate for geese was 7,800 in 2008 (Raftovich et al. 2009). The Alaska subsistence harvest estimate for 2008 was 76,311 geese, amounting to approximately 2.0 of nationwide goose harvest.

The Alaskan subsistence take of sandhill cranes is proportionally larger than that for ducks or geese. Total national harvest of cranes (not including subsistence) was estimated at 25,651 in 2008 (Kruse 2009). Of this, 1,249 cranes in 2008 were taken by non-subsistence hunters in Alaska (Kruse 2009). Canadian harvest of sandhill cranes was approximately 9,439 in 2008 (Kruse 2009). The annual Alaska subsistence crane harvest was estimated at 2,642 (Naves, 2010), representing about 7.3 of total North American sandhill crane harvest in recent years. Alaska subsistence tundra swan harvest is almost entirely for the western population and has been approximately equal to the fall-winter harvest for this population in recent years. Tundra swans are not hunted in Canada. Crane and swan populations have continued to increase over time (see Chapter 4), therefore, no measurable impact of this harvest has been observed. This harvest is a continuation of the cultural and traditional use of these species to rural Alaskan natives that is being conducted in a sustainable fashion.

APPENDIX 9
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LIST OF PRINCIPAL SPECIES CUSTOMARILY AND TRADITIONALLY TAKEN FOR SUBSISTENCE IN THE UNITED STATES

Migratory birds known to be used for subsistence in Alaska, from Wolfe, R.J. et al., The Subsistence Harvest of Migratory Bird Species in Alaska (Alaska Department of Fish and Game,
Division of Subsistence, Technical Paper No. 197, 1990)

GEESE

White-fronted, Lesser Canada, Cackling Canada, Taverner's Canada, Lesser snow, Emperor, Black brant

DUCKS

Mallard, Pintail, Gadwall, Wigeon, Shoveler, Redhead, Ring-necked, Canvasback, Green-winged teal, Blue-winged teal, Bufflehead, Harlequin, Greater scaup, Goldeneye, Oldsquaw, White-winged scoter, Black scoter, Surf scoter, Common eider, King eider, Spectacled eider, Common merganser, Red-breasted merganser

OTHER

Yellow-billed loon, Red-throated loon, Common loon, Arctic loon, Common murre, Mew gull, Sabine's gull, Glaucous gull, Arctic tern, Tundra swan, Sandhill crane, Miscellaneous shorebirds

U.S. Fish and Wildlife Service Region 7 (Alaska) Endangered Species Program Documents

The U.S. Fish and Wildlife Service Region 7 (Alaska) Endangered Species Program has used subsistent harvest survey data in listing documents and biological opinions. Listing documents communicate evaluations and decisions regarding whether species warrant listing under the Endangered Species Act. Biological opinions are prepared in annual consultations conducted under Section 7 of the Endangered Species Act. A biological opinion is a required in the annual promulgation of regulations for subsistence harvest.

Recent examples of listing documents:

1) Federal Register publication on 12-month finding on a petition to list the Yellow-billed Loon as threatened or endangered (warranted but precluded determination) in 2009 (see attached document “Finding to List Yellow-billed Loon Proposed Rule 2009.pdf”).

2) Federal Register publication on 12-month finding on a petition to list the Yellow-billed Loon as threatened or endangered (not warranted determination) in 2014 (see attached document “Finding to List Yellow-billed Loon Proposed Rule 2014.pdf”)

3) Yellow-billed Loon Species Status Assessment developed in 2014 in support of listing determination (see attached document “Yellow-billed Loon Species Status Assessment 2014.pdf”).

Recent example of a biological opinion:

1) Intra-Service Biological Opinion for Hunting Regulations for the 2014 Spring/Summer Harvest (see attached document “Biological Opinion on Subsistence Hunting 2014.pdf”)

Other Biological Opinion documents are available online at:
http://www.fws.gov/alaska/fisheries/endangered/bio_opinion.htm

Pacific Flyway Council Management Plans and Annual Regulatory Decision Making

The Pacific Flyway Council has about 30 migratory game bird management plans. All of these plans are available at the Pacific Flyway Council's website (http://pacificflyway.gov). Some migratory game birds are subject to both spring-summer (subsistence) and fall-winter (sport) harvest. A review of Pacific Flyway Council management plans for populations subject to both subsistence and sport harvest indicates that most include subsistence bird harvest estimates, but none use subsistence harvest estimates in a formal regulatory decision making process. Presentation of subsistence harvest survey estimates is without measures of sampling precision or bias, which limit the utility of these estimates. It should be noted that many of these plans were adopted prior to the establishment of the statewide Alaska Migratory Bird Co-management Council subsistence harvest surveys in 2004 and the revisions incorporated in 2010 to improve the survey.

The Pacific Flyway Council formulates harvest management regulation recommendations twice annually: in March (for seasons generally beginning in September) and July (for seasons generally beginning after September). Recent regulatory recommendation packages are available at the Pacific Flyway Council's website (http://pacificflyway.gov). A review of the regulatory recommendations package from the most recent regulatory cycle (2014) indicates inclusion of some subsistence bird harvest estimates, but no regulatory recommendations use subsistence harvest estimates in a formal regulatory decision making process. Presentation of subsistence harvest survey estimates is without measures of sampling precision or bias, which limit the utility of these estimates.

Review of Pacific Flyway Council management plans.

Cackling Canada Geese (July 1999)

Reference to subsistence bird harvest estimates: Yes, page 19.
Reference to subsistence egg harvest estimates: No.
Use in regulatory decision making: No, abundance objective, no harvest strategy (page 4 and Appendix H).

Aleutian Canada Geese (July 2006)

Reference to subsistence harvest estimates: No.
Reference to subsistence egg harvest estimates: No.
Use in regulatory decision making: No, abundance objective, no harvest strategy (page 5).

Pacific Population of Lesser and Taverner's Canada Geese (July 1994 draft)

Reference to subsistence harvest estimates: Yes, page 8.
Reference to subsistence egg harvest estimates: No.
Use in regulatory decision making: No, fuzzy objective, no harvest strategy.

Pacific Population of Greater White-fronted Geese (July 2003)

Reference to subsistence harvest estimates: Yes, page 11.
Reference to subsistence egg harvest estimates: No.
Use in regulatory decision making: No, abundance objective, no harvest strategy (page 3).

Emperor Geese (July 2006)
Reference to subsistence harvest estimates: Yes, page 9.
Reference to subsistence egg harvest estimates: Yes, page 10.
Use in regulatory decision making: No, abundance objective, no harvest strategy (page 2).

Pacific Population of Brant (July 2002)
Reference to subsistence harvest estimates: Yes, page 17.
Reference to subsistence egg harvest estimates: No.
Use in regulatory decision making: No, abundance objective, vague harvest strategy (pages 1 and 21).

Wrangel Island Population of Lesser Snow Geese (July 2006)
Reference to subsistence harvest estimates: Yes, page 9.
Reference to subsistence egg harvest estimates: N/A.
Use in regulatory decision making: No, abundance objective, no harvest strategy (page 1).

Western Canadian Arctic Population of Lesser Snow Geese (July 2013)
Reference to subsistence harvest estimates: No.
Reference to subsistence egg harvest estimates: No.
Use in regulatory decision making: No, abundance objective, no harvest strategy (page 4).

Pacific Coast Population of Trumpeter Swans (March 2008)
Reference to subsistence harvest estimates: No.
Reference to subsistence egg harvest estimates: No.
Use in regulatory decision making: No, abundance objective, no open hunting seasons (page 4).

Western Population of Tundra Swans (July 2001)
Reference to subsistence harvest estimates: Yes, page 14.
Reference to subsistence egg harvest estimates: Yes, page 14.
Use in regulatory decision making: No, abundance objective, vague harvest strategy (pages 3, 20, and 21). Alaska subsistence harvest rate, including eggs, is assumed to be about 5. Harvest strategy includes formula for calculation of maximum allowable kill (5 for sport hunting) and permits; however, the annual allocation process is not currently used due to lack of demand for permits.

Eastern Population of Tundra Swans (July 2007)
Reference to subsistence harvest estimates: Yes, page 12.
Reference to subsistence egg harvest estimates: No.
Use in regulatory decision making: No, abundance objective, vague harvest strategy (pages 2 and 26/Appendix C). Alaska subsistence harvest rate, including eggs, is assumed to be about 5. Harvest strategy includes formula for calculation of maximum allowable kill (5 for sport

hunting) and permits; however, the annual allocation process is not currently used due to lack of demand for permits.

Pacific Coast Population of Sandhill Cranes (March 1983)

Reference to subsistence harvest estimates: Yes, page 8.
Reference to subsistence egg harvest estimates: No.
Use in regulatory decision making: No, abundance objective, no harvest strategy (page 1).

Midcontinent Population of Sandhill Cranes (March 1983)

Reference to subsistence harvest estimates: Yes, page 39.
Reference to subsistence egg harvest estimates: Yes, page 39.
Use in regulatory decision making: No, abundance objective, no harvest strategy (pages 2 and 12).

Yukon-Kuskokwim Delta Goose Management Plan (2005)

Reference to subsistence harvest estimates: No.
Reference to subsistence egg harvest estimates: No.
Use in regulatory decision making: No, abundance objective, no harvest strategy (page 4).

Review of Pacific Flyway Council regulatory recommendations packages.

March 2014

Reference to subsistence harvest estimates: Yes, pages 21 (sea ducks), 92 (cackling geese), 98 (Pacific greater white-fronted geese), 99 (black brant), and 103 (Pacific population of sandhill cranes).
Reference to subsistence egg harvest estimates: No.
Use in regulatory decision making: No, no formal harvest strategies involved.

July 2014

Reference to subsistence harvest estimates: Yes, pages 78 (tundra swans), 88 (black brant), and 91 (Emperor geese).
Reference to subsistence egg harvest estimates: No.
Use in regulatory decision making: No, no formal harvest strategies involved.

APPENDIX C. COMMENTS ON DRAFT PROGRESS REPORT.

Analysis of subsistence survey harvest performance

Questions/issues raised by TWG members during the initial review of the draft Progress Report

1. **Project review process**- Our draft Progress Report did not adequately place in context how the proposed initial analyses of survey performance relates to the project milestone of producing a Final Report on the performance of the current harvest survey on 6/30/15. The responses from the TWG to our questionnaire provided us with a starting point for the analyses we proposed (and additional analyses or modifications that are agreed upon at this meeting). The results of these analyses will be presented and discussed at the AMBCC meeting in April, which will provide another opportunity to discuss refinement of our final analyses and, importantly, a process for moving forward to the goal of reaching consensus on a final set of specific objectives and priorities for the AMBCC harvest survey.
2. **Data quality**- Concerns about how/if the quality of harvest survey data may be compromised by several potential sources of bias have been discussed and reviewed in previous AMBCC reports. Our draft report acknowledged these concerns, but we proposed to revisit this issue at a later date. Several respondents suggested that this evaluation should be a more immediate priority. At the meeting we will first discuss the different types of potential bias (i.e., species misidentification and response bias including region, subregion, village, and household refusal, memory bias, sensitive question bias, missing seasonal data), to insure that we all have a common understanding of these terms. We can then discuss priorities and suggestions for analyses we could conduct using currently available data from both the AMBCC survey and auxiliary datasets.
3. **Estimation of statewide harvest**- Several TWG members questioned why we do not plan to provide statewide estimates of harvest of species and species groups in the report. The AMBCC reports indicate that a non-random subset of regions was surveyed in any given year and we believe that substitution of averages from past surveys of missing regions in order to produce a statewide estimate cannot be justified given the significant inter-year variation in harvest. This viewpoint has also been expressed in AMBCC harvest reports. If a state-wide estimate is a priority, then a proper sampling design and collection protocol can be designed and followed. This comment brings up the larger issue of priorities, e.g., what spatial scale and species groups are most important to AMBCC members? Though a survey can be designed to meet multiple objectives, there are trade-offs and compromises will have to be made.
4. **Species included in analyses**- We proposed including the following species or species groups in our review of the reliability of the subsistence harvest.

Harvest Category	Species or species group
Important subsistence resources (> 2 of subsistence harvest)	white-fronted goose, mallard, northern pintail, Canada/cackling geese, king eider, brant, black

	scoter, scaup, snow goose, American wigeon, murres, white-winged scoter, teal, goldeneyes, and auklets
Large proportion (>5) of estimated Alaska breeding population harvested by subsistence users.	Canvasback, brant, black scoter, long-tailed duck, surf scoter, pelagic cormorant, and mallard
Large proportion (>5) of estimated Alaska breeding population harvested by subsistence users. Harvest during fall and winter includes birds from other regions (mixed populations).	king eider, Steller's eider, common eider
Species of conservation concern that are harvested in significant numbers	black scoter, common eider, king eider, brant, emperor goose

One TWG member suggested moving Steller's and common eider to the "Species of conservation concern" category. It was also suggested that we include spectacled eider in the species of conservation concern category.

Another TWG member asked for justification of the cutoffs (2 and 5) we used when including species in the various categories. These cutoffs were based on a 2011 analysis by ADFG and USFWS of subsistence harvest and population data. The cutoffs are arbitrary and we can use other values the TWG suggests.

APPENDIX D. NOTES FROM FEBRUARY 20, 2015 PROGRESS MEETING.

Alaska Migratory Bird Co-Management Council
Analysis of Subsistence Survey Harvest Performance

February 20, 2015 – Chugachmiut Board Room, Anchorage, Alaska

Present:

Jim Fall, ADF&G	Tim Andrew, AVCP	Dan Rosenberg, ADF&G
Todd Sanders, USFWS	Eric Taylor, USFWS	Luke George, CSU
Dave Otis, CSU	Khristi Wilkins, USFWS (teleconference)	
	Molly Chythlook	
Grey Pendleton, ADF&G		

The meeting was opened by Luke George at 9:12 a.m. Introductions were made. The agenda was reviewed and any changes made were noted. Eric suggested including "objectives" in the discussion items and would like to get an update on the identification of survey objectives. He would also like to have a discussion about the uses of data. Objectives, data uses, bias, and precision were four key components Todd Sanders mentioned that are critical in this process. It is important that the Technical Working Group (TWG) agree on a process that will effectively address the issues.

Dave Otis reviewed the work conducted thus far. A survey was sent to the TWG members to get people to begin to think about what their preferences were and what was important to them. Those responses were used to develop the draft progress report based on the input received from the surveys. This meeting was called to provide an opportunity for additional input into the draft report and provide additional input on what the TWG would like us to do before the AMBCC in April. This will be considered as the first progress report. After feedback is received from the AMBCC meeting, a final report for Phase I will be submitted by the end of June, 2015.

It was agreed that the TWG must agree on what the objectives and priorities of the survey are. This would flow easily into Phase II, which is to design and evaluate alternative survey designs, cost-effectiveness, and trade-offs.

A lengthy discussion ensued on potential objectives of a migratory bird subsistence harvest survey and the need for these to be articulated in order to assess the harvest survey program.

Jim Fall thought they were going to look at the past data that have been collected and evaluate it in terms of reliability, meeting sampling goals, etc., and what this means for reliable statistical estimates. Does the current survey design, which involves face to face surveys with stratified random samples in a selection of villages with one or two recall periods provide accurate estimates of the harvest of the most important species?

Accurate and reliable estimates of harvest of protected species (could be a separate survey)

Tim indicated that identification of all species that are harvested by Alaska Natives is also an important goal of the survey. The group needs to decide what type of estimates are most important . . . state-wide estimates or estimates from high harvest areas of the state.

Concerns included data reliability and statement of the objectives. Molly suggested that if the data are not considered to be reliable and the survey objectives are not being achieved, then it needs to be changed.

USFWS identified four key areas: 1) what are the objectives?; 2) how are the data being used?; 3) is the survey addressing the objectives?; and 4) what is the bias and precision associated with the current design?. Todd would like to leave the meeting with an agreement on how we are going to move forward and not lose track of the four issues previously identified.

After much discussion and no consensus, the group was asked if they wanted to move on to the next agenda item. It was decided to continue to work to achieve consensus on the objectives process. After more discussion, it was agreed that each representative group identify their top three (or so) survey objectives/priorities and send them to Luke and Dave by next Friday, February 27, 2015.

When developing the objectives, the following items should be considered (some of these items were added later in the discussion, we included them here so the list would be complete):

1. Scale of the survey harvest estimate (subregion, region, or state)
2. Species or species groups
3. Frequency of the survey (every year, every other year, etc.)
4. Statistical precision
5. Season (spring, summer, fall, winter)
6. Egg vs bird harvest

Tim Andrew suggested that the survey should attempt to provide a complete inventory of species harvested – not ones harvested the most.

Jim Fall cautioned that this needs to be weighed into the future design. Cross cultural communication, give and take of information; we are dealing with humans; so developing goals and objectives should consider these things. No matter what is done, it is done in a manner that develops trust and confidence. This could be a prologue to the list of objectives.

Molly: Trust is important

When doing objectives, make a beginning statement about the survey being culturally sensitive, etc.

What about uses and bias?

How are the data being used and how would we like the data to be used in the future?

Has the use of the data influenced management decisions? – Vaguely. However, the Fish and Wildlife Service used yellow-billed loon subsistence harvest data from St. Lawrence Island to justify its decision to conduct an assessment to determine if protection under the Endangered Species Act was warranted; a specific survey designed to assess the importance of loon species to two Native Villages on St. Lawrence Island later determine yellow-billed loon harvest estimates were erroneous based upon species identification issues. USFWS stated no other regulatory, harvest or conservation regulatory decisions have been based on Alaska migratory bird subsistence data.

Discussion of Specific Species of Concern:

In the Yellow Billed Loon survey, ADF&G utilized an approach that would address the species of specific concern. When USFWS reviewed the survey results form 2013, they looked at the estimates and pointed out where there seemed to be some discrepancy either between the presence at all of those species given the community geographic location or the numbers that were being estimated. Jim suggested going back in time and looking at other species. Eric is not ready to give you a list of species to look at. We could look at the same species at the same level showed up in other harvest surveys. You could also look at high numbers and see if they are coming from one or two respondents which could indicate whether or not it is a misidentification of species or what. The question was raised as to whether or not we should even be reporting info with small response or numbers.

Tim: The AMBCC has not been able to see how the numbers are expanded in the survey.

Harvest survey is inadequate for gathering data on species that are closed or are threatened and endangered. Is the survey designed to do that?

Misidentification is another potential source of error or bias. One method to possibly address a potential species identification problem is to compare subsistence harvest data from subregions with USFWS aerial survey breeding bird data. Subsistence harvest data that illustrate the presence (or magnitude) of harvest in areas where aerial survey data do not report the species occurring may indicate s potential source of error.

Discussion ensued on the role of the Refuge Information Technicians (RITs) in the subsistence harvest survey program. Molly and Tim indicated that were very helpful in implementation of the harvest survey.

Break

Memory Bias/Recall Bias:

Under discussion on the list of objectives, Luke and Dave asked for input regarding seasonal estimates. Right now, the estimates are reported as spring, summer, fall and winter, i.e., up to four seasonal estimates. Seasonal estimates represent a potential trade-off, i.e., this is an important cost and potentially could impact the issue of memory bias. Are summer and spring harvest estimates acceptable as these periods represent when most harvest occurs and may be more efficient relative to cost? Tim said fall and winter subsistence harvest estimates are also important to allow the importance of these periods to subsistence hunters.

Molly said that for Bristol Bay, it would be the spring and fall since people are fishing in the summer. The survey is still conducted and asking about harvest in the summer months. The survey is handed out at the beginning of the season and the calendars are sent in after the season is over, like a harvest diary or calendar. This works very well for salmon. If the information is not sent in, a follow-up phone call is issued as a reminder. In the Yukon-Kuskokwim Delta, there is only a 10 return on the calendars, so the data gathered from personal interviews are more reliable for that region. The data from the calendars do not contain enough information to conduct a controlled comparison. Halibut fishermen, since 2003, have to register with the National Marine Fisheries Service. In January, a one-page survey is mailed in to subsistence fisherman wherein they report their halibut harvest for the previous year. One or two reminder letters are sent out and in selected communities, face-to-face interviews are conducted. The overall sampling set is 70 of the people who have registered. 55-60 of the information is from the mail-outs and the rest is from the person-to-person interviews. Response rates vary from region to region. Molly said that what might work for AMBCC is to have the birds listed on one page and on the flip side have the harvest months similar to what is done with salmon. Jim felt that some people will do that, but most will not. Discussion ensued regarding the use of calendars.

<u>Response Bias</u>:

Regarding refusal rates, Dave and Luke feel that they are not that high. If there is a bias on who opts out (like a very high harvester), then it could be a concern. Molly noted that the respect for the surveyor by the person being surveyed as well as the support of the tribal council is of utmost importance. If a village chooses not to participate, they are represented in the sub-region numbers. People also have to be in the community at least one year before they can participate in the survey. Discussion centered on village refusal and it was the consensus that the survey would be moved to another village who is willing to participate in the survey. The number of villages that decline is very small and the big picture and mid-level picture are not really affected by one village refusal. This would change, however, if a particular village that refused to participate may have higher than normal harvest numbers. The average refusal rates for surveys overall is 15-20.

The bulk of the harvest on the Y-K Delta is done in the coastal communities. Jim Fall feels as though 50 sampling rate is good and though there are some villages that are not participating, there is not a bias. A critical issue is the selection of subregions and villages. The Kawerak region, for example has Nome, St. Lawrence Island, and other villages. If you are representing the region, and you don't include St. Lawrence Island, for example, this could produce a very different response.

Sensitive question bias – this was not addressed in the CSU report, but it is very difficult to quantify. Molly said that this does not occur very often. If they don't want to answer the question they don't have to. Sometimes they will provide an answer but request that it not be recorded. Molly felt it would be unlikely that a respondent would intentionally provide an incorrect answer to a question about harvest of sensitive species. It should be made clear to the respondents that the numbers are for the birds harvested, not birds given or received. In group hunts, the birds are distributed equally amongst the hunters. Each hunter should report what they took from the harvest effort, not the total of birds killed. There is a tremendous level of sharing and giving amongst the Native population.

Luke will look at the 2008 subsistence survey review (Special Publication No. 2008-05), confer with Jim Fall and others, and include information about potential sources of data errors and bias in subsistence harvest estimates in the report to the TWG.

Estimation of Statewide Harvest:

Eric pointed out that eighty percent of Brant are harvested during the subsistence hunt and are harvested all the way from the North Slope down to Izembek. From a management standpoint and harvest regulations, it would be beneficial to have an accurate total state harvest because of the magnitude of the brant harvest relative to the fall harvest. This is an example of why a statewide harvest is warranted for a particular species. Luke stated that the biggest issue is that not all regions are surveyed each year but also the fact that the regions that have been surveyed each year have not been chosen randomly and some regions have only been surveyed once or twice. If you were to do a statewide estimate, what species would you want it for? This may be more cost effective than doing all the species. There is tremendous value in statewide estimates, understanding that part of the limitation is funding. What would it take to do a statewide estimate and what would it cost to get that information? Does the subsistence harvest have an impact on the recovery effort for the spectacles eiders, for example. Ted Swem in the USFWS Endangered Species Office would like to have a reliable estimate of the take of Steller's and Spectacled eiders by subsistence hunters to determine whether this activity poses a threat to the recovery potential for these species. CSU will provide more justification for their conclusion that reliable statewide estimates cannot be achieved with the current survey.

How do you get statewide estimates without region and subregion data? A statewide survey versus the way the surveys are conducted now by region and sub region.

Species Included in the Analyses:

Is there a down side to asking about all species as long as you are in the household? Lili has an opinion that there is not a downside to collecting all the information. The time and money is spent on setting up the survey and getting through the door. If you're in there, you might as well ask about other species as well. There is no benefit to asking about just one species. Is asking about categories of birds (ducks or geese) a good method to use? Jim says no because respondents are very precise in their answers and prefer to list species harvested rather than a category of birds. If people refuse to be surveyed, it should be noted as to why because it may be because the respondents are not getting paid for their information. Brief discussion on the pros and cons of paying respondents to participate in a survey.

Do we need to add to the attribute list that we are interested more in bird harvest than egg harvest? Do we need to be more specific on eggs? Add this to consideration list as we think about the objectives (this was added to the list). There is also identification issues associated with eggs more than birds. Given the current estimates we have now, is it worth collecting egg data in the future?

What does the potential of including closed species on a survey form do more harm than good? Or how would it be to conduct a survey exclusive to closed species.

The proposed CSU list of species into categories was reviewed and it was decided that although the review process was changed earlier today, this information could be useful to the group when establishing their objectives and priorities.

It was suggested that the Native Caucus develop a list of harvested bird species that are culturally important in each region.

Each group will submit their list of the following species to Luke and Dave. The Native Caucus will submit their list at the meeting in April. The categories are:

1. Species that are Commonly Harvested
2. Species of Conservation Concern
3. Species that are of Cultural Importance

Indigenous Inhabitants – Alaska Native Tribal Governments and regional entities have no information as to the allocation of harvest between Natives and non-Natives so this affects management strategies from the Tribal side.

APPENDIX E. SPECIES CATEGORIES USED IN SUMMARY OF PRECISION OF AMBCC SUBSISTENCE HARVEST DATA.

Species or Species Group[1]	Scientific name	Category
American Wigeon	*Anas americana*	Commonly Harvested Species
Brant	*Branta bernicla*	Commonly Harvested Species
Black Scoter	*Melanitta americana*	Commonly Harvested Species
Cackling Goose	*Branta hutchinsi*	Commonly Harvested Species
Cackling/Canada Goose		Commonly Harvested Species
Canvasback	*Aythya valisineria*	Commonly Harvested Species
Common Eider	*Somateria mollissima*	Commonly Harvested Species
Greater White-fronted Goose	*Anser albifrons*	Commonly Harvested Species
King Eider	*Somateria spectabilis*	Commonly Harvested Species
Lesser Canada Goose	*Branta canadensis*	Commonly Harvested Species
Long-tailed Duck	*Clangula hyemalis*	Commonly Harvested Species
Mallard	*Anas platyrhynchos*	Commonly Harvested Species
Northern Pintail	*Anas acuta*	Commonly Harvested Species
Scaup		Commonly Harvested Species
Snow Goose	*Chen caerulescens*	Commonly Harvested Species
Surf Scoter	*Melanitta perspicillata*	Commonly Harvested Species
White-winged Scoter	*Melanitta fusca*	Commonly Harvested Species
Emperor Goose	*Chen canagica*	Species of Conservation Concern
Steller's Eider	*Polysticta stelleri*	Species of Conservation Concern
Spectacled Eider	*Somateria fischeri*	Species of Conservation Concern
Goldeneye		Species Group
Murres		Species Group
Swans		Species Group
Teal		Species Group
Total ducks		Species Group
Total geese		Species Group
Total seabirds		Species Group

[1]- Commonly harvested species represent more than 2 of the subsistence harvest for the years (Oates, R. and Naves, unpublished data). Species groups include more than one species either because species could not be distinguished (Auklets, Cormorants, Goldeneye, Murres, and Teal) or were lumped after the survey (Total ducks, Total geese, Total seabirds). Species of Conservation Concern were identified by the Technical Working Group of the Subsistence Harvest Survey Review.

APPENDIX F. CONFIDENCE INTERVAL PERCENTAGE (CIP) OF AMBCC SUBSISTENCE BIRD HARVEST ESTIMATES BY SPECIES OR SPECIES GROUP, REGION, AND YEAR.

CIP values were calculated from subsistence harvest survey data compiled and analyzed by L. Naves (ADFG). The calculations are described in Appendix W of Naves et al. (2012).

2004	**Region**				
Species or Group[1]	**Bering Strait-Norton Sound**	**Gulf of Alaska-Cook Inlet**	**Interior Alaska**	**Upper Copper River**	**Yukon-Kuskokwim Delta**
Commonly Harvested Species					
Greater White-fronted Goose	53[2]		14		9
Mallard	39	66	16	37	12
Northern Pintail	16	73	21	78	12
Cackling Goose	50	91			10
Lesser Canada Goose	21	133	16	107	12
King Eider	21				23
Brant	20		94	96	17
Black Scoter		43	69	130	11
Scaup	101	34	55	113	10
Snow Goose	13		23		38
American Wigeon	66		17	99	17
Murre	22				
White-winged Scoter	85	29	20	130	51
Common Eider	12				30
Long-tailed Duck	73	96	42		20
Species Groups					
Auklets	16				
Cormorant	17	163			108
Swans	22	131	115	130	10
Total seabirds	14	92			34
Teal	44	66	29	55	15
Total ducks	11	32	15	46	8
Total geese	13	74	13	71	8
Species of conservation Concern					
Emperor Goose	13				24
Steller's Eider	179				131
Spectacled Eider	145				71

2005	Region			
Species or Group[1]	Bering Strait-Norton Sound	Bristol Bay	North Slope	Yukon-Kuskokwim Delta
Commonly Harvested Species				
Greater White-fronted Goose	33[2]	46	16	8
Mallard	41	28	70	10
Northern Pintail	60	34	99	11
Cackling Goose	24	16	29	7
Lesser Canada Goose	28	20	38	9
King Eider	24	41	14	21
Brant	26	96	29	13
Black Scoter	74	34		29
Scaup	52	124	129	26
Snow Goose	22	84	32	35
American Wigeon	40	82		45
Murre	36		81	124
White-winged Scoter	107	41		37
Common Eider	16	88	26	47
Long-tailed Duck	68	74	100	97
Canvasback	90	57		50
Surf Scoter	117	65		51
Species groups				
Cormorant	54			
Goldeneye	133	64		31
Auklet	36			
Swan	25	39	49	8
Teal	46	73		33
Total ducks	37	39	13	13
Total geese	17	27	15	6
Total seabirds	24	85	61	59
Species of conservation Concern				
Emperor Goose	18	81		18
Steller's Eider	76	120	49	67
Spectacled Eider	81		41	50

2006	Region	
Species or Group[1]	Interior Alaska	Yukon-Kuskokwim Delta
Commonly Harvested Species		
Greater White-fronted Goose	20[2]	13
Mallard	17	13
Northern Pintail	21	15
Cackling Goose		11
Lesser Canada Goose	17	14
King Eider		24
Brant	116	17
Black Scoter	50	19
Scaup	61	12
Snow Goose	59	18
American Wigeon	20	27
White-winged Scoter	24	23
Common Eider		41
Long-tailed Duck	37	25
Canvasback	42	24
Surf Scoter	52	27
Species groups		
Cormorant		116
Goldeneye	37	22
Swans	42	11
Teal	28	17
Total ducks	19	9
Total geese	17	9
Total seabirds		100
Species of conservation Concern		
Emperor Goose	126	17
Steller's Eider		135
Spectacled Eider		91

2007	Region				
Species or Group[1]	Bering Strait-Norton Sound	Bristol Bay	North Slope	Upper Copper River	Yukon-Kuskokwim Delta
Commonly Harvested Species					
Greater White-fronted Goose	23[2]	23	25		11
Mallard	27	21	175	55	15
Northern Pintail	19	30	148	65	14
Cackling Goose	22	25	58		9
Lesser Canada Goose	17	36	40	82	27
King Eider	24	35	32		28
Brant	32	38	46		18
Black Scoter	144	29	122		12
Scaup	133	77	111		11
Snow Goose	16		45		53
American Wigeon	36	74			17
Murre	17	122			
White-winged Scoter		51	175		23
Common Eider	17	74	29		51
Long-tailed Duck	60	102	67		21
Canvasback	150	92		66	29
Surf Scoter		50			25
Species Groups					
Cormorant	20				
Goldeneye		41		92	41
Auklet	17				
Swans	17	44	83	92	15
Teal	44	37			21
Total ducks	14	18	29	47	8
Total geese	13	19	24	82	10
Total seabirds	14	63	76		79
Species of conservation Concern					
Emperor Goose	34	63	176		29
Steller's Eider	186	130	135		62
Spectacled Eider	35	88	79		86

2008	Region			
Species or Group[1]	Aleutian-Pribilof Islands	Bristol Bay	North Slope	Yukon-Kuskokwim Delta
Commonly Harvested Species				
Greater White-fronted Goose		23	27	13
Mallard	45[2]	18	135	16
Northern Pintail	109	22	184	29
Cackling Goose	47	23	76	15
Lesser Canada Goose		24	41	15
King Eider		85	40	57
Brant	39	62	18	20
Black Scoter	71	56		23
Scaup	82	144		32
Snow Goose			40	39
American Wigeon		44		23
Murre	169			
White-winged Scoter	98			33
Common Eider		144	26	121
Long-tailed Duck		89	80	38
Canvasback				51
Surf Scoter		146		50
Species Groups				
Goldeneye	110	57		74
Swan		36	64	12
Teal	58	39		32
Total ducks	44	17	33	12
Total geese	34	20	22	9
Total seabirds	54	55	92	96
Species of conservation Concern				
Emperor Goose	75			17
Steller's Eider	126	98		
Spectacled Eider			184	121

2009	Region	
Species or Group[1]	North Slope	Yukon-Kuskokwim Delta
Commonly Harvested Species		
Greater White-fronted Goose	25[2]	8
Mallard	119	10
Northern Pintail	172	16
Cackling Goose	55	11
Lesser Canada Goose	57	10
King Eider	49	25
Brant	55	15
Black Scoter	75	13
Scaup		16
Snow Goose	45	31
American Wigeon		24
Murre		
White-winged Scoter		34
Common Eider	57	40
Long-tailed Duck	65	27
Canvasback		30
Surf Scoter		35
Species Groups		
Goldeneye		46
Swan	172	8
Teal		17
Total ducks	43	9
Total geese	22	7
Total seabirds		59
Species of conservation Concern		
Emperor Goose		34
Steller's Eider		119
Spectacled Eider	151	71

2010	Region		
Species or Group[1]	Interior Alaska	Kodiak Archipelago	Yukon-Kuskokwim Delta
Commonly Harvested Species			
Greater White-fronted Goose	21[2]		8
Mallard	22	23	10
Northern Pintail	41	57	17
Cackling/Canada Goose	22	124	9
King Eider			25
Brant			16
Black Scoter	61	81	13
Scaup	55	72	18
Snow Goose	54		27
American Wigeon	32	70	16
White-winged Scoter	28	47	17
Common Eider			44
Long-tailed Duck	52	43	29
Canvasback	28		24
Surf Scoter	68	29	18
Species Groups			
Goldeneye	66	25	15
Swan			9
Teal	42	38	19
Total ducks	33	19	11
Total geese	18	124	8
Total seabirds		143	52
Species of conservation Concern			
Emperor Goose			18
Steller's Eider			90
Spectacled Eider			90

2011	Region	
Species or Group[1]	Bristol Bay	Yukon-Kuskokwim Delta
Commonly Harvested Species		
Greater White-fronted Goose	31[2]	10
Mallard	17	16
Northern Pintail	19	22
Cackling/Canada Goose	28	10
King Eider	33	22
Brant	53	20
Black Scoter	29	14
Scaup	140	31
Snow Goose		54
American Wigeon	62	26
Murre		66
White-winged Scoter	30	28
Common Eider		43
Long-tailed Duck	38	44
Canvasback	134	54
Surf Scoter	47	39
Species Groups		
Cormorant	115	105
Goldeneye	47	29
Swan	23	13
Teal	32	26
Total ducks	15	10
Total geese	21	8
Total seabirds	86	38
Species of conservation Concern		
Emperor Goose	62	33
Steller's Eider		78
Spectacled Eider		109

[1]- Commonly harvested species are species that represented more than 2 of the subsistence harvest (Oates, R., and Naves, unpublished data). Species groups include species that were 1) lumped because they were difficult to distinguish (e.g. Auklets), 2) were an ecologically similar group of several species that were rarely harvested (e.g., Total seabirds), 3) of were an important management group (e.g., Total ducks). Species of Conservation Concern are species that are either listed as threatened by the U.S. Fish and Wildlife Service or were identified as a species of concern by the Alaska Department of Fish and Game or U.S. Fish and Wildlife Service. Lesser Canada, and Cackling Geese were identified separately in

surveys up until 2009 and lumped into Canada/Cackling Goose and Glaucous in thereafter. Scientific names are provided in Appendix E.

[2]- Confidence interval percentage is the one-sided 95 confidence interval/harvest estimate. CIP values were color-coded to distinguish estimates that are considered good (CIP≤50, green), moderate (50<CIP≤100, yellow), and poor (CIP>100, red). Blank cells indicate regions that either were not surveyed in a particular year or species or species groups were not recorded as being harvested in the region.

Appendix G. CONFIDENCE INTERVAL PERCENTAGE (CIP) OF AMBCC SUBSISTENCE EGG HARVEST ESTIMATES BY SPECIES OR SPECIES GROUP, REGION, AND YEAR.

	Region								
Year/Species or Species Group	**Aleutian-Pribilof Islands**	**Bering Strait-Norton Sound**	**Bristol Bay**	**Gulf of Alaska-Cook Inlet**	**Interior Alaska**	**Kodiak Archipelago**	**North Slope**	**Upper Copper River**	**Yukon-Kuskokwim Delta**
2004									
Murres		18[2]		59					
Glaucous Gull		27			126				33
Greater white-fronted Goose									25
Cackling Goose		110							17
Lesser Canada Goose		52		112	94				31
Terns		51		77	121				43
Glaucous-winged Gull				35					
Herring Gull				42	121				
2005									
Murres		21	92				44		126
Glaucous Gull		50	49				44		32
Greater white-fronted Goose		122					52		15
Cackling Goose		148	134				56		16
Lesser Canada Goose		42	120				56		14
Terns		59	97				56		34
Herring Gull			102						
2006									
Murres									135
Glaucous Gull									46
Greater White-fronted Goose									25
Cackling Goose									28

Year/Species or Species Group	Region: Aleutian-Pribilof Islands	Bering Strait-Norton Sound	Bristol Bay	Gulf of Alaska-Cook Inlet	Interior Alaska	Kodiak Archipelago	North Slope	Upper Copper River	Yukon-Kuskokwim Delta
Lesser Canada Goose					123				45
Terns									94
2007									
Murres		14	49				175		
Glaucous Gull		28	32						47
Greater White-fronted Goose		97					109		22
Cackling Goose		152	92						25
Lesser Canada Goose		61	86						50
Terns		59	77						39
Glaucous-winged Gull			118						
2008									
Murres	169								
Glaucous Gull			21				145		69
Greater White-fronted Goose							82		21
Cackling Goose			89						19
Lesser Canada Goose			89						32
Terns			31						81
Glaucous-winged Gull	42								
Herring Gull	102		108						
2009									
Murres									
Glaucous Gull									39
Greater White-fronted Goose							124		17
Cackling Goose									18
Lesser Canada Goose									27
Terns									39

Year/Species or Species Group	Region: Aleutian-Pribilof Islands	Bering Strait-Norton Sound	Bristol Bay	Gulf of Alaska-Cook Inlet	Interior Alaska	Kodiak Archipelago	North Slope	Upper Copper River	Yukon-Kuskokwim Delta
2010									
Murres									90
Large gull						27			29
Greater White-fronted Goose									18
Cackling/Canada Goose									18
Terns						143			54
2011									
Murres			77						109
Large gull			35						24
Greater White-fronted Goose			122						21
Cackling/Canada Goose			122						22
Terns			70						28

[1]- Species and species groups are ordered from highest to lowest egg harvest within each year based on total egg harvest from 2004-2011. Eggs that could not be reliably identified to species were lumped into species groups. Two groups of species that were identified separately in earlier surveys were lumped after 2009. Lesser Canada, and Cackling Geese were lumped into Canada/Cackling Goose and Glaucous, Glaucous-winged and Herring Gulls were lumped into Large gulls.

[2]- Confidence interval percentage is the one-sided 95 confidence interval/harvest estimate. CIP values were color-coded to distinguish estimates that are considered good (CIP ≤ 50, green), moderate (50 < CIP ≤ 100, yellow), and poor (CIP > 100, red). Gray cells identify regions that were surveyed in a particular year but no egg harvest estimates were obtained. Blank cells indicate regions that either were not surveyed in a particular year or eggs of species or species groups were not recorded as being harvested in the region.

Comparison of Alternative Designs for the Alaska Migratory Bird Subsistence Harvest Survey

31 March 2016

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EXECUTIVE SUMMARY

At the September 2015 meeting of the Technical Working Group (TWG) of the Alaska Migratory Bird Co-management Council (AMBCC), we presented our review of the subsistence harvest survey. The TWG concurred with our conclusion that the current survey design was not adequately meeting the objectives of the stakeholders. Our review also suggested alternative designs for evaluation. Subsequent discussions with all stakeholders led to a consensus decision to conduct a comparative analysis of the performance three designs, with the emphasis on estimation of the total harvest of the most commonly harvested species: 1) the All Regions design (survey all 10 subsistence harvest regions), 1) the Five Regions design (survey the five regions with the highest harvest) and, 3) the Four Regions design (survey the four regions with the highest harvest). The Five Regions design collectively accounts for approximately 91% of the statewide harvest and the Four Regions design accounts for approximately 84%. The budget amounts considered were $100K - $200K.

We used harvest data and cost estimates from prior AMBCC surveys to derive the optimal allocation of survey effort among regions, villages, and households for each design. Using the values for the optimal allocation calculations, we then computed a measure of the statistical precision (Confidence Interval Percentage, CIP) for the estimate of all commonly harvested species combined, for each commonly harvested species separately, and for three species of conservation concern, at both the regional and statewide scales.

All designs with budgets >$130K achieved the statewide precision criteria specified by the TWG (CIP < 0.50). The CIP values for the All Regions design were larger than the two restricted region designs, which had approximately the same precision. The two restricted regions designs produce biased estimates of statewide harvest because they do not include several regions in the survey. We therefore compared designs with a Mean Squared Error (MSE) statistic that combines both precision and bias. For smaller budgets, the restricted region designs have smaller MSE values than the All Regions Design, and for larger budgets the MSEs are approximately equal.

Regional estimates of total harvest were much less precise than statewide estimates for all designs. The regional harvest estimates from the restricted designs had better precision than the All Regions design, but in general none of the designs could produce regional estimates with the desired precision. For the All Regions design, regional CIP values were below 0.50 only for the Yukon-Kuskokwim Delta at the $200,000 budget level. With the Five Regions design, CIP values were below 0.50 only for the Yukon-Kuskokwim Delta for budgets of $130,000, $150,000, and $200,000 and for the North Slope for $200,000. The Four Regions design had similar results.

The CIP values for estimates of individual commonly harvested species were rarely less than 0.50 for any of the designs. The CIP values for Brant, Cackling/Canada Goose, White-fronted Goose, and Northern Pintail were generally the smallest, and CIP values for Common Eider,

Long-tailed Duck, Snow Goose and White-winged Scoter were generally the greatest. For the largest budget of $200,000, the average species CIP value was 0.78, 0.73, and 0.68 for the All Regions, Five Regions, and Four Regions designs, respectively. Precision for all three species was poor for all designs and budgets. CIP values were large (>2.00) for Emperor Goose, Spectacled Eider and Steller's Eider for all designs and budgets.

Our evaluation suggests that no single design can be expected to produce harvest estimates that satisfy all of the performance requirements of the stakeholders with realistic annual budgets. However, all of the designs are capable of producing acceptable estimates of the total harvest of commonly harvested species summed over all regions in the design. Performance and cost tradeoffs in the designs become more evident in comparisons of bias, regional estimate precision, and individual species precision. These results and stakeholder priorities should provide the foundation for making informed decisions about how to move forward with the survey.

At the February 2016 Technical Working Group meeting, the stakeholders unanimously decided that the Five Regions survey design with a budget of $150,000 for data collection should be implemented in 2016. However, there was concern expressed about our decision to establish a minimum of 5 sampled households in each village. ADFG harvest survey staff also suggested that very small villages (< 10 households) be deleted from the sample frame. Based on this input, we made two adjustments to the design: 1) 10 small villages were eliminated from the survey and, 2) a total of 10 households would be surveyed in all sampled villages. After making these changes, we recalculated the optimal number of villages that should be surveyed in each region and then estimated the CIPs for the species we examined in the previous analyses. With the adjusted survey, the number of sampled villages dropped from 48 to 45 and the CIPs were similar to the original Five Region design. The results of the reanalysis are provided in an addendum.

INTRODUCTION

In 2014, our Colorado State University team was contracted by the U. S. Fish and Wildlife Service (FWS) to review of the Alaska Migratory Bird Subsistence Harvest Survey (survey) and provide recommendations for revisions to the survey design as necessary. In September 2015, we presented our review of the survey to the Technical Working Group (TWG) of the Alaska Migratory Bird Co-management Council (AMBCC) and concluded that the current survey design was not adequately meeting the objectives of the stakeholders. We also suggested three alternative designs for consideration. At the September meeting, the TWG unanimously agreed that we compare two of these alternative survey designs by evaluating their effectiveness in achieving statistical precision objectives for harvest estimates of the most commonly harvested species. Stakeholders were also interested in performance of the designs at both regional and statewide scales.

The two initially chosen alternatives were a statewide design in which all 10 AMCC regions would be sampled (All Regions) and a design that sampled only a subset of regions with the highest annual harvest. Both designs are implemented every year. After discussions with the FWS Alaska Region Migratory Bird Office staff, we decided to evaluate two restricted region designs. The first, which we refer to as the Five Regions design, samples the five regions (Bristol Bay, Yukon-Kuskokwim Delta, Bering Strait-Norton Sound, North Slope, and Interior Alaska) with the highest harvest. The second, which we refer to as the Four Regions design, is the same except that it does not include Bristol Bay. The Five Regions design collectively accounts for approximately 91% of the statewide harvest and the Four Regions design accounts for approximately 84%. Thus, it is important to recognize that harvest estimates from both of these designs will not produce a true estimate for the entire state, i.e., they underestimate statewide harvest in any given year by the unknown harvest that occurred in the regions not sampled.

We used harvest data from prior AMBCC surveys to derive the optimal allocation of survey effort among regions for each design and computed the Confidence Interval Percentage (CIP) for the estimate of all commonly harvested species combined, for each commonly harvested species separately, and for three species of conservation concern, at both the regional and statewide scales. In this report we present the results of these analyses and use these to provide recommendations for consideration by the TWG about the survey design to be implemented in the 2016 harvest season.

METHODS

General Survey Design

All three designs employ a stratified two-stage sampling design. In sample survey terminology, regions are considered strata and within each region, villages are primary or first-stage sampling units and households within villages are considered secondary or second-stage sampling units. There are several alternative estimators of total harvest for multi-stage sampling designs (Cochran 1977) and we explored the use of both a simple unbiased estimator and a ratio estimator. Although the unbiased estimator can have slightly larger variance in some applications, we chose to use it primarily because of its simplicity in estimation of both statewide and regional harvest, i.e., total harvest and its variance are estimated independently in each region and the statewide estimate is then the sum of the regional estimates.

For every region in the design, a systematic random sample of villages is independently chosen to be surveyed, with the objective of obtaining a geographically dispersed set of villages (refer to Fig. 1 for an example illustration of the village systematic selection protocol). Within each selected village a simple random sample of households is chosen. Surveyors then follow the same interview and data collection protocols used in the current design. We note that this protocol has several differences with the current sampling design:

1. Rather than rotating among regions every year, the same regions are sampled each year.
2. The clustering of villages into subregions has been eliminated because the survey emphasis is on statewide and regional harvest estimates.
3. Villages are chosen randomly without regard to the number of households in the village.
4. Households are chosen completely at random from all village households. In the current design, households within moderate to large size villages are pre-stratified by the interviewer into 'harvester' and 'other' groups, and a larger proportion of the 'harvester' group is interviewed. This protocol requires that the interviewer devote sufficient effort to achieve accurate assignment of households to the 2 groups. This effort carries an associated cost and the resultant gain in statistical efficiency is unknown. Our rationale is that the use of a simplified and less expensive household selection protocol should be formally evaluated for its cost effectiveness.
5. Independent of village size, a fixed proportion of households are interviewed in each selected village (see Optimum Allocation section below).

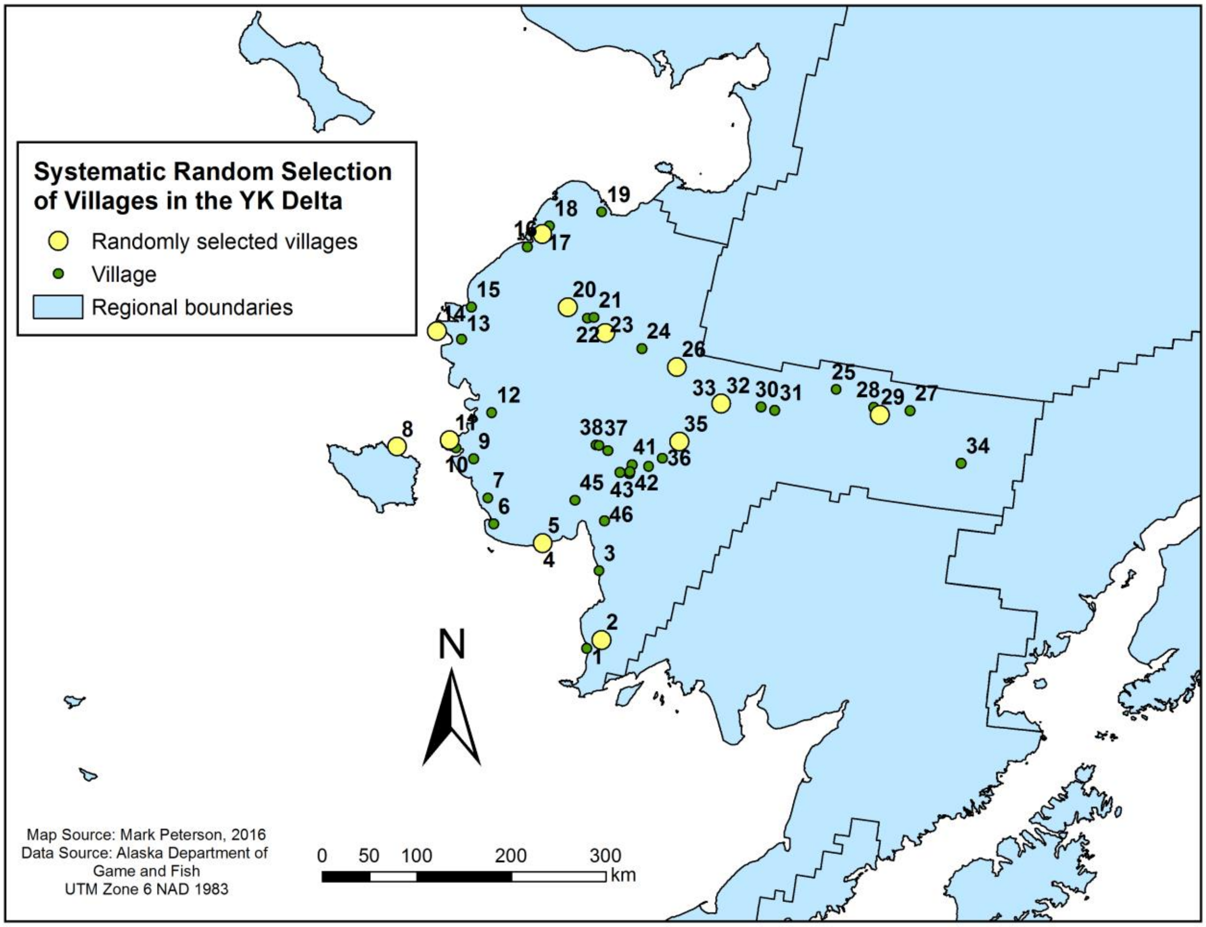

Figure 1. Example of systematic-random selection of 12 villages in the Yukon-Kuskokwim Delta. Villages are first numbered consecutively using geographic patterns of harvest as a guideline (in this case, coastal villages vs inland villages). Villages included in the subsistence harvest survey are then selected using a systematic design with a random starting point.

Optimum Allocation of Sampling Effort

Survey sampling statisticians have developed statistical techniques for determination of the most cost-efficient strategy for assigning sampling effort to each stage of a given sampling design (Hansen et al. 1953, Cochran 1977, Thompson 2012). In our situation, this process translates into decisions about how many villages should be sampled in each region, and what proportion of households in a selected village should be interviewed in a given region. These decisions depend upon:

1. A specified annual survey budget amount.
2. Region-specific estimates of: i) fixed costs, ii) per village cost, iii) per household cost.

3. Region-specific estimates of i) variation in annual harvest among villages, ii) variation in annual harvest among households within villages.

Survey budget

At the September AMBCC meeting, FWS requested that we evaluate designs with a budget range of $100K - $200K.

Cost estimates

We developed cost estimates in coordination with L. Naves (Alaska Department of Fish and Game, hereafter ADFG) based on estimates from previous surveys and adjustments for current costs of airline travel. Indirect costs were added to each cost category based on previous indirect cost charges from each region. Fixed costs in a region include: 1) the cost for each of the regional coordinators to travel from the regional hub to Anchorage for three days to be trained by the Subsistence Harvest Division of ADFG and, 2) five days of salary to coordinate the survey effort and compile the data for submission to ADFG. The hourly salary for the regional coordinator was $47/hr. in each region except the Yukon-Kuskokwim Delta where we used $30/hr. because the coordinator duties likely would be partially subsidized by the FWS (L. Naves and E. Taylor, pers. Comm.). The fixed costs varied by region but averaged about $4,300 per region (Table 1). The per/village cost includes the cost for surveyors to travel to the regional hub to be trained by the regional coordinator. Costs ranged from $2100-$2900 per region but to simplify the calculations we used an average cost of $2400/village. The household cost is the amount paid ($40) to a surveyor for obtaining the annual survey data from a household (which requires at least two visits per household) and the overhead cost charged by each region (approximately $10), resulting in a total per household cost of $50.

Table 1. Fixed cost estimates by region. Fixed costs include costs of training and survey implementation by the regional coordinator.

Region	Fixed cost
Gulf of Alaska-Cook Inlet	$ 4,354
Kodiak Archipelago	$ 4,456
Aleutian-Pribilof Islands	$ 4,695
Bristol Bay	$ 4,161
Yukon-Kuskokwim Delta	$ 3,188
Bering Strait-Norton Sound	$ 4,352
Northwest Arctic	$ 4,386
North Slope	$ 4,330
Interior Alaska	$ 4,256
Upper Copper River	$ 4,857

Variance estimates

The variable used in the variance analysis was the total harvest of all commonly harvested species, which we defined as any species that represented at least 2% of the subsistence harvest, based on R. Oates and L. Naves (unpublished data) harvest estimates.

We used 2004 – 2014 AMBCC harvest survey statistics provided by L. Naves (ADFG) to conduct the variance analysis. The dataset contained survey statistics from a total of 397 surveyed villages, about ½ of which had been surveyed in more than 1 year.

We performed the sample allocation analysis separately for each design. Estimation of the required variance components for the analyses was problematic because a complete survey of all regions contained in any of the designs had never been implemented in a single year. In addition, several regions had been sampled only a few years and/or had only a small sample of villages. Therefore, we pooled data from all previous surveys into a single dataset (representing a hypothetical single year) and we averaged statistics from villages that had been sampled in multiple years. These decisions resulted in a dataset of harvest statistics from 197 different villages (Fig. 2). Although we used all the available data for variance estimation, we acknowledge that we have made the assumption that the resultant estimates are reasonable approximations to the variation in harvest that would be observed in in an actual statewide survey conducted in a single year.

We also modified the sample frame of villages in each region. The variance of estimates of harvest totals from multi-stage sampling designs can be significantly inflated by having extremely large variation in the size of the first stage (village) sampling units (Hansen et al. 1953). In our situation, every region except the Upper Copper River had at least 1 village of extreme size. Therefore, we were motivated to try and mitigate the effect of these villages on the expected precision of harvest estimates. Based on an examination of the distribution of village size, we decided to divide a village into multiple 'neighborhoods' if it exceeded a threshold value of 300 households. Each of these neighborhoods is then considered as an independent village in the sampling frame. For example, Kotzebue has an average village size of 960 households, so we divided it into 4 neighborhoods of 240 households. Each of these 4 neighborhoods was then assigned a new unique village number in the sampling frame. We also note that our approach of creating a single dataset allows us to calculate estimates for statewide and regional harvest.

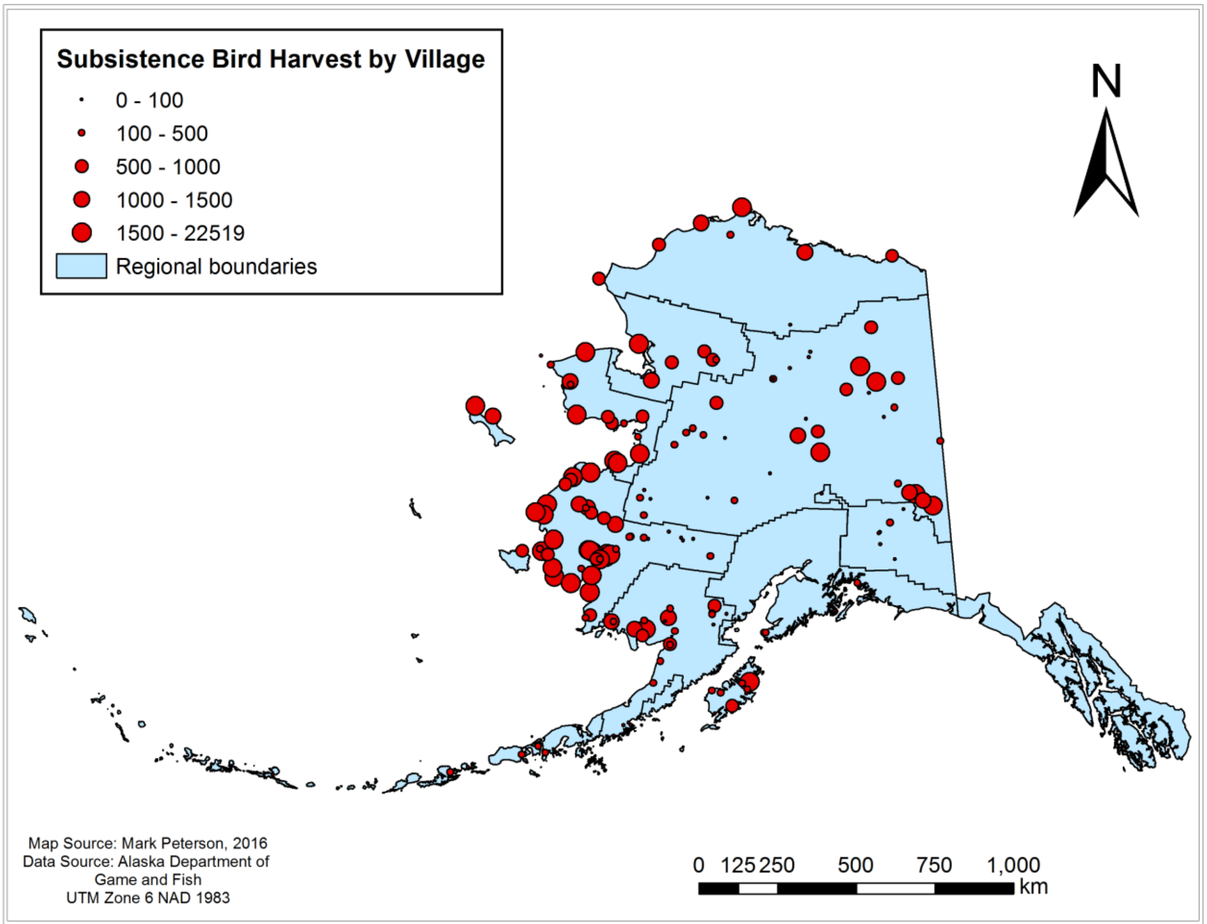

Figure 2. Mean annual harvest of all commonly harvested species by village based on Alaska Migratory Bird Co-management Council data 2004-2014.

Comparative Evaluation of Alternative Designs

For each design and budget, the optimum allocation analysis determines the number of villages in each region to be sampled and the proportion of households to be interviewed in a village. Given these sample sizes, we then used the appropriate formulas to calculate for each design the expected sampling variance of each regional harvest estimate. The sum of these variances is then the variance of the combined harvest estimate for all regions in the design. We also calculated an estimate of design bias, which we defined as the difference between the total harvest estimate from each design and the statewide harvest estimate from the All Regions design.

We compared the performance of each design with two statistics. The Confidence Interval Percentage (CIP) is defined as (2 * the coefficient of variation) and is considered a measure of the relative sampling variance (precision) of the harvest estimate. The concept of precision can be thought of as a measure of the variability in the harvest estimates that would result from repeatedly selecting different random samples from the list of sampling units (households). The

Mean Squared Error (MSE) statistic combines both variance and bias into a single index (variance + bias^2) that represents both the repeatability of the sample estimate and the average difference between the average sample estimate and the true population value.

We used only the CIP statistic for comparison of statewide estimates for individual commonly harvested species and for 3 species of conservation concern, i.e., Emperor Goose, Steller's Eider, and Spectacled Eider.

RESULTS

Optimal Allocation of Effort to Regions and Villages

For the All Regions design, the optimum allocation results for smaller budgets resulted in some regions having only 1 sampled village and/or very few households interviewed. These sample sizes compromise the ability to produce valid estimates of variance and we therefore imposed the constraints that every region would have at least 2 sampled villages and 5 households sampled per village.

Regions with larger harvest, more villages and households, and greater variance in harvest among villages generally receive more sampling effort (Tables 2-4). The number of villages sampled in each region is relatively small because of the large cost required per village relative to the cost of interviewing a household. Note that in the Five Regions and Four Regions designs, fewer households are actually interviewed for a given budget than in the All Regions design, but more villages are sampled. This result is largely due to the fact that more money is available per region and that the proportion of households sampled per village is generally smaller.

Table 2. Number of villages (Vill) and households (HH) surveyed per region based on optimum allocation calculations for different budget estimates for the All Regions survey design.

		Estimated Budget							
	Prop	$100,000		$130,000		$150,000		$200,000	
Region	HH[1]	Vill	HH[2]	Vill	HH	Vill	HH	Vill	HH
Gulf of Alaska-Cook Inlet	0.19	2	50	2	50	2	50	2	50
Kodiak Archipelago	0.14	2	54	2	54	2	54	2	54
Aleutian-Pribilof Islands	0.12	2	30	2	30	2	30	2	30
Bristol Bay	0.07	2	10	2	10	2	10	4	20
Yukon-Kuskokwim Delta	0.05	2	12	8	48	12	72	19	114
Bering Strait-Norton Sound	0.08	2	22	2	22	3	33	4	44
Northwest Arctic	0.13	2	36	2	36	2	36	2	36
North Slope	0.05	2	18	2	18	3	27	6	54
Interior Alaska	0.08	2	10	5	25	7	35	12	60
Upper Copper River	0.32	2	48	2	48	2	48	2	48
Total		20	290	29	341	37	395	55	510

1- Proportion of households sampled per village.
2- Expected number of households surveyed based on average village size in the region.

Table 3. Number of villages (Vill) and households (HH) surveyed per region based on optimum allocation calculations for different budget estimates for Five Regions survey design.

		Estimated Budget							
	Prop	$100,000		$130,000		$150,000		$200,000	
Region	HH[1]	Vill	HH[2]	Vill	HH	Vill	HH	Vill	HH
Bristol Bay	0.07	2	10	3	15	4	20	6	30
Yukon-Kuskokwim Delta	0.05	12	72	17	102	20	120	28	168
Bering Strait-Norton Sound	0.08	3	33	4	44	5	55	6	66
North Slope	0.05	4	36	5	45	6	54	8	72
Interior Alaska	0.08	8	40	11	55	13	65	18	90
Total		29	191	40	261	48	314	66	426

1- Proportion of households sampled per village.
2- Expected number of households surveyed based on average village size in the region.

Table 4. Number of villages (Vill) and households (HH) surveyed per region based on optimum allocation calculations for different budget estimates for Four Regions survey design.

		Estimated Budget							
	Prop	$100,000		$130,000		$150,000		$200,000	
Region	HH[1]	Vill	HH[2]	Vill	HH	Vill	HH	Vill	HH
Yukon-Kuskokwim Delta	0.05	14	84	20	120	23	138	31	186
Bering Strait-Norton Sound	0.08	3	33	4	44	5	55	7	77
North Slope	0.05	5	45	6	54	7	63	9	81
Interior Alaska	0.08	9	45	12	60	14	70	20	100
Total		31	207	42	278	49	326	67	444

1- Proportion of households sampled per village.

2- Expected number of households surveyed based on average village size in the region.

Performance of Statewide Estimates of All Commonly Harvested Species

Confidence Interval Percentage (CIP) for commonly harvested species combined achieved the precision criteria specified by the TWG (CIP < 0.50) for all combinations of designs and budgets except for the All Regions design with a $100,000 budget (Figure 3). The CIP values for the All Regions design were larger than the two restricted region designs, which had approximately the same precision.

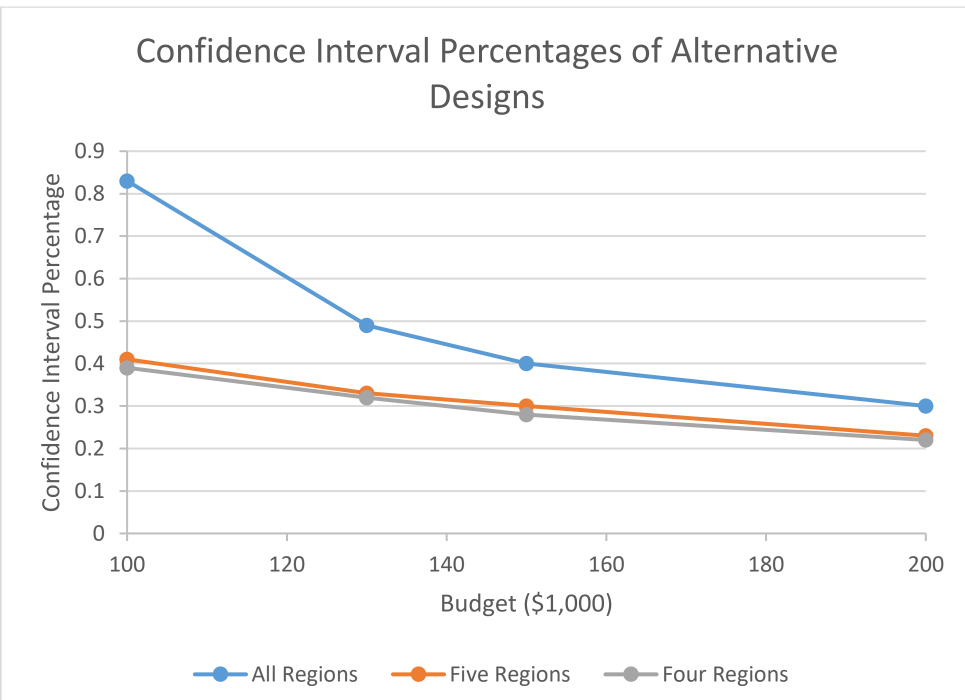

Figure 3. Confidence Interval Percentage of statewide harvest estimate of all commonly harvested species for alternative survey designs and budgets.

For all budget amounts except $200,000, the restricted region designs both had smaller MSE values than the All Regions design. The Five Regions design had the smallest MSE values (Figure 4).

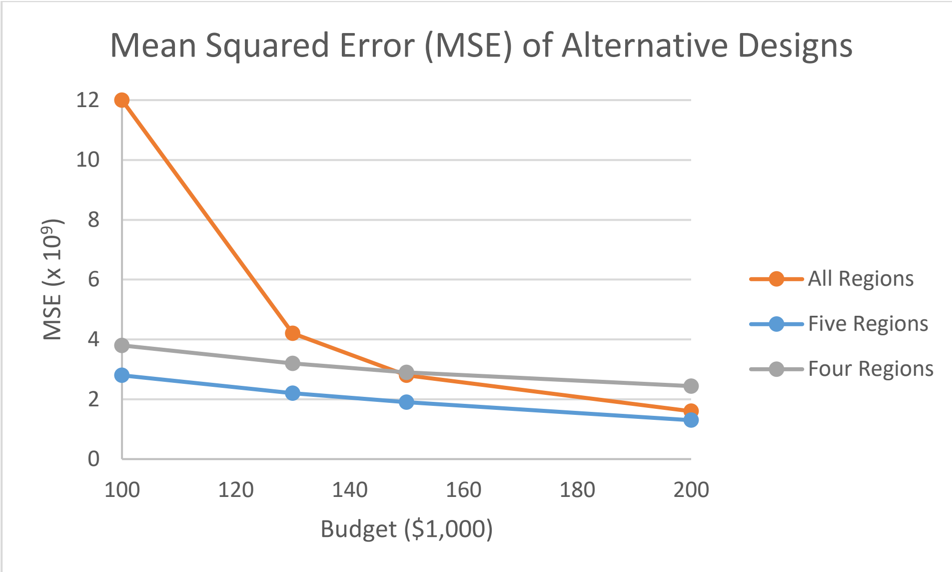

Figure 4. Mean Squared Error (MSE) of statewide harvest estimate of all commonly harvested species for alternative survey designs and budgets.

Performance of Regional Estimates of All Commonly Harvested Species

Regional estimates of total harvest were much less precise than statewide estimates. For the All Regions design, regional CIP values were below 0.50 only for the Yukon-Kuskokwim Delta at the $200,000 budget level (Figure 5). With the Five Regions design, CIP values were below 0.50 only for the Yukon-Kuskokwim Delta for budgets of $130,000, $150,000, and $200,000 and for the North Slope for $200,000 (Figure 6). The results were similar for the Four Regions design (Figure 7).

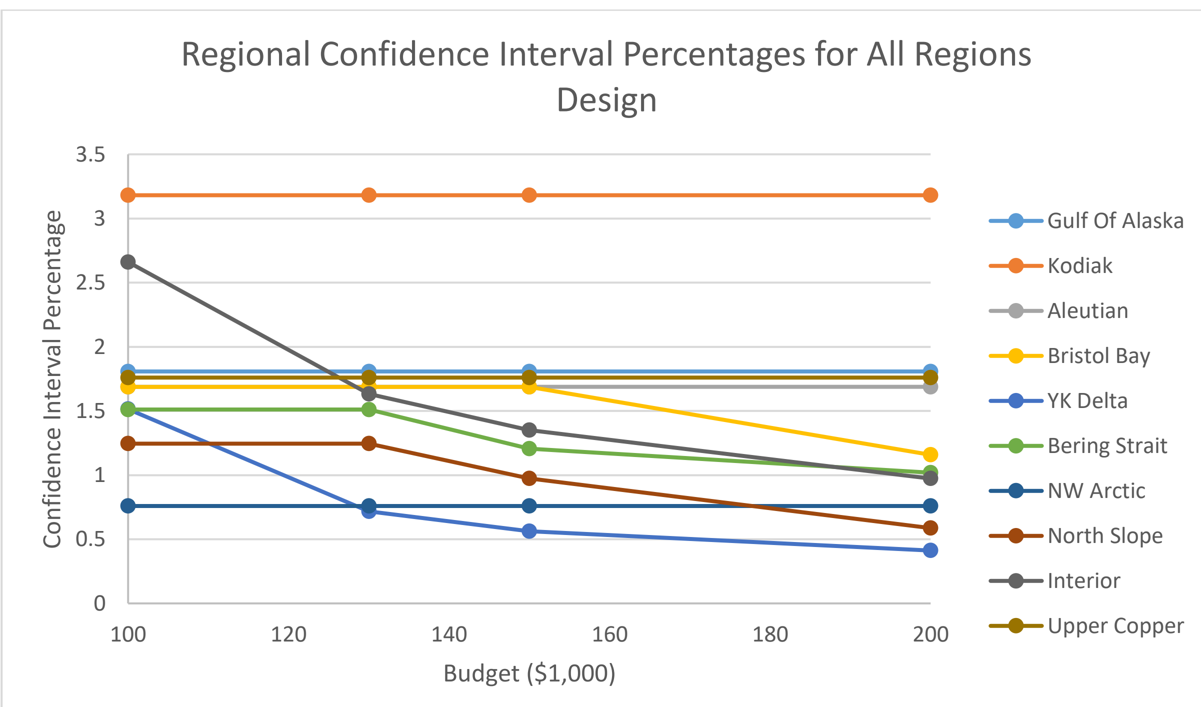

Figure 5. Regional Confidence Interval Percentage of commonly harvested species for All Regions design.

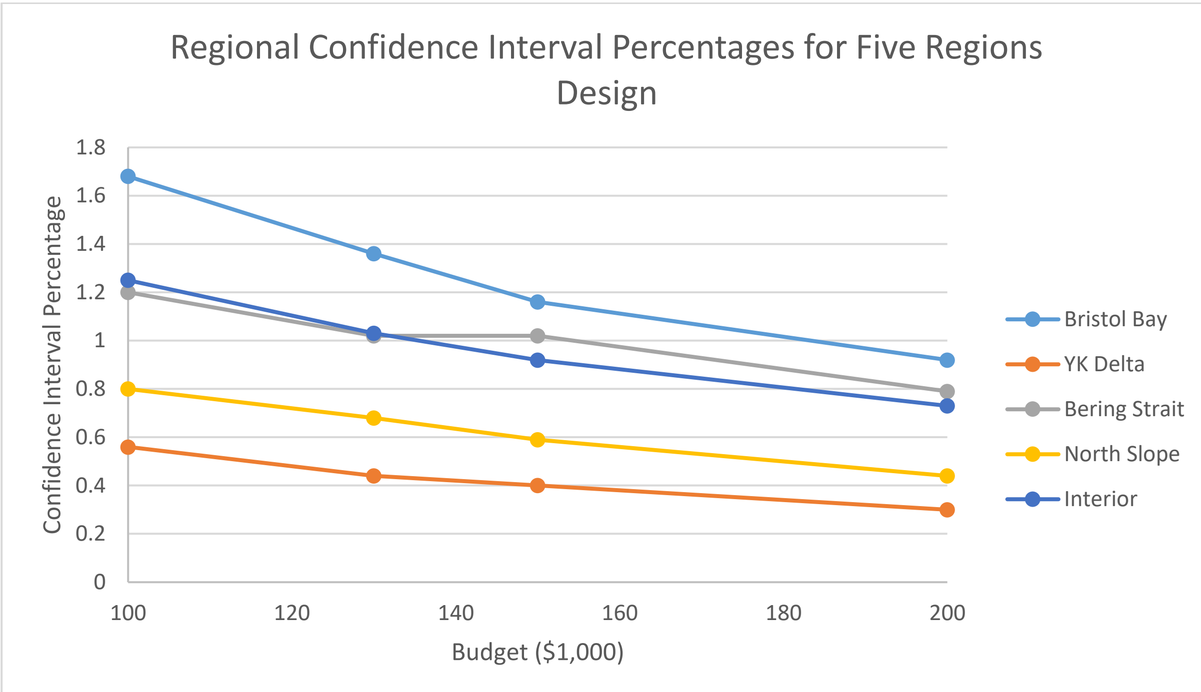

Figure 6. Regional Confidence Interval Percentage of commonly harvested species for Five Regions design.

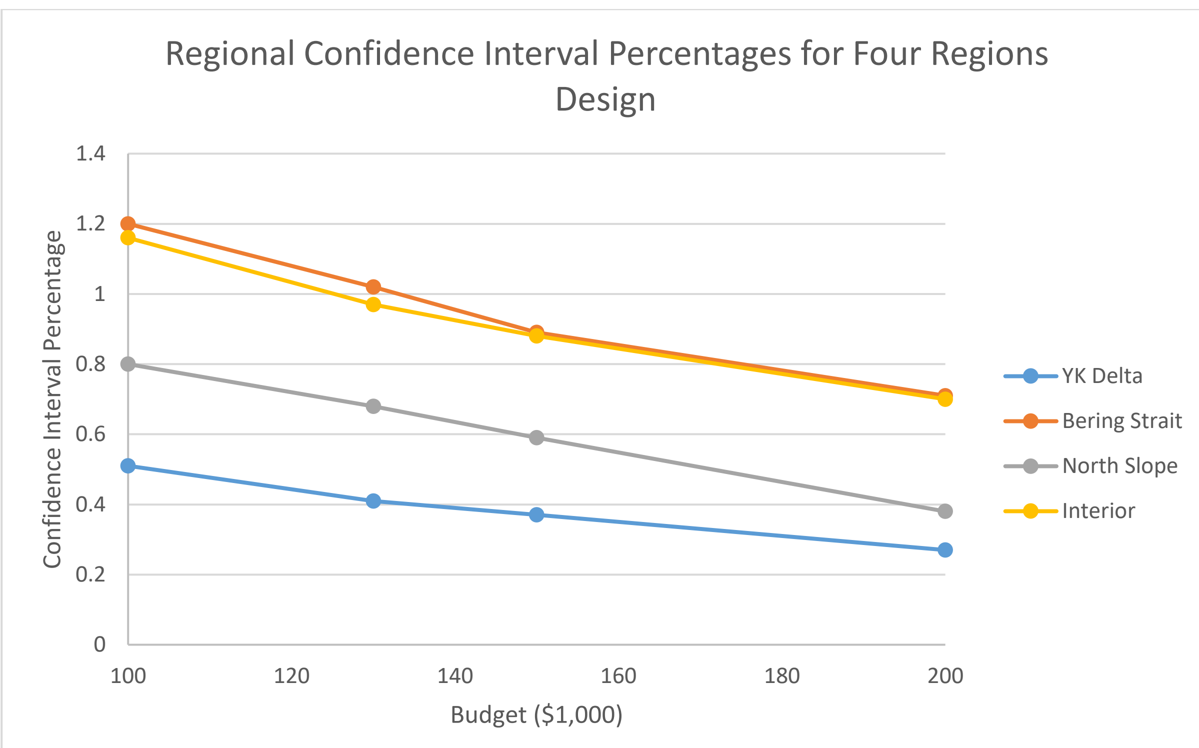

Figure 7. Regional Confidence Interval Percentage of commonly harvested species for Four Regions design.

Performance of Estimates of Individual Species Harvest

Commonly harvested species

The CIP of estimates of individual species was rarely less than 0.50 for any of the designs (Appendices 1a-c.). The CIP values for Brant, Cackling/Canada Goose, White-fronted Goose, and Northern Pintail were generally the smallest, and CIP values for Common Eider, Long-tailed Duck, Snow Goose and White-winged Scoter were generally the greatest. For the largest budget of $200,000, the average species CIP was 0.83, 0.71, and 0.66 for the All Regions, Five Regions, and Four Regions designs, respectively.

Species of conservation concern

Informed and effective conservation strategies for species of conservation concern that are subject to subsistence or sport harvest generally require estimates of population parameters and harvest that can be considered statistically reliable. CIP values for the harvest estimates for all three species suggest that the alternative designs and budgets under consideration will not be capable of producing estimates with acceptable precision (Appendices 1a-c). The statewide Spectacled Eider harvest estimates too imprecise to be considered at all reliable. The precision of Emperor Goose and Steller's Eider estimates were smaller (CIP ~ 2.0) but would still be considered imprecise for management purposes. It might be possible to conduct additional analyses to investigate how much additional sampling effort would be required to achieve acceptable precision, but we caution the data available from AMBCC surveys for these species is limited.

DISCUSSION OF ASSUMPTIONS

Variance estimates

A critical step in the development of a new or significantly revised survey design is the use of any data available that can inform decisions about the allocation of survey effort/cost to the various stages of the design, e.g., regions, villages, households. Although we were fortunate to have available the archived AMBCC survey data and the institutional memory and expertise of the ADFG subsistence harvest survey staff, available data from prior surveys commonly does not match exactly with the required statistics for an allocation analysis of the new design. Therefore, analysts must use their prior experience and best judgement to employ assumptions and analysis techniques necessary to accomplish the task.

In our evaluation, the potentially most important of these issues was the fact that only a subset of regions was sampled in any given past year and that during the 10-year history of the AMBCC survey there has been a substantial disparity in survey effort among regions. As we previously described, we reduced this dataset to a single statewide survey dataset of 197 villages by using average statistics for villages sampled in multiple years and pooling over all survey years. This was the dataset used to estimate the variance components for the optimum allocation analysis and it is important to recognize two potential sources of inaccuracy in these estimates. First, we have unequal information about individual village harvest because of the differences in the number of times they have been surveyed. Our analysis does not account for this inequality. Second, ample evidence exists from previous AMBCC surveys that regional harvest can vary substantially among years. However, we do not have adequate data to estimate how the variance in harvest among regional villages and households may vary from year to year. Our analysis pools data from ten years of surveys and assumes that all regions and villages were sampled in a single year, which may affect the accuracy of our estimates of variation in harvest among villages and households within a region in a given year.

The current AMBCC survey design includes a protocol in which households in sampled villages are pre-stratified into 'harvester' and 'other' strata, and the 'harvester' stratum is surveyed more heavily. Our design uses a simple random sample of households. Stratification usually results in some gain in precision relative to a simple random sampling, assuming the assignment of the sampling units to strata is accurate, but the past effectiveness of this technique has not been evaluated for the AMBCC survey. Although our protocol may result in some increase in estimation of variance among households, our premise is that this increase will be offset by advantages of a simplified protocol that does not involve additional surveyor time and acknowledgement that the assignment of households to harvester strata prior to the harvest season is at risk to significant inaccuracy.

In our redesigned survey, we subdivided large villages into multiple 'neighborhoods' which then were considered as independent villages in the sampling frame. This step required that we assign harvest statistics to these neighborhoods and we did so by evenly dividing the statistics for the original large village. Therefore, all neighborhoods created from a large village have the same harvest characteristics and the same number of households, which undoubtedly induces some underestimation of the variance among villages within a region.

Seasonal estimates and missing data

Our analysis considers only total annual harvest, i.e., all seasons combined. We acknowledge that stakeholders have expressed an interest in seasonal estimates as well, but our approach has been to use total harvest to compare performance of the alternative designs. Although we cannot speculate on the precision of seasonal estimates we are comfortable with assuming that the best design based on total harvest will also be best for seasonal harvest estimates. We also acknowledge that we have assumed that missing data is not a problematic issue for estimation of total harvest.

Data quality

In our last report we discussed several data quality concerns and provided suggestions on special studies that could be conducted to fully address these concerns. At the September meeting the TWG agreed to focus on the evaluation of alternative designs and not on special studies. We acknowledge that our evaluation of alternative designs is concerned only with the sampling error of the estimators and not the biases that will result from non-sampling errors such as nonresponse and measurement error. However, our perspective is that the choice of an alternative design based on our evaluation will not have an impact on the relative seriousness of non-sampling errors, i.e., the negative effect of these errors will be the same for all designs.

CONSIDERATIONS FOR SELECTION OF AN ALTERNATIVE HARVEST SURVEY DESIGN

A key consideration in the selection of an alternative design is the geographic scale of the survey. We have provided three alternatives, the All Regions, Five Regions, and Four Regions designs. The All Regions design includes all of the subsistence harvest regions (except Southeast Alaska which has not been included in any AMBCC bird harvest surveys) and therefore provides a valid estimate of total subsistence migratory bird harvest in Alaska. The drawback of the All Regions design is that by including regions with low harvest, the CIPs and MSEs of the harvest survey estimates are greater than the Five Regions or Four Regions designs for the same cost. It is important to remember, however, that the Five Regions and Four Regions designs provide only an index of statewide harvest. As we noted in the previous report, inferences about future shifts in spatial distribution and composition of statewide harvest will be compromised in monitoring programs based on a survey design that excludes regions. Also, the loss of outreach, education, and employment opportunities, and lack of harvest documentation in the non-surveyed regions could reduce engagement, support, and cooperation in the migratory bird subsistence harvest co-management process.

Our analysis indicates that for budget amounts within the range considered in our evaluation, none of the alternative designs will be capable of producing estimates of total harvest of common species with CIP < 0.50 for regions with high harvest or CIP < 1.00 for regions with lower harvest. Alternatively, the analysis indicates all of the survey designs except the All Regions design with a budget of $100,000 can achieve the precision criteria of CIP < 0.50 for statewide total harvest. This result may seem surprising, but it is common in stratified designs that the relative precision (e.g., CIP) of the total estimate (e.g., statewide) is less than the relative precision of the estimates for individual strata (e.g., regions).

Formal harvest management strategies for individual species typically require precise harvest estimates. A CIP value < 0.50 is achieved at the maximum budget of $200,000 for two of the species (Canada/Cackling Goose, White-fronted Goose) with the All Regions design, three of the species (same as the All Regions with the addition of Northern Pintail) for the Five Regions design, and four of the species (same as the Five Regions design with the addition of Brant) for the Four Regions design.

No single design can be expected to achieve all of the precision criteria for all stakeholders. Our evaluation provides statistical performance information about the tradeoffs among the designs in achieving multiple objectives, which is critical to the process of reaching an informed decision about the survey design to be implemented in the 2016 harvest season. However, our philosophy is that this decision represents only the next step in establishment of a long term subsistence harvest monitoring program that can be justified based upon its direct contributions to Alaskan migratory bird conservation and the maintenance of cultural and social values of Native Alaskans. We acknowledge that the implementation of any of the alternative survey designs in 2016 will present significant challenges in logistics, training, and analysis, but the experience and lessons learned are necessary steps in any transition period. Additionally, the data collected in 2016 will provide the valuable opportunity to evaluate the accuracy of the critical statistical design parameters that we derived from historical AMBCC surveys, and make adjustments as necessary in the allocations of survey effort, budget estimates and perhaps even modifications to the basic design. This process of evaluation and the experience gained in 2016 should then provide a solid foundation for a cost-effective operational program.

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APPENDICIES

Appendix 1a. Confidence Interval Percentage (CIP) of species harvest estimates for the All Regions design. Values highlighted in green achieve the desired CIP < 0.50 criteria.

	Estimated Budget			
Commonly Harvested Species	$100K	$130K	$150K	$200K
American Widgeon	1.73	1.04	0.88	0.66
Brant	1.57	0.98	0.82	0.63
Black Scoter	2.24	1.15	0.95	0.73
Cackling/Canada Goose	1.07	0.59	0.48	0.37
Canvasback	2.69	1.57	1.31	0.97
Common Eider	1.98	1.92	1.55	1.27
White-fronted Goose	1.07	0.71	0.57	0.39
King Eider	1.92	1.33	1.07	0.73
Long-tailed Duck	2.87	1.82	1.52	1.25
Northern Pintail	1.35	0.82	0.68	0.53
Scaup	3.41	1.65	1.32	0.99
Snow Goose	2.80	2.24	1.80	1.51
Surf Scoter	2.54	1.47	1.27	1.03
White-winged Scoter	3.12	1.91	1.60	1.22
Species of Conservation Concern				
Emperor Goose	3.92	3.26	2.66	2.28
Spectacled Eider	9.48	9.32	8.89	6.54
Steller's Eider	5.98	4.00	3.35	2.73

Appendix 1b. Confidence Interval Percentage (CIP) of species harvest estimates for the Five Regions design. Values highlighted in green achieve the desired CIP < 0.50 criteria.

	Estimated Budget			
Commonly Harvested Species	$100K	$130K	$150K	$200K
American Widgeon	0.93	0.77	0.69	0.56
Brant	0.89	0.73	0.65	0.54
Black Scoter	1.04	0.85	0.76	0.60
Cackling/Canada Goose	0.51	0.42	0.37	0.30
Canvasback	1.27	1.05	0.95	0.77
Common Eider	1.52	1.30	1.16	1.03
White-fronted Goose	0.53	0.44	0.39	0.31
King Eider	0.98	0.81	0.72	0.57
Long-tailed Duck	1.70	1.44	1.30	1.11
Mallard	0.75	0.61	0.55	0.44
Northern Pintail	0.73	0.60	0.54	0.44
Scaup	1.43	1.14	1.02	0.79
Snow Goose	1.88	1.59	1.40	1.24
Surf Scoter	1.39	1.15	1.05	0.86
White-winged Scoter	1.65	1.39	1.26	1.05
Average	1.15	0.96	0.86	0.71
Species of Conservation Concern				
Emperor Goose	2.92	2.50	2.24	2.01
Spectacled Eider	8.86	7.32	6.38	5.34
Steller's Eider	3.38	2.88	2.60	2.27

Appendix 1c. Confidence Interval Percentage (CIP) of species harvest estimates for the Four Regions design. Values highlighted in green achieve the desired CIP < 0.50 criteria.

	Estimated Budget			
Commonly Harvested Species	$100K	$130K	$150K	$200K
American Widgeon	0.87	0.73	0.66	0.53
Brant	0.80	0.66	0.59	0.48
Black Scoter	0.97	0.78	0.71	0.56
Cackling/Canada Goose	0.50	0.40	0.36	0.29
Canvasback	1.17	0.98	0.89	0.71
Common Eider	1.50	1.30	1.15	0.96
White-fronted Goose	0.49	0.41	0.37	0.29
King Eider	0.87	0.73	0.65	0.52
Long-tailed Duck	1.64	1.39	1.26	1.05
Mallard	0.75	0.62	0.57	0.44
Northern Pintail	0.73	0.61	0.54	0.43
Scaup	1.32	1.04	0.94	0.73
Snow Goose	1.86	1.57	1.39	1.13
Surf Scoter	1.32	1.10	1.01	0.84
White-winged Scoter	1.57	1.34	1.23	1.01
Average	1.09	0.91	0.82	0.66
Species of Conservation Concern				
Emperor Goose	3.01	2.58	2.31	1.94
Spectacled Eider	4.73	4.10	3.68	3.12
Steller's Eider	3.52	3.01	2.74	2.34

ADDENDUM

The subsistence harvest survey Technical Working Group (TWG) of the Alaska Migratory Bird Co-management Council (AMBCC) met on 22 February 2016 to review the alternative survey designs we proposed in the 15 January 2016 report (Meeting Notes are provided at the end of this report). The three stakeholder groups unanimously approved that the Five Region design with a survey budget of $150,000 be implemented in 2016. During the meeting, concerns were raised by the NC and ADF&G about the small number of households surveyed in smaller villages using the Five Region design. ADF&G also felt that it would be difficult to recruit surveyors if the number of households surveyed in a village was less than 10. To address these concerns and to simplify the implementation of the survey, in consultation with the Subsistence Harvest Division at ADF&G, we decided to survey a fixed number of households (10) per village. In addition, James Fall pointed out that several of the villages with fewer than 10 households were either no longer occupied or were occupied only intermittently. We decided, therefore, to eliminate villages with less than an average of 10 households over the 2004-2014 period. This resulted in 10 villages being removed from the sampling frame in the 5 regions included in the survey (4 villages were dropped from the Bristol Bay Region and 6 were dropped from the Interior). While reviewing the village size data, we also noticed that the village size for several of the villages was smaller in the harvest data set than the village size data set that was based on census data. After rechecking the village sizes in the two data sets it was clear that the village size data in the harvest data was incorrect so we used the village size from the census data in our calculations. This resulted in an increase in average village size in several of the regions which increased regional and survey-wide harvest estimates. After setting the number of households surveyed per village to 10, removing villages with less than 10 households, and using the village size values from the census data, we recalculated the CIP values for the species and regions. Although the variances of the estimates increased with these changes, the CIPs of all commonly harvested species combined were slightly lower for the revised design than the original design for each region all regions combined (Table A1). The CIP for individual species were also lower with the revised design (Table A2). The decrease in the CIPs with the revised design was primarily due to the increase in estimated harvest as a result of using the revised village sizes and removing small villages.

Table A1. Number of villages (Vill), households (HH), and Confidence Interval Percentages (CIP) for commonly harvested species by region and for all regions combined based on the original and the revised Five Regions survey designs.

	Original Design			Revised Design		
Region	Vill	HH[1]	CIP	Vill	HH[2]	CIP
Bristol Bay	4	20	1.16	4	40	1.08
Yukon-Kuskokwim Delta	20	120	0.40	21	210	0.35
Bering Strait-Norton Sound	5	55	0.89	5	50	0.82
North Slope	6	54	0.59	5	50	0.59
Interior Alaska	13	65	0.92	10	100	0.98
All regions combined	48	314	0.30	45	450	0.29

1- Expected number of households surveyed based on average village size in the region.

2- Expected number of households surveyed assuming 10 households are surveyed in each village.

Table A2. Confidence Interval Percentage (CIP) of species harvest estimates for the revised Five Regions design with 10 households surveyed per village and dropping villages with less than 10 households. Values highlighted in green achieve the desired CIP < 0.50 criteria.

Commonly Harvested Species	CIP
American Wigeon	0.62
Brant	0.57
Black Scoter	0.62
Cackling/Canada Goose	0.32
Canvasback	0.84
Common Eider	1.01
White-fronted Goose	0.38
King Eider	0.71
Long-tailed Duck	0.95
Mallard	0.50
Northern Pintail	0.48
Scaup	0.92
Snow Goose	1.19
Surf Scoter	0.75
White-winged Scoter	1.09
Average	0.73

Species of Conservation Concern	CIP
Emperor Goose	1.55
Spectacled Eider	3.08
Steller's Eider	1.78

MEETING NOTES

Notes from Technical Working Group meeting 22 February 2016 recorded by Patty Schwalenberg including edits by D. Otis and L. George.

CSU Subsistence Harvest Monitoring Review

Technical Working Group Meeting

U.S. Fish & Wildlife Service – Gordon Watson Conference Room

Monday, February 22, 2016 – 9:00 a.m.

Participants

Molly Chythlook	Rick Lanctot	Liliana Naves
Jim Fall	Dan Rosenberg	Luke George
Dave Otis	Ted Swem	Eric Taylor
Todd Sanders	Donna Dewhurst	Patty Schwalenberg
Kristi Wilkins (teleconference)	Mike Pederson	Kelly Kreuger
Tim Andrew (Teleconference)		

The meeting opened with a brief discussion of the budget. Eric explained that he placed budgetary parameters on the options being presented by Colorado State University. There was concern expressed by the Native Caucus regarding the budget and the ability to have a robust harvest monitoring program. He stated that the $100,000-$200,000 is for the basic implementation of the survey and does not include the $100,000 cooperative agreement with the Alaska Department of Fish & Game. Dave mentioned that there may be cost savings with the alternative designs, but Liliana Naves stated that many of the costs are fixed and that any savings may be absorbed by rising costs of implementing the survey, due to cost of living, etc. Eric Taylor confirmed that the funding for the ADF&G is not included in this estimate, so that the total estimate would be anywhere from $200,000 to $300,000. It was noted that the funding dedicated to surveys in the past was $500,000 to $600,000 per year.

Luke George provided a PowerPoint presentation. Top survey priorities were 1) estimate of total harvest of most commonly harvested species and 2) statewide and regional estimates. The secondary survey priority was estimates of individual commonly harvested species.

<u>Alternative Survey Designs:</u>

All Regions Design – every region every year

Five regions Design (captures 91% of total harvest) - Bristol Bay, Yukon-Kuskokwim Delta, Bering StraitNorton Sound, North Slope, and Interior Alaska (excluded areas include Gulf of Alaska-Cook Inlet, Kodiak, Aleutian-Pribilof Islands, Northwest Arctic, and Upper Copper River Delta)

Four Regions Design (captures 84% of total harvest) – Yukon-Kuskokwim Delta, Bering Strait-North Sound, North Slope, and Interior Alaska (excluded areas include Gulf of Alaska-Cook Inlet, Kodiak, Aleutian-Pribilof Islands, Northwest Arctic, Upper Copper River Delta, and Bristol Bay)

<u>Table detailing percentage of harvest:</u>

Yukon-Kuskokwim Delta	43.5
Interior	15.4
North Slope	15.0
Bering Strait	9.9
Bristol Bay	7.3
Northwest Arctic	4.6
Kodiak	2.6
Aleutians	0.9
Gulf of Alaska	0.6
Upper Copper	0.2

It was noted that although there are high harvesters in the Northwest Arctic area, this is not one that is included in the five-region design. Luke mentioned that the group may want to consider including them in the design as well. Eric noted that the total percentage of harvest for that area is only 4.6%, but that is only based on one survey. It has been very difficult in the past to get villages to participate in the harvest survey program.

<u>Suggested Changes to the Sampling Design:</u>

Multistage design - 1) region, 2) village, 3) household

Same regions will be sampled every year

No subregions (due to lack of funding and emphasis on regional/statewide estimates)

Large villages (>300) are divided into neighborhoods of 300 households or less

Villages/neighborhoods within each region are chosen using a systematic random design

Households chosen randomly within each village

A fixed regional proportion of households are visited in each village

It was noted that once a region is included in the sampling design, they cannot pull out of the survey program. Donna brought up the concern that situations can occur with the partners having other issues where they cannot participate, so the data is lost. These are key issues that must be dealt with up front. A commitment must be made by the partners to participate every year. In the past when this has occurred, the Alaska Department of Fish & Game has stepped in to try and gather the data on their own. The contracts are of 3-5 years in duration. Eric Taylor said that the bottom line is that we need to get outreach and education out in the villages. The success of this or any design depends upon the feeling of ownership by the regional management bodies and the villages they serve.

Variance among households has much less influence on the regional and statewide estimates than does the variance among villages. The CSU analysis determined that the most cost-effective strategy is to use the resources to sample more villages because that is where the most variance occurs. The overall design uses Regions to stratify the overall sampling effort. One of the assumptions CSU made is that because they didn't have the household level data, they could not figure out if the stratification helped or not. So, they pretended that it was a simple random sample, but it's not. So it may be a little larger than one might expect, but we don't know that. Their analysis results suggest that the variance between villages is larger than the variance between households. Molly indicated that due to rising fuel costs, some of the villages have designated hunters that share with their households and oftentimes with other villages. This could result in a low harvest report or high harvest report, depending on who was interviewed. Representation and estimates of variances are affected by many zeroes and some high numbers.

Statewide estimates for management purposes was identified at the first priority by the USFWS. ADF&G and the NC identified regional estimates as having the highest priority.

The allocation of sampling effort is dependent upon:

Total annual funding available for the survey

Breakdown of survey costs

Household-surveyor payment for each household surveyed

Village-surveyor travel to regional hub for training

"Fixed" costs – travel/training of survey coordinators and data compilation

Variance of harvest estimates

Between households

Between villages

Estimated for each region

The recommended approach is to not use stratification of harvesters/non-harvesters in villages, but to use a random approach. Discussion ensued regarding issues that may arise with the random sample strategy. Dave Otis suggested doing a random sample for one year, compare it with the estimates from previous surveys and go from there.

Molly said that when they start a survey project, they go into the tribal council office and explain the project. They will tell you immediately which households to hit because they know who the high harvesters are. This approach has built a trust and respect for the survey project. If we go in there and say we are just going to prick randomly and maybe leave out the respected harvesters, the credibility of our survey project diminishes right there before we even leave the very people we are asking to support the project. There is a lot more to the success of the survey than developing something like the design being presented today. The migratory bird survey project was designed to be compatible to the communities that we are working with, so when the migratory bird survey is reintroduced to the communities, we have to be very careful to not say the reason why we are making this change is to get more information about a resource that is being harvested but not surveying the people who are doing the harvesting. Tim Andrew said that there are high harvest communities and high harvest households, both of which are very important to this survey and they should not be lost in the random selection of households. He doesn't know what that does to the outcome of the surveys and how it reflects the harvest in those communities and how it relates to other areas. He doesn't understand how that is extended to other areas. Luke George said that total harvest of the communities that are surveyed will be calculated but only regional and statewide estimates will be included in the reports. Their primary focus is statewide and in order to do that, that means you put your effort where you have the most variance, which means not sampling as many households within a village in order to sample more villages within a region because that is where the most variance occurred. Tim's other concern is regarding villages who opt to not participate and in the random village selection process, would there be another selection process if one or several villages opted out? They would have to come up with a rule to do that while saving the distribution of the sample, like choose the next closest village until you got one that was willing to participate to ensure that the sample is representing the region as best as possible. This would apply to the surveys conducted at the household level also. Donna noted that missing the harvesters or the high harvesting communities through a random sample could drastically change the annual variation when you are talking about a region that does not have very many villages.

Budgetary Allocation Inputs:

Funding levels - $100k, $130k, $150k, $200k

Per Unit Costs – $50 per Household; $2,400 per Village

Fixed Costs – All Regions - $43,000; Five Regions - $20,300; Four Regions - $16,000

Going to the same region every year may result in some cost savings in training new individuals, etc.

All Region –

$ 100k	2 villages in each region surveyed
$130k	8 villages in YKD; 5 in Interior
$150k	12 in YUKD; 7 in Interior; 3 in NS and BS/NS
$ 200k	4 in BB; 19 in UKD; four in BS/NS; six in NS; 12 in Interior Alaska

Five Region –

$100k 10 BB; 72 YKD; 33 BSN; 36 NS and 40 Interior

$130k

$150k

$200k

Four Region –

Reasons for the Survey: The survey should be conducted to show continued use of subsistence harvest and to determine levels of harvest by subsistence users. Another reason is to have the survey is to document the importance of these resources to communities in the region. People will keep harvesting no matter what. Molly is not convinced that this survey program will monitor food security because of the low level of survey effort. Harvest will continue, no matter what.

The region confidence intervals go down with the four or five region design as opposed to the all-region design.

Considerations of Each Design (Pros and Cons)

All Regions Design:

Pros:

Unbiased estimate of statewide harvest

Satisfied desired CIP for >$130,000

Robust to shifts in spatial distribution of harvest over time

Engagement of entire state in outreach, education and employment

Cons:

Higher regional CIP at all levels of funding

Higher MSE at $100,000 and $130,000, similar at $150,000 and $200,000

Four- and Five–Region Designs:

Pros:

Lower CIPs at all levels of funding

Lower MSE below $150,000

Cons:

Estimate of statewide harvest biased low

Not robust to shifts in spatial distribution of harvest over time

Some regions never surveyed, loss of outreach, education, and employment

LUNCH BREAK

It was requested that we go around the room and give everyone an opportunity to 1) state their preferred design, either all region or priority region; 2) if the priority region design is chosen, which one is preferred; and 3) preferred budget

The State of Alaska supports the 5-Region Design

The U.S. Fish & Wildlife Service supports the 5-Region Design

The Native Caucus supports the 5-Region Design

A request was made to hear more from the Native Caucus, specifically in regards to how they feel regarding each design and their feelings of inclusion.

Regions that are not being surveyed can provide their own surveys and do their own thing. This data would not be incorporated into the AMBCC reports, however, but could be provided as a separate report.

Consensus was reached on the five-region design. Education and outreach must be conducted in those regions not being surveyed so that they continue to be engaged in the AMBCC. It is important that these regions feel ownership in the process and are willing to participate. Harvesting will continue regardless of whether or not they are included in the survey program. If any region wanted to conduct their own surveys, this information could be included in the AMBCC report, but not added in to the calculation for the statewide harvest trend for subsistence. The Alaska Department of Fish & Game could help in the training and analysis of the data that is collected by the regional management bodies that are not included in the five-region design. Mike Pederson said he would rather do limited communities to increase the number of households per community rather than more communities with less number of households being surveyed.

The U.S. Fish &Wildlife Service prefers the 5-Region Design for $150,000. Their preference was based on the result that the precision of the estimates of individual commonly harvested species was best for the 5 region design and that the $150,000 budget level was the most cost efficient for this design.

The meeting ended at 4:00 p.m.

Update on AMBCC Harvest Survey Review, AMBCC Spring Meeting

Prepared by T. L. George, L. Naves, D. Otis, P. Doherty, P. Schwalenberg
31 March 2016

Recent developments

The Harvest Survey Technical Working Group (TWG) met 22 February 2016 to discuss alternative scenarios for allocation of sampling effort (documented in CSU Report of 15 January 2016).

The TWG recommended the 5-region design with a budget of $150K (Y-K Delta, Interior, Bering Strait, Bristol Bay, and North Slope).

Following the TWG meeting, the CSU adjusted the recommended scenario to account for some points then discussed:

- 10 households surveyed per community (as opposed to 5, as originally proposed).
- Communities with less than 10 households total were not included (4 communities in Bristol Bay, 6 communities in Interior).

Survey Design Recommended by the TWG:

1. Regions and communities no longer rotate. The same regions are sampled each year. In each surveyed region, communities are randomly selected in a systematic manner (e.g., every 3rd community). Hubs divided into blocks of 300 households.
2. Subregions no longer used. Harvest estimates produced only for regions and sum of regions.
3. Ten randomly selected households are surveyed in each village. Harvest level stratification (harvester, non-harvester) would no longer be used. This proposed change generated concerns within the TWG because, with a reduced sample size within villages, high harvesters could be missed in a simple random sampling. It was proposed to do SRS for one year and compare results with estimates from previous years.
4. Harvest in the 5 regions of most harvest would be an index to the statewide harvest. Harvest data for non-surveyed regions would be sporadically available because other entities occasionally conduct surveys across the state. Depending on priorities, the AMBCC could do dedicated studies to address specific questions in the non-surveyed regions. Also, non-surveyed regions could conduct surveys on their own and the AMBCC-HAP could provide technical assistance. These data would not be incorporated in the regular AMBCC 5-region estimates, but could be provided as a separate report.
5. The total number of households surveyed per village is lower in the proposed survey design. This is related to the priority is at regional and statewide estimates. The revised design would not allow producing community-level estimates.
6. Two household visits per survey year (current survey method calls for 3 hh visits, but surveys have been conducted with 1 hh visit per year).

Next steps

1. Harvest Survey Committee makes recommendation to AMBCC on revised survey design (HSC will meet 5 April 2016, 10:30 am).
2. AMBCC considers recommendations from TWG and HSC and makes a decision about adopting the new design.
3. Allocate funds for 2016 survey and develop contracts with regional organizations for data collection.
4. Prepare revised training materials.
5. Develop timetable to implement 2016 survey.

Proposed Sampling Design for 2017 Subsistence Harvest Survey of the Alaska Migratory Bird Co-Management Council

Prepared by David Otis, Luke George, and Paul Doherty - Colorado State University
June 14, 2017

Introduction

In April, 2016 the AMBCC approved a revised sampling design for estimation of migratory bird subsistence harvest. The design was developed by Colorado State University (CSU) staff in collaboration with staff from the 3 AMBCC partner organizations. The design was implemented in 2016 as a pilot year (Appendix 1). Preliminary 2016 harvest estimates and an assessment of the performance of the survey in terms of the statistical precision (i.e., reliability) of the estimates was released at the April, 2017 AMBCC meeting. During April-May 2017, we used the 2016 data to conduct an updated optimal sample allocation analysis. The objective was to improve precision and cost efficiency of the 2017 survey by making adjustments to the relative amount of sampling effort that is allocated to communities and households within the five regions. This report contains our recommended adjustments.

At the April, 2017 AMBCC meeting it was decided that recommendations for the 2017 survey will be reviewed by the AMBCC Harvest Survey Committee. Our suggested review process is to resolve any questions or concerns that may arise from the review via a conference call to be held in late June so that the needed preparations for implementation of the 2017 survey can be initiated.

Background

Revised harvest survey objectives (2015) and top TWG survey priorities

- Statewide estimate of total harvest of commonly harvested species with CV = 0.25
- Regional estimates are secondary priority
- Statewide estimates of each commonly harvested species are secondary priority

Table 1. Commonly harvested species

Species	Scientific name
American Widgeon	*Anas americana*
Brant	*Branta bernicla*
Black Scoter	*Melanitta americana*
Cackling/Canada Goose	*Branta hutchinsi/canadensis*
Canvasback	*Aythya valisineria*
Common Eider	*Somateria mollissima*
Greater White-fronted Goose	*Anser albifrons*
King Eider	*Somateria spectabilis*
Long-tailed Duck	*Clangula hyemalis*
Mallard	*Anas platyrhynchos*
Northern Pintail	*Anas acuta*
Greater/Lesser Scaup	*Aythya marila/affinis*
Snow Goose	*Chen caerulescens*
Surf Scoter	*Melanitta perspicillata*
White-winged Scoter	*Melanitta fusca*

2016 design and summary results

Sampling design

- Two-stage sampling in each region: community, household (no subregions)
- Same 5 regions sampled every year (91% of statewide harvest)
- Large communities divided into parcels (≤300 households)
- Communities or parcels chosen using systematic random design within each region
- Households chosen randomly within community
- Ten households surveyed per community/parcel
- Communities with <10 households were excluded
- Equal survey costs assumed in each region

Allocation of sampling effort dependent on

- Total annual funding for survey
- Survey costs
    - Community surveyors training
    - Surveyor payment for each household surveyed
    - Fixed costs per region (field coordinators training and travel, coordination of local surveyors)
- Variance of regional harvest estimates
    - Between households
    - Between communities

Advantages of revised design

- More efficient allocation of effort
- Much simpler to implement
- Provides survey-wide estimates that are expected to meet precision criterion
- Annual survey-wide and regional estimates are comparable to each other
- Flexible to changes in regional sampling effort
- No annual uncertainty about regions to be sampled and gains in efficiency over time

The 2016 sampling design specified 45 communities to be sampled in the five survey regions and 10 households to be sampled in each selected community (Table 1), resulting in a sampling goal of 45 communities and of 450 households. The achieved sample size was 41 communities and 407 households.

Table 2. Sampling design implemented in the 2016 AMBCC survey.

Region	Total communities[1]	Total households[2]	Communities to be surveyed (achieved)	Households to be surveyed per community	Total households to be surveyed (achieved)
Bristol Bay	29	2,490	4 (4)	10	40 (38)
Yukon-Kuskokwim Delta	53	6,854	21 (21)	10	210 (209)
Bering Strait-Norton Sound	20	2,744	5 (4)	10	50 (46)
North Slope	12	2,022	5 (5)	10	50 (52)
Interior Alaska	41	2,962	10 (7)	10	100 (72)
Total	155	17,072	45 (41)	--	450 (417)

1: Large communities were divided in parcels with ≤300 households. Communities with ≤10 households were excluded from the sampling frame.
2: Based on 2010 census data

In the 2016 survey, the coefficient of variation (CV) of the statewide estimate of the total harvest of the 15 most commonly harvested species was 0.30 (the target CV was 0.25). The average CV of the regional total harvest was 0.55 and the average CV of the statewide individual species harvest was 0.44.

Table 3. 2016 Survey results by region.

Region	Harvest (number of birds)	CV (CIP=2*CV)
Bristol Bay	42,710	0.88
Yukon-Kuskokwim Delta	56,626	0.22
Bering Strait-Norton Sound	31,582	0.60
North Slope	72,941	0.23
Interior Alaska	89,499	0.82
All regions combined	293,359	0.30

Table 4. 2016 Survey results by species.

Species	Harvest (number of birds)	CV (CIP=2*CV)
American widgeon	21,165	0.58
Black scoter	12,304	0.35
Brant	16,502	0.52
Cackling/Canada goose	45,565	0.26
Canvasback	1,117	0.58
Common eider	9,127	0.43
Greater white-fronted goose	88,338	0.38
King eider	20,297	0.34
Long-tailed duck	2,520	0.41
Mallard	28,246	0.54
Northern pintail	26,137	0.42
Scaup	6,792	0.41
Snow goose	11,421	0.59
Surf scoter	1,033	0.43
White-winged scoter	2,796	0.36
Total	293,359	0.29

Recommended 2017 sampling design adjustments

The sampling design adjustment recommendations for the 2017 survey (Table 5) were derived from an optimal allocation analysis based on 2016 harvest data and costs as well as on administrative and logistic factors related to the implementation of the survey.

1) Analysis of 2016 data indicated that sampling substantially more households per community in 2 regions (Bristol Bay and North Slope) could yield more cost efficient estimates. Thus, we recommend that a minimum of 10 households be sampled in each community.

2) As a technique for reducing variance in total harvest among communities within a region, in 2016 we divided large communities (> 300 households) into smaller parcels that were considered independent sampling units. Our analysis suggested that additional reduction in variance could be achieved by reducing the criterion to 200 households. i.e., we recommend that communities with more than 200 households be divided into parcels.

3) Given the above constraint on household sample size and a budget of $150,000, the optimum total sample size for communities = 70. However, based on experience in survey implementation, given the current funding level and administrative structure, ADFG staff had concerns about the ability to complete surveys in more than 50 communities in a survey year. Thus we developed another allocation scenario that constrained the total number of communities to be surveyed to 50. With this reduced community sample size, the predicted CV of the total statewide harvest estimate increased from 0.124 to 0.157 and the average CV of a regional estimate increased from 0.274 to 0.346. We considered the predicted CVs at both scales to be within the acceptable range of the precision desired by the AMBCC.

4) The total survey budget in each region is divided into 3 components: 1) fixed costs, e.g., field coordinator training and salary, 2) cost per sampled community, 3) cost per household. The relative difference in costs between the regions is explicitly taken into account in the allocation of sampling effort to regions, communities and households. Generally, higher costs in a region will reduce sampling effort. The 2016 survey assumed equal costs in all regions, but in our analysis for 2017 we used actual cost components from the 2016 survey (L. Naves, pers. comm.) and this resulted in differential costs among regions. Details are provided in Appendix 2.

Table 5. Recommended sampling design for 2017 AMBCC survey.

Region	Total communities[1]	Communities to be surveyed	Households to be surveyed per community	Total households to be surveyed	Coefficient of variation (CV)	Total cost (communities+ households+ regions)
Bristol Bay	32	11	10	110	0.375	21,168
Y-K Delta	59	18	10	180	0.266	32,104
Bering Strait	24	6	19	114	0.369	20,866
North Slope	14	5	30	150	0.150	22,333
Interior	43	10	10	100	0.568	22,751
Total	172	50	--	654	0.157	119,222

1: "Communities" refer to sampling units. Large communities were divided in parcels with ≤200 households. Communities with ≤10 households were excluded from the sampling frame.

Sampling design based on optimal allocation, where:

a) Cost parameters were based on costs of 2016 survey (Appendix 2).
b) Large communities were divided in parcels with ≤200 households.
c) The number of households to be surveyed per community was set to at ≥10.
d) The total number of communities to be sampled was set to a maximum of 50.

Appendix 1. Survey 2016 and 2017 implementation timetable.

Table A. Timetable

2016-2017 Timetable	2016									2017											
	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D
2016 Data collection																					
Complete and document revised sampling design	X	X																			
Transition into revised survey (forms, data base)		X	X																		
Cost estimates, contracts, and agreements		X	X	X	X	X	X	X	X												
Prepare training & survey packages			X	X	X	X															
Community consent					X	X	X	X	X	X	X										
Field coordinator/surveyor training							X	X	X	X	X										
Household visits (data collection)								X	X	X	X	X									
Data analysis										X	X	X									
Spring AMBCC meeting: draft 2016 results, next steps													X								
2017 Data collection																					
Evaluation by CSU of pilot data collection													X	X							
Harvest Survey committee meeting: review 2017 sampling design															X						
2017 Survey community consent																	X	X	X		
Cost estimates, contracts, and agreements															X	X	X	X			
Prepare training & survey packages																	X	X			
Field coordinator/surveyor training																			X		
Household visits (data collection)																				X	X
Data entry and analysis																					X

White/gray cells indicate federal fiscal year.
Red font: changes as compared to 2016 work plan.

Appendix 2. Cost estimate parameters

1) Cost estimate parameters were based on costs of 2016 survey
2) Togiak NWR did 1 community in Y-K Delta region. Thus Bristol Bay region shows as surveying 5 communities per year and Y-K Delta region as 20 (sampling goal was 4 community in Bristol Bay and 21 community in Y-K Delta).
3) Field Coordinator training: travel and salary during training
4) Surveyor training: travel and salary during training ($100)
5) Local surveyor or RIT: payment for conducting surveys. Local surveyors are paid $25 per HH completed because survey is being done with one HH visit. Previous cost estimates considering 2 HH visits considered $50 per HH completed.
6) Cost per region (fixed cost): (field coordinator training + 1/2 of field coordinator oversight duties) * indirect rate
7) Cost for all communities: (surveyor training + travel to conduct surveys + shipping supplies + 1/2 of field coordinator oversight duties) * indirect rate
8) Cost for all HHs: surveyor * indirect rate
9) Cost per community: cost of including a community in the sampling
10) Cost per HH: cost of including a HH in the sampling
11) Fixed cost, cost per community, and cost per HH vary among regions depending on partnerships (Refuges or regional Native organization) and work logistics (hiring local surveyor, travel to conduct surveys)
12) Costs were adjusted by an added 10% to account for annual variation is costs due to different sets of communities being surveyed

Table B. Cost estimate parameters used in optimal allocation for 2017 data collection.

Partners, regions	Comm. to be surveyed	HH to be surveyed	Field coordinator training	Surveyor training	Travel to conduct surveys	Local surveyor or RIT	Field coordinator oversight duties	Supplies, shipping	Indirect cost	Total	Total 10% adjusted	**Cost per region (fixed cost)**	Cost for all comm.	Cost for all HHs	**Cost per comm.**	**Cost per HH**
Togiak NWR (Bristol Bay region)	5	50	$2,154	$0	$3,510	$1,792	$3,360	$40	$0	$10,856	$11,942	**$4,217**	$5,753	$1,971	**$1,151**	**$39**
Yukon Delta NWR (Y-K Delta region)	20	200	$4,547	$8,219	$6,519	$9,250	$3,000	$200	$0	$31,735	$34,909	**$6,652**	$18,082	$10,175	**$904**	**$51**
Kawerak (Bering Strait-Norton Sound region)	5	50	$1,340	$5,880	$0	$1,250	$3,600	$0	$3,018	$15,088	$16,596	**$4,318**	$10,560	$1,719	**$2,112**	**$34**
North Slope Borough (North Slope region)	5	50	$1,340	$4,930	$0	$1,250	$3,600	$0	$2,780	$13,900	$15,290	**$4,318**	$9,254	$1,719	**$1,851**	**$34**
Kanuti NWR (Interior AK region)	1	10	$1,631	$0	$607	$645	$322	$0	$0	$3,205	$3,526	**$1,971**	$845	$709		
Tetlin NWR (Interior AK region)	3	30	$744	$0	$1,554	$2,344		$0	$0	$4,643	$5,107	**$819**	$1,709	$2,579		
Koyukuk-Nowitna-Innoko NWRs (Interior AK region)	3	30	$1,472	$0	$2,240	$1,000	$1,000	$0	$0	$5,712	$6,283	**$2,169**	$3,014	$1,100		
Yukon Flats NWR (Interior AK region)	3	30	$1,527	$0	$2,712	$1,934	$967	$0	$0	$7,140	$7,854	**$2,211**	$3,515	$2,128		
Interior AK total	10	100	$5,374	$0	$7,113	$5,924	$2,290	$0	$0	$20,700	$22,770	**$7,171**	$9,084	$6,516	**$908**	**$65**
Total	45	450	$14,755	$19,029	$17,142	$19,466	$15,850	$240	$5,798	$92,279	$101,507	**$26,675**	$52,732	$22,100		

Results from the 2017 Subsistence Harvest Survey of the Alaska Migratory Bird Co-Management Council and Proposed Updates to the Sampling Design for 2018

Prepared by David Otis and Paul Doherty (Colorado State University)
September 11, 2018

Introduction

Following the 2014–2016 survey review (George et. al 2015) of the Alaska Migratory Bird Co-Management Council (AMBCC) harvest survey, a revised survey sampling design was implemented for estimating the total harvest of the 15 most commonly harvested species in the 5 regions that comprise 90% of the statewide harvest (Appendix Table 6). An optimum sample allocation analysis was then conducted based on 2016 data (Otis et al. 2017) to improve survey precision and cost efficiency (Appendix Table 7). This document presents estimates from the 2017 survey and the results of the 2018 optimum allocation analysis based on these data.

Background

Harvest survey objectives

- Five-regions estimate of total harvest with a target CV = 0.25
- Regional estimates of total harvest with desired CV = 0.50
- Five-regions estimates of each commonly harvested species are a secondary priority

Table 1. Commonly harvested species

Species	Scientific name
American Widgeon	*Anas americana*
Brant	*Branta bernicla*
Black Scoter	*Melanitta americana*
Cackling/Canada Goose	*Branta hutchinsi/canadensis*
Canvasback	*Aythya valisineria*
Common Eider	*Somateria mollissima*
Greater White-fronted Goose	*Anser albifrons*
King Eider	*Somateria spectabilis*
Long-tailed Duck	*Clangula hyemalis*
Mallard	*Anas platyrhynchos*
Northern Pintail	*Anas acuta*
Greater/Lesser Scaup	*Aythya marila/affinis*
Snow Goose	*Chen caerulescens*
Surf Scoter	*Melanitta perspicillata*
White-winged Scoter	*Melanitta fusca*

Sampling design

- Two-stage sampling in each region with community and household stages
- Same 5 regions sampled every year
- Large communities divided into parcels (≤200 households)
- Communities/parcels chosen using systematic random design within each region
- Households chosen randomly within community/parcel
- Minimum of 10 households surveyed per community/parcel
- Communities with <10 households were excluded
- Survey costs are region specific

Allocation of regional sampling effort dependent on:

- Total annual funding for data collection
- 2016 survey costs (Otis et al. 2017)
    - Training of local surveyors
    - Surveyor payment, based on number of surveyed households
    - Fixed costs per region (field coordinators training and travel, coordination of local surveyors)
- Total number of community/parcel and households
- Sampling variance
    - Among households
    - Among communities/parcels

Results

The estimated 5-regions harvest of about 139,000 birds in 2017 was 50% lower than that for 2016 (Table 2). The coefficient of variation (CV) of this estimate decreased substantially and was less than the target value of 0.25. The target CV for regional estimates was achieved in 4 of 5 regions. Although the 5-regions harvest estimates of individual species were of lesser priority, the average CV of 0.39 is reasonably precise.

Table 2. Total harvest (number of birds) and (CV) for the 15 commonly harvested species in the five regions for 2016 and 2017. Note that Confidence Interval Percentage (CIP) = 2 x CV.

	2016		2017	
Region	Harvest	CV	Harvest	CV
Bristol Bay	42,710	0.88	48,198	0.42
Yukon-Kuskokwim Delta	56,626	0.22	47,960	0.26
Bering Strait-Norton Sound	31,582	0.60	15,079	0.55
North Slope	72,941	0.23	14,489	0.31
Interior Alaska	89,499	0.82	13,341	0.41
Region Average		0.55		0.39
5-Region Total	293,359	0.30	139,067	0.19

Table 3. Total harvest (number of birds) and CV by species for the 5-region area. Note that Confidence Interval Percentage (CIP) = 2 x CV.

	2016		2017	
Species	Harvest	CV	Harvest	CV
American wigeon	21,165	0.58	3,562	0.48
Black scoter	12,304	0.35	9,476	0.33
Brant	16,502	0.52	11,111	0.49
Cackling/Canada goose	45,565	0.26	23,433	0.19
Canvasback	1,117	0.58	179	0.71
Common eider	9,127	0.43	3,278	0.40
Greater white-fronted goose	88,338	0.38	26,057	0.18
King eider	20,297	0.34	22,928	0.48
Long-tailed duck	2,520	0.41	454	0.49
Mallard	28,246	0.54	15,004	0.31
Northern pintail	26,137	0.42	9,025	0.26
Scaup	6,792	0.41	7,607	0.53
Snow goose	11,421	0.59	5,602	0.68
Surf scoter	1,033	0.43	452	0.51
White-winged scoter	2,796	0.36	898	0.76
Species Average		0.44		0.45
Total	293,359	0.30	139,067	0.19

Table 4. Recommended sampling design for 2018 AMBCC survey.

Region	Total communities/ parcels	Communities to be surveyed	Households to be surveyed per community	Total households to be surveyed	Projected CV	Projected cost
Bristol Bay	33	10	20	200	0.317	$23,527
Y-K Delta	58	25	10	250	0.200	$42,002
Bering Strait	23	6	20	120	0.491	$21,070
North Slope	14	4	30	120	0.371	$15,802
Interior	43	6	10	60	0.464	$16,519
Total		51		750	0.152	$118,920

Sampling design based on optimal allocation, where:

a) Cost parameters were based on costs of 2016 survey (Otis et al. 2017).
b) Communities with ≤10 households were excluded from the sampling frame.
c) Large communities were divided in parcels with ≤200 households.
d) The number of households to be surveyed per community was set to at ≥10.
e) The total number of communities to be sampled was set to a maximum of ~50.
f) Funding for survey capped at $120,000.

Table 5. Data collection timetable.

	2018									2019											
	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D
Discuss and adopt adjustments to 2018 sampling design						X															
Prepare training & survey packages					X	X															
Cost estimates, contracts, and agreements						X	X														
Community consent						X	X	X	X												
Field coordinator/surveyor training							X	X													
Household visits (data collection)								X	X												
Data analysis										X	X	X									
Spring AMBCC meeting: draft 2018 results													X								

White/gray cells indicate federal fiscal year.

Recommendations for adjustments in allocation of sampling effort for the 2018 survey

The recommended adjustments to the sampling design for the 2018 survey (Table 4) were derived from an optimal allocation analysis based on 2017 harvest data as well as on administrative and logistic factors related to the implementation of the data collection.

5) The recommended number of sampled households per community in each region did not change with the exception of Bristol Bay. In this region, the optimum allocation specified a sample of 10 households per community (same as 2017) and an increase of 5 sampled communities (from 11 in 2017 to 16 in 2018). However, because of challenges in the implementation of data collection, we decided to double the household sampling effort and reduce the recommended number of sampled communities.

6) Given the above adjustments for Bristol Bay and a total budget of $120,000 for data collection, the recommendation is that a total of 51 communities be sampled (an increase of 1). Recommended changes in the number of communities to be surveyed are: decrease by 1 for Bristol Bay, Bering Strait, and North Slope; decrease by 4 in Interior; and increase by 7 in the Y-K Delta. The explanation for the proposed increase in sampling effort in the Y-K Delta is related to the fact that relative sampling effort in each region is a function of: (a) the total number of communities/parcels; (b) total number of households; (c) data collection cost; and (d) sampling variation. The Y-K Delta has the most communities and households and has the least expensive cost per sampled community, but in 2016 it had a relatively small sample variance compared to the large North Slope variance and the extremely large variance in Interior. In 2017, the sampling variances in the North Slope and Interior were smaller and this change resulted in a reallocation of additional sampling effort to Y-K Delta.

Recommendations for 2019 survey analysis

1) We recommend that a 3rd optimal allocation analysis be performed based on the pooled data from the 2016-2018 surveys and that the resultant allocation of sampling effort among the regions then be fixed for a period of at least five years.
2) We recommend revisiting the current systematic random sampling protocol for selecting the sample of communities. Knowledge of the fixed sample sizes over a period of years (starting in 2019) will facilitate evaluation of alternative systematic random selection protocols with the objective of a more even distribution of sampling effort across years among individual

communities in each region (i.e., over a period of 5 or 10 years, all communities in a region will be surveyed a similar number of times).

References

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Appendices

Table 6. Sampling design implemented in the 2016 AMBCC harvest survey.

Region	Total communities/ parcels[1]	Total households[2]	Communities to be surveyed (achieved)	Households to be surveyed per community	Total households to be surveyed (achieved)
Bristol Bay	29	2,490	4 (4)	10	40 (38)
Y-K Delta	53	6,854	21 (21)	10	210 (209)
Bering Strait-Norton Sound	20	2,744	5 (4)	10	50 (46)
North Slope	12	2,022	5 (5)	10	50 (52)
Interior Alaska	41	2,962	10 (7)	10	100 (72)
Total		17,072	45 (41)		450 (417)

1: Large communities were divided in parcels with ≤300 households. Communities with ≤10 households were excluded from the sampling frame.
2: Based on 2010 census data

Table 7. Sampling design implemented in the 2017 AMBCC harvest survey.

Region	Total communities/ parcels[1]	Total households[2]	Communities to be surveyed (achieved)	Households to be surveyed per community	Total households to be surveyed (achieved)
Bristol Bay	32	2,490	11 (9)	10	100 (89)
Y-K Delta	59	6,854	18 (16)	10	180 (164)
Bering Strait-Norton Sound	24	2,744	6 (5)	19	114 (102)
North Slope	14	2,022	5 (5)	30	150 (150)
Interior Alaska	43	2,962	10 (10)	10	100 (132)
Total		17,072	50 (45)		654 (637)

1: Large communities were divided in parcels with ≤200 households. Communities with ≤10 households were excluded from the sampling frame.
2: Based on 2010 census data