MPA Capstone Project:

The Effectiveness of the 1996 Protocol Amendment to the Migratory Bird Treaty with Canada Establishing the Alaska Migratory Bird Co-management Process

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For:

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I. Executive Summary:

The Migratory Bird Treaty Act Protocol Amendment of 1996 called for the legalization of subsistence hunting for migratory birds. The US Congress charged the Secretary of the Interior with promulgating annual regulations for migratory bird subsistence hunting in Alaska for the purposes of conserving migratory birds and perpetuating subsistence hunting customs and cultures. The Congress provided Alaska Natives a meaningful role in management decisions affecting the customary subsistence hunting opportunities. Regulations for this hunt were published in 2003 and annually thereafter. After five years of annual regulations, I tried to determine whether the regulations have conserved birds and perpetuated customs and cultures. I tested the means of pre-2003 and post-2003 harvest-to-breeding populations of 16 species of waterbirds on the Yukon-Kuskokwim Delta coastal area to determine if a change in the ratios has occurred since 2003. I also surveyed Alaska Native regional representatives past and presently serving on the Alaska Migratory Bird Co-management Council (AMBCC) to compile traditional environmental knowledge of parameters that might have been affected with the regulations, and that contribute to the subsistence economies and thus to the customs and cultures of Alaska Native migratory bird subsistence hunters. I could not detect a difference in harvest ratios for 94% (15/16) of the species tested. I found that AMBCC members generally accept the regulatory process and are confident this process allows more local input. I found relatively little change in three of four waterfowl-related hunting and social activities that I asked about. Change was not strongly associated with the regulations; other factors are suggested as causing change. A strong majority of AMBCC members believe the co-management process will protect their long-term right to harvest waterfowl. There is a social and cultural aversion to the requirement of a state hunting license and Federal duck stamp because these legalizing documents are not considered traditional. I conclude that Alaska Native regional subsistence hunter representatives, for the most part, are cautiously optimistic about their long-term outlook for migratory bird subsistence hunting opportunities, and thus for perpetuating their customs and cultures. I further conclude that harvest-to-breeding-bird ratios have not changed significantly on the Y-K Delta. The quantitative and qualitative evidence suggests that the co-management process is protecting waterfowl subsistence hunting customs and cultures and is allowing for the conservation of birds. Additional years of data and a broader target audience for the qualitative survey would improve the statistical power and meaning of my findings.

II. Background/Problem Statement:

The Migratory Bird Treaty was signed by Canada and the United States in 1913 and ratified by the U.S. Congress in 1918 with passage of the Migratory Bird Treaty Act [(16 U.S.C. 703-712: Ch. 128; July 13, 1918; 40 Stat. 755; (MBTA)]. The MBTA was designed to stem declines in waterfowl and wading bird populations impacted by market

hunting by prohibiting harvest of migratory birds from March 11 through August 31 annually in North America (U.S. Fish and Wildlife Service 2007a). However, in establishing the Migratory Bird Treaty and enacting the MBTA the U.S. Congress and Canadian government failed to recognize northern peoples' traditional subsistence customs that had been occurring for centuries in northern Canada and Alaska.

The Migratory Bird Treaty Protocol Amendment (Protocol Amendment) of 1996 called for the legalization of migratory bird subsistence hunting during spring and summer and required, in the United States, that Alaska Natives be given a meaningful role in management decisions regulating this harvest. The Protocol Amendment also invited the State of Alaska to participate in a management body that included Alaska Natives and the Interior Department Secretary, represented by the U.S. Fish and Wildlife Service (Service). The Alaska Migratory Bird Co-management Council (AMBCC) is the entity derived from this Congressional invitation and mandate.

The Protocol Amendment established four primary goals for administration of the Act: goal #1 *legalization of spring and summer subsistence hunting*, goal #2 *compliance with various international treaties*, goal #3 *perpetuation of subsistence customs and cultures*, and goal #4 *conservation of migratory birds*.

The Secretary of the Interior and the Service are the Federal agent/agency responsible for implementing the requirements of the Protocol Amendment. The goals are achieved through a Federal administrative process based on regulations recommended by the

AMBCC. The Federal agents are solely responsible for process-oriented goals #1 and #2; these goals are met annually through publishing the regulations and legal review to ensure compliance with international treaties. The AMBCC is responsible for recommending regulations intended to accomplish goals #3 and #4.

The AMBCC first recommended regulations for the spring and summer subsistence hunt to the Secretary of the Interior in fall of 2002. The Secretary supported those recommendations and promulgated the first-ever migratory bird spring/summer subsistence harvest regulation in July, 2003. Five regulated seasons have now occurred. On January 16, 2008, the AMBCC asked me to pursue this project (Appendix A) in response to a proposal I submitted.

I attempted to measure and evaluate the effectiveness of the shared responsibilities and co-management approach of the AMBCC in accomplishing the goals set forth in the Protocol Amendment. I addressed the following management questions: *Is the management and regulatory approach to implementing the 1996 MBTA Protocol Amendment protecting subsistence customs and cultures, and conserving migratory birds as mandated by the United States Congress?* To answer this question I employed both quantitative and qualitative methods to evaluate the success of the AMBCC in accomplishing these two goals of the Protocol Amendment.

III. Research Objectives:

I accomplished three study objectives to complete my project. The first and second objectives addressed goal #3 "*perpetuation of subsistence customs and cultures,"* and formed the qualitative component of this project. Objective 3 addressed goal #4 *"conservation of migratory birds."* It involved quantitative analyses of existing data to determine if change has occurred in harvest ratios for species on the Yukon-Kuskokwim Delta since the establishment of a regulated season in 2003. Specifically, the objectives were as follows:

Objective 1 – *Review literature or interview subsistence hunters to determine indicators of subsistence hunting customs and cultures.*

To address goal #3 I reviewed published and unpublished literature and consulted Alaska Native subsistence hunters. From those efforts, I determined which parameters could best be used as indicators of changing or stable subsistence customs and cultures, and best be discussed by subsistence hunters.

Objective 2 – *Survey AMBCC regional representatives to find out if the parameters identified in Objective 1 are changed since 2003, and if those changes are a result of the 2003 regulations.*

To address goal #3 I developed a survey questionnaire and asked each current and some former AMBCC board members to provide me their "traditional environmental knowledge" (TEK) regarding those specific parameters identified in Objective 1, to

assess whether customs and cultures are changed and whether those changes are related to the regulations in place since 2003. This objective forms the qualitative component of this research project.

Objective 3 – *Quantitatively compare pre- and post-2003 regulations data sets for populations and for harvest to establish harvest-to-population ratios.*

To address goal #4 I used a single time-series design (McDavid and Hawthorn, 2006) to quantitatively compare conditions pre- and post-2003, the first regulated spring/summer subsistence hunt. I compared pre- and post-2003-regulations breeding bird population indices of 15 species of waterfowl plus similar data for red-breasted merganser on the Yukon-Kuskokwim Delta. I studied these existing data sets to determine if the populations have changed since regulations were established. I compared these data sets with harvest estimates for the same time periods and calculated annual harvest-to-breeding-bird ratios. I was able to then compare pre- and post 2003 harvest rates, looking for change for any of the 16 species.

IV. Study Method:

Goal #3 – Perpetuation of Customs and Culture:

I reviewed historic and current technical papers (Lonner, 1980) authored by the Alaska Department of Fish and Game Subsistence Division to identify subsistence economy indicators. I then used a root cause analysis and logic modeling technique described by Frechtling (2007) to narrow the list of parameters that contribute to the subsistence

economy, and that can be used as indices of subsistence customs and cultures. I selected four parameters. The Alaska Native subsistence culture that includes, but does not rely solely on, migratory birds is much more complex than four simple parameters. I chose these four because they seem distinct and definitive, and perhaps are easily measured or counted. The four parameters are: 1) hunting frequency, or number of hunting trips, 2) hunting effort that could be measured in days, hours, trips, or even willingness to spend, 3) social events where waterfowl are consumed or used in some way, 4) number of family and friends involved in waterfowl harvesting. I also addressed the hunters' general perception of the co-management process and the health and stability of waterfowl for future uses.

Rather than quantify these parameters, I chose to ask for estimates of pre- and post-2003 activities in relative terms like "less," "more," or "about the same." These relative terms could describe the responders' opinions based on their own perceptions of how they and their families and friends have been impacted by the regulations.

I used a qualitative survey (Appendix B) of 17 multiple choice questions to determine whether subsistence hunters, especially Alaska Natives, feel their customs and cultures are being protected and perpetuated by these annual regulations. I allowed each responder to provide additional comments at the end of the multiple choice questions.
I ordered the survey questions in a pattern that asked a behavior or phenomenon (questions 1, 3, 5, 7, 9, 11, and 13) followed by the test question. The test question was the question that related the observed phenomenon or behavior with the test situation. In this study, the test

was the establishment of the 2003 regulations, and the follow-up question (questions 2, 4, 6, 8, 10, 12, and 14) asked whether the change is/was thought to be due to the test. If the preceding behavioral or phenomenon question answer suggested no change from the pre-2003 to post-2003 condition, the follow-up question did not apply and a N/A was the presumed answer.

I e-mailed the survey to 16 current and former AMBCC regional representatives, all of whom are Alaska Native subsistence hunters. I followed up with telephone calls to each, prompting them to return the survey forms via email, fax, or U.S. mail.

Goal #4 – Conservation of Migratory Birds:

Quantitative data regarding harvest and bird population trends on the Y-K Delta are collected annually by the Service. I decided to use those data sets to analyze for change because the data sets are more comprehensive for that area than any other in Alaska and because approximately 50% of Alaska subsistence waterfowl harvest occurs on the Y-K Delta (J. Fischer, personal communication). I used a single time-series design to compare harvest and population indices pre- and post-2003, the first regulated spring/summer subsistence hunt.

T test:

I used aerial survey data reported in "Abundance and Trend of Waterbirds on Alaska's Yukon-Kuskokwim Delta Coast based on 1988 to 2007 Aerial Surveys" by Platte and Stehn (2007, unpublished). The survey transects are shown in Figure 1. I also used data

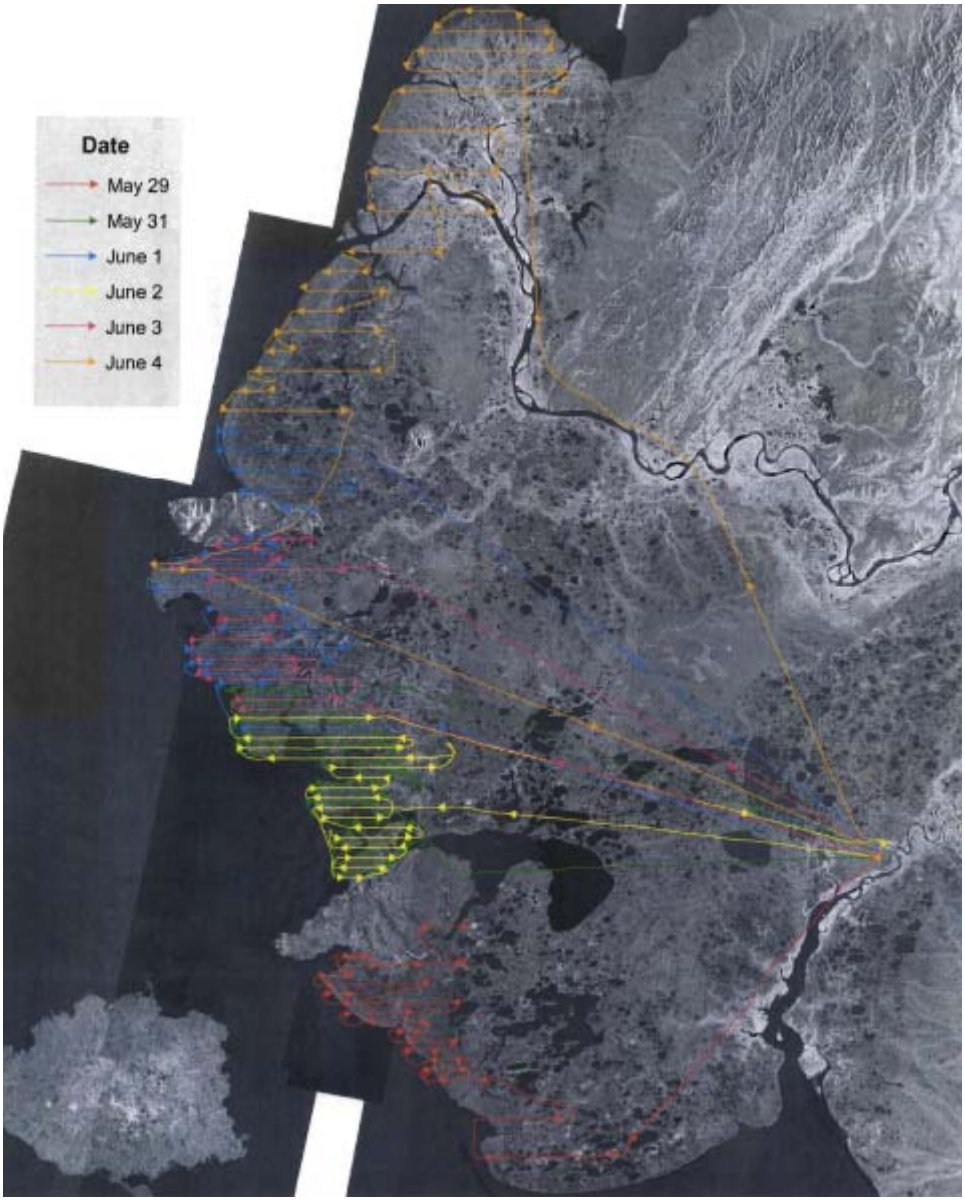

Figure 1: Yukon-Kuskokwim Delta survey transects coded by date, 2007. All transect flights originated in the community of Bethel (lower right in photo).

reported in "Subsistence Migratory Bird Harvest Survey: Yukon-Kuskokwim Delta 2001 – 2005" by Wentworth (2007).

I compared population and subsistence harvest estimates for 16 species of waterbirds that are regularly harvested on the Y-K Delta (Table 1). For each species I calculated a ratio

Table 1: T test comparison and power calculation of a difference in means between ratios for subsistence harvest and index populations of nesting waterbirds on the Yukon-Kuskokwim Delta 1989 – 2002 and 2004 – 2005.

Species	Mean spr/summer harvest ratio 1989-02	Mean spr/summer harvest ratio 2004-05	T test	Power Δ = .5 x mean n_1 = 14 pre 2003 n_2 = 2 post 2003	Power (est.) Δ = .5 x mean w/ estimated n_2 =	Power Δ = 1.5 x mean n_1 = 14 pre 2003 n_2 =2 post 2003
Tundra swan	0.187	0.134	0.378	0.483	0.814 n_2 = 5	0.999
Black Brant	0.129	0.178	0.161	0.617	0.869 n_2 = 4	0.999
White-fronted Goose	0.148	0.117	0.351	0.758	0.889 n_2 = 3	1
Emperor Goose	0.098	0.051	0.210	0.385	0.631 n_2 = 7	0.992
Cackling Canada Goose	0.139	0.115	0.346	0.890	0.890 n_2 = 2	1
Northern Pintail	0.110	0.104	0.778	0.789	0.913 n_2 = 3	1
Greater Scaup	0.107	0.131	0.621	0.296	0.296 n_2 = 2	0.953
Northern Shoveler	0.078	0.179	0.018	0.273	0.273 n_2 = 2	0.930
Green-wing Teal	0.338	0.272	0.746	0.213	0.439 n_2 = 10	0.817
Mallard	0.954	0.800	0.467	0.752	0.801 n_2 = 3	1
Spectacled Eider	0.094	0.012	0.327	0.144	0.368 n_2 = 10	0.540
Black Scoter	0.651	0.337	0.314	0.287	0.709 n_2 = 10	0.945
Long tailed duck	0.342	0.262	0.722	0.191	0.477 n_2 = 10	0.749
American Widgeon	0.327	0.420	0.520	0.314	0.331 n_2 = 3	0.967
Common Eider	0.401	0.272	0.525	0.263	0.306 n_2 = 4	0.917
Red Breasted Merganser	0.188	0.023	0.228	0.161	0.441 n_2 = 10	0.624
Mean of Means	0.298	0.213	0.243	0.686	0.827 n_2 = 3	0.999

by dividing the birds harvested in a given year by the birds estimated in the aerial surveys. I used the Microsoft Excel software statistics package to perform a T test comparison of the mean of the ratios for the time period 1989 – 2002 and the mean of the ratios for the post 2003 (survey years 2004-2005) test group. Harvest survey estimates have not been finalized beyond 2005 so I was only able to calculate a 2-year mean of ratios for the data representing the post-2003 test group.

I performed the T test to determine if the ratios of spring/summer harvest to estimated index populations of the 16 species had changed. A T test probability of 10% or less would indicate, with 90% confidence, that there was a difference of the two means that was not due to chance. This series of analyses would allow me to accept or reject the null hypothesis *"there is no difference between the means of the pre-2003 and post 2003 harvest-to-breeding-bird population ratios at α=.10."*

Power to Detect Change in the Mean:

To determine whether my T test analyses were powerful enough to be statistically conclusive, I calculated the power of detecting a positive and negative 50% change of the14-year pre-2003 harvest ratio mean used for each T test analysis for each species, using $\alpha/2$ level 0.1 corresponding to a 90% confidence interval. I used the formula described by Bart, et al. (1998) (Appendix C).

I chose to set 0.80 as a threshold for minimal power for detecting a 50% change in the mean of the 14-year pre-2003 data set. I chose these values because these are typically used in biological population modeling and hypothesis testing (Bart et al. 2004). I used Microsoft Excel software to calculate the power coefficient for detecting a 50% reduction and a 50% increase in the mean values of the harvest-to-breeding-bird ratios for each species.

Power with n_2 = 1 through 10:

I developed a simple algebraic model using Microsoft Excel software to hold all variables constant except n_2 to calculate the years needed to improve the power coefficient value to 0.8. This additional step was especially important for species that had high variance between the pre-2003 and post-2003 data sets, where I was unable to attain a detection power of 0.8. The model held all variables constant, including y_1 and y_2 variance, solving for n_2 only. For mathematical purposes to solve for n_2, I assumed that all other variables (y_1 and y_2 variance, pre- and post-2003 means, and n_1 sample size) would not change.

Mean of the Means:

In applying the Central Limit Theorem I calculated the mean of the means for the harvest-to-breeding-bird ratios to render one T test probability for the entire suite of species. I also calculated power coefficients to detect a positive or negative 50% change in the 14-year pre-2003 harvest ratio mean of all species. I used the same mean data in my algebraic model to determine how many years (n_2) of this analysis would be needed to attain a power coefficient of at least 0.80 for detecting a 50% reduction of the 14-year pre-2003 harvest ratio mean of all species.

V. Results:

Goal #3 – Perpetuation of Customs and Culture:

Of the 16 surveys I sent out, I received 10 responses for a response rate of 63%. I also encouraged each respondent to provide additional thoughts. The following Figures 2 and 3 indicate the survey results for the multiple choice survey.

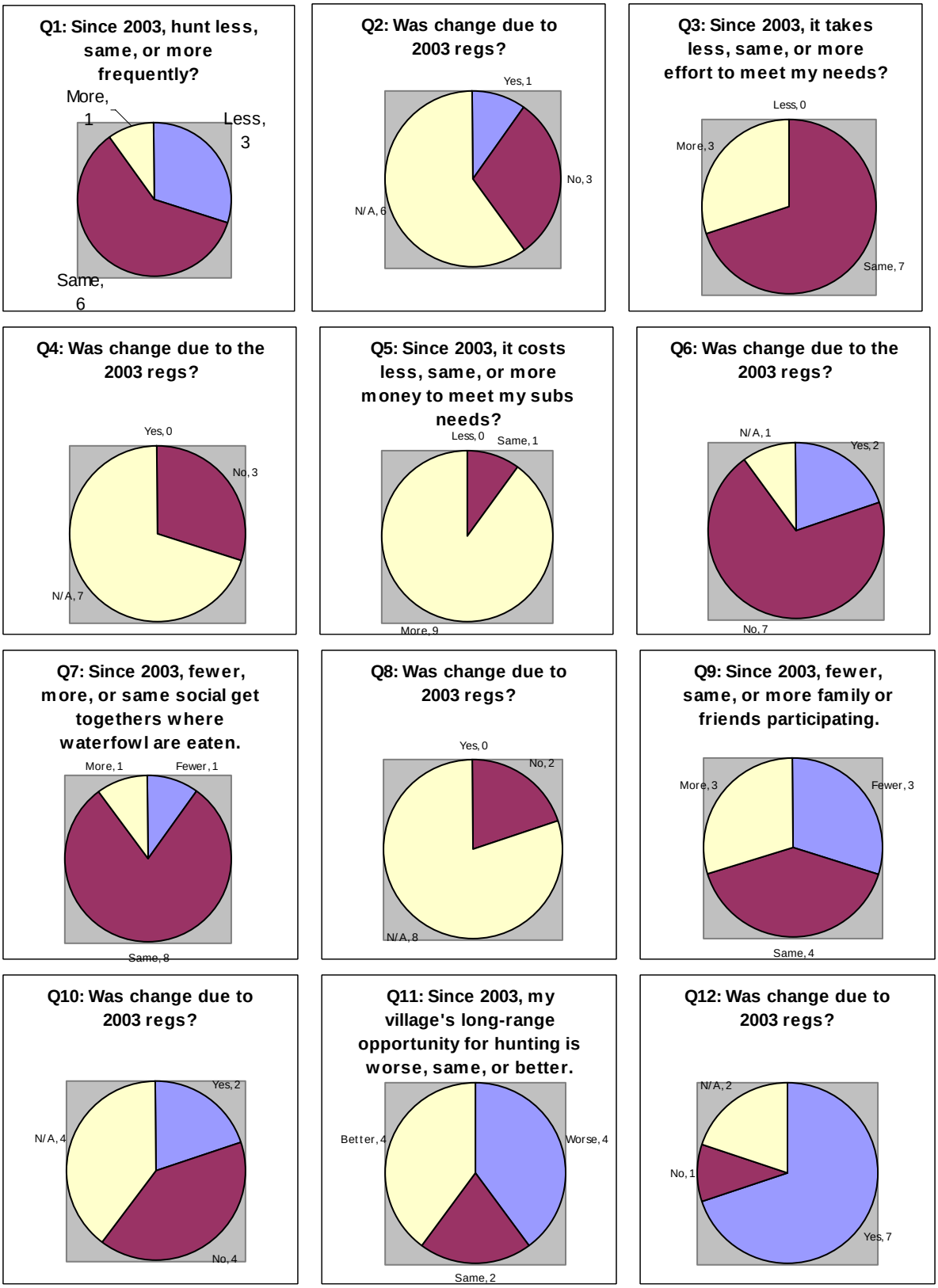

Figure 2: Responses to Questions 1 – 12 of the multiple choice survey of Alaska Migratory Bird Co-management Council members, past and present. n = 10.

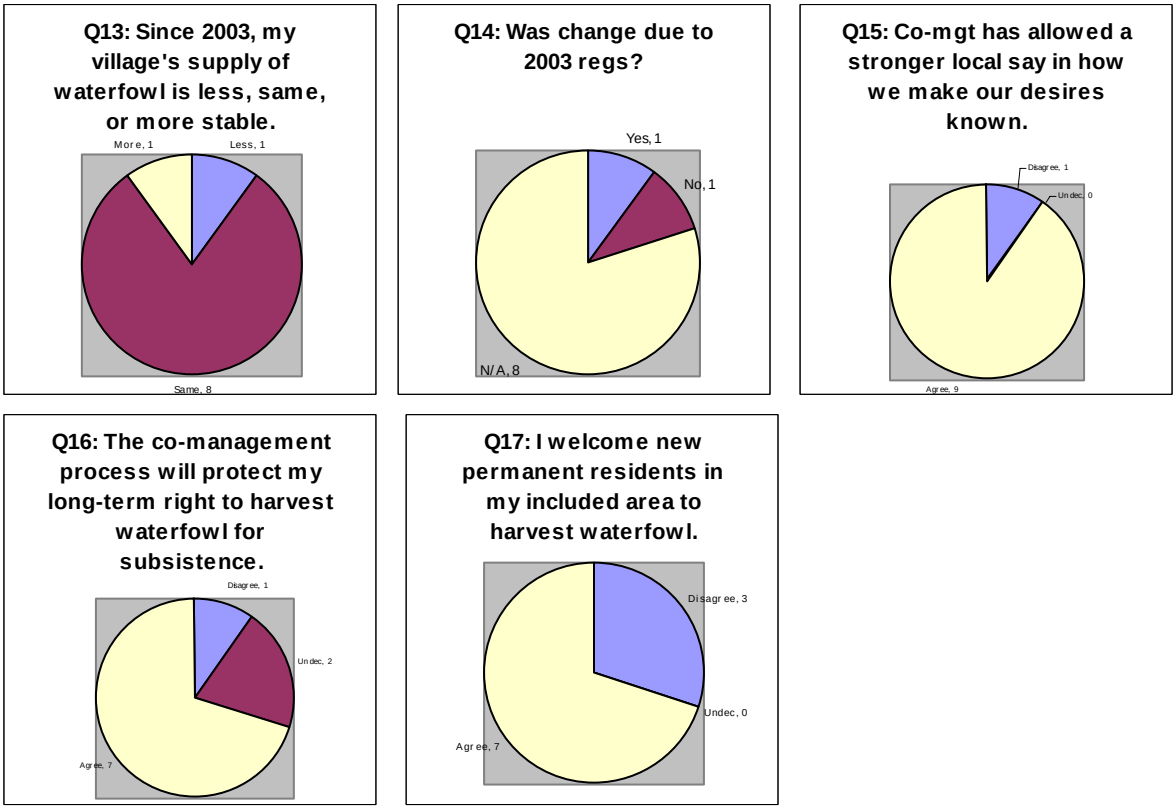

Figure 3: Responses to Questions 13-17 of the multiple choice survey of Alaska Migratory Bird Co-management Council members, past and present. n = 10.

Question 1: Since 2003, I hunt waterfowl for subsistence purposes less, about the same, or more frequently.

Six of ten respondents (60%) indicated there is no change in this phenomenon. For the three respondents that indicated they hunt less, only one attributed this change to the test.

Question 3: Since 2003, it takes less, about the same, or more effort to harvest enough waterfowl to meet my own subsistence needs.

Seven of ten respondents (70%) indicated that it takes about the same effort to harvest waterfowl. Three respondents (30%) indicated it takes more effort but none of them

suggested that the change was due to regulations.

Question 5: Since 2003, it costs me less, about the same, or more money to harvest enough waterfowl to meet my own subsistence needs.

Nine of ten respondents (90%) indicated it costs more to harvest waterfowl now. Only two of those nine respondents that suggested it costs more attributed the increase to the regulations.

Question 7: Since 2003, there are fewer, about the same, or more social get-togethers where waterfowl are eaten.

Eight of ten respondents (80%) indicated the there are about the same number of social get-togethers where waterfowl are eaten. One respondent indicated there are fewer, and one indicated there are more social get-togethers. Neither of the two respondents that indicated a change in the number of social get-togethers attributed that change to the regulations.

Question 9: Since 2003, there are fewer, about the same, or more family and friends participating in subsistence hunting for waterfowl.

Four of ten respondents (40%) indicated no change in the number of family and friends participating in the hunt. The majority (60%) indicated change has occurred, and the responses were evenly split as to whether the change was an increase (more) or a decrease (fewer). Three respondents indicated there are fewer; three respondents indicated there are more family and friends participating. Two of the three respondents

that indicated there are fewer friends and family members participating did not attribute the change to the regulations. Only one of those three (10% of the total response group) indicated that the reduction was associated with the regulations. The other two suggest that it is because of economic or other reasons that fewer people currently participate in the activity. Of the three respondents that indicated more family and friends participated in subsistence hunting for waterfowl, one attributed the change to the regulations, two did not.

Question 11: Since 2003, my village's long-range opportunity for waterfowl subsistence hunting is probably worse, about the same, or probably better.

Four of ten respondents (40%) feel their village's long-range opportunity for waterfowl subsistence hunting is better; 40% feel it is worse, and 20% believe it is about the same since regulations were established. All but one of the respondents who suggested that a change has occurred attributed this opinion to the regulations. Regardless of whether they feel the long-range opportunity is better or worse, there is a strong association of the regulations to those perceived long-range opportunities.

Question 13: Since 2003, my village's supply of waterfowl is less, about the same, or more stable.

Eight of ten respondents (80%) believe the stability of their village's supply of waterfowl remains unchanged since the test. Of the two that believe there has been a change, one believes the supply is less stable, the other believes the supply is more stable. The one responder who believes the supply is less stable does not attribute the change to the

regulations. On the other hand, the one responder who believes the supply is more stable does attribute the change to the regulations.

Question 15: Co-management has allowed a stronger local say in how we make our desires known.

Nine of ten responders (90%) agree that co-management has allowed for a stronger say in how their desires are made known.

Question 16: The co-management process will protect my long-term right to harvest waterfowl for subsistence purposes.

Seven of ten responders (70%) agree with the statement. One responder disagreed with the statement, and presumably believes that the co-management process will not protect subsistence rights over the long-term. Two responders (20%) are undecided.

Question 17: I welcome new permanent residents in my included area to harvest waterfowl for subsistence.

Seven of ten responders (70%) welcome new permanent residents into their area to harvest waterfowl for subsistence, while 30% do not. Each responder has formed an opinion on this question, as no one responded as "undecided."

Goal #4 – Conservation of Migratory Birds:

T test:

I found the correlation between the pre- and post-2003 harvest-to-breeding-bird ratios for

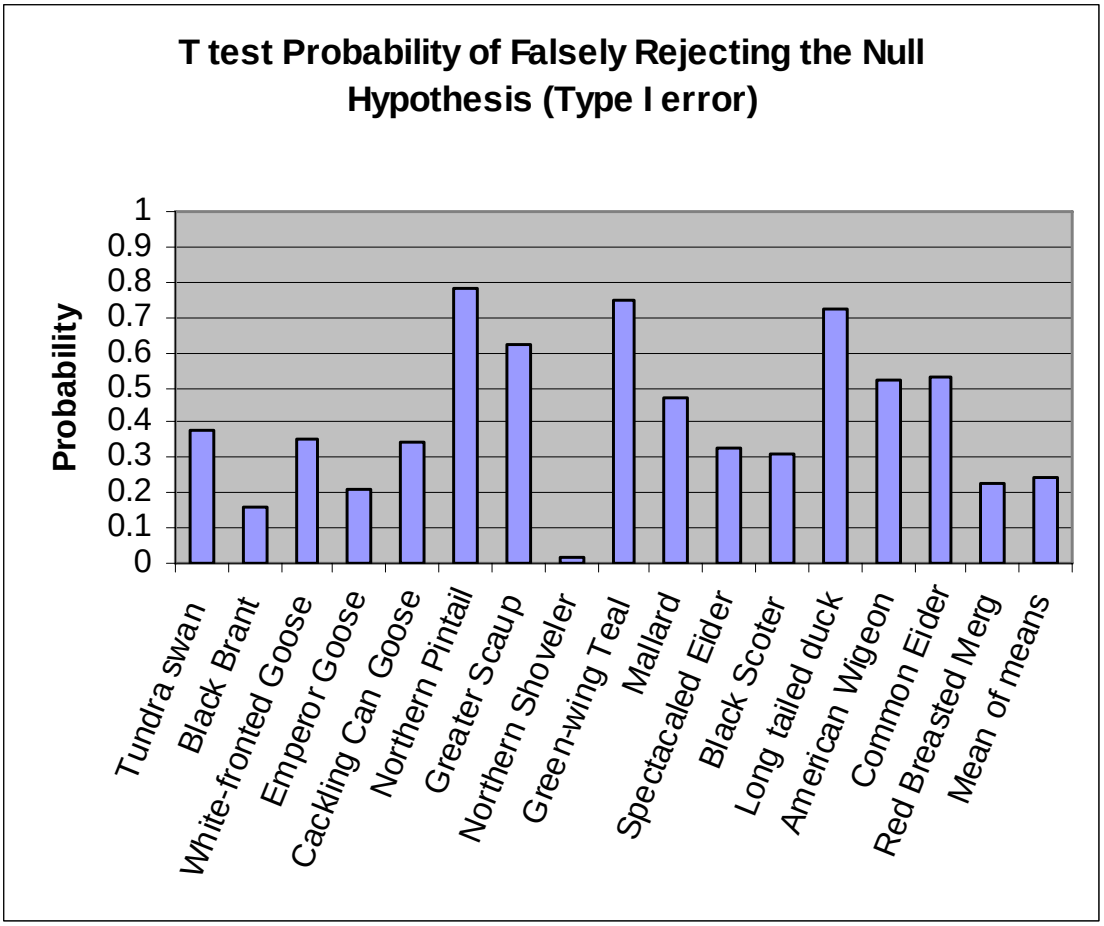

Figure 4: T test probabilities for falsely rejecting (Type I error) the null hypothesis "*there is no difference between the means of the pre-2003 and post 2003 harvest-to-breeding-bird population ratios at α=.10."*

Northern Shoveler to be positive and different at p<.10 (Table 1 and Figure 4). This was the only species of the 16 tested for which the means were significantly different at p<.10. The T test values for the remainder of species have a probability of greater than 10% for falsely rejecting (Type I error) the null hypothesis: "*there is no difference between the means of the pre-2003 and post 2003 harvest-to-breeding-bird population ratios at α=.10."*

Power to Detect Change in the Mean:

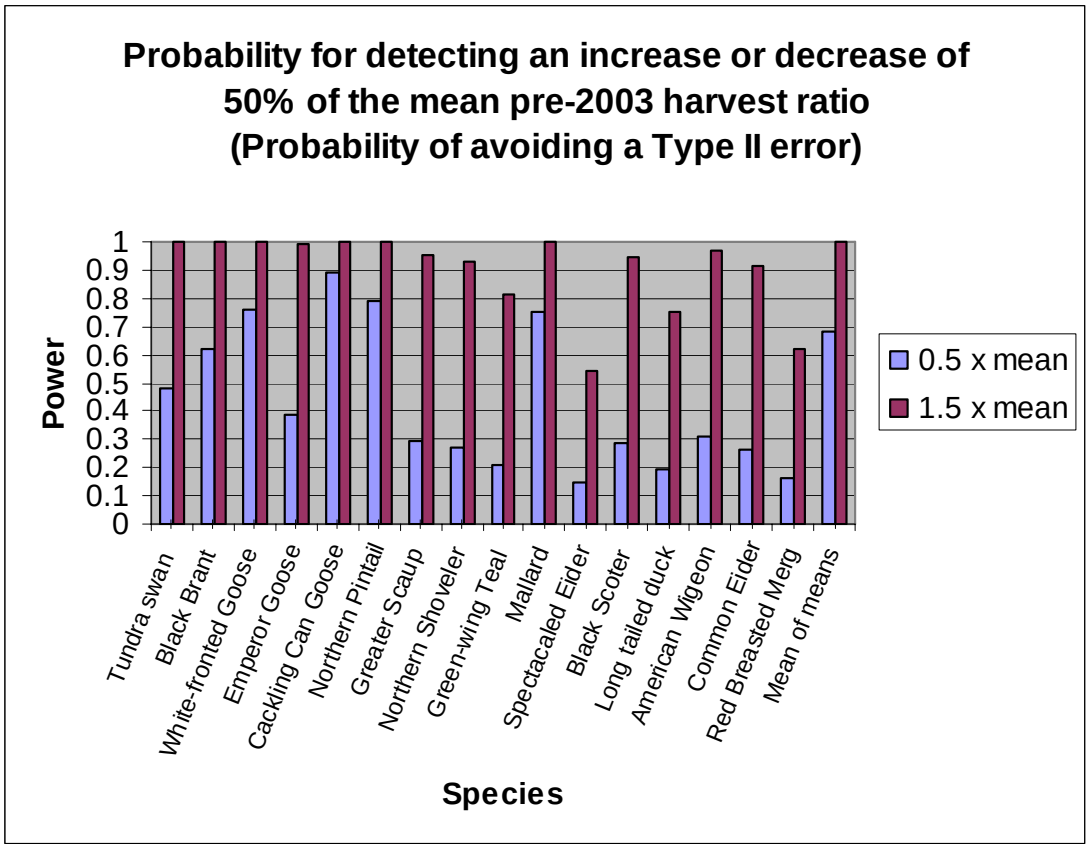

Figure 5: Probability of detecting a 50% increase or decrease in the mean pre-2003 harvest ratio, by species. (Probability of avoiding a Type II error.)

I list the results of my power analyses for detecting a 50% decrease or a 50% increase in the mean of the pre-2003 harvest ratios, by species, in Table 1 and Figure 5. The power analyses indicate the probability of obtaining a significant result in a statistical test when the null hypothesis is false (rejected) and a particular alternative is true (Bart, et al., 1998). In these analyses, the "particular alternatives" are post-2003 harvest ratios differing negatively or positively from the pre-2003 mean ratios by more than 50% of the value of the pre-2003 mean ratio values.

I found that power for detecting a decrease of 50% in the pre-2003 harvest ratios was above 0.80 only for Cackling Canada goose. Consequently, I had low power for detecting a decrease of 50% in the mean of pre-2003 harvest ratios. Said another way, the probability of making a Type II error exceeded my threshold of 20% for all but one species.

Power values for detecting a 50% increase over the pre-2003 mean harvest ratios were higher for all species. I found that power for detecting an increase of this magnitude was above 0.80 for 13 of 16 species analyzed. The probability of making a Type II error when detecting this magnitude of increase was below 20% for 13 of 16 species, indicating I had good power.

Power with n_2 = 1 through 10:

The results of my algebraic model holding all variables constant except n_2 to calculate the years needed to improve the power coefficient value to 0.8 are shown in Table 1. Because I had low power for detecting a decrease of 50% in the mean of pre-2003 harvest ratios, I only ran this model for detecting a decrease of 50%.

I found that by increasing the number of sample years from $n_2 = 2$ to $n_2 = 5$, power values above 0.80 for detecting a decrease of 50% in the mean of pre-2003 harvest ratios could be accomplished for six of 16 species. No additional increases in n_2 would improve power values.

Mean of the Means:

The results of the T test of the mean of all 16 species are shown on the bottom row of Table 1 and the far right column in Figure 4, labeled "Mean of means." The T test value for all means with $n_2 = 2$ is 0.243, meaning the probability of making a Type I error (falsely rejecting the null hypothesis when it is true) is 0.243. I have a 24% chance of making a Type I error. The threshold I set is a 10% chance. The power values for detecting a 50% decrease and a 50% increase in the mean harvest ratios are displayed in Figure 5, in the column labeled "Mean of means" These results indicate a power of 0.686 and 0.999, respectively.

I show in Figure 6 the results of my algebraic model testing for n_2 to estimate how many years of data might be needed to improve the power of detecting a 50% decrease. Assuming variances do not increase, I estimate a power of 0.827 when $n_2 = 3$ (years).

VI. Discussion:

Goal #3 – Perpetuation of Customs and Culture:

Of the four parameters for which I questioned hunters, three parameters are distinctly unchanged, suggesting that the hunting custom and culture remains unchanged as a result of the regulations. According to the ten responders, hunting frequency, effort, and numbers of social get-togethers remain unchanged.

Responders suggest that change has occurred for one of the four parameters since 2003. Their collective responses indicate there is a change in the number of family and friends

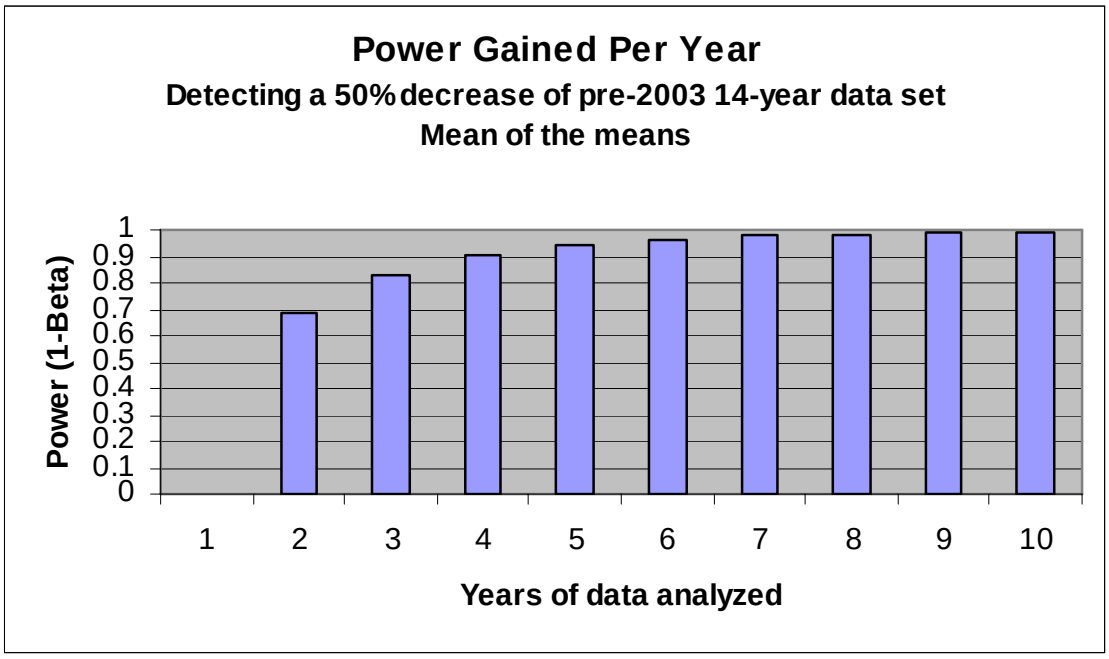

Figure 6: Power gained per year when analyzing the means of 16 waterbird species.

involved in migratory bird subsistence hunting. Three responders indicated fewer family and friends are involved while three indicated more are involved. There is a mix of opinions as to whether the change is a result of the regulations or resulting from other causes; two responders suggest that the change is due to the regulations while four responders suggest that the change is not due to the regulations. One responder offered that the change is due to more non-native hunters engaging in the activity. The responder suggested that there are more non-native hunters involved now because of regulations that make spring/summer hunting legal. This might suggest that new traditions are being created. Establishing new traditions is expressly prohibited in the Treaty Protocol Amendment but addressing that question is beyond the scope of this research project. It should, however, be addressed in future evaluations.

The responders also collectively suggest that the long-range opportunity for hunting, while not necessarily a descriptor of the subsistence economy, has changed. Four responders suggested it is better and four suggested that it is worse. Seven of the eight responders that indicated a change has occurred also attribute that change to the regulations.

Regarding responders' attitudes toward co-management and the outlook for the future of the resource and their opportunities, I believe responders are cautiously optimistic for the future of this co-management process and their future opportunities for waterfowl subsistence hunting. Nine of ten (90%) agreed that the co-management process allows a stronger local say in making their desires known to policymakers. Seventy percent of responders believe that their long-term rights would be protected through "true" co-management (where regulators truly listen to, and apply, local input) and seventy percent of responders welcome new permanent hunters into their included areas to harvest waterfowl. I interpret these generally positive responses as optimistic and supportive.

I do not venture to conclude, however, that the regulations are fully accepted nor are they agreeable. A common fear expressed in AMBCC meetings from Alaska Native hunters is the belief that regulations represent an incremental loss of what they consider to be their ancestral right.

Some responders offered their own personal opinions and experiences, while others indicated they were speaking for those that they represent. The following quotes are characteristic of this sentiment, and also describe some of the caution expressed or insinuated. I believe they are a rich source of insights regarding local, heart-felt opinion of this public policy:

"The comments I provided you are two-fold, they are a combination of my opinion and my observance of others who I personally know that take time to harvest waterfowl."

"Regulations that NOW permit us to harvest birds did go unnoticed for many in the native community, while the non-native community took it hesitantly. If anyone does any hunting in our area, the majority is non-native and it may well be because regulation permits it."

"As long as Alaska residence and especially the local subsistence users are an integral part of any regulatory process, education/understanding to changes, the user groups usually comply. It is when regulations are formulated and changed to apply nationally that issues are created. Fears, misunderstanding and mistrust are created when local users have no clear understanding of regulations. The agencies have enhanced this with regular Advisory Council meetings in local villages. The local household migratory surveys and yearly regional bird meetings have added additional tools for updates and education."

"I'm undecided (for question #16) *mainly due to the fact that I view and anticipate unnecessary restrictions on our traditional view and anticipate unnecessary restrictions on our traditional hunt for waterfowl. The implications of negative outcomes will be blamed by this co-management process. Our people are feeling micromanaged by the co-management process."*

"Traditional harvester's harvest birds by regional seasons and availabilities of resources and sometimes not necessarily by written regulations."

"The requirement for our people to possess hunting licenses and duck stamps will likely reduce hunting demands during the entire waterfowl stay duration in the YK Delta. Our people have hunted over the millennia without a piece of paper(s) telling them it is okay to do so. There are alternatives to duck stamps and hunting licenses we can utilize."

"For my household, it is more because our harvests sometimes are not enough to share (give away) so we are inviting more into our home to share fresh harvested eggs and or fresh cooked birds. It is rare to see."

"Incorporating some TEK in regulatory processes by agencies has made better relationships between rural residents / communities."

"The scare of the waterfowl virus has stopped some hunters in my family from harvesting migratory birds. They are afraid of getting sick and dying."

"The new summer/spring regulations has removed the fear of getting arrested, having firearms confiscated, and either facing fines that are difficult to pay with the shortage of jobs and employment opportunities or going to jail."

"I feel that one of the players in the so called co-management of migratory birds has yet to become a full player-State of Alaska. Still does not recognize subsistence of migratory bird even when they say they do, and consistently voting no on every issue bring up to protect whatever subsistence protections we have. And currently the feds further interpreting that subsistence is only recognized during spring when migratory birds are also hunted for subsistence during the fall as well."

Alaska Native AMBCC representatives have a mix of opinions and experiences. Some appear to be optimistic about the future of their culture and most believe the co-management process will protect their rights and the bird resources for the long term. Some have indicated that other influences like increased cost and fear of disease may be impacting this culture more than the regulations.

Rudestam and Newton (2007) wrote "a phenomenological study usually involves identifying and locating participants who have experienced or are experiencing the phenomenon that is being explored… there is no attempt to claim an ability to generalize to a specific population, but instead, the findings are relevant from the perspective of the user of the findings." My findings do not necessarily apply to the general subsistence hunting population. Rather, they are derived from survey responses of ten past and

current members of the AMBCC, and should be applied accordingly. I chose regional representatives of the AMBCC because of their unique positions of participating in the regulatory process as well as representing hunting communities on the AMBCC.

Goal #4 – Conservation of Migratory Birds:

T test:

The T test probability for my study is the probability that the post-2003 mean of the harvest ratios arose by chance. T test probability translates into the probability of making a Type I error when rejecting the null hypothesis. O'Sullivan, et al., (2003) refers to a Type I error as a "false signal," that is, erroneously rejecting the null hypothesis and declaring a statistical difference in the means when, in fact, a statistically significant difference does not exist.

The one species, Northern Shoveler, for which a significant difference (T test probability of .018) between the pre- and post-2003 harvest-to-breeding-bird ratios exists, prefer inland areas of the Y-K Delta (J. Fischer, pers. comm.). Northern Shoveler ducks are perhaps not a good species to monitor because of their preference for other areas and possible aversion for the coastal areas surveyed. I included Northern Shoveler in my test because of extant data sets. The value of this sole species as an indicator of change is negligible. Regardless of how valuable Northern Shoveler is as an indicator species, it is only one of 16 analyzed. I was unable to detect a difference for the remaining 15 species. I address the power analyses and combined mean statistical approach in the discussions under *Power to Detect Change in the Mean* and *Mean of the Means* below.

Subsistence waterfowl hunting was voluntarily reduced in the early 1980s by Y-K Delta hunters for bird conservation purposes (M. Naneng, personal communication). It could be argued that the pre-2003 data set that includes sample years 1989 through 2002 are skewed low because of voluntary reductions in harvest. I was unable to obtain paired harvest survey and population estimates for periods earlier than 1989. However, this issue is moot at this point because I did not measure an increase. The data actually shows a weakly-detectable decrease in the harvest ratio. Future analyses should consider and attempt to resolve this issue.

Power to Detect Change in the Mean:

The power value represents the probability of avoiding a Type II error. A type II error is a failure to reject a false null hypothesis, and thus, a failure to detect change (O'Sullivan, et al., 2003). In these analyses, a Type II error fails to accept that there is a significant difference between the pre- and post-2003 data sets, when in fact there is a difference.

My T test analyses have good power (>0.80) for detecting a 50% increase from the pre-2003 mean harvest ratio values of 13 of the 16 species analyzed. I am at least 80% confident that my T test analyses would have detected increases in harvest ratios for these 13 species had they occurred. The same analyses are not so powerful for detecting a 50% decrease in the pre-2003 harvest ratio means. Only one species' data set had enough power to detect a 50% decrease – Cackling Canada goose. The T test value was 0.346, suggesting a 35% chance of making a Type I error of falsely rejecting the null hypothesis and considering the means to be significantly different.

Of significant note, however, is that my post-2003 data set only contains two data points ($n_2 = 2$). This small sample size calls the entire T test and power analysis method application into question. Statisticians prefer sample sizes of n>30 to approximate distribution assumptions (R. Stehn, pers. comm.). When I proposed this project, I assumed that post-2003 harvest estimates existed for 2003 through 2007. I found that no harvest survey occurred in 2003, and that 2006 and 2007 harvest estimates have yet to be calculated. I had to use the two remaining years of harvest estimate data (2004–2005) in my analyses, acknowledging the statistical weakness that the small sample size creates.

Power with n_2 = 1 through 10:

Low power to detect a decrease in harvest rates for 15 of 16 species led me to question how might the power be increased above .80? One variable within management control is to continue collecting data, thereby adding to the n_2 variable in the equation offered by Barte, et al. (1998):

$$se(y_1 - y_2) = \sqrt{[(n_1 + n_2)/n_1 n_2)[n_1(n_1\text{-}1)(\ se(y_1)^2 + n_2(n_2\text{-}1)(se(\ y_2)^2)]/(n_1+n_2\text{-}2)]}$$

This equation is to calculate the standard error of the differences of the variances of the means, cited in the *Study Method: Power to Detect Change in the Mean* section above and shown in Appendix C. The variable n_2 is the number of samples for the post-2003 data set. We add to this number by one, annually, as we collect harvest and population data.

The model shows that I could achieve power values >.80 for only six of 16 species. This brings into question whether this is a good way to evaluate goal #4. Power might increase with additional years of data as n_2 increases and if the variance (y_2) of the post-2003 data set also decreases, as would be expected as harvest decreases and sample size increases.

The problem of a small n_2 sample size and low analytical power to detect change also raises the management question "is it worth continuing collecting data for this purpose?" My model suggests that power to detect a 50% decrease in the means of the pre- and post-2003 harvest ratios can be improved for 5 additional species if we add the three additional years to n_2 sample size. Harvest surveys for 2006 and 2007 have already occurred and analyses of those data are underway. The US Fish and Wildlife Service will continue the harvest survey on the Y-K Delta in 2008. When those data are collected and analyzed, they can be incorporated into this T test analysis to determine if power has, in fact, improved. Managers will presumably be better equipped to make decisions at that time.

Mean of the Means:

The sample means for the pre- and post-2003 data sets are 0.298 and 0.213 respectively (Table 1). These data suggest a decrease in the collective harvest-to-breeding-bird rate from the pre- to post-2003 sample period.

The T test value for all means with $n_2 = 2$ is 0.243, meaning the probability of the difference arising by chance and thus, the probability of making a Type I error (falsely rejecting the null hypothesis when it is true) is 0.243, or 24%. This exceeds my threshold of 10% acceptable Type I error probability.

My analyses of the sample means suggest that I have excellent power (0.999) to detect an increase in the means from the pre-2003 data sets, collectively. However, I have weak power (0.686) to detect a 50% decrease. The decrease represented by the pre- and post-2003 sample means is only 29%. Power to detect this change would be even lower than the weak power value determined by my power analyses. Based on these statistical results, I must accept the null hypothesis: "*there is no difference between the means of the pre-2003 and post 2003 harvest-to-breeding-bird population ratios at α=.10.*"

I show in Figure 6 the results of my algebraic model testing for n_2 to estimate how many years of data might be needed to improve the power of detecting a 50% decrease. Assuming variances do not increase, I estimate a power of 0.827 when $n_2 = 3$ (years).

VII. Conclusion:

Goal #3 – Perpetuation of Customs and Culture:

Is the Alaska Migratory Bird Co-management Council's approach accomplishing goal #3 of perpetuating subsistence hunting customs and cultures? I would say "yes" for these reasons: 1) three of the four parameters that I identified as indicators of the subsistence culture remain unchanged, and for the one that has changed this change is not solely

attributed to the regulations, 2) attitudes of those surveyed are generally supportive and optimistic; specifically Alaska Natives surveyed generally support the co-management process, they are generally optimistic about the future of the migratory bird resource and their right to harvest, and they generally welcome new permanently residing hunters to subsistence hunt.

Goal #4 – Conservation of Migratory Birds:

Is the Alaska Migratory Bird Co-management Council's approach accomplishing goal #4 of conserving birds? My sample means analysis suggests a reduction in the harvest ratio on the Y-K Delta coastal area. However, my T test probability for falsely rejecting my null hypothesis exceeded 10% probability – the threshold I set for this analysis. I therefore accept the null hypothesis for my quantitative analysis: "*there is no difference between the means of the pre-2003 and post 2003 harvest-to-breeding-bird population ratios at* α*=.10."*

The Power of this analysis to detect this decrease is limited by the number of data sets used in my calculations. I determined that at least one more year is needed to perform a T test analysis with adequate power to detect a 50% reduction in the harvest rate.

The mandate to conserve bird populations is given in the 1996 MBTA Protocol Amendment which states that it is the intent of the United States and Canada to not "cause significant increases in the take of species of migratory birds relative to their continental population sizes." I did not detect an increase of at least 50% of the pre-2003

harvest ratio sample mean. The power of this analysis exceeded 0.80 and was therefore powerful enough to detect a change of that magnitude.

Based on the afore-mentioned quantitative analyses, I conclude that the regulations are not violating the intent of the Protocol Amendment. We appear to be conserving birds, and the Alaska Migratory Bird Co-management Council appears to be accomplishing goal #4. However, this is merely an analytical snapshot of a select area for select species over a very much abbreviated sample period. Regional variation occurs and this is only one look at one specific area. This analysis should be repeated more exhaustively when more data sets for this and other geographic areas and species exist.

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I must thank my supervisor, Gary Edwards, for supporting me in this effort. My energies have been divided between work, school, and family for nearly three years. I would not have been able to do this without his support and understanding.

Most of all, I owe my wife, Della, and daughter Kim, a huge "thank you" and "I love you" because they have endured countless nights alone, covered my neglected chores, and suffered many stress- and work-filled weekends to get me through. I could not have done this without their love and help.

I thank God for all of you.

"No man is an island…" (John Donne, 1572-1631)

Alaska Migratory Bird Co-Management Council
1011 E. Tudor Rd, MS 201
Anchorage, AK 99507
Toll-Free 1-877-229-2344

January 16, 2008

Mr. Doug Alcorn
c/o U.S. Fish & Wildlife Service
1011 E. Tudor Road
Anchorage, Alaska 99503

Dear Mr. Alcorn:

The Executive Committee of the Alaska Migratory Bird Co-management Council, (AMBCC) has reviewed the proposal you submitted to us for review and comment. You propose to research and conduct an analysis of the AMBCC program to determine the effectiveness of the management and regulatory model for achieving the goals established by the Congress when they ratified the Migratory Bird Treaty Act protocol amendment in 1996. The goals set before the AMBCC were, and remain, to conserve migratory birds as well as to perpetuate the customary and traditional way of life enjoyed by the indigenous inhabitants of eligible regions in Alaska.

An evaluation of the model is appropriate and timely. We therefore concur with the proposed project and encourage you to proceed. We look forward to a written and oral report at our spring AMBCC regulatory meeting slated for April 1-3, 2008 here in Anchorage, Alaska.

Sincerely,

Fred Armstrong
Executive Director, AMBCC

Appendix B

Alaska Migratory Bird Co-Management Council
Process and Regulations Questionnaire
By Doug Alcorn
In Partial Fulfillment of a Master's Degree in Public Administration
University of Alaska, Anchorage

This questionnaire is to gather information regarding the Alaska Migratory Bird Co-Management Council's co-management process for recommending annual migratory bird subsistence harvest regulations. I am trying to answer the fundamental question "Are the AMBCC's co-management process and regulations protecting the customs and culture of subsistence hunters in Alaska?" I am doing this as a final project for a Master's Degree in Public Administration at the University of Alaska, Anchorage. This is not a project associated with my work with the US Fish and Wildlife Service, rather, it is as a student that I'm asking for your help.

The first annual regulations were published in 2003, and annually thereafter. These questions touch on the subsistence harvester's perception of how these regulations have affected the traditional custom and culture of Alaska subsistence hunters since 2003. The questions focus on subsistence harvest of waterfowl, which include ducks, geese, and swans, because they form the group of species predominantly harvested. The survey becomes longer and more cumbersome if I include questions for other species hunted. Please forgive me if you feel I've missed the more essential component of your subsistence species. If so, please indicate by naming which species or group of species you primarily harvest.

If you're willing to help me with this project, I would really appreciate you returning the completed survey by email or hard copy to:

Doug Alcorn
7020 Lowell Circle
Anchorage, AK 99502

Email address is tr4@gci.net or doug_alcorn@fws.gov

You can also FAX it to me at (907) 786-3575.

Thanks a lot! Give me a call if you wish to discuss this project and the use of the information.

Doug

Instructions: Circle the one response that best captures your feelings. If you are going to return this by email, you can either scan it as a .pdf file, or you can place an X below the appropriate response, then return it to me at tr4@gci.net, or doug_alcorn@fws.gov

1. Since 2003, I hunt waterfowl for subsistence purposes *less, about the same, or more* frequently.	less about the same more
2. If you answered *"less frequently"* or *"more frequently"* for question 1, was the major cause for changing the frequency of your waterfowl hunting due to the regulations in place since 2003?	Yes No N/A
3. Since 2003, it takes *less, about the same, or more* effort to harvest enough waterfowl to meet my own subsistence needs.	less about the same more
4. If you answered *"less effort"* or *"more effort"* for question 3, was the major cause for changing the effort due to the regulations in place since 2003?	Yes No N/A
5. Since 2003, it costs me *less, about the same, or more* money to harvest enough waterfowl to meet my own subsistence needs.	less about the same more
6. If you answered *"less money"* or *"more money"* to harvest waterfowl for question 5, was the major cause for the changed cost due to the regulations in place since 2003?	Yes No N/A
7. Since 2003, there are *fewer, about the same, or more* social get-togethers where waterfowl are eaten.	fewer about the same more
8. If you answered *"fewer get-togethers"* or *"more get-togethers"* for question 7, was the major cause for the change due to the regulations in place since 2003?	Yes No N/A
9. Since 2003, there are *fewer, about the same, or more* family and friends participating in subsistence hunting for waterfowl.	fewer about the same more
10. If you answered *"fewer"* or *"more"* family and friends participating, for question 9, was the change due to the regulations in place since 2003?	Yes No N/A

11. Since 2003, my village's long-range opportunity for waterfowl subsistence hunting is *probably worse, about the same, or probably better.*	probably worse	about the same	probably better
12. If you answered *"probably worse"* or *"probably better"* for question 11, was the change due to the regulations in place since 2003?	Yes	No	N/A
13. Since 2003, my village's supply of waterfowl is *less, about the same, or more* stable.	less stable	about the same	more stable
14. If you answered *"less stable"* or *"more stable"* for question 13, was the change due to the regulations in place since 2003?	Yes	No	N/A
Please circle the answer that best captures your feeling. 15. Co-management has allowed a stronger local say in how we make our desires known.	I disagree	I'm undecided	I agree
16. The co-management process will protect my long-term right to harvest waterfowl for subsistence purposes.	I disagree	I'm undecided	I agree
17. I welcome new permanent residents in my included area to harvest waterfowl for subsistence.	I disagree	I'm undecided	I agree

Additional comments:

Power analysis formula taken from Bart, et al. (1998):

$$power = P[Z > t_{\infty}(\alpha/2) - \delta/(se(y_1 - y_2))]$$

where:

$t_{\infty}(\alpha/2)$ is calculated to be 1.645 taken from t test tables with $\alpha/2$ level 0.1

$se(y_1 - y_2)$ is the standard error of a difference of two means from independent estimates with $n_1 \neq n_2$, calculated using the formula:

$$se(y_1 - y_2) = \sqrt{[(n_1 + n_2)/n_1 n_2)[n_1(n_1\text{-}1)(\, se(y_1)^2 + n_2(n_2\text{-}1)(se(\, y_2)^2)]/(n_1 + n_2\text{-}2)]}$$

δ is the desired detectable change of management interest in the 14-year harvest ratio mean. I chose a detection threshold value of +/-50% of the mean of the n_1 sample.