Susitna-Watana Hydroelectric Project Document
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Kimberly D. Bose June 23, 2016
Secretary
Federal Energy Regulatory Commission
888 First Street, NE
Washington, DC 20426

Re: Comments on the Alaska Energy Authority's Initial Study Report and Supplemental Filings, Susitna-Watana Hydrologic Project No. 14241-000

On behalf of Susitna River Coalition, Talkeetna Community Council, Alaska Survival, Talkeetna Defense Fund, Alaska Center, Trout Unlimited, and Wild Salmon Center we offer comments and proposed modification to the Alaska Energy Authority's wildlife studies including Moose Distribution, Abundance, Movement, Productivity, and Survival (10.5), Caribou Distribution, Abundance, Movements, Productivity and Survival (10.6), Dall's Sheep Distribution and Abundance (10.7), Distribution and Abundance, and Habitat Use of Large Carnivores (10.8), and Wolverine Distribution and Abundance (10.9).

On June 4, 2014, the Alaska Energy Authority (AEA) filed its Initial Study Report (ISR). Pursuant to Federal Energy Regulatory Commission's (FERC) Integrated Licensing Process (ILP) regulations, the ISR details AEA's "overall progress" in implementing the FERC approved study plan and reports on the data collected. 18 CFR §5.15(c)(1). For this particular project, in addition to the initial ISR filing, FERC also determined that AEA's 2014 Technical Memorandum and other supplemental study implementation reports and study completion reports filed later by AEA also "serve the intent of the ISR" and are reviewable during this comment period.[1]

Under the ILP, the default study period for most projects is 1-2 years, however, FERC may require potential applicants to extend this study period if additional study time is necessary.[2] The required length of each study is "case specific."[3] Licensing participants have the opportunity to review the ISR and file comments and proposed "modifications to ongoing studies or new studies" including additional seasons of study. 18 CFR §5.15(c)(4). A showing of good cause" is evaluated on a case-by-case basis, and FERC with broad discretion, may require a potential applicant to conduct additional studies, or extend the study season.[4] Proposed modifications must be made with a showing of "good cause" and must include a "demonstration that (1)[a]pproved studies were not conducted as provided for in the approved study plan; or (2) [t]he study

[1] FERC Letter, ILP Process Plan and Schedule, Project No. 14241-000, December 2, 2015.
[2] A Guide to Understanding and Applying the Integrated Licensing Process Study Criteria, Federal Energy Regulatory Commission, March 2012, Page 13.
[3] Guide to Study Criteria, at 13.
[4] *See* 16 U.S.C. § 797, 42 U.S.C. § 4321, 18 C.F.R. § 5

was conducted under anomalous environmental conditions or that environmental conditions have changed in a material way." 18 CFR §5.15(d).

Currently AEA is conducting 58 FERC approved studies to collect the information needed to support a license application. The studies are designed to collect baseline information on the Susitna River and the fish, wildlife, botanical resources and other recreational, aesthetic and cultural resources that may be impacted by the proposed project's construction and operation. These studies are conducted in "preparation of quality environmental documents," which "plays a critical role in the hydropower licensing process."[5] Notably, these studies must be adequate to evaluate the cumulative effects of the project on area resources over a "30-50 year licensing term" as well as robust enough to "evaluate the beneficial and adverse environmental effects of the proposed project" and any "impacts of continued operation of the project."[6]

We offer comments on the wildlife studies conducted by AEA. The Initial Study Reports, Supplemental Study Reports, and Study Completion Reports filed by AEA illustrate many problematic variances, data collection under anomalous environmental conditions, and the omission of important studies. We do not believe that the studies as presented by AEA are adequate to predict the impacts of the propose Susitna-Watana project to wildlife and habitat. For that reason, we propose FERC requires AEA to conduct additional wildlife studies, as is summarized in the comments contained in this letter and the more detailed comments of Sterling Miller, incorporated by reference herein, to obtain adequate baseline data for proper analysis of the project's potential impacts.

Moose Distribution, Abundance, Movement, Productivity, and Survival (10.5)

The proposed Susitna dam has the potential to significantly impact moose and moose habitat. Potential impacts include a decrease in winter moose browsing habitat, increased hunting pressure due to the development of new access roads and transmission lines, and more vehicular collision fatalities.

The Moose Distribution, Abundance, Movement, Productivity, and Survival Study (10.5) seeks to document the "population and composition" of area moose and assess "the relative importance of the habitat in the inundation zone, proposed access/transmission corridors, and the riparian area below the Project." [7]

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[5] Preparing Environmental Documents, Guidelines for Applicants, Contractors, and Staff, Federal Energy Regulatory Commission, September 2008, page v.
[6] 18 C.F.R. § 5.18(b)(2)-(5)
[7] Moose Distribution, Abundance, Movements, Productivity, and Survival Study, Final Study Plan, Susitna-Watana Hydroelectric Project, FERC No. 14241, July 2013, Page 10-2.

I. The Moose Study should be modified to require AEA to collect additional collared moose survey data during winter months when low-elevation moose use the inundation area.

A primary objective of the Moose Study (10.5) is to "document the level of late winter use of adults and calves in the proposed inundation area."[8] The approved study plan called for deploying VHF and GPS collars on moose in the project area with "monthly areal radio-tracking surveys."[9] However, during the 2014-2015 winter, AEA reported that "the study team ceased monthly radio-tracking flights of VHF-collared moose in the winter months of December, January, February, and April."[10] AEA justified the decision stating that winter monitoring was unnecessary "[b]ecause little movement typically occurs during those months."[11] We do not believe that AEA can meet the FERC approved study objectives without collecting year round data on moose populations in the vicinity of the inundation zone.

We hired wildlife expert Sterling Miller to review the Moose Study and offer comments. *Please refer to the attached report for more detailed comments*. He specifically identified this variance to the FERC approved study plan as particularly problematic. Low elevation moose are most likely to use the inundation zone during the peak four winter months.

> "While it is true that moose move less during winter, this modification will result in far fewer locations of the VHS-collared (sic) moose during the season when they are at lowest elevations and in closest proximity to the proposed impoundment. This modification, therefore, will result in a bias against locations of moose at a time when moose are most likely to occur in the area that will be most affected by the proposed impoundment. This is also at the time of year when moose are most stressed by browse availability and other winter stresses. Correspondingly, the locations of VHS (sic) collared moose cannot be used to evaluate habitat selectivity of moose during this critical period."[12]

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[8] Initial Study Report (ISR), Moose Study (10.5), Part A at 2.
[9] Moose Final Study Plan, at 10-4
[10] Moose Distribution, Abundance, Movements, Productivity, and Survival 2014-2015 Study Implementation Report, Susitna-Watana Hydroelectric Project, FERC No. 14241, November 2015, Page 3
[11] *Id.*
[12] Miller, Sterling, Moose comments Su-Hydro ISR by Alaska TU, Wild Salmon Center, and Sterling Miller, page 2

Additionally, by eliminating winter surveys of VHF-collared moose, the sample size of comparative data is greatly reduced, eliminating 62% of the collared moose from the habitat selectivity data.[13]

> "To avoid underestimation of impoundment use by VHF-collared animals, however, it will probably be necessary to restrict analysis of point location data to GPS-collared animals. This will greatly reduce the sample size of individuals that can be used to document late winter habitat use by moose in the proposed inundation area. It will also reduce the number of moose available to describe subherds as winter use of habitats by subherds tend to be distinct during winter."[14]

This variance from the approved study plan decreases the sample size and fails to document the use of adults and calves in the inundation zone during winter months as required by the FERC approved study plan. For the foregoing reasons, FERC should modify the Moose Study and require AEA to conduct at least one additional year of year-round moose surveys that includes sampling during the winter months.

II. The Moose Study should be modified to require AEA to collect additional moose browse data on CIRWG lands in close proximity to the dam site.

FERC approved study plan directs AEA to "document moose browse utilization in and adjacent to the inundation zone and the riparian area below the Project."[15] During the 2013 study season, AEA reported an important variance that prevented access to some of the sample plots for moose browse because AEA had not secured access agreements to Cook Inlet Regional Working Group (CIRWG) lands.[16] The CIRWG lands are in close proximity to the Susitna River and the dam site. These lands were also identified by AEA as "high" for browse.[17] AEA attempted to work around the problem by replacing these sample plots with others in a different location that had the same moose density classification.[18]

Wildlife consultant Sterling Miller contends that this is problematic for the moose habitat data:

[13]Miller, Sterling, et. al., Moose comments at 2.
[14] Miller, Sterling, et. al., Moose comments at 6
[15] Moose Final Study Plan, at 10-2.
[16] Moose, Initial Study Report, Part A – Page 5
[17] *Id.* at 15.
[18] Moose, Initial Study Report, Part A – Page 5

> "Doing this assumes that all quadrats within the "high" stratum for browse are equivalent in terms of having more or less browse that the average quadrat within the high stratum. This is not a valid assumption…. [A]ll quadrats classified as "high" are not equal, and the lowest elevational quadrats likely have more moose browse and browse utilization than the higher elevational quadrats within the same stratum."[19]

AEA's study "work around" will likely "result in *over-sampling* of browse plots distant from the impact areas and *under-sampling* of plots where impacts of the project will be least and most significant."[20] Any impact assessments based on the browse data collected "will likely be biased unless this is corrected."[21] To correct these biases and meet the objectives of the FERC approved study plan, FERC should require AEA to collect additional browse data and adopt plot selection and categorization methods that take into account elevation and proximity of the plots to the project area and the Susitna River.

III. The Moose Study should be modified to require AEA to collect additional survey data to replace the information that was collected under anomalous weather conditions in 2013 and better describe and identify subpopulations.

Data collected during the spring of 2013 were collected under anomalous environmental conditions. Some of the moose surveys were conducted during "the unusually late spring in 2013."[22] These abnormal conditions likely affected moose movements, calving area, and survival of the moose in the project area. Since very few years of moose telemetry surveys were planned, it is critical that baseline data is reliable. Samples taken during a very unusual year can dramatically skew the data. To establish a reliable baseline for moose populations in the project area, FERC should require AEA to conduct at least one additional year of data collection under normal environmental conditions.

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[19] Miller, Sterling, et. al., Moose comments at 2.
[20] Miller, Sterling, et. al., Moose comments at 6.
[21] Miller, Sterling, et. al., Moose comments at 6.
[22] Initial Study Report, Caribou Distribution, Abundance, Movements, Productivity, and Survival Study, Alaska Energy Authority, Susitna-Watana Hydroelectric Project, FERC Project No. 14241, June 2014, Part A – Page 5.

In addition, additional surveys should be conducted to identify subpopulations of moose in the study area. "Ballard and Whitman (1988) identified 11 different subpopulations of moose, all of which had different patterns of movement and habitat use and would have been impacted by the then-proposed impoundment in different ways. In the ISR, all moose are treated as if they were part of one big subpopulation."[23]

Some subpopulations of moose are likely to be more impacted by the proposed project due to differences in behavior and habitat use patterns. It is critical to identify subpopulations to properly assess impacts on moose populations. For that reason, FERC should require AEA to conduct additional moose surveys to identify subpopulations, behavior and habitat use patterns.

Caribou Distribution, Abundance, Movements, Productivity and Survival (10.6)

Caribou heavily use the area in the vicinity of the proposed Susitna dam. Over time, different herds have used the area so the impacts to each herd can vary dramatically depending on the caribou range at the time of the study. Fundamentally, "[c]aribou need large landscapes in which to survive in large herds. When formerly large landscapes are infringed on or limited by developments, it limits the ability of caribou to shift their movements and centers of distribution in a pattern that have evolved over thousands of years. Large herds need large landscapes and without them caribou cannot survive in large herds."[24] The proposed project will likely prevent the large established herds from remaining together, hinder caribou from accessing traditional calving grounds, disrupt migratory patterns and access to habitat.

The Caribou Study is designed to "obtain sufficient population information on caribou to evaluate project effects on important seasonal ranges, such as calving areas, rutting areas, wintering areas, and migration/movement corridors."[25] For the following reasons, we believe that the Caribou Study needs to be modified to address identified variances and ensure that AEA collects adequate baseline data to assess impacts.

I. The Caribou Study should be modified to require AEA to collect additional years of radio collared data to achieve appropriate levels of resolution on all caribou herds using the study area.

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[23] Miller, Sterling, Caribou comments Su-Hydro ISR by Alaska TU, Wild Salmon Center, and Sterling Miller, at 3.
[24] Miller, Sterling, Caribou comments Su-Hydro ISR by Alaska TU, Wild Salmon Center, and Sterling Miller, Page 2.
[25] Caribou Initial Study Report, at Part C - Page 1; *See also,* Final Study Plan, Alaska Energy Authority, Susitna-Watana Hydroelectric Project, FERC Project No. 14241, July 2013, Page 10.6-1.

Two primary objectives of the Caribou Study are to "document seasonal use of and movement through the Project area by both females and males of the Nelchina caribou herd (NCH) and the Delta caribou herd (DCH) and assess the relative importance of the Project area to both the NCH and DCH."[26] To accomplish this task, AEA deployed radio collars on caribou from the NCH and DCH.

However, AEA reported one problematic variance in the caribou study. Due to the mixing of the herds within the study area, AEA did not deploy the collars on the individual caribou based on their associated herd.[27] Instead, after collar deployment and monitoring AEA grouped the collared caribou as the "Western Migratory Group" and the "Eastern Migratory Group" based on winter movements.[28] While wildlife expert Sterling Miller noted that the variance is reasonable because AEA's plan to designate herds is sound, he does not believe that adequate herd designations and proper resolution can be accomplished without additional years of study and the recognition of additional caribou groups, specifically the Chulitna group and the Cantwell group. *(Please see the attached Caribou Study review for more detail.)*

> "Because of the complicated nature of the herds and groups in the vicinity of the proposed Susitna-Watana Impoundment, many years of study will be necessary to sort out which groups or herds will be most impacted and how these impacts will occur; especially since there is significant year to year variation in movements and areas utilized. It is unlikely that these relations can be adequately sorted out with only 2-3 years of study of radio-marked individuals especially if resolution is lost by recognizing only two groups as is done in the current study (the WG and the NCH)."[29] "Appropriate levels of resolution on all the groups using the study area are unlikely to be obtained with only 2-3 years of study."[30]

AEA recognizes that "herd designations remain the best tool for understanding caribou population dynamics and quantifying the potential effects of development."[31] For that reason and given the fact that Caribou have extremely wide ranges, "to adequately study the range, grazing patterns, productivity, important breeding and calving areas, and other important areas to a caribou herd, it is important to conduct

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26 Caribou Initial Study Report, Part A at 1.
27 Caribou Initial Study Report, at Part A - Page 3.
28 Caribou Initial Study Report, at Part A – Page 3.
29 Miller, Sterling, et. al., Caribou comments at 3.
30 Miller, Sterling, et. al., Caribou comments at 4.
31 Caribou Initial Study Report, at Part A-Page 3.

studies for more than 2-3 years."[32] For the aforementioned reasons, FERC should modify the Caribou Study and require AEA to collect additional years of radio collared data to achieve appropriate levels of resolution on all caribou herds using the study area to fully understand and assess project impacts.

II. The Caribou Study should be modified to require AEA to collect additional years of information to address data gathered under anomalous environmental conditions during the 2013 study season.

The caribou surveys conducted during the spring of 2013 were preformed under anomalous environmental conditions. In the ISR, AEA acknowledges that "spring migration and peak calving were delayed during the *unusually* late spring in 2013 and very few collared cows were found on the traditional calving grounds… during the typical period of peak calving."[33] "A very high proportion of parturient cows lost their calves in 2013 (66%). This is much higher than reported in previous studies for the NCH based on work conducted during 2008 (Schwanke 2011)."[34]

"Caribou productivity and survival is variable between years and areas based on habitat quality and weather conditions."[35] The heavy and late snows of 2013 as well as the colder weather in April and May of 2013 likely caused Caribou herds to dramatically alter normal migratory movements. It also significantly increased adult and calf mortality. To meet study objectives and assess potential impacts it is imperative that AEA collect accurate baseline data especially when conducting a short term study for a species that has long term trends. For these reasons, FERC should modify the Caribou Study and require AEA to collect additional years of information to address data collected under anomalous environmental conditions to ensure accurate and reliable baseline data.

Dall's Sheep Distribution and Abundance (10.7)

Please see the attached review by Sterling Miller for comments on the Dall's Sheep Study. These comments were prepared based on the June 3, 2014 Initial Study Report. The review has not been subsequently updated.

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[32] Miller, Sterling, et. al., Caribou comments at 4.
[33] Caribou Initial Study Report, at Part A – Page 5.
[34] Caribou Comments, Sterling Miller at 4.
[35] Miller, Sterling, et. al., Caribou comments at 5.

Study of Distribution, Abundance, and Habitat Use by Large Carnivores (Wolves and Bears) (10.8)

Bears (10.8)

I. The Bear Study should be modified to require AEA to collect additional survey information and samples in the vicinity of the Susitna project.

The goal of the Large Carnivore study is to "obtain sufficient information on three species of dominant predators and game animals in the region- brown bear, black bear, and wolf-to use in evaluating Project related effects and identifying any appropriate protection, mitigation, or enhancement measures."[36] The Bear Study was designed to be a combination of a "desk analysis" with a field study component.[37] AEA identified the Study Area as all of Game Management subunit 13E plus subunits 13A, 16.A and 16B.[38] For purposes of the Bear Study, this is a very large study area and incorporates the analysis of study results that are very far from the proposed project.

We hired wildlife expert Sterling Miller to review the Large Carnivore Study (10.8) and provide detailed comments and recommendations. *Please see the attached Large Carnivore Study review for detailed comments.* The comments provided are based on the review of the Initial Study Report filed in June 2014. While AEA conducted additional field work in 2015 and updated its report by noting that field work is complete, we do not believe that AEA has sufficient information to meet the study objectives or evaluate project effects. [39]

a. <u>AEA should continue to collect additional bear hair samples, expand the sample area north of Devils Creek and assess habitat use and movement of bears.</u>

AEA identified two variances in the ISR regarding the hair-snag studies along the salmon spawning areas. These variances impact the ability of AEA to assess the "bear use of streams supporting spawning by anadromous fishes."[40] Of particular concern,

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[36] ISR, Large Carnivore Study (10.8), Part A at 2.
[37] *Id.* at 1.
[38] *Id.*
[39] AEA, Study Implement Report, Distribution, Abundance, and Habitat Use by Large Carnivores, Page 7
[40] AEA, Initial Study Report, Distribution, Abundance, and Habitat Use by Large Carnivores,, Part A – Page 1

AEA did not take hair-snag samples upstream of Devil's Canyon and collected samples at less than one third of the "documented salmon spawning sites" in during the 2013 study season.[41] Due to these variances "[i]t is unlikely that salmon use by bears living in the vicinity of the proposed Susitna dam site will be documented."[42]

Although AEA conducted additional bear hair samples in 2015, no samples were taken above Devils Canyon and data gaps from the 2013 study season still remain. The continuation of hair-snag studies is not only important to assess the use of salmon spawning areas by bears, but also to assess the relative density of bears in this area. In addition, an assessment of the impacts of the proposed project cannot be conducted without information on bear habitat use and movements. AEA conducted no habitat use or movement studies of either brown or black bears in the study area. Without such, a proper assessment of the importance of the project area to bears is not possible.

For these reasons, we request that FERC require AEA to preform additional years of hair-snag sampling, including sampling upstream from Devil's Canyon. The effort "should include sample collection times relative to timing of salmon use and bear molting."[43] Additionally, to better assess bear use of the project area AEA should redesign the Bear Study to include radio-tracking bears using GPS transmitters to permit determination of bear use of project impact areas, like the studies done for caribou and moose in the project area.[44]

II. The Bear Study should be modified to address fundamental problems.

a. AEA should reduce the size of the study area to properly evaluate project effects.

AEA reported in the ISR that the study area for both brown and black bears is the same as "ADF&G's Talkeetna study area" and "includes the entire area of Game Management Unity Subunit 13E plus parts of adjacent Subunits 13A, 16A, and 16B."[45] Sterling Miller raised concerns with the size of the study area:

- "The Large Carnivore Study Area used to estimate bear density and abundance is 26,490 km^2. This greatly exceeds the size of the area within which bears conceivably could be impacted by the proposed Susitna Dam

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[41] Large Carnivore, ISR, Part A – Page 9
[42] Sterling Miller, Bear comments on Su-Hydro ISR by TU, Wild Salmon Center, and Sterling Miller at 6.
[43] Miller, Sterling Bear comments at 19
[44] Miller, Sterling Bear comments at 14
[45] Large Carnivore, ISR, Part A – Page 2

project. This study area was configured for an estimate based on data collected during 2000-2003 that was unrelated to Susitna Dam studies."[46]

- "The Large Carnivore Study Area is too large to accurately meet study objectives for Large Carnivores that would be impacted by the proposed project… The method currently being used does not provide an abundance or a density estimate for either species of bear in the area that will be impacted by the impoundment."[47]

We propose that the population and density study analysis follow the study area used for the Su-Hydro bear studies in 1987, which "was 1,317 km^2 centered on the proposed Watana-Susitna dam site".[48]

b. Single season surveys were conducted during the spring only, due to decreased visibility in the summer and fall from flora growth, this created a bias in the density assessments, and additional studies in additional seasons need to be conducted to fix this bias.

AEA conducted bear density and population studies during the spring months when the likelihood of observing individual bears is higher due to limited foliage growth. However, this biases the density estimates, as bear activity, location, and density differ throughout the seasons based on food availability. Sterling Miller identified the biases this single-season sampling has on density maps and population estimates.

- Spring location of bears include avalanche tracts "where bears forage for newly emergent vegetation and tubers." Spring locations may also "reflect the presence of a winter-killed or wolf-killed ungulate."[49]

- In the spring months bears are "searching for mating opportunities or avoiding predation on their newborn cubs. Many spring sightings, therefore, occur in places a bear is moving through rather than exploiting for food."[50]

- AEA density maps show the highest density of bears along the 5,000 foot contour, however the density of bears as abnormally high "only because bears emerging from dens occur here in the spring; the food resources available in this area are

[46] Miller, Sterling Bear comments at 2
[47] Miller, Sterling Bear comments at 6-16
[48] Miller, Sterling Bear comments at 6
[49] Miller, Sterling et. al. Large Carnivore comments, at 4
[50] Miller, Sterling Bear comments at 5

inadequate to support a high density of bears throughout the year"[51] and "because during spring, many bears (especially females with newborn cubs [Miller 1987]) occur in the vicinity of their high elevation dens where there is no food in order to avoid infanticide of their cubs by other bears."[52]

- AEA reported that proximity to salmon streams was not a driving factor in brown bear abundance.[53] However, these surveys were conducted in the spring when salmon are not yet spawning in the rivers, therefore bears are not yet using these anadromous areas. "This does not mean that the driving force influencing and correlated with brown bear density in the Large Carnivore Study Area is not salmon."[54]

- The factor most influencing bear density is the abundance and spatial distribution of food (Schwartz et al. 2003). In the Large Carnivore Study Area and most other places with bears, brown bear density is more influenced by availability of salmon for food than by any other factor. However, bears are not on salmon streams during spring when the MRDS surveys were conducted because the salmon have not yet arrived."[55]

The single-season sampling methods employed by AEA influenced the density estimation maps of the study area, overestimating densities in high elevations at great distances from salmon spawning streams, and underestimating densities in close proximity to streams. The resulting biases in the density maps underestimate the importance and use of the salmon streams by bears in the project area, and prevent an accurate assessment of the impacts of the proposed project and changes in the project area to bears. Although AEA conducted an additional season of data collection in 2015, additional study seasons are necessary to fill data gaps from the 2013 study season and properly estimate bear distribution and abundance in the project area. To rectify these biases, we urge FERC to require AEA to conduct additional density studies during the summer and fall months, as well as incorporate density estimates from hair-snag studies to accurately estimate the density of bears in the project area.

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[51] Miller, Sterling Bear comments, "This problem was identified in the ISR (page 10): "[the modeling effort] left the concentrations of brown bears in the northeastern portion unexplained…[and] the study team surmised that brown bears were overestimated in the northeastern portion of the study area…" at 5.
[52] Miller, Sterling Bear comments at 5
[53] Large Carnivore, ISR Part A-Page 10
[54] Miller, Sterling Bear comments at 8
[55] Miller, Sterling Bear comments at 4

III. The Bear Study should be redesigned to address fundamental problems related to the MRDS study method to properly estimate the density and abundance of bears in the study area and assess project impacts.

AEA reported in the Study Implementation Report that no additional data is needed for the Bear Study because "the objective to estimate the populations of brown and black bears has been completed."[56] Due to AEA's numerous modification request to the ILP, this is the first time licensing participants are able to fully comment on AEA's study progress. The data results and analysis reported by AEA in the ISR contain glaring errors that suggest underlying biases and inaccuracies. We do not believe that AEA has sufficient information to meet the study objectives or assess project impacts as required by the FERC approved study plan. We recommend that the Large Carnivore studies be modified to require AEA to preform additional years of field work to fix errors in the study results.

a. Density surface maps created from MRDS results show inaccurate densities of bears

AEA employed a "mark recapture distance sampling" technique to estimate the density and population of bears within the study area.[57] Sterling Miller points out that, this technique has an "underestimation bias even with the correction added based on point independence."[58] "This approach … is under development for bears in Alaska… this technique, as currently envisioned for use in Susitna studies, has not been subjected to peer review[59] and does not meet the criteria established by AEA for Susitna Dam studies that techniques must be 'consistent with generally accepted scientific practice.'"[60]

Density maps generated from AEA's MRDS studies present inaccuracies in the data collection and analysis compared to previous peer reviewed studies on brown and black bears, some in the same area. For instance, AEA reported estimated high density of brown bears in high elevation areas that cannot support those densities, and low density in areas near salmon streams that should show a high number of bears. The extremely

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[56] Miller, Sterling Bear comments at 2
[57] Large Carnivore, FSP at Page 10.8-5
[58] Miller, Sterling Bear comments r at 7
[59] Becker (ADF&G, personal communication) reports that publications on point independence reanalysis of MRDS data are in preparation. Similar techniques have been used for other species and are reported in the literature.
[60] Miller, Sterling Bear comments at 14

high densities of both bears in some areas and low density calculations in others point to underlying biases and errors in the study. In addition, AEA's density map "indicates **lower** densities in southern and western portions of the Large Carnivore Study Area where bears have access to multiple runs of salmon, than in interior areas where bears do not have access to salmon. All available studies indicate that where brown bears have access to multiple runs of Pacific salmon, densities are much higher than in interior areas."[61]

As concluded by Sterling Miller, "[t]he indicated densities appear much too high based on comparisons with densities reported in other studies. This indicates, at best, a calibration problem and makes the density surface maps useless for the purpose of determining how many bears use any portion of the Large Carnivore Study Area. Additionally, the ISR does not even attempt to provide estimates of the number of bears of either species that will be impacted by the proposed project (much less the level or mechanisms of such impacts). There is no indication that any additional effort will be forthcoming in subsequent reports to provide information pertinent to evaluating project impact on bears."[62]

For those reasons, we propose AEA be required to conduct additional data analysis using available data from the current study to evaluate abundance and density estimates that can be compared to Su-hydro studies conducted in 1980s.

b. <u>Calculated detectability of bears in the surveys was overestimated in the report, which resulted in the underestimation of the total number of bears in the study area.</u>

It is likely the observation of bear in the study area during surveys lacked independence, raising the detectability rate of the bears and resulting in the underestimation of bears in the study area. The mark recapture distance study relies heavily upon the independence of the two observers to calculate an accurate estimate of bear density and abundance in an area. AEA reported that the two observers (flight passenger and pilot) were separated by curtain to maintain independence. Sterling Miller indicates that this is key to the success of the model,

> "The most critical assumption in this technique may be that the sightings by each observer are <u>independently</u> <u>obtained</u>; a sighting by one observer must not influence the likelihood that the other will also see the

[61] Miller, Sterling Bear comments at 3
[62] Miller, Sterling Bear comments at 5

> bear. The importance of this assumption was evaluated by Benson (2010). Violations of this assumption will lead to a systematic underestimation bias."[63]

Review of the densities and estimated population size of brown bears in the study area reported by AEA, and previous studies in the area, indicates the model resulted in the underestimations. Sterling Miller suggests that this underestimation is likely due to the violation of the assumption of independence,

> "We suspect that this underestimation bias most likely resulted from lack of independence between observers in the aircraft during MRDS surveys. Lack of independence between observers would lead to overestimation of detection probabilities which would cause underestimation of bear abundance."[64]

The possible lack of independence in the mark recapture distance surveys poses a major problem of the assumptions in the bear density and abundance estimations which need to be addressed. We propose AEA be required to conduct additional season of field work in the study area using the Capture-Mark Resight methods presented in the comments by Sterling Miller and summarized below.

Recommended Modification

Bear studies should be redesigned to permit direct estimation of the number of bears in the area likely to be impacted by the proposed impoundment, rather than the current study area which is approximately 20 times larger. The method currently being used does not provide an abundance or a density estimate for either species of bear in the area that will be impacted by the impoundment. CMR, hair-snaring DNA studies, and/or Resource Selection Function studies based on data from radio-marked bears are all appropriate techniques that should be considered to provide useful information for evaluating project impacts on bears. Depending on techniques used, this would require 2-4 years of study with the quickest result from DNA hair snaring studies (e.g., Kendall et al. 2009, Boulanger et al. 2002). This is particularly important for brown bears. The estimates derived by Miller (1987) for black bears are unlikely to have changed much in the Susitna Dam area.

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[63] Miller, Sterling Bear comments at 25
[64] Miller, Sterling Bear comments at 3

c. AEA should use different methods to survey bears in forested areas to accurately evaluate density and abundance.

AEA reported observations and estimated density for both brown and black bear within the study area in the ISR. Low density areas reported by AEA include large forested areas. The inability of AEA observers to see bears within this area likely contributed to the underestimation of density and population for both brown and black bear in this area.

> "The reason there are no previous bear density or population estimates in the western and southern portion of the Large Carnivore Study Area is because much of the bear habitat in this area is forested. It is very difficult to use techniques based on observations in habitats where bears cannot be seen because of overstory vegetation… if any bears present in the study area cannot be detected, then any analytical technique based on observations will underestimate abundance."[65]

These non-observances of bears in the forested areas are particularly problematic for the estimation of black bear in the area, as ideal black bear habitat includes heavily forest areas. Sterling Miller expresses the impact this likely had on AEA's reported estimations,

> "We suspect this is because black bears living in these lightly forested or shrubby riparian habitats penetrating to the northeast in the middle of the study area are more likely to be seen than in the more heavily forested habitats further south and west where higher density black bear populations most likely occur. This is because these are the most forested habitats that are preferred by black bears. Black bears occur primarily in forested habitats and, in the project area, in the riparian

[65] Miller, Sterling Bear comments at 2, *who notes* In the key paper on mixed mark-recapture and line transect models, Laake et al. (2008:299) noted*: "In particular, it is much more difficult to cope with availability bias and it will typically require additional effort such as a known marked population* [references], *separating in time between surveys* [references], *or an independent estimation of the availability process* [references]". Availability bias is when animals are not available for detection (e.g., hidden by vegetation). In the same paper (page 300) the authors acknowledge that for double-count methods (such as used in the current study): *"…these methods cannot account for animals that are unavailable to both observers."* Further (page 301) these authors acknowledge that when some groups are hidden (unavailable to be seen), it represents a form of heterogeneity "…*that cannot be modelled with mark-recapture and, unfortunately, it is a fairly common form of heterogeneity*".

> habitats along the upper Susitna River and its tributaries like Watana Creek (Miller 1987)."[66]

We propose FERC require AEA to conduct additional studies in the project area using the capture mark resight methods as described below in Section IV and in attached comments by Sterling Miller.

d. AEA's study methods limited the number of bears recorded by observers, which contributed to the underestimation of bear populations in the study area.

Limitations in AEA's methods likely resulted in observers missing or not counting bears present in the study area, which contributed to the underestimation of the population and density of bears in the study area. Bears above 5,000 feet, those outside of the transect lines, and any which were "incidental" sightings were not counted in the abundance, density, or population calculations, and reduced the number of estimate bears in the study area. FERC should require AEA to conduct additional data collection consistent with the capture mark resight methods which use all bear sightings in calculating the population and density of bears in the study area.

IV. The Bear Study should be modified to require AEA to use the CRM method rather than the MRDS method to estimate the density and abundance of bear populations in the study area and assess impacts.

For the aforementioned reasons, we urge FERC to require AEA to conduct further studies of bears within the project area, using the capture-mark resight methods outlined by Sterling Miller below and supported by the attached Bear Study review. The capture-mark resight method is not only a peer-reviewed and accepted method for bear research, but also more accurate method of estimating bear abundance and density. This modification will ensure that AEA has sufficient information to assess project impacts and develop a mitigation plan to address adverse impacts consistent with the purpose of the Large Carnivore Study (10.8).

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[66] For both black and brown bears the apparent incorrect depiction of bear densities in the density surface maps presented in the ISR can be roughly evaluated using bear harvest data. Our comments on the Analysis of Harvest Data Study (Study 10.20) include a recommendation on how this can be done and why it is pertinent to the bear studies.

Proposed Modifications and Other Recommendations Bear Study (10.8)[67]

1. Bear studies should be redesigned to permit direct estimation of the number of bears in the area likely to be impacted by the proposed impoundment, rather than the current study area which is approximately 20 times larger. The method currently being used does not provide an abundance or a density estimate for either species of bear in the area that will be impacted by the impoundment. CMR, hair-snaring DNA studies, and/or Resource Selection Function studies based on data from radio-marked bears are all appropriate techniques that should be considered to provide useful information for evaluating project impacts on bears. Depending on techniques used, this would require 2-4 years of study with the quickest result from DNA hair snaring studies (e.g., Kendall et al. 2009, Boulanger et al. 2002). This is particularly important for brown bears. The estimates derived by Miller (1987) for black bears are unlikely to have changed much in the Susitna Dam area. In contrast, efforts have been ongoing for decades to reduce the number of brown bears in GMU 13 so earlier estimates may no longer apply to the current population (Miller et al. 2011).

2. Redesigned bear studies should include radio-tracking bears using GPS transmitters to permit determination of bear use of project impact areas more precisely than was possible during 1980s studies using VHF collars. This study requires more than three years.

3. Although we believe the density and abundance estimates generated by this project are not biologically credible (probably because of incorrect data inputs), the idea of generating a density surface map from observational data has merit at least for other species and perhaps, if done correctly, for bears as well. The spatial modeling for this project has apparently resulted in densities being assigned to all 1-km^2 cells in the Large Carnivore Study Area based on covariates where bears were seen. Smoothing software from this database was used to generate the density surface maps where shading indicated a purported gradient of bear density. A more valuable way to use these data than difficult-to-interpret shadings on a map, would be to build tables showing the number of 1-km^2 cells in different density categories (e.g., 0-4.9/1,000 km^2 , 5-9.9, 10-14.9, 15-19.9, 20-24.9, etc.). This tabular data could be used to derive population and mean density estimates for a subportion of any study area (including a portion of the Large Carnivore Study Area surrounding the proposed impoundment or the 1,317 km^2 study area where abundance and density was estimated by Miller (1987)). We suggest that the midpoint of each density category could be used to derive these estimates. It may be possible to derive a variance for such estimates based on Coefficient of Variation surface maps such as are displayed in the ISP using

[67] Miller, Sterling, ISR Review of Brown and Black Bear Study 10.8, at 16-20.

the same 1-km^2 cell approach. We recommend that AEA contract to do something like this for the existing 1-km^2 data set for some portion of the Large Carnivore Study Area that is geographically pertinent to impact assessment studies for the proposed project. This will also be a useful test of the validity of the results generated by the MRDS approach used in this project and reported in the ISR.

4. Regardless of whether the above is done, we recommend that AEA acquire the databases used to generate the results shown in the ISR which generated the density surface and related maps so that they can be independently evaluated for problems that lead to apparent non-credible results. According to the FSP, AEA paid for the spatial analyses used to generate these products and therefore should have a right to have them. Available information presented in the ISR is inadequate to evaluate problems. We don't even know which covariates were found pertinent to the final model used to construct the density surface map and which covariates were determined to be non-significant. Neither do we know the Akaike's Information Criteria (AIC) scores for any of these covariates. This information is necessary to evaluate the results.

5. All maps in the ISR should be modified to show geographic features to permit viewers to orient themselves within the Large Carnivore Study area. The needed features include the proposed Susitna Dam impoundment and major rivers. For brown bears this includes Figures. 5.1-11 and 5.1-12 and the corresponding maps for black bears.

6. Regardless of the approach to future bear studies, the project on Wildlife Harvest Analysis (ISR Chapter 10.20) should include analysis of kill density by harvest reporting units (UCUs) in the entire Large Carnivore Study Area. This will facilitate interpretation of the logic of density surface area plots in the ISR. Recommendations for presentation of harvest data for brown and black bears are in our comments for Project 10.20.

7. The reports on bear and population density estimation techniques are too complex for those without current advanced training in biometrics. Our review of the ISR required consultation with several Alaskan biometricians, including some who have studied the techniques in question. That level of complexity is contrary to the intended purpose of the study reports. The purpose is to inform FERC, the concerned public (and professional wildlife biologists) of study progress so that the suitability of techniques to accomplish stated objectives can be evaluated. The one published paper cited as the authority for these techniques and results is also highly technical and complex (Becker and Quang 2009). If AEA is going to make a case that research

reports—and associated comment periods—are ultimately adequate to support a FERC license application, reports must be presented in a way the interested and reasonably well-educated public can understand. Other study reports for terrestrial species were adequately comprehensible, but this was not the case for the bear portion of the Large Carnivore ISR that involved estimating bear abundance, density and creating the final products based on spatial modeling.

8. If the experimental MRDS approach continues to be employed in Susitna Dam impact assessment studies, power analyses must also be conducted to determine what level of change would be detectable utilizing a subsequent application of the approach (e.g., post dam construction) in the same study area. Walsh et al. (2010) conducted a rigorous power analysis, without which, the management utility of any technique cannot be evaluated.

9. A sensitivity analysis should also be conducted. This will permit evaluating the impact on final results of not observing a subset of randomly selected bear groups on the estimate of bear population size. The same kind of sensitivity analysis should be done to evaluate the impacts of having seen additional groups on the final results.

10. ADF&G chose to use an experimental technique for these studies even though a more comprehensive model for impact assessment studies has long been available to ADF&G (e.g., Flynn et al. 2012, Miller 1987). Meaningful information on changes in bear abundance, population composition, and additional information on bear use of the potential impact area could have been obtained by replicating the studies of Miller (1987) using the same study area. This study area was used to conduct 2 density estimates using CMR techniques in 1985 and 1995 (Miller 1997b). Replicating this work would provide useful information on changes and trends in the bear population. More pertinent information on dam impacts could also have been attained using Resource Selection Function techniques (e.g., Boyce et al. 2002, Manley et al. 2008, Flynn et al. 2012), or DNA hair sampling techniques (e.g., Woods et al. 1999, Kendall et al. 2009, Proctor et al. 2012).

11. Authors must be explicit about the units with which they are estimating bear numbers and bear density. Although it is not explicitly stated, the ISR estimates actually represent bears of all ages. This was based on extrapolations from mean group size observed. Absent explicit description of the units for population or density estimates, they are of little value in making spatial or temporal comparisons with other study areas.

12. Results of the MRDS technique should include search intensity (minutes searched/km^2) and associated variability based on covariates (e.g., vegetation type or elevation). This facilitates comparisons with results of other techniques such as the CMR approach. The search intensity for CMR studies in the Susitna study area ("MidSu") was 1 min/km^2 (Miller et al. 1997a: Table 3).

13. Tables should be provided based on number of bears seen by group size (including groups of newborn, yearling and 2 year-old cubs) and mean and median group size. This is the only information on population composition the MRDS technique can provide. This information is also useful in evaluating the extrapolation for number of groups seen to total number of bears in the population. It is also potentially very useful to evaluate whether the MRDS technique systematically under-samples groups of females with newborn cubs which are the last to exit dens in the spring (Miller 1990) and stay at high elevations near their den sites for an extended period following emergence (Miller 1987).

14. Tabular data for the MRDS technique should show range and means for detectability based on important covariates, especially group size, distance, snow cover, and vegetation. This information is important to permit evaluation of suspected overestimation bias in detectability.

15. The authors should display the locations, elevations, and dates of their MRDS transects on a study area map and in tables so that readers can see where and when transects were flown. This is necessary to evaluate likely bias in the categories of bears likely to be seen such as females with newborn cubs who tend to remain at high elevation near dens during spring.

16. The analysis of isotopes in bear hair to detect salmon use by bears should include sample collection times relative to timing of salmon use and bear molting.

17. Neither the final study plan nor the ISR have any objective associated with evaluating the impacts of proposed roads and transmission lines that will be required to support the proposed project. Although bears can and will cross these corridors, the corridors will likely result in negative impacts on movements by avoidance reactions and increased access to currently remote areas of GMU 13 for hunters and other recreationists which will increase mortality from legal hunting, defense of life and property kills, and illegal kills. There is a huge body of literature on the adverse impacts of roads and access corridors on brown bears including: Simpson (1986), Mattson et al. (1987), McLellan and Shackleton (1988), Kaswork and Manley (1990), Gibeau et al. (2002), Chruzez et al. (2003), Waller and Servheen (2005),

Cook et al. (2006), Graves et al. (2006), Graves et al. (2007), Clevenger and Huijser (2011), Proctor et al. (2012). This impact was also observed by Schwanke (2011:145): "[Brown bears in Unit 13] *are wary of motorized vehicles*."

Wolves (10.8)

I. The Large Carnivore Study should be modified to actually "study" wolf distribution and abundance in the project area to fill important data gaps and adequately assess adverse impacts.

The studies proposed and conducted by AEA regarding wolf abundance and habitat use of the project area are wholly inadequate. AEA proposed a "desk analysis" of wolf abundance and distribution from ongoing studies conducted by Alaska Department of Fish and Game (ADF&G). However, the studies routinely conducted by ADF&G, which AEA rely upon, do not measure the abundance, distribution, or habitat use of wolves within the proposed project area.

a. <u>AEA should conduct field work and study a smaller geographic area in the vicinity of the project.</u>

AEA relies on studies conducted by ADF&G to provide information to support the desk analysis of wolf use of the project area to evaluate potential impacts. The data however is "collected for a geographic area (Game Management Unit or Subunit) that is too large to be of utility in evaluating project impacts on wolves." "These routinely-collected data pertain to the number of wolves in various Subunits of Unit 13 (at best) and will not generate any estimates of the number of wolves in the study area for large carnivores…in the much smaller area of actual impact of the proposed Susitna-Watana Dam and associated corridors." "A study on a smaller geographic area in the vicinity of the proposed project is needed to evaluate these impacts."[68]

Although AEA conducted some field surveys in 2015, the survey only included a very small portion of the project area. These studies do not provide the data parameters and data points necessary for AEA to meet the Large Carnivore study objectives and goals for the Large Carnivore Study (10.8).

For those reasons, we urge FERC to require AEA to designate an appropriately sized wolf study area in the vicinity of the project area, conduct additional aerial surveys and propose methods to determine project methods. These methods should also include

[68] Miller, Sterling, Wolves Comments on Su-Hydro ISR by Alaska TU, Wild Salmon Center, and Sterling Miller, Page 2-3

evaluating information information on the number of wolves harvested in the geographic area that would be impacted by the proposed project and corresponding corridors and transmission lines."[69]

Study of Distribution and Abundance of Wolverines (10.9)

I. The Wolverine Study should be modified to require AEA to collect additional data to fill the data gap from the first study season.

Although AEA has filed a Study Completion Report for wolverine studies, FERC should require AEA to conduct at least one additional year of data collection to meet the study objectives. The goal of the wolverine study is to "collect pre-construction baseline population data on wolverines in the Project area (reservoir impoundment zone; facilities; laydown; and storage areas; access and transmission line routes) to enable assessment of the potential impact from development of the proposed Project."[70]

Under the FERC approved study plan, "the wolverine study is a multi-year project involving evaluation of existing information and field surveys."[71] This primarily includes the use of "snow-tracking and the SUPE technique… to estimate the number and density of wolverines in the Project Area."[72] "Occupancy modeling is a viable approach that can be used in conjunction with the SUPE."[73] In the first year of wolverine studies, due to poor weather conditions, AEA was unable to conduct SUPE surveys, instead only conducting occupancy modeling surveys.[74] AEA recognized that, "OM was unlikely to preform adequately to provide a multi-season index to wolverine populations" and "the statistical power of OM to detect changes in wolverine abundance is very low."[75]

In the ISR, AEA reported the limitations of the OM surveys, and recommends that, "the objective of establishing a population index with OM as a reliable monitoring tool in lieu of regular and repeated SUPE surveys was not achieved and future efforts should focus on SUPE surveys."[76] We concur with AEA on this point, and propose that

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[69] Miller, Sterling, et. al., Wolves comments at 5-6
[70] Wolverine Distribution, Abundance, and Habitat Occupancy, Final Study Plan, Susitna-Watana Hydroelectric Project, FERC No. 14241, July 2013, Page 10.9-1.
[71] Wolverine Final Study Plan, at 10.9-1.
[72] Wolverine Final Study Plan, at 10.9-3.
[73] Wolverine Final Study Plan, at 10.9-3.
[74] Wolverine Distribution, Abundance, and Habitat Occupancy, Initial Study Report, Alaska Energy Authority, Susitna-Watana Hydroelectric Project, FERC Project No. 14241, June 2014, Part A – Page 2.
[75] Wolverine Distribution, Abundance, and Habitat Occupancy, Study Completion Report, Alaska Energy Authority, Susitna-Watana Hydroelectric Project, FERC Project No. 14241, November 2015, Page 4.
[76] Wolverine Study Completion Report, at 4.

an additional year of SUPE surveys for wolverine be conducted to accomplish these population objectives.

II. The Wolverine Studies should be modified to require additional data collection to fill important data gaps in wolverine population studies.

AEA reported two variances for the Wolverine Distribution, Abundance, and Habitat Occupancy studies in the Study Completion Report that limit the sample size of the study, and need to be addressed.

Although AEA filed a Study Completion Report for Wolverine Distribution, Abundance and Habitat Occupancy, we propose that FERC require AEA conduct an additional year of SUPE studies to reconcile these variances with the approved study plan and meet the study objectives.

III. The Wolverine Study should be modified to require additional data collection to address biases in the SUPE data collected in 2015 and use the proper model to assess the impacts of the proposed project on wolverine habitat.

AEA acknowledges the limitations of the SUPE data collected in 2015, and recognizes the potential biases of this data in regards to wolverine abundance and habitat use. AEA recognized two important variance ins the Study Completion Report. These variances include:

- "In 2015… A band of sample units on the southern end of the survey are were excluded" from the SUPE surveys.[77] These excluded sample plots are classified as "high strata" and are the only plots classified as such on the south side of the Susitna River and in close proximity to the proposed Project Area.[78]

- AEA did not conduct SUPE surveys in 2013 or 2014, due to lack of ideal snow conditions.[79] Data from SUPE surveys conducted in 2015 remains the only data available for analysis. This data is insufficient and may hold many biases, as was recognized by AEA in the Study Completion Report.

[77] Wolverine Study Completion Report, at 4.
[78] Wolverine Study Completion Report, Figure 4.1, at 15.
[79] Wolverine Study Completion Report, at 4; Wolverine Initial Study Report, at Part A-Page2.

AEA delineates multiple potential biases within the SUPE data,

- "One potentially bias of track surveys is that they may over-represent habitats and elevations that animals use in transit and under-represent habitats and elevations in which animals are relatively stationary."[80]

- SUPE "sampling was stratified, in part, by elevation and by *a priori* assumptions about habitat quality. Therefore, the data are representative of wolverine occurrence among habitats in the sample units with high elevation, alpine habitats over-represented."[81]

- "Late-winter avoidance of tundra or 'open' habitats may be confounded by the tendency for wolverines to shift elevation seasonally, driven by snow depth and food availability."[82]

- "Females use natal dens for parturition… some adult females and young of the year may be missed in surveys at that time. Likewise any individuals not moving during the survey period would not be represented in the observed group of tracks, again leading to and underestimation of abundance."[83]

These potential biases in the data from only one short (4 day) SUPE sampling of wolverine population and habitat use increases the variability and decreases the reliability of the impact analysis of the proposed project on wolverines. We propose that FERC require AEA to conduct additional SUPE surveys to obtain adequate population baseline data for proper impact analyses.

Additionally, because the SUPE and OM studies conducted by AEA offer little insight into the habitat use of wolverines outside of a limited number winter days we propose that FERC require AEA conduct additional wolverine habitat surveys. Sterling Miller suggests,

> "A good model for impact assessment studies for wolverine by ADF&G biologists was available in the ADF&G studies of Lewis et al. (2012)[84] designed to evaluate impacts of a proposed road in southeastern Alaska.

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[80] Wolverine Study Completion Report, at 8-9.
[81] Wolverine Study Completion Report, at 9.
[82] Wolverine Study Completion Report, at 9.
[83] Wolverine Study Completion Report, at 8.
[84] Lewis, S.B., R.W. Flynn, L.R. Beier, D.P. Gregovich, and N.L. Barten. 2012. Spatial Use, Habitat Selection, and Diets of Wolverines along the proposed Juneau Access Improvements Road Corridor, Southeast Alaska. Final Wildlife Research Report, ADF&G/DWC/WRR-2012-05. 48pp.,

> This model is more appropriate to meet objectives of the current study on Susitna-Watana Dam impacts as it involved GPS-equipped wolverine to evaluate habitat use in the proposed impact area. The current study will add no new information on habitat use by wolverine in the project area although this is identified as an objective."[85]

Wolverine are an elusive and difficult to study species, but important to the Susitna-Watana area ecosystem. For the aforementioned reasons, AEA should collect at least two consecutive years of SUPE data to fill important data gaps to ensure reliable baseline data and to evaluate project impacts.

Wildlife Harvest Analysis Study (10.20)

AEA reported in both the filed Initial Study Report in June 2014 that "this study was rescheduled for implementation during 2015."[86] No additional reports on progress or results from the study have been published by AEA at this time. We propose AEA conduct this study as approved by FERC in the Final Study Plan.

All Wildlife Studies (10.5 – 10.20)

I. All of AEA's studies on wildlife should be modified to require AEA to conduct studies that evaluate the impacts of the proposed roads and transmission lines that will be built to support the proposed project.

To satisfy FPA and NEPA requirements, FERC requires "potential applicants" to identify and describe all wildlife resources including those in "the project's transmission line corridor or right-of-way."[87] AEA mentioned project impacts along transmission lines and access roads in some (i.e. wolverine, moose), but not all of the wildlife study plans, additionally, AEA provides no discussion of study results or analysis of data in the Initial Study Reports, Supplemental Study Reports, or Study Completion Reports for any of the wildlife studies. Sterling Miller expressed the need for additional data and analysis in the caribou, moose, wolverine, wolf, and Dall's sheep studies,

- The transmission lines and access roads to the project area will increase hunter access to and increase pressure on wildlife species.

> *Comment on Moose Studies: "Roads have negative impacts because of increased human access to formerly remote areas for hunting and other*

[85] Miller, Sterling, et. al. Wolverine comments, Page 2.
[86] Wildlife Harvest, Initial Study Report, Part C – Page ii
[87] 18 CFR§ 5.6(d)(3)(v)(A)-(B)

> *recreation, disturbance avoidance by moose and collisions with vehicles."*[88]
>
> *Comment on Caribou: "The proposed corridors will provide increased access to hunters in a formerly roadless and relatively isolated area in the heart of the Nelchina Caribou range and the Unit 13 portion of the Delta Caribou herd range. Corridor impacts will be especially significant for the Denali highway access route which passes through a large portion of the Delta Caribou herd range in Unit 13; this herd is already declining and stressed (Seaton 2011) and the Denali Highway access corridor will increase hunting pressure especially on this small herd."*[89]
>
> *Comments on Wolf Studies: "Because these corridors will provide improved human access to the impoundment area, they will exacerbate already heavy human harvests and cause displacement by avoidance reactions of wolves (Ballard et al. 1984)."*[90]

- The transmission lines and access roads to the proposed project area will cause displacement of herds, fragmentation of habitat, and generate stress and disturbance of individuals of wildlife species.

> *Comments on Dall's Sheep: "Because these corridors will provide improved human access to the impoundment area, they will exacerbate impacts associated with human presence. This is especially the case for the Denali route which is the one through the sheep range. Every effort should be made to construct this road to minimize impacts on sheep."*[91]
>
> *Comment on Wolverine Studies: "Because these corridors will provide improved human access to the impoundment area, they will exacerbate impacts associated with human presence."*[92]
>
> *Comments on Caribou Studies: "These corridors will likely result in negative impacts on movements and also likely slow succession of lichens and other plants important to caribou… Of the three routes under consideration, it is likely that the Gold Creek route would have the least*

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[88] Miller, Sterling, et. al., Moose Comments at 5.
[89] Miller, Sterling, et. al., Caribou Comments at 6.
[90] Miller, Sterling, et. al., Wolves Comments at 6.
[91] Miller, Sterling, et. al., Dall's Sheep Comments at 3
[92] Miller, Sterling, et. al., Wolverine Comments at 4

> *impact and the Denali Highway route would have the most impact on caribou (and other terrestrial wildlife species).*"[93]

The lack of evaluation of the project's transmission lines and access road impacts on wildlife is of great concern. To meet FERC requirements, AEA must conduct studies and evaluate the cumulative effects of the project, which includes an assessment of impacts from transmission lines and access roads. For these reasons, we urge FERC to require AEA to develop, conduct, and report on impacts associated with project infrastructure development.

Thank you for the opportunity to comment. Please see the attached expert reviews for more detailed comments, recommendations and proposed modifications.

Sincerely,

Mike Wood
President
Susitna River Coalition

Whitney Wolff
Board President
Talkeetna Community Council

Judy Price
Board President
Alaska Survival

Ellen Wolf
Board Secretary
Talkeetna Defense Fund

Ryan Schryver
Deputy Director
Alaska Center

Sam Snyder
Alaska Engagement Director
Trout Unlimited

Emily Anderson
Alaska Sr. Program Manager
Wild Salmon Center

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[93] Miller, Sterling, et. al., Caribou Comments at 6.

Attachments

Wildlife Study Reviews
Sterling Miller

1. **Review of Moose Distribution, Abundance, Movement, Productivity, and Survival (10.5)**

2. **Review of Caribou Distribution, Abundance, Movements, Productivity and Survival (10.6)**

3. **Review of Dall's Sheep Distribution and Abundance (10.7)**

4. **Review of Distribution and Abundance, and Habitat Use of Large Carnivores (10.8)**

    a. **Bear Study**
    b. **Wolf Study**

5. **Review of Wolverine Distribution and Abundance (10.9).**

MOOSE

Comments on: Moose Distribution, Abundance, Movements, Productivity, and Survival, Initial Study Report Section 10.5 (Parts A, B and C), and Prepared for AEA, Susitna-Watana Hydropower by Alaska Department of Fish and Game, Palmer, AK. 15 pp . June 2014. (No authors named), and

Final Study Plan (FSP), Study Plan Section 10.5. Moose Distribution, Abundance, Productivity, and Survival. Susitna-Watana Hydroelectric Project, FERC Project No. 14241, AEA, July 2013.

Purpose of these comments: The Initial Study Report (ISR) and Final Study Plan (FSP) for the Susitna-Watana project were reviewed to:

1. Evaluate progress toward the study objectives identified in the ISR and in the FSP;
2. Evaluate whether data collection and analysis techniques are adequate to achieve stated objectives;
3. Evaluate whether stated objectives and study plans are adequate to evaluate impacts on moose of the proposed project
4. Evaluate and contrast earlier studies on the same project by Ballard and Whitman (1988), Becker and Steigers (1987) and Becker (1988) to determine if these results are integrated into the current project; and
5. Make recommendations for improving data collection or analysis to permit more meaningful evaluations of project impacts.

Objectives of the moose study (ISR page 2); (Analyses of progress toward these objectives are provided in a separate section, below, by objective):

1. Document the moose population and composition in the study area.
2. Assess the relative importance of the habitat in the inundation zone, proposed access/transmission corridors, and the riparian area below the Project.
3. Document the productivity and calf survival of moose using the study area.
4. Document the level of late winter use of adults and calves in the proposed inundation area.
5. Document moose browse utilization in and adjacent to the inundation zone and the riparian area below the Project.
6. Document the amount of potentially available habitat for improvement through crushing, prescribed burning, or other habitat enhancement.
7. Analyze and synthesize data from historical and current studies of moose as a continuation of the 2012 big-game distribution and movements study (AEA 2012).

General overview comments

The ISR does not present results on many of the stated objectives. It is not unreasonable to assume, however, that the final report will present results in a way that will permit evaluation of whether the stated objectives were accomplished. Assuming that these more detailed analyses will be done in the final report, then some of the concerns raised below based on the results to date reported in the ISR may prove to have been adequately addressed.

A "modification" from the FSP was identified to eliminate monitoring of moose marked with VHS collars during 4 months of winter 2014 (December-March). This was justified on the basis that "little movement occurs during this period" (ISR Part C, page 1). While it is true that moose move less during winter, this modification will result in far fewer locations of the VHS-collared moose during the season when they are at lowest elevations and in closest proximity to the proposed impoundment. This modification, therefore, will result in a bias against locations of moose at a time when moose are most likely to occur in the area that will be most affected by the proposed impoundment. This is also at the time of year when moose are most stressed by browse availability and other winter stresses. Correspondingly, the locations of VHS collared moose cannot be used to evaluate habitat selectivity of moose during this critical period. There are 55 VHF-collared moose and 37 GPS-collared moose so this means that approximately 62% of the transmitter-equipped moose cannot be used to estimate habitat selectivity during the time they are closest to the proposed impoundment. GPS-collared moose generate many more point locations and habitat selectivity on an annual basis will depend on this much smaller sample of individuals. It would have been far better to continue to monitor the VHS-collared moose during winter, thereby increasing the number of individuals useful to evaluate habitat selectivity and capture the wide range of individual variability that exists between subpopulations of moose.

A "variance" from the FSP was identified for the browse survey that resulted from the inability to sample cells on Cook Inlet Regional Working Group (CIRWG) lands (ISR, part C). The assertion that "…the flexibility of the browse survey methods allowed the study team to work around these lands and still meet the study objectives" (ISR PART C Page ii) is not convincing. The pertinent study objective is: "Document moose browse utilization in and adjacent to the inundation zone and the riparian area below the Project." Inspection of Figure 5.1-4 of the ISP (page 15) reveals that all of the CIRWG lands are in strata subjectively classified as "high" for browse and are in the areas in closest proximity to the Susitna River. These are the areas where Ballard and Whitman (1988) specifically identified that moose selected preferentially during winter. Although they do not specify, it appears that the way the study team "worked around" not being able to sample the quadrats on CIRWG lands was to select another "high" stratum quadrat to sample. Doing this assumes that all quadrats within the "high" stratum for browse are equivalent in terms of having more or less browse that the average quadrat within the high stratum. This is not a valid assumption. The studies by Ballard and Whitman (1988) concluded that the lowest elevation areas (near the Susitna River where the CIRWG lands occur) are preferred by moose during winter. Inspection of Figure 5.1-4 reveals that all of the quadrats in the stratum classified as "low" are at high elevations. This supports the conclusion that there is an elevational gradient in moose browse from high to lower elevations. Correspondingly, all quadrats classified as "high" are not equal, and the lowest elevational quadrats likely have more moose browse and browse utilization than the higher elevational quadrats within the same stratum. Subjective stratification of a study area only works if all quadrats within a stratum have equal opportunities of being sampled which land access issues prevented. Alternative methods of selecting quadrats to sample based on weighting by elevation and proximity to the Susitna River should have been utilized.

It is important to identify subpopulations of moose in the study area. Ballard and Whitman (1988) identified 11 different subpopulations of moose, all of which had different patterns of movement and habitat use and would have been impacted by the then-proposed impoundment in different ways. In the ISR, all moose are treated as if they were part of one big subpopulation; this should be remedied for the final report.

There are no results reported for Objective 6 and no study mechanisms identified to achieve Objective 6 (mitigation through habitat modification). In the current ISR, there is essentially no effort made toward Objective 7 which is to integrate the results of earlier Susitna Dam studies on moose (Ballard and Whitman 1988). It is essential that this be done in the final report.

Evaluations of reported progress by objective

Objective 1. Document the moose population and composition in the study area.

No data on this objective are presented in the ISR although the general techniques for data collection are described. The processes for data collection seem generally appropriate. The GeoSpatial Population Estimator Survey (GSPE) described on page 3 of the ISR is the appropriate technique to estimate moose numbers in the vicinity of the proposed impoundment. Data were apparently obtained for moose using this technique but the study area where these data were obtained is not identified, the density strata are not illustrated, and no results from this work are reported. Corresponding, it is not possible based on information presented in the ISR to evaluate the results. Hopefully, these deficiencies will be remedied in the final report.

Although it is not clear, it is possible that the GSPE estimator was applied to the entire "moose study area" illustrated in Figure 3.1 (page 11) of the ISR. If so, this estimate will apply to an area that is too large to provide a meaningful estimate of moose numbers in the smaller area that will be impacted by the proposed impoundment. A biologically-meaningful study area surrounding the proposed impoundment needs to be identified and moose numbers estimated for this area using appropriate techniques.

Generally, techniques for estimating moose population composition have been standardized by ADF&G for many decades and it is reasonable to continue to use these techniques, as proposed in this study, to determine population composition. These data are obtained for Count Areas (CAs) 7 and 14 illustrated in Figure 3-1 (page 11) of the ISR. However, these 2 CAs include areas far from the proposed impoundment and do not include a large portion of the area immediately adjacent to the proposed impoundment. Correspondingly, it is unclear what valid conclusions can be drawn from these 2 CAs with respect to anticipated impoundment impacts on moose. At a minimum, the basis for drawing conclusions from these CAs needs to be explained in the Final Report on these studies.

The earlier ADF&G report on this project (Ballard and Whitman 1988) identified 11 subpopulations of moose in the Susitna-Watana impoundment area. It is unclear whether or not this study has an objective of identifying subpopulations. If the current study assumes that the subpopulations identified in the 1980s have not changed in distribution, numbers or behavior, the analysis will be inadequate. Ballard and Whitman clearly identified differences in behavior (migratory, non-migratory, partially migratory) that are pertinent to evaluation of impacts. Subpopulation identity studies require reporting of the results of radio-collar monitoring in order to identify differences between groups. The results reported in the ISR treat all individuals as if they are members of a single subpopulation which is incorrect as demonstrated by Ballard and Whitman (1988). Identification of subpopulations is important for impact assessment studies as some subpopulations are likely to be more impacted by the proposed project than others. The behavior and habitat use patterns of the subpopulations likely to be most affected by the project need to be documented to assess impacts. ADF&G is aware of this as shown by an excellent paper by 4 ADF&G biologists that described the benefits of migratory behavior in a southeastern moose population (White et al. 2014).

On page 11 of the ISR (Results), it is reported that surveys were conducted daily during May 15-June 4, 2013. However, calf survival (53%) was reported to July 1. More mortality likely occurred between June 4 and July 1. Survey information after June 4 should be reported, including methodology and results.

Objective 2. Assess the relative importance of the habitat in the inundation zone, proposed access/transmission corridors, and the riparian area below the Project.

The stated variance to not monitor VHF collars during winter (December, January, February, and March) (Part C) severely compromises subpopulation identification (see more discussion of this under discussion for Objective 4). Identification of subpopualtions/subherds tends to be most distinguishable based on winter, rutting season, and calving area differences in areas occupied (Ballard and Whitman 1988). Timing of movements varied between years largely based on weather (especially snow) conditions (Ballard and Whitman 1988). Numbers of moose within the Susitna-Watana impoundment during winters of moderate severity ranged from 42-580 (0.2-2.3 moose/km^2) (Ballard and Whitman 1988:*v*). Moose occurred at lowest elevations during April (Ballard and Whitman 1988).

Figure 5.1-2 is presented to show the area defined as the “inundation zone” or “Reservoir Inundation Zone Survey Area”. The area illustrated is much larger than the area actually flooded so it presumably reflects some standardized ‘inundation zone impact area’ that is common to all studies; however, this is not clear in the report. Correspondingly, impact area should be labeled/characterized as something other than “inundation zone”. The term “inundation zone” was used by Ballard and Whitman (1988) in reference to the actual zone flooded by the impoundments and this is the literal meaning of this term.

There is essentially nothing in the FSP to evaluate impact associated with access roads or transmission line corridors. Negative impacts of access corridors on moose are well documented (e.g., Harris et al. 2014 and studies cited in that report which included 2 ADF&G co-authors). During the October 21, 2014 AEA meetings on the ISRs for terrestrial mammals, AEA staff asserted that information obtained during these studies would be used to inform the decision on which route to use and that is why specific studies on the corridors are not included in the study plans for terrestrial mammals. Although there is some logic to this proposed sequence, it will inevitably result in inadequate studies of impacts on moose for whichever access route is ultimately chosen. Roads have negative impacts because of increased human access to formerly remote areas for hunting and other recreation, disturbance avoidance by moose and collisions with vehicles. Transmission line corridors--if not heavily used as corridors for human--may have a positive impact on moose through improvement of browse as a result of setting back successional stage.

We believe that the process for evaluating the riparian habitat below Suitina-Watana Dam is probably appropriate if numbers of point locations are adequate, especially from GPS collars (currently, n=37: 24 cows, 13 bulls)[1]. Monthly monitoring of VHF collars (currently n=55: 36 cows, 19 bulls) will generate few data except during spring when they monitor calf survival daily.

Maps of point locations for VHF-collared moose are presented in this report (e.g., Fig. 5.1-2). However, it is necessary to identify the initial capture sites for these individuals in order to determine that moose captured and monitored were captured in appropriate locations to adequately represent the moose that area likely to be impacted by the project. This information on initial capture locations is also important to permit evaluation of whether the moose were captured in areas where subpopulations were identified by Ballard and Whitman (1988). It is also important to differentiate between point locations of different individuals and types of moose (i.e., sex and reproductive status: with twins, singletons, no calves, etc.), and to display and analyze data in areas beyond the inundation zone. Without data presented in this way, the adequacy of planned studies is difficult to evaluate. This should be done in the final report on moose studies.

Objective 3. Document the productivity and calf survival of moose using the study area.

Techniques are generally appropriate but no data are presented to evaluate whether analysis will be appropriate and the techniques for data analysis are presented in only the most general way. As noted above, we recommend improving interpretability of the relevance of these data by identifying them with distinct symbols on plots (figures) indicating where cows were captured in different categories (with twins, singletons, no calves, etc.).

Objective 4. Document the level of late winter use of adults and calves in the proposed inundation area.

Reaching this objective is severely compromised by the variance (described in Part C) to stop monitoring VHF collars during the 4 peak winter months (see below). Part 4.2.1 (Variances for the moose movement studies) says no variances were necessary in 2013 but, apparently, a major variance is due for winter 2014 and subsequently. See comments under Objective 2 above. Not collecting location data for VHF collars during the 4 winter months when low-elevation moose use of the impoundment impact zone is likely highest for the subpopulations most likely to be adversely affected will bias results by underestimating annual use of impoundment impact zones. Furthermore, collection of information on "distribution of radio-collared moose in the study area" was identified as an objective for the deployment of the VHF collars (ISR Part A, page 2).

[1] The studies by Ballard and Whitman (1988) involved putting either VHF radio collars or visual collars on 184 adults. GPS collar technology generally was not available during these studies.

Good winter data on moose movements can be obtained from the large number of locations documented by GPS-collared animals. To avoid underestimation of impoundment use by VHF-collared animals, however, it will probably be necessary to restrict analysis of point location data to GPS-collared animals. This will greatly reduce the sample size of individuals that can be used to document late winter habitat use by moose in the proposed inundation area. It will also reduce the number of moose available to describe subherds as winter use of habitats by subherds tend to be distinct during winter (also during calving).

Objective 5. Document moose browse utilization in and adjacent to the inundation zone and the riparian area below the Project.

Reaching this objective with regard to browse sampling plots located in and adjacent to the inundation zone is compromised by the inability to sample on plots CIRWG lands (see variance identified in Section 4.3.1). This design change will apparently result in **over-**sampling of browse plots distant from the impact areas and **under**-sampling of plots where impacts of the project will be least and most significant. This bias is evident in Figure 5.1-4 of the ISR (Part A, page 15). Correspondingly, impact assessments likely will be biased unless this is corrected. The provided justification[2] of this problem is insufficient.

One way to avoid this apparent sampling bias for browse utilization plots would be to target-sample the BLM lands in the "high" strata just north and east of the CIRWG lands along Watana Creek, rather than stick to random selection of high strata plots throughout the study area. Plots available for selection can be weighted based on proximity to the impoundment and/or elevation These are more equivalent high value moose winter areas to the CIRWG lands than, for example, the high strata areas in the upper Talkeetna River, upper Deadman Creek, or on the east side of the Browse Survey Study Area. It is evident from Fig. 5.1-4 (ISR, Part A, page 15) that no high density strata were sampled in the lowlands near Watana Creek which is highly important for moose based on the studies conducted by Ballard and Whitman (1988).

The importance of the unsampled quadrats in the impoundment zone (especially Watana Creek) was supported by browse data from Becker and Steigers (1987) and movement data from Ballard and Whitman (1988). Becker and Steigers (1987:24), stated:

> *The data on proportion of willow plants browsed, the results from analyzing observations of moose locations, and the fact that the higher elevation areas, outside the impoundment, have higher willow productivity than the lower elevation areas inside the Watana impoundment[3] is consistent with the hypotheses that a large amount of the biomass found at higher elevations is not available to moose during winter…*

[2] "…the flexibility of the established study method allowed the study team to move to alternative cells when CIRWG lands were encountered [e.g. selected by the random sampling procedure]…" (ISR, Part A, page 7). The 'alternative cells' available did not include CIRWG lands in the highest impact areas closest to the impoundment. It is incorrect to suggest that all alternative cells are equivalent in terms of impact based on proximity to the impoundment."

[3] There were 2 impoundments proposed in the 1980s; references to the "Watana impoundment" in those 1980s studies refer to the same dam and impoundment area as the current project under consideration. The second dam proposed in the 1980s was further downstream and referred to as the "Devils Canyon" impoundment.

> *The proportion of browsed willow plants found in the Watana impoundment was significantly greater than that found outside the impoundment. Browsing pressure on willows outside of the impoundments increased with decreasing elevation at a constant rate; starting at 3400 feet the expected odds a willow plant is browsed versus not browsed increases by 35.4% as elevation decreases by 200 feet. The odds that a willow plant is browsed versus not browsed appeared to be constant, over elevation, in the Watana impoundment. Ballard and Whitman (1986) hypothesized that moose were more likely to use the Watana impoundment in severe winters than in mild ones. Their data suggest that the highest use of the Watana impoundment occurs during the winter period (February 1 through April 30) and, in general, the moose population exhibits movements toward lower elevations during this period. Their analysis of habitat use by moose shows that strata in the Watana impoundment are selected for while almost all strata in the area outside this impoundment are avoided.*

Ballard and Whitman (1988) focused most of their work in areas where moose were expected to be most impacted by the upstream ("Watana") proposed project then under consideration. This "Watana" project is essentially the same project as the Susitna project currently under consideration. Ballard and Whitman (1988) conducted relatively little moose work in the vicinity of the then-proposed Devil's Canyon impoundment further downstream on the Susitna River. However, Modafferi (1988) conducted extensive population identity and habitat use studies in Units 14A and 14B and 16A downstream of the proposed Devils Canyon project; much of this work was designed to identify potential habitat improvement areas for the purpose of mitigating for habitat losses upstream. There is no indication that current studies considered earlier work by Modafferi (1988) or incorporated it into the design of mitigation work for current studies.

Objective 6. Document the amount of potentially available habitat for improvement through crushing, prescribed burning, or other habitat enhancement.

No methods or results for documenting achieving this objective are presented. For mitigation purposes, this is an important objective. It is noteworthy that almost no habitat improvement techniques like those named in this objective have been conducted in Unit 13 for many years. Instead of habitat improvement, "predator control" efforts (liberalized bear hunting regulations and wolf control) have been favored by ADF&G in an effort to increase moose numbers.

Predator control efforts directed at wolves have been implemented for decades and are reported to have increased moose numbers. However, these efforts have been inadequate to meet moose harvest and population objectives (Tobey and Schwanke 2010). Bears potentially impact moose primarily through predation on neonatal moose (Ballard et al. 1991). In spite of dramatically liberalized bear hunting regulations and increased brown bear harvests however (Miller et al. 2011), there has been no increase in moose calf survival (Tobey and Schwanke 2010). This finding is consistent with earlier research (Miller and Ballard 1992).

Tobey and Schwanke (2010 and earlier reports), report no efforts at habitat improvement in the impoundment impact area through "crushing, prescribed burning, or other habitat enhancement." This raises questions regarding the likelihood of implementation of these methods as project mitigation for moose impacts. These authors report a prescribed burn took place in 2004 in Unit

13B. Tobey and Schwanke (2010:159) acknowledge that "The lack of substantial fires over the past 50 years has resulted in lower browse quality" and "…productivity data suggests Unit 13 moose reproductive performance figures remain average for moose statewide".

As a practical matter, prescribed (or natural) fires are likely the only way to improve moose browse across large areas. In limited areas such as along transmission line and road corridors, some improvements in browse quantity and quality from setback of vegetative successional stage are likely to occur.

Objective 7. Analyze and synthesize data from historical and current studies of moose as a continuation of the 2012 big-game distribution and movements study (AEA 2012).

Essentially no effort is made in the ISR to analyze and synthesize data from the earlier report by Ballard and Whitman (1988). Neither is there any indication that Ballard and Whitman (1988) formed a basis of any part of the study plan. There is very little in ISR reports for moose that suggests the pertinent earlier work from the 1980s was read, consulted, or informed the current study. This needs to be remedied in the final study report.

Ballard and Whitman (1988) list 13 "important" impacts (both positive and negative) of the proposed project and 7 "potentially important" impacts which are listed in the attached summary of their 1988 report. This 1988 report also enumerated the characteristics and main impacts on 11 subpopulations of moose in the then-proposed 2 dam project area.

Similarly, Becker and Steigers (1987) produced a detailed report on moose browse utilization in the then-proposed 2-impoundment study area that apparently did not inform the current study. Current studies should have been designed to reveal whether the current level of browse utilization (utilized or not) differs from that found by Becker and Steigers (1987). Becker and Steigers (1987) estimated total biomass lost as a result of project development, and the proportion of plants utilized. In contrast, the current study is designed only to estimate the proportion of plants utilized and does not propose to estimate biomass which is the most important parameter to estimate in terms of doing mitigation to compensate for habitat losses.

Some important conclusions from the Becker and Steigers (1987) and Becker (1988) reports with regard to losses of browse due to impacts of Watana dam[4] construction (raising the Watana impoundment to its final height) were:

- **Stage 1** (Watana initial earthen dam): Loss of 74,430 kg of willow biomass 6,788 kg of paper birch biomass and 1,929,182 kg of mountain cranberry biomass (Table 43).
- **Stage 3** (Watana final full impoundment height): Additional loss (excluding Stage 1 losses) of 58,511 kg of willow biomass, 6,767 kg of paper birch biomass, and 1,941,003 kg of Mt. cranberry.
- Summing stages 1 and 3 resulted in total losses of 132,941 kg of willow biomass, 13,555 kg of paper birch biomass, and 3,870,185 kg of Mt. cranberry biomass. Table 43 also

[4] In the earlier 2-impoundment studies the term "Watana impoundment" was used to distinguish the dam in the current proposal (Susitna-Watana dam) from the downstream proposed dam at Devils Canyon.

provides the upper limit of the 80% confidence interval (CI). No CI can be calculated for the lumped estimate for both stages.

- The amount of biomass above 50 cm in height lost was estimated at (Table 44, page 72):
  - Stage 1: 32,866 kg for willow and 5,000 for paper birch,
  - Stage 3: 27,593 kg for willow and 4,559 for paper birch,
  - Total: 60,459 kg for willow and 9,559 kg for paper birch (no CI for combined estimate).
- "Greatest browse utilization by moose occurred at lower elevations where less browse was produced…Utilization of browse within the impoundments (2,200 ft) during 1985 (a winter of moderate severity) was about 70%. Browsing intensity was greater within both impoundment zones than outside…The impoundment zones may be even more important to moose during severe or moderately severe winters." (Figs. 45-46 of Ballard and Whitman 1988)
- "Winter use of the impoundment zones appeared partially dependent on snow depth…When snow accumulations made browse unavailable at high elevations, moose moved into the impoundment zones where browse was more available." (Ballard and Whitman 1988:67)
- "The most sensitive parameter in the moose population submodel [part of the overall carrying capacity model] is the amount of browse that is available to moose as forage." (Becker 1988:11)
- For the individual submodel, the most sensitive parameters are animal condition and diet digestibility. Overall, these parameters are the most sensitive to the whole model.

Recommendations

1. Retain winter monitoring of VHF collars as winter is a key period when dam impacts are likely to occur. Alternatively, increase numbers of GPS collars and rely on GPS collars exclusively to evaluate habitat selectivity.
2. It is extremely important to report the Winter Severity Index for each year of the study as done by Ballard and Whitman (1988). A comparable method would suffice so long as extreme conditions (or lack thereof) are associated with the results presented. Moose populations are primarily limited by browse availability which is most important in terms of moose movements and demography during extreme winters (Ballard and Whitman 1988, Becker 1988, Schwartz and Franzman 1993). There is a prevailing misconception that management of predation can overcome inadequate browse during severe winters.
3. The term "inundation zone" or "inundation survey area" is used frequently but never defined. This term is not used in the ISRs for the other terrestrial species reports we have reviewed so the biological rational for it needs to be better explained. From the figures, it appears larger than the area flooded (as is appropriate) but it should be explicitly defined,
4. There is no direct mention of any objective to identify moose subpopulations in the study area where Ballard and Whitman (1988 pages 55-66) identified 11 subpopulations. Each subpopulation exhibits different patterns of movement including migratory, non-migratory, and some mixed migration. Impacts of the proposed project will impact some subpopulations much more than others (Ballard and Whitman 1988). Directly comparable techniques should be used in the current study to permit identification of subpopulations. Subpopulations of moose likely have changed since the studies of

Ballard and Whitman (1988) and it cannot be assumed that the same subpopulations and patterns of use still occur.

5. Design browse utilization studies so that at least some data will be directly comparable to the results reported by Becker and Steigers (1987). The earlier study focused more on utilization and availability by species whereas the current study focuses on obtaining percent utilization data using the approach of Seaton et al. (2011). Regardless, data on utilization and availability are readily obtainable at the same time percent utilization data are collected.
6. In the Susuitna-Watana Dam impact area, Ballard and Whitman (1988) estimated moose abundance using the Gasaway et al. (1986) and related techniques. Results from directly comparable techniques proposed for use in this study need to be use to permit evaluation of any changes that have occurred.
7. Impact assessment studies should not be considered adequate unless study plans incorporate (including allocation of funds) post-project studies to determine actual impacts on moose movements, use of habitats, and changes in numbers and reproductive parameters. Post-project studies should be incorporated into the study plan and these studies should use GPS collars to permit statistically valid comparisons with pre-project studies currently underway.
8. Persons conducting the investigations and author(s) of the study reports should be identified by name as was done in the earlier ADF&G reports on Susitna dam studies conducted during 1980-1986 (e.g., Ballard and Whitman 1988). Anonymous reports do not have the credibility that comes with reports by people willing to identify themselves as responsible for the studies and conclusions.

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CARIBOU

Comments on: "Caribou Distribution, Abundance, Movements, Productivity, and Survival, Study plan Section 10.6, Initial Study Report, (Parts A, B and C), and Prepared for AEA, Susitna-Watana Hydro by Alaska Department of Fish and Game, Palmer, AK. 14 pp. (part A). June 2014. (No authors named), and

Revised Study Plan, Wildlife Resources, 10.6. Caribou Distribution, Abundance, Movements, Productivity, and Survival. Susitna-Watana Hydroelectric Project, FERC Project No. 14241, AEA, pages 10-16 to 10-24. December 2012. (Please note the Caribou Revised Study Plan was approved by FERC without modification and is thus equivalent to the Final Study Plan.)

Purpose of these comments: The Initial Study Report (ISR) and RSP for the Susitna-Watana project was reviewed to:

1. Evaluate progress toward the study objectives identified in the ISR and in the RSP;
2. Evaluate whether the data collection and analysis techniques are adequate to achieve the stated objectives;
3. Evaluate whether the stated objectives and study plans are adequate to evaluate the impacts on caribou of the proposed project with a view to assuring that adequate information is available to determine both impacts and appropriate kinds and levels of mitigation for impacts; and
4. Evaluate and contrast earlier studies on the same project by Pitcher (1987) to determine if these earlier studies are integrated into the current project; and
5. Make recommendations for improving data collection or analysis to permit more meaningful evaluations of project impacts on caribou.

Objectives for Caribou Project (RSP pages 10-16). (Analyses of progress toward these objectives are provided in a separate section, below, by objective):

1. Document seasonal use of and movement through the Project area by both females and males of the Nelchina caribou herd (NCH) and the Delta caribou herd (DCH).
2. Assess the relative importance of the Project area to both the NCH and DCH.
3. Document productivity and survival of caribou using the Project area.
4. Analyze data from historical caribou studies and synthesize with recent data for NCH and DCH, as a continuation of the caribou task of the 2012 study (AEA 2012).

General overview comments:

Caribou, far more than moose or most ungulates make wide-ranging movements and migrations. These commonly follow one pattern for a number of decades and then shifts may occur possibly because range conditions in different areas change or deteriorate. This is an important fact for impact assessment studies as impact assessments could vary dramatically decades later (or earlier), depending on the caribou range at the time of evaluation. The area near the impoundment and in the Chulitna Mountains north of the impoundment was more heavily utilized by Nelchina caribou than during the studies by Pitcher (1987) (Skoog 1968 from Pitcher 1987). Skoog (1968 from Pitcher 1987) considered the Chulitna Mountains to be the most important for year-round use by Nelchina caribou. Pitcher (1987) recognized a subherd of caribou consisting of about 350 individuals in the Chulitna Mountains. He reported that about 1,500 animals occurred year-round in the upper drainages of the Susitna, Nenana, and Chulitna Rivers. In recent years, it appears that more Nelichina caribou herd (NCH) animals are using the area around the impoundment and north of the impoundment thereby increasing the frequency with which the impoundment, associated corridors and infrastructure would be encountered by Nelchina caribou.

The most general point about caribou and the proposed impoundment is that caribou need large landscapes in which to survive in large herds. When formerly large landscapes are infringed on or limited by developments, it limits the ability of caribou to shift their movements and centers of distribution in a pattern that have evolved over thousands of years. Large herds need large landscapes and without them caribou cannot survive in large herds.

Another general point is that NCH (and to a lesser extent the Delta herd and the Chulitna and Cantwell groups) is an extremely popular resource for Alaska hunters and subsistence users. The NCH herd is intensively managed by ADF&G for this reason (Schwanke 2011). There is nothing positive about proposed Watana hydroelectric project for the long term potential of the Nelchina caribou herd to continue as a large herd. All foreseeable impacts will be negative. The magnitude of these impacts will be difficult to predict and may not become evident for decades.

In terms of immediate impacts, Pitcher (1987:iv) observed:

> The major concern with the Watana impoundment is that the female segment of the herd will try to cross the reservoir during spring migration to the calving grounds and that mortalities will result because of hazardous conditions.

Over the long term Pitcher (1987:iv) recognized that:

> Most importantly, the Susitna hydroelectric project should be viewed as one of a number of developments which have or may occur on the Nelchina caribou range. While no single action may have catastrophic results, the cumulative impact will likely be a reduced ability of the Nelchina range to support large numbers of caribou.

Evaluations of reported progress by objective

The stated goals of the ISP as repeated in the ISR are "…to obtain sufficient population information on caribou to evaluate Project-related effects on important seasonal ranges, such as calving areas, rutting areas, wintering areas, and migration/movement corridors. Four specific objectives were identified and progress toward each of these is evaluated below based on the Initial Study Report (ISR).

Objective 1. Document seasonal use of, and movement through, the Project area, as defined in Section 8.6.3) by both females and males of the Nelchina caribou herd (NCH) and the Delta caribou herd (DCH).

The study plan calls for deploying 30 VHF collars on bulls and 55-65 GPS collars on cows and bulls. The ISR reported that the collars were deployed as intended in the revised study plan (RSP) with an appropriate variance (discussed below) based on issues associated with admixture of NCH and DCH at the time collars were deployed.

Monitoring of these collars is done using both project funds and regularly scheduled management flights for collared caribou and counts of all caribou. This number of collars should be adequate to accomplish this objective if they are appropriately distributed geographically and the ISR reported an appropriate number of telemetry survey locations for these collars that is consistent with the study plan. However, only gross scale analyses of these data were presented in the ISR so it is not possible to evaluate how or whether these data will be appropriately analyzed. At present, there is no reason to believe that available data will not be analyzed appropriately.

The inclusion of GPS collars on caribou in this study represents a major advance over the technology available to Pitcher (1987) and should reveal new and meaningful results pertinent to this impact study and, more broadly, to caribou management in the study area.

To determine if both kinds of collars (GPS and VHF) were appropriately distributed, it will be necessary, in subsequent reports, to plot the distributions of initial capture locations by date collared, herd, type of collar, and sex of animal collared.

The variance reported in the ISR (page 6) with respect to the distribution of radio-transmitters appears reasonable. This variance is based on the admixture of Delta and Nelchina herd animals in the study area. It is probably an appropriate distribution of collars to distribute two-thirds of collars to Eastern Migratory Group (EMG) individuals (clearly NCH) and one-third to Western Group (WG) individuals (containing a larger number of DCH individuals that winter in the study area south of the Alaska Range). Once movements of collared animals is evaluated to determine their affiliation with the DCH or the NCH, analyses of project impacts based on these movements will have to be weighted based on the proportion of collars in each herd (this can't be known at the time collars are deployed) and the size of each herd to determine cumulative impacts on caribou (both herds). No doubt the investigators plan on doing this and will not assume that each herd had an equal percentage of its members collared.

There are additional categories of caribou in the Watana Dam impact area including a permanent Chulitna group. There is also a group of migratory caribou centered in the Cantwell area. Both of these groups will be heavily impacted if the northern (Denali) access route is developed and the Chulitna group is likely to be impacted by the dam as well. Because of the complicated nature of the herds and groups in the vicinity of the proposed Susitna-Watana Impoundment, many years of study will be necessary to sort out which groups or herds will be most impacted and how these impacts will occur; especially since there is significant year to year variation in movements and areas utilized. It is unlikely that these relations can be adequately sorted out with only 2-3 years of study of radio-marked individuals especially if resolution is lost by recognizing only two groups as is done in the current study (the WG and the NCH). If there are reasons why these groups are lumped in with the EMG and WG individuals, this should be better explained.

Objective 2. Assess the relative importance of the Project area to both the NCH and DCH.

No results for this objective were reported. With multiple years of study, there is no reason to expect that the relationships between these herds cannot be sorted out appropriately but, as noted above, appropriate levels of resolution on all the groups using the study area is unlikely to be obtained with only 2-3 years of study. There are more than NCH and DCH individuals in the Susitna-Watana Dam area and this objective should be expanded to include impacts on individuals from the Cantwell area and in that overwinter in the Chulitna Hills but are not DCH individuals.

During the AEA ISR meetings on October 22, 2014, ADF&G researcher Kim Jones said that radio-marked caribou would be followed for a third year. This is an important and necessary change but it is unclear if addition of one additional year will be sufficient to permit identification of subherds and to evaluate impacts on the basis of subherds. In percentage terms, impacts on subherds can vary greatly because they currently vary greatly in size.

No data analysis of data collected in 2014 was presented at the October 22, 2014 meeting and only 2013 data presented in the ISR were available for analysis. No further meetings are scheduled to discuss data collected after 2013; these data will not be available for outside review until the final study report at which time planned studies will all have been concluded and scheduled opportunities for modifications of study plans based on review data collected after the first year of study (i.e. 2014-2015) will no longer exist.

Objective 3. Document productivity and calf survival of caribou using the Project area.

Few results for this objective were reported. It was mentioned that there was a late spring in 2013 which delayed spring migration and peak calving. A very high proportion of parturient cows lost their calves in 2013 (66%). This is much higher than reported in previous studies for the NCH based on work conducted during 2008 (Schwanke 2011). It is very important that anomalous conditions like this (and also winter conditions) continue to be reported in subsequent reports on these caribou studies.

Objective 4. Analyze data from historical caribou studies and synthesize with recent data for the NCH and DCH as a continuation of the caribou task of 2012 study W-S1 (AEA 2012).

This report appropriately included comparison data on number of VHF collars deployed and number of locations/collared caribou during the 1980-1985 by Susitna Hydro project studies on caribou conducted by Pitcher (1987). No comparison or synthesis of results with these earlier studies or with Survey and Inventory work (e.g. Schwanke 2011) are presented in the current ISR and this is reasonable at this point in the current studies. Subsequent reports should include this analysis and synthesis. It was not known (or at least determined) by Pitcher (1987) that DCH animals occurred in Unit 13. This was apparently determined in 1993 based on studies by Valkenburg et al. (2002) that documented movements of DCH animals collared in 20A into Unit 13 (Seaton 2011).

The DCH is much smaller and less productive than the NCH and has a population estimate of about 2,520 in 2009 (Seaton 2011) compared to 44,985 in 2010 for the NCH (Swanke 2011). The 2010 fall estimate for the NCH was likely inflated by an unusually large number of calves (Swanke 2011).

Caribou productivity and survival is variable between years and areas based on habitat quality and weather conditions. Generally, the NCH has been increasing and the DCH has been declining in both numbers and productivity (Schwanke 2011, Seaton 2011). Condition and parturition studies indicate that both herds may periodically (at least) be nutritionally stressed compared to other herds (Pitcher 1991, Schwanke 2011, Seaton 2011). It is important that the current impact assessment studies ultimately incorporate the status and trends of both herds into an analysis of the proposed project's impacts as identified by this objective. Short term studies under perhaps anomalous conditions cannot adequately evaluate impacts absent the appropriate long term context for species like caribou.

Schwanke (2011:101) in her caribou Survey and Inventory report recognized the potential impact of the Susitna Hydroelectric project on caribou:

> Large numbers of Nelchina caribou have spent a considerable amount of time between late summer and winter in the Watana Creek area in recent years. As this project [the Susitna-Watana dam], moves forward, it will again be necessary to fully evaluate the effects of a large hydroelectric dam on movements and habitat use by the NCH.

Recommendations:

1. As we recommended during the October 22, 2014 AEA meeting, in order to determine if both VHF and GPS collars were appropriately distributed, subsequent reports must plot distributions of initial capture locations for each individual by date (spring or fall), type of collar (VHF or GPS), and sex of animal. The Watana Dam project area includes a complex set of associations of caribou associated with 4 different groups or herds including the Nelchina herd (the largest group), the Delta herd, a group in the Chulitna Hills, and a Cantwell group. The ISR collapses these into two groups: the Eastern Migratory Group (largely migratory Nelchina Herd that currently calve in the foothills of the Talkeetna Range and overwinter farther east in Unit 13) and the Western Group (animals that winter in the study area supposedly composed of mixed Nelchina and Delta herd individuals). There is no specific identification in the study plan of the small Chulitna Hills group which is likely to be the most impacted by the project especially if the Denali access route is selected. We suggest that it would be helpful if future reports specifically address how collars were deployed by each of the herds/groups in the study area or clarify the justifications for collapsing these into only 2 categories.

2. Neither the RSP nor the ISR have any objective associated with evaluating impacts of roads and transmission lines that would be built to support the proposed project. Although caribou can cross these corridors during migrations and other movements, these corridors will likely result in negative impacts on movements and also likely slow succession of lichens and other plants important to caribou; this may benefit moose but have negative impacts on caribou. This kind of impact of the project was recognized by Pitcher (1987) and it is unfortunate and incorrect for the current analysis to ignore the impacts of corridors, especially since both herds increasingly occur in the area impacted by (especially) the Denali Highway corridor and the Chulitna corridor as illustrated in Fig. 4.1-1, page 12 and Figure 3-1 (page 11) of the ISR. Of the three routes under consideration, it is likely that the Gold Creek route would have the least impact and the Denali Highway route would have the most impact on caribou (and other terrestrial wildlife species). The comparison deserves documentation and discussion in this report.

3. In addition to impacts on caribou movements, the proposed corridors will provide increased access to hunters in a formerly roadless and relatively isolated area in the heart of the Nelchina Caribou range and the Unit 13 portion of the Delta Caribou herd range. Corridor impacts will be especially significant for the Denali highway access route which passes through a large portion of the Delta Caribou herd range in Unit 13; this herd is already declining and stressed (Seaton 2011) and the Denali Highway access corridor will increase hunting pressure especially on this small herd. The problems associated with road corridors was recognized by Pitcher (1987:iv):

   > The proposed Denali access road would cut through summer and winter range from about half of the upper Susitna-Nenana subherd and run though historical summer and winter range for the main Nelchina herd. Heavy human traffic could result in avoidance by caribou and perhaps mortality though caribou-vehicle collisions.

4. Pitcher (1987) provided a list of likely ways caribou would be impacted by the project. The current study shows no indication that it was designed to evaluate the relative importance of these impact mechanisms. A study of impacts should be based on a list of the impact mechanisms that will likely occur.

5. The study plan and the ISR fail to evaluate mitigation of project impacts on caribou. Mitigation for caribou is not straightforward as they are a species adapted to advanced successional stages of vegetation (e.g. climax) and almost all human interventions in such habitats move succession toward earlier stages which are less useful to caribou. Schwanke (2011:101) reported that there are more than 5 million acres of caribou habitat in Unit 13 that can be improved [implication is that burning would improve but this is far from certain as Joly et al. (2003) reports that the NCH routinely selects habitats older than 50 years after a burn. Unlike moose, caribou generally are adapted to habitats in late stages of vegetation succession.

6. Persons conducting the investigations and author(s) of the study reports should be identified by name as was done in for 1980s ADF&G reports (e.g. Ballard and Whitman

1988). Anonymous reports do not have the credibility that comes with those by people willing to identify themselves as responsible for the studies and conclusions.

7. Figures 5.1-1 and 5.1-p2 showing seasonal utilization of habitats based on kernel home range plotting techniques are useful but should be displayed separately, based on animals from the Eastern Migratory Group (primarily NCH) and the Western Group (mixed NCH and DCH animals). Individuals from other groups—e.g., Chulitna Hills and Cantwell groups—should also be identified as these are likely pertinent grouping categories for evaluating impacts. Mixing these 4 groups/herds together in single plots loses important resolution between groups as acknowledged variances to the Study plan based on the mixing of these herds and groups. VHF and GPS data must continue to be presented separately, as was done for the ISR. The ISR defines “low,” “medium,” and “high” density strata in Figures 5.1-1 ,5.1-2. Visually, these figures are hard to interpret because density shading obscures features (e.g., the summer and fall depictions of the impoundment for VHF collared caribou in Figure 5.1- pg. 13). Also, the scale of these Figures is too large to permit interpretation of how they overlap impoundment impact zones.

8. Impact assessment studies are inadequate until study plans incorporate (and fund) post-project impact analysis of caribou movements, habitat use, and population and reproductive changes. Post-project studies should be incorporated into the study plan and should use GPS collars to facilitate statistically valid comparisons with ongoing pre-project studies in the actual impoundment area. For documenting river and impoundment crossings and seasonal use of seasonal ranges, VHF collars are adequate to document project impacts during post project studies.

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DALL'S SHEEP

Comments on: Dall's Sheep Distribution and Abundance, Study Plan Section 10.7, Initial Study Report (Part A Sections 1-6, 8-10), Prepared for AEA, Susitna-Watana Hydro by Alaska Department of Fish and Game and ABR, Inc. June 2014. (No authors named). 17 pp (part A); and

Revised Study Plan, Wildlife Resources, 10.6. Dall's Sheep Distribution and Abundance Study, Final Study Plan, Section 10.7, Susitna-Watana Hydroelectric Project, FERC Project No. 14241, AEA, pages 10.7-1 to 10.7-7. July 2013.

Purpose of these comments: The Initial Study Report (ISR) and Final Study Plan (FSP) for the Dall's sheep portion of the Susitna-Watana project was reviewed to:

1. Evaluate progress toward the study objectives identified in the ISR and in the FSP;
2. Evaluate whether the data collection and analysis techniques are adequate to achieve the stated objectives;
3. Evaluate whether the stated objectives and study plans are adequate to evaluate the impacts on Dall's sheep of the proposed project with a view to assuring that adequate information is available to determine both impacts and appropriate kinds and levels of mitigation for impacts;
4. Evaluate and contrast earlier sheep studies on the same project by Tankersley (1984) to determine if these results are or will be integrated into the current project; and
5. Make recommendations for improving data collection or analysis to permit more meaningful evaluations of project impacts.

Objectives for Dall's Sheep Project (FSP pp. 10.7-1 to 2); (Analyses of progress toward these objectives are provided in a separate section, below, by objective):

1. Estimate the current minimum population size of Dall's sheep in the study area.
2. Delineate the summer range of Dall's sheep in the study area.
3. Evaluate the current condition of mineral licks in and near the Project Area.
4. Analyze and synthesize data from historical and current studies of Dall's sheep in the study area as a continuation of the 2012 study (AEA 2012a).

General overview comments:

The variance described in section 4.2.1 of the ISR to deploy a time-lapse camera at the Jay Creek site to automatically record sheep presence is a valuable addition to the FSP. In spite of the camera being knocked over by a bear (probably), it provided valuable information to permit more direct comparisons with the direct observational data reported by Tankersley (1984). As stated in the FSP, techniques used in this project are consistent with generally accepted scientific practices.

Analysis of accomplishments by Objective:

Objective 1. Estimate the current minimum population size of Dall's sheep in the study area.

This objective was accomplished. Survey procedures documented a minimum of 512 sheep in the study area of which 277 (54%) were in the Chulitna Mountans, 194 in the West Kosina Hills south of the Susitna River, and 41 in the Watana Creek Hills closest to the proposed impoundment. Surveys to count sheep were more extensive in the Chulitna Mountains than they were in the 1980s. Overall, there are about 1,562 sheep in the populations ranging from the Talkeetna Mountains to the Chulitna Hills. Those numbers are down from approximately 2,500-3,000 sheep in 1999 (Petlier 2011).

Objective 2. Delineate the summer range of Dall's sheep in the study area.

This objective was accomplished. Sheep locations obtained during 2013 aerial surveys are adequately depicted in Fig. 5.1-1 (page 13) of the ISR and tabulated in Table 5.1-2 (page 8) of the ISR.

Objective 3. Evaluate the current condition of mineral licks in and near the Project Area.

It is unclear what "current condition" in the context of this objective is. Tankersley (1984) presented chemical analysis of the Jay Creek and Watana sheep licks and the current study does not add to this information. If "current condition" means whether there have been changes in the chemical or physical characteristic of the licks since the 1980s, there is no indication in the ISR or FSP that such changes have occurred, or how they would have been measured if they had occurred. Had gross changes occurred (e.g., the lick being covered by a mudslide), they would have been detected during this study. If "current conditions" refers to the numbers of sheep using the licks, this was also accomplished and showed a general decline in lick use consistent with the decline in sheep numbers in the entire study area and in adjacent herds. This decline is thought to result from severe winters (Petlier 2011).

Objective 4. Analyze and synthesize data from historical and current studies of Dall's sheep in the study area as a continuation of the 2012 study (ADA 2012a).
The ISR made appropriate use of the historical data from Tankersley (1984) and from routine ADF&G data collection sources. It appears that sheep use of the Jay Creek lick is declining in comparison to the 1980s. This follows a general population trend for sheep inn this area.

Recommendations:

1. The study should include an evaluation of the composition of the three populations (% adult males, lambs/100 ewes, etc.), their use of mineral licks, and how those factors varied from 1980s observations.
2. At the AEA meeting on October 21, we recommended consideration of a new study proposal to evaluate whether the Kosina Hills population was isolated from the Jay Creek-Watana population by the intervening Susitna River. We suggested that this could be done via

genetic analysis of shed hair to see if genetic interchange is currently occurring between these populations. We suggested the Kosina Hills sheep might be attracted to the mineral licks on the north side of the river and that when the impoundment is built, such movements would be impossible, thereby increasing the isolation of both populations/herds. We believe this would be a valuable addition to the existing study plan, but acknowledge there is a high likelihood that these populations are currently isolated by the formidable barrier of the Susitna River. At a minimum, a literature review should be conducted to determine if there are data indicating that the distance between these herds or the presence of the Susitna River between them already prevents interchange between them.

3. Neither the ISP nor the FSP have any objective associated with evaluating the impacts on sheep of the proposed roads and transmission lines that will be built to support the proposed project. Because these corridors will provide improved human access to the impoundment area, they will exacerbate impacts associated with human presence. This is especially the case for the Denali route which is the one through the sheep range. Every effort should be made to construct this road to minimize impacts on sheep.
4. There is nothing in the FSP or ISR that is designed to identify appropriate kinds or levels of mitigation for adverse impacts of the project on Dall's sheep. The most likely source of adverse impacts identified by Tankersley (1984) is from disturbance and, possibly loss of connectivity between the Watana Hills and Kosina Hills and/or Chulitna Mountains populations caused by the large impoundment blocking sheep movements.
5. Persons conducting the investigations and author(s) of the study reports should be identified by name as was done in the earlier ADF&G reports on Susitna dam studies conducted during 1980-1986 (Tankersley 1984). Anonymous reports do not have the credibility that comes with reports by people willing to identify themselves as responsible for the studies and conclusions.
6. Impact assessment studies should not be considered adequate unless study plans incorporate (including allocation of funds) post-project studies to determine actual impacts on Dall's sheep movements, use of habitats such as the sheep licks, and changes in numbers and reproductive parameters. It is likely that the proposed impoundment will block movements between the Watana Hills sheep population and the Kosina Creek population. Such movements have not been documented or evaluated. Post-project studies should be incorporated into the study plan.

References Cited

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Tankersley, N. 1984. Susitna Hydroelectric Project, Big Game Studies, Vol. VIII Dall Sheep. Alaska Dept. of Fish and Game, Anchorage. 44pp.

BROWN AND BLACK BEARS, portion of Study Plan Section 10.8 (Large Carnivores)

Comments on: Part A: Initial Study Report, "Distribution, Abundance, and Habitat Use by Large Carnivores, Study Plan Section 10.8, and Prepared for AEA, Susitna-Watana Hydro by Alaska Department of Fish and Game, Palmer, AK. June 2014. (No authors named) 38 pp (part A) (available at: http://www.susitna-watanahydro.org/wp-content/uploads/2014/05/10.08_LGCAR_ISR_PartA.pdf); and

Part B: Supplemental Information (and Errata) to Part A (February 3, 2014 Draft Initial Study Report Study Plan Section 10.8, Susitna-Watana Hydroelectric Project, FERC Project No. 14241, AEA, 3pp. June 2014; and

Revised Study Plan, Wildlife Resources, 10.8. Distribution, Abundance, and Habitat Use by Large Carnivores Study, Final Study Plan, Section 10.8, Susitna-Watana Hydroelectric Project, FERC Project No. 14241, AEA, pages 10.8-1 to 10.8-13 . July 2013. (Please note the Large Carnivore Revised Study Plan was approved by FERC without modification and is thus equivalent to the Final Study Plan.)

Purpose of these comments: The Initial Study Report (ISR) and Revised Study Plan (RSP) for the Susitna-Watana (hereafter referred to as Susitna) project was reviewed to:

1. Evaluate progress toward the study objectives identified in the ISR and in the RSP;
2. Evaluate whether the data collection and analytical techniques are adequate to achieve the stated objectives;
3. Evaluate whether the stated objectives and study plans are adequate to evaluate the impacts on brown (grizzly) and black bears of the proposed project with a view to assuring that adequate information is available to determine both impacts and appropriate kinds and levels of mitigation for impacts;
4. Evaluate and contrast earlier studies on the same project by Miller (1987) to determine if these results are integrated into the current project;
5. Identify factual errors in the ISR and RSP;
6. Make recommendations for improving data collection or analysis to permit more meaningful evaluations of project impacts;
7. Provide an intelligible description of what these studies consisted of (see Appendix A).

Objectives for the Large Carnivores Project (RSP pages 10.8-1 to 2).

1. Estimate the current populations of brown bears, black bears, and wolves in the study area, using existing data from ADF&G.
2. Evaluate bear use of streams supporting spawning by anadromous fishes in habitats downstream of the proposed dam that may be altered by the Project.
3. Describe the seasonal distribution of, and habitat use by, wolves in the study area using existing data from ADF&G.

4. Synthesize historic and current data on bear movements and seasonal habitat use in the study area, including the substantial body of data gathered by radio-tracking during the 1980s, as a continuation of the 2012 wildlife studies (AEA 2012).

General overview comments

It is our belief that the investigative methods used in this study will not provide information of value in evaluating the impacts of the proposed Susitna Dam on brown bears or black bears. The Large Carnivore Study Area used to estimate bear density and abundance is 26,490 km^2. This greatly exceeds the size of the area within which bears conceivably could be impacted by the proposed Susitna Dam project. This study area was configured for an estimate based on data collected during 2000-2003 that was unrelated to Susitna Dam studies. The ISR asserts that the objective to estimate the populations of brown and black bears has been completed, suggesting no additional data or analyses are forthcoming.

Density surface maps (ISR 10.8 Figures 5.1-5 and 5.1-11) are based on the incorrect premise that where bears happen to be documented during spring surveys is related to the carrying capacity of the habitat (expressed as density). In addition, the technique used to generate estimates of bear abundance and density in the entire Large Carnivore Study Area (hereafter termed the Mark-Recapture Distance Sampling or MRDS technique) has not been described or proved accurate for black or brown bears in any existing publications or reports in Alaska or elsewhere. The data collection and analytical methods used for bears in this study have not been peer reviewed and are correspondingly not "consistent with generally accepted scientific practice" as required for AEA Susitna studies. For some other species, the person involved in the spatial modeling, Miller et al. (2013:23) described "Density surface modelling from survey data [as] an active area of research" and noted that "we look forward to further improvements and extensions in the near future." Distance sampling techniques have been used to estimate abundance of polar bears in the Barents Sea subpopulaltion (Aars et al. 2009), but this work did not involve the capture-recapture component of the MRDS technique used for the current Susitna bear studies. Unlike the Susitna area bear studies, the habitat variables for the polar bear studies were very limited because there were no elevation or vegetation variables (covariates) that required consideration.

The reason there are no previous bear density or population estimates in the western and southern portion of the Large Carnivore Study Area is because much of the bear habitat in this area is forested. It is very difficult to use techniques based on observations in habitats where bears cannot be seen because of overstory vegetation. Regardless of efforts to correct for this problem by covariate analysis in the MRDS method, if any bears present in the study area cannot be detected, then any analytical technique based on observations will underestimate abundance.[1]

[1] In the key paper on mixed mark-recapture and line transect models, Laake et al. (2008:299) noted*: "In particular, it is much more difficult to cope with availability bias and it will typically require additional effort such as a known marked population* [references], *separating in time between surveys* [references], *or an independent estimation of the availability process* [references]". Availability bias is when animals are not available for detection (e.g., hidden by vegetation). In the same paper (page 300) the authors acknowledge that for double-count methods (such as used in the current study): *"…these methods cannot account for animals that are unavailable to both observers."* Further (page 301) these authors acknowledge that when some groups are hidden (unavailable to be seen), it

Although the ISR and Becker and Quang (2009) do not provide location data upon which their analysis is based, we suspect very few bears were seen in forested portions of the study area, openings in the forest, or sedge flats. This means that their abundance estimates and corresponding density surface maps reflect primarily the segment of the population available for observation. This segment is largely between timberline and 5,000 feet for brown bears.

There is no possibility of calculating a detection probability based on bears observed by only one of two observers if no bears are observed because of overstory vegetation. The brown bear population estimate derived for the Large Carnivore Study Area and published by Becker and Quang (2009) is implicitly acknowledged in the ISR as an **under**estimate. The ISR reported a brown bear population estimate that was 46% higher than reported (based on exactly the same data for the same study area) by Becker and Quang (2009). This increase resulted from use of new mathematical techniques involving point independence. [2] The estimate increased from 575.9 brown bears to 841 brown bears, and density from 26.3 bears/1000 km^2 to approximately 35.8 bears/1000 km^2. We suspect that even when point independence is included in the math used to calculate population size, there remains an underestimation bias. Our suspicion is based on the fact that the density surface map for brown bears presented in the ISR (Fig. 5.1-11, page 30) is contrary to expectations. This map indicates **lower** densities in southern and western portions of the Large Carnivore Study Area where bears have access to multiple runs of salmon, than in interior areas where bears do not have access to salmon. All available studies indicate that where brown bears have access to multiple runs of Pacific salmon, densities are much higher than in interior areas (Miller et al. 1997, Hildebrand et al. 1998, Table 1 in this document).

We suspect that this underestimation bias most likely resulted from lack of independence between observers in the aircraft during MRDS surveys. Lack of independence between observers would lead to overestimation of detection probabilities which would cause underestimation of bear abundance. We present evidence that is consistent with overestimation bias in the MRDS data. This evidence is based on comparisons of detection probabilities calculated using the MRDS technique with other studies (Capture-Mark-Resight or CMR) where sightability of bears was directly estimated based on number of marked bears known to be present in an area that were observed. The CMR studies used equivalent aircraft and observers but more intensive search techniques. Correspondingly, sightability of bears would be expected to be higher in the CMR estimates than for the detection probabilities calculated using the MRDS technique. This should occur for each set of the MRDS covariates associated with a bear sighting. Based on examination of Figure 5.1-7 (page 26 of the ISR), however, the calculated MRDS detection probabilities were higher than found in the more intensive CRM surveys.

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represents a form of heterogeneity "*…that cannot be modelled with mark-recapture and, unfortunately, it is a fairly common form of heterogeneity*".

[2] *Point independence involves the assumption that somewhere on the curve describing* probability of detection as a function of distance from the airplane and associated covariates (slope, aspect, vegetation, group size, etc.), the probability of detection is 100% for both observers. Laake et al. (2008:305) observed: *"To use point independence, it is essential to meet the assumptions for distance sampling. The assumption of locally uniform density around the line or point is the key assumption. For line transects, this means that within a specified strip, the expected distribution of perpendicular distances to all objects (observed and unobserved) is uniform."*

It is likely too, that the MRDS application in the current study may not have appropriately identified the correct covariates that influence the likelihood of seeing a bear. Laake et al. (2008:307) noted that:

> *Even if every horse* [read object or animal] *had a measurable probability of detection, the use of covariates relies on the investigator's ability to identify all covariates and properly measure the covariates…All of the important covariates will have to be identified before the survey unless they can be adequately obtained from a GIS layer or some other means….Even if the uniformity assumption holds and you can use MRDS, there are limits to how much visibility bias* [reason animals are not detected by observers] *can be accommodated when it results from availability bias* [animals not available to be seen because, for example, they are hidden under a forest canopy or in dens].

Based on available information in the ISR, we do not know which covariates were investigated during the current study or used in the final model. The ISR (page 3) mentions explanatory variables (e.g., covariates) such as "elevation, aspect, habitat, and east-west and north-south gradients," and it is clear that some of these were covariates considered. However, it is also clear some of these covariates are not directly correlated with bear abundance including north-south and east-west gradients. These gradients do not directly reflect food availability. The most important factor that influence bear abundance is food availability (Schwartz et al. 2003 and many others). Elevation, aspect, and slope are likely proxy variables for things that affect food availability for bears which, in spring, might be avalanche tracts where bears forage for newly emergent vegetation and tubers. Where a bear is seen in spring might also reflect the presence of a carcass of a winter-killed or wolf-killed ungulate or availability of ungulate calves. A springtime southwest-northeast gradient in the Large Carnivore Study area might reflect salmon availability during summer and fall. The most important covariate affecting detection probability for bears (and most other wildlife) is vegetation/canopy coverage.

We recommend that bear population estimates—at least for brown bear—be made exclusively for the area where project impacts are expected on bears.[3] Instead, the current study reported in the ISR makes a population estimate for a huge study area (26,490 km^2 of which 23,515 km^2 was below 5,000 feet elevation and classified as bear habitat on that basis). Earlier Susitna-Watana Dam impact assessment studies conducted in the 1980s directly estimated the number of bears in a study area of 1,317 km^2 that was considered a reasonable size for estimating the number of bears that would be impacted by the then-proposed project (Miller 1987). The size of study areas and population estimates for the current and earlier study are contrasted in Table 1.

We are also concerned that basic assumptions behind the density surface maps presented in the ISR based on spatial modeling may be biologically inappropriate for bears. The characteristics of places where bears are seen, especially during spring surveys, are likely to be largely irrelevant to the carrying capacity (expressed as density) of any study area. The factor most influencing bear density is the abundance and spatial distribution of food (Schwartz et al. 2003).

[3] A new estimate for black bears may not be necessary if AEA is willing to accept the estimate of 47 bears made by Miller (1987) during earlier Susitna Dam studies. Unlike brown bears which have been subject to intensive harvest management in Unit 13, it is unlikely there have been significant changes in black bear abundance in the limited area of black bear habitat in the Susitna River riparian habitat in the proposed Watana impoundment area.

In the Large Carnivore Study Area and most other places with bears, brown bear density is more influenced by availability of salmon for food than by any other factor. However, bears are not on salmon streams during spring when the MRDS surveys were conducted because the salmon have not yet arrived. Additionally, bears constantly move between non-contiguous patches of food or for other reasons such as, during spring, searching for mating opportunities or avoiding predation on their newborn cubs. Many spring sightings, therefore, occur in places a bear is moving through rather than exploiting for food. Analyses based on multiple relocations of the same bear and throughout seasons, therefore, are necessary to identify habitats bears use disproportionately to availability. This kind of distinction is frequently conducted based on resource selection function (RSF) analyses (e.g., Flynn et al. 2012) that are based on many relocations of the same radio-marked individuals during all seasons.

Techniques based on observing bears including the MRDS and CMR techniques must be conducted in the spring before leaves come out, but the characteristics of the spot where a bear happens to occur during spring is likely to be irrelevant to carrying capacity (density). This problem with creating a density surface map based on spring observations of brown bears is evident in Fig. 5.1-11 (page 30) of the ISR. The darkest shaded areas intended to represent the highest densities are at high elevations and are mostly adjacent to the 5,000 foot contour. This is because during spring, many bears (especially females with newborn cubs [Miller 1987]) occur in the vicinity of their high elevation dens where there is no food in order to avoid infanticide of their cubs by other bears (Miller 1987, Steyaert et al. 2013). The darkest area in Figure 5.1-11 indicating the most densely populated area is in the extreme northeastern corner of the study area at high elevations in the Alaska Range near the Susitna River headwaters. This area, in fact, is dark only because bears emerging from dens occur here in the spring; the food resources available in this area are inadequate to support a high density of bears throughout the year.[4] The color shading in this area on Figure 5.1-11 suggests it has a density >300 bears/1000 km^2. Densities this high occur only in areas with abundant salmon (Miller et al. 1997). Similarly, relatively low brown bear densities are indicated in the southern portion of the density surface map along the lower Susitna and Yentna Rivers (Figure 5.1-11). These areas are where salmon occur during summer and fall, thus are most likely important to bear populations in this area, and would be expected to exhibit the highest densities.

Problems are apparent with the spatial modeling used to construct density surface maps for both bear species. The indicated densities appear much too high based on comparisons with densities reported in other studies (this is discussed in more detail below). This indicates, at best, a calibration problem and makes the density surface maps useless for the purpose of determining how many bears use any portion of the Large Carnivore Study Area. Additionally, the ISR does not even attempt to provide estimates of the number of bears of either species that will be impacted by the proposed project (much less the level or mechanisms of such impacts). There is no indication that any additional effort will be forthcoming in subsequent reports to provide information pertinent to evaluating project impact on bears.

[4] This problem was identified in the ISR (page 10): "[the modeling effort] left the concentrations of brown bears in the northeastern portion unexplained…[and] the study team surmised that brown bears were overestimated in the northeastern portion of the study area…"

Application of the MRDS technique in this study will, at best, produce only estimates of abundance and density. Nothing in the proposed 10.8 study design will provide necessary information on bear movements or habitat use. Such information is essential to evaluate Susitna Dam project impacts on bears. Flynn et al. (2012) produced such an analysis for brown bears in southeastern Alaska. In this study, the ADF&G researchers used GPS collared bears and Resource Selection Functions analyses (e.g., Boyce et al. 2002, Manley et al. 2002) to evaluate bear use of habitats near a proposed new road. Similar techniques would provide highly pertinent information needed to augment studies using VHF-collared bears that were conducted in the 1980s for the proposed Watana dam (Miller 1987). Similar studies using GPS transmitters on bears would significantly advance knowledge of proposed Susitna-Watana Dam impacts on black and brown bears. Repeating the Capture Mark Recapture (CMR) density and population composition estimates in the same area surrounding the Susitna dam, where density was measured in 1985 and 1995 (Miller 1997b) would also provide useful and directly comparable information on trends in bear numbers and population composition.

The isotope studies identified to address Objective 2 will provide new information on the importance of salmon in bear diets in the Susitna River. None of the sites sampled for bear hair during 2013 (Fig. 5.1-14, page 33 of ISR, Part A), however, were upstream of Devils Canyon. Therefore, it is unlikely that salmon use by bears living in the vicinity of the proposed Susitna dam site will be documented. It is also likely that any salmon use based on hair analysis that is documented by bears upstream from Devils Canyon would be complicated by an inability to distinguish between salmon from the Susitna River and salmon from Prairie Creek (a tributary of the Talkeetna River where Miller 1987 documented use of salmon by some study area brown bears).

Analysis of accomplishments by Objective

Objective 1. Estimate the current populations of brown bears, black bears, and wolves in the study area, using existing data from ADF&G. [See separate comments for our analysis of wolf studies]

The MRDS technique used in this study to estimate bear abundance and density are mathematically very complex and difficult to understand. We have provided a broad overview of this technique, as best we can understand it, in Appendix A. We provide this in hope that it will facilitate ease of understanding the material presented in the ISR.

The Large Carnivore Study Area is too large to accurately meet study objectives for Large Carnivores that would be impacted by the proposed project. This study area was based on an earlier study unrelated to Susitna Dam impact assessment studies. This earlier study generated a population estimate in what was called the “Talkeetna Study Area” (Becker and Quang 2009). This study area is identical to the Large Carnivore Study Area in the ISR (Figure 3-1, page 19). The size of this area is 26,490 km^2, of which 23,515 km^2 is below 5,000 feet elevation and was classified on this basis as being “bear habitat” in both Becker and Quang (2009) and the ISR. In contrast, 1980s Su-hydro bear studies (Miller 1987) estimated bear numbers and density in a more appropriately-sized area for predicting project impacts on bears. This earlier study area was 1,317 km^2 centered on the proposed Watana-Susitna dam site (Table 1).

Table 1. Comparison of bear population estimates and study area size for current AEA Susitna Dam impact assessment studies (AEA 2014) and the 1980s studies (Miller 1987).

Source	Brown bear population estimate	Black bear population estimate	Size of study area used to estimate density
AEA ISR (2014)	841		23,515 km^2 portion (<5,000' elevation) of 26,490 km^2 total study area
AEA ISR (2014)	--	1,262	Unspecified area lower than 4,600 feet contour.
Miller (1987)	35.7	--	1,317 km^2
Miller (1987)	--	47.0	532 km^2 portion of brown bear study area classified as suitable black bear habitat

Miller (1987) estimated black bear numbers in the same 1,317 km^2 study area used for the brown bear estimate, but classified only 532 km^2 as black bear habitat suitable for making density calculations. The ISR used the elevational upper limit of black bear observations (4,600 feet) as the upper limit of bear habitat and therefore pertinent to black bear density calculations. However, the ISR does not report what this area was. A large part of the Large Carnivore Study Area is not forested and therefore not suitable black bear habitat; some of this is correctly depicted in Figure 5.1-5. However, it is anomalous that the riparian figures of habitat are more darkly shaded (indicating higher densities) than the forest lowlands on the southern and eastern portions of the study area in the density surface map. We suspect this is because black bears living in these lightly forested or shrubby riparian habitats penetrating to the northeast in the middle of the study area are more likely to be seen than in the more heavily forested habitats further south and west where higher density black bear populations most likely occur. This is because these are the most forested habitats that are preferred by black bears. Black bears occur primarily in forested habitats and, in the project area, in the riparian habitats along the upper Susitna River and its tributaries like Watana Creek (Miller 1987).[5]

The population estimates made by Miller (1987) included brown bears seen above 5,000 feet elevation. Furthermore bears were actively searched for at all elevations. The MRDS surveys, in contrast, were truncated at the 5,000 foot contour and any bears occurring above 5,000 feet could not be counted. Both studies appropriately used only the area below 5,000 feet to estimate density. However, excluding bears above 5,000 feet from density calculations contributes to an underestimation bias.[6]

It appears probable that the MRDS technique has an underestimation bias even with the correction added based on point independence. Becker and Quang (2009:13) reported on the line

[5] For both black and brown bears the apparent incorrect depiction of bear densities in the density surface maps presented in the ISR can be roughly evaluated using bear harvest data. Our comments on the Analysis of Harvest Data Study (Study 10.20) include a recommendation on how this can be done and why it is pertinent to the bear studies.

[6] High elevations are used by brown bears primarily as denning habitat and not as foraging areas in the study area (Miller 1987).

transect technique in the only peer-reviewed paper published on this method, and mistakenly said, "*Our model produced an estimate within the range of mark-resight density estimates (10-41 bears/1,000 km^2) of bears in interior Alaska (Schwartz, Miller and Haroldson 2003).*" In fact, the ISR density estimate as we calculated it (this number was not reported in the ISR) was 35.7 brown bears/1,000 km^2). Although this estimate is within the range for populations of interior bears that do not have access to salmon, it appears to be significantly lower than populations of bears that do have access to salmon. In much of the Large Carnivore Study Area (Table 2) the bears do have access to salmon, so comparisons with "interior" bear densities are inappropriate. Areas with abundant salmon typically have much higher densities (>100 bears/1,000 km^2) than interior areas without salmon where brown bears subsist on moose and caribou calves in the spring, berries, roots and vegetation (Miller et al. 1987, Hildebrand et al. 1998, Schwartz et al 2003). Brown bears in the immediate Susitna Dam impact area have interior diets without access to abundant salmon.[7]

In discussion at the AEA meetings on October 21, 2014, E. Becker from ADF&G asserted that he was unable to identify proximity to salmon streams as a covariate influencing brown bear abundance during his surveys (also reported in the ISR 10.8, Part A Page 10). No doubt this is because during the spring, when his surveys were conducted, bears are not on salmon streams. This does not mean that the driving force influencing and correlated with brown bear density in the Large Carnivore Study Area is not salmon. In the spring, bears are focusing on finding the foods that are available at that time which are more likely maintenance foods that suffice only to sustain high bear densities until salmon arrive. Many bears in spring are also at or near den sites. The issue with salmon is illustrative of a general problem with the spatial modeling using the MRDS technique. This assumption is that the characteristics of the habitat where a bear group is seen in the spring are relevant to the overall population density in the area. The single factor most correlated with bear density is the abundance and distribution of food (Schwartz et al. 2003; Hildebrant et al. 1998, Miller et al. 1997, and many others). Bears move long distances between food patches which vary seasonally in distribution and amount of available food to obtain breeding opportunities, or to move to or from den sites for example. Their location during any one time may not reflect habitat characteristics that are important relative to the carrying capacity (expressed as density) of the habitat overall. This explains why habitat utilization/selection patterns are more accurately based on multiple data points for numerous individual bears rather than just one point where a bear happens to be when a survey observation is made.

Estimates of bear density using the MRDS method for salmon-rich habitats of the Alaska Peninsula (Subunits 9A, northern 9B, 9C, and 9D) are also lower than estimates obtained using CMR techniques (Miller et al. 1997a). This suggests the same kind of underestimation bias in analyses (without adjustments for point independence) as in Becker and Quang (2009). Riley and Butler (2011:110) reported an estimate of approximately 110 bears/1,000 km^2 in these Alaska Peninsula subunits. Comparison of this with other areas where salmon are available (Table 2) suggests that these Alaska Peninsula MRDS estimates are too low (i.e., have an underestimation bias).

[7] Miller (1987) reported that some brown bears in the Susitna Dam area made seasonal trips to Prairie Creek to exploit a run of king Salmon; other than this, they existed on an interior brown bear diet of vegetation and ungulate calves (moose and caribou).

Table 2. Brown/grizzly bear densities in North America based on presence/absence of salmon as a significant source of food. The ISR estimates considered disparate are indicated in bold; these were obtained using Mark-Recapture Distance Sampling (MRDS) technique initially reported by Becker and Quang (2009).

Area	Significant salmon available?	Reported density (bears of all ages)/1,000 km^2	Reference
Northern Yukon, Canada	no	3-4	Schwartz et al. 2003*
Arctic coastal plain, Alaska	no	4	Schwartz et al. 2003*
Alberta, Canada	no	4-5	Schwartz et al. 2003*
Cabinet-Yaak Ecosystem, NW Montana	no	4.3-4.8	Kendall et al. in press
Eastern Brooks Range, Ak	no	7	Schwartz et al. 2003*
Jasper NP, Alberta, Canada	no	10-12	Schwartz et al. 2003*
Northern GMU 13, Alaska	no	10-13	Schwartz et al. 2003*
GMU 13E and 13A Alaska	no	11-41	Schwartz et al. 2003*
MacKensie Mts., Canada	no	12	Schwartz et al. 2003*
Yellowstone Ecosystem, Wyoming	no	14-18	Schwartz et al. 2003*
Waterton Lakes, Alberta, Canada	no	15	Schwartz et al. 2003*
Arctic NWR, AK	no	16	Schwartz et al. 2003*
East-central Alaska Range	no	16	Schwartz et al. 2003*
Seward Peninsula, AK	no	18	Schwartz et al. 2003*
Northern BC, Canada	no	21	Schwartz et al. 2003*
Northern Continental Divide Ecosystem, MT 2009	no	24**	Kendall et al. 2009, JWM 73:3-17
SE BC, Canada (Selkirks)	no	27	Schwartz et al. 2003*
Western Brooks Range, AK	no	30	Schwartz et al. 2003*
Glacier NP, Montana (2005)	no	30	Kendall et al 2008, JWM 72:1693-1705
Denali NP, AK	no	34	Schwartz et al. 2003*
Kluane NP, Yukon, Canada	no	37	Schwartz et al. 2003*
Glacier NP, MT	no	47	Schwartz et al. 2003*
Flathead River, MT	no	80**	Schwartz et al. 2003*
Susitna-Watana ("Talkeetna") Study area, Alaska, 2000-2003	**yes#**	**26.3 (based on population estimate of 576)**	**Becker and Quang (2009)**
Susitna-Watana Large Carnivore ("Talkeetna") Study area, Alaska	**yes#**	**35.8## (based on population estimate of 841)**	**AEA 2014 (ISR 10.8)**
Alaska Peninsula, Black Lake	yes	191	Schwartz et al. 2003*
Chichagof Island, SE AK	yes	318	Schwartz et al. 2003*
Kodiak Island, AK	yes	323-342	Schwartz et al. 2003*
Admirality Island, AK	yes	399-440	Schwartz et al. 2003*
Katmai NP, AK	yes	551	Schwartz et al. 2003*

*C. Schwartz, S. Miller and M. Haroldson, 2003. Grizzly Bear. Chapter 26 in Feldhamer, Thompson and Chapman (E*ds.*), Wild Mammals of North America: Biology, Management, and Conservation, 2nd Ed., Johns Hopkins, Univ. Press. (see Table 26.9, page 574 for references to primary sources for density estimates)

** Calculated by S. Miller based on Kendall's estimate of 765 bears in a 31,401 km^2 study area

*** Estimate likely reflects area of concentration rather than wide area density

Study Area was a mixture of habitats where salmon were available along the Susitna River below Devils Canyon and Upper Cook Inlet (an estimated 50-75% of study area) and interior habitats with little to no salmon along the Susitna River above Devils Canyon (25-50%)

This density estimate was calculated by S. Miller based on the estimate of 841 bears in the Large Carnivore Study Area (26,490 km^2) reported in the ISR divided by the area of the study area considered to be bear habitat because it is below 5,000 feet elevation (23,515 km^2). The ISR population estimate is a 46% increase in the estimate of 576 bears that was reported by Becker and Quang (2009) but was based on the same data that were collected during 2000-2003. Although based on the same data, the ISR estimate was a 46% higher because a different mathematical technique was used to estimate population size.

The brown bear density surface map (ISR 10.8 Fig. 5.1-11) appears to overestimate density even though the MRDS approach appears to underestimate bear abundance as discussed above. The darkest areas on this figure represent the highest densities and according to the color index scale,[8] a significant portion of the study area is indicated as having densities near 0.2 bears/km^2 (or 200/1,000 km^2) even in areas where no salmon are present such as in the big bend portion of

[8] This shading scale is incorrectly labeled "Estimated abundance" when it should be "estimated density".

the Susitna River on the east end of the study area. As displayed in Table 2, all Alaska study areas where brown bear density has been estimated where salmon are not present have densities <50 bears/1,000 km ^{2}. This suggests a serious calibration problem with the spatial modeling used to derive the density surface map. At best, the density surface map may be characterized as depicting relative (not absolute) densities. A similar calibration problem was found with the density surface map for black bears as discussed below. We believe this kind of problem results when species experts are not involved with the development and calibration of mathematical models such as those producing the results reported in the ISR.

The ISR acknowledges that brown bears in the Study Area downstream of Devils Canyon eat a significant amount of salmon. This is evident is the stable isotope signatures from bear hairs collected in this area and reported in ISR 10.8 Part B: Supplemental Information (and Errata) to Part A (February 3, 2014 Draft Initial Study Report) by ABR Inc. (June 2014). Although these data have not been fully analyzed, they appear to indicate that brown bears, at least, eat significant amounts of salmon in this area. Correspondingly, this should be reflected as higher bear densities in areas where hair samples were collected, as densities should be similar to those reported for coastal areas rather than interior areas (Table 2).

All techniques for **estimating** abundance and density may include bias. However, it appears that the detection probabilities calculated for the Mark-Recapture Distance sampling (MRDS) technique are unreasonably high. If detection probabilities are biased high, the resulting estimate of bear numbers will be biased low.

An underestimation bias in the MRDS technique is indicated by the calculated detection probabilities in comparison with sightability data obtained during Capture Mark Resight (CMR) techniques (Miller et al. 1997a). Detection probabilities in MRDS surveys are calculated based on bear groups seen by only one observer in the plane and bear groups seen by both observers. This is the mark-resight component of the MRDS technique and is based on the assumption that observations of the two observers are independent (i.e., the sighting of a bear by one observer does not increase the likelihood that the bear will be seen by the other observer). If this critical assumption is incorrect, then the estimates will be biased low and minor violations of this assumption can result in significant underestimation bias (Benson 2010).[9] Sightability of bear groups during CMR surveys, in contrast, does not require any assumptions and is empirically calculated based on the percentage of marked bears (known to be present) that are seen during CMR survey flights. Identical to the MRDS surveys, the CMR flights have both a pilot and an observer in a fixed wing aircraft. During the survey, however, everything is done to maximize the likelihood of seeing bears. This means that the pilot and observer cooperate: they fly in a spiraling pattern allowing views of the ground from many angles; they can fly tighter circles in habitats where bears are likely to occur and where visibility is restricted by vegetation; they can

[9] Based on simulation studies, Benson (2010:2) reported: *"… the* [Becker and Quang] *estimator had substantial bias if even 10% of observations were dependent. Incorporation of an "ideal" covariate, i.e., the scale parameter for each transect, decreased the bias of the estimator, but there was substantial bias for most simulated scenarios, regardless of the covariate. Precision of the estimator increased (i.e., standard error decreased) as the level of dependency was increased, likely because dependent data caused an overestimate of the* h_{max} [maximum probability of detection]. *These results suggest that Gamma MRDS* [mark-recapture distance sampling] *methods should be used with caution when detection probabilities are not independent."*

follow bear tracks in the snow; and they are not constrained by any elevation contours or time. This means any bear that is present is much more likely to be detected during CMR surveys than during MRDS surveys regardless of the characteristics of the habitat (these characteristics are called covariates in the MRDS analysis).

The calculated brown bear Horowitz-Thompson (H-T) detection probabilities for the MRDS surveys are shown in Figure 1. A red line displays the average sightability (24%) for a CMR study that was conducted in 1985 in the 1,317 km^2 study area used to estimate bear density (Miller 1987, sightability data in Miller et al. 1997a). Average sightabilities for many CMR studies in Alaska were presented by Miller (1997a:Table 3), and almost all of them are lower than the median detection probability for brown bears reported by AEA (0.485, ISR 10.8 Part A Page 8) (Figure 1). This comparison supports our suspicion that detection probabilities were overestimated in the MRDS technique reported by AEA (2014). This would have led to an underestimation of bear abundance.

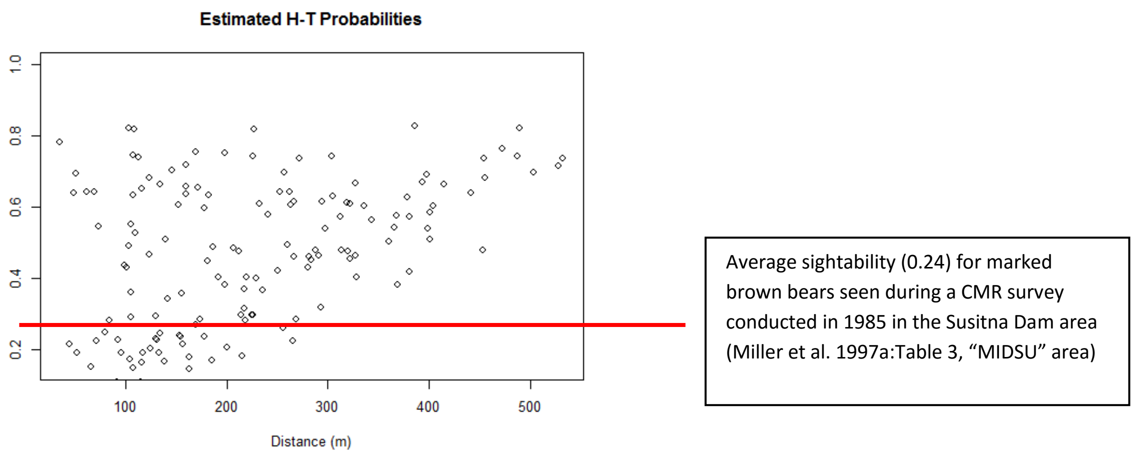

Figure 1. Estimated Horowitz-Thompson (H-T) detection probabilities for brown bears in the Large Carnivore Study area (extracted from Figure 5.1-7 of the Large Carnivore ISR, page 26, red line and text box added).

E. Becker of ADF&G said that this comparison was invalid because detection probabilities for the MRDS technique were calculated differently than sightabilities for the CMR studies. Although calculated differently, for each of the dectection probability points in Fig. 1, the likelihood that a particular bear would have been seen during a CMR survey flight would be higher. This is because of the higher search effort during CMR surveys. Additionally, the likelihood of any bear being seen in forested habitats that composed >50% of the Large Carnivore Study Area would be even lower than in the predominantly shrub habitats where the 24% sightability value was obtained during earlier Susitna studies (Miller 1987). Bears in these forested habitats would not only have detection probabilities less than the median of 0.48 reported in the ISR and illustrated in Fig. 1, the likelihood of observing these bears would be much less than the 24% found in the shrubby habitats of the 1985 Susitna study area.

Black bear estimates in the ISR suffer from similar problems to those described above for brown bears. The ISR reports that the median detection probability for black bear groups was 0.4930 (ISR 10.8 Page 7 and Figure 5.1-1). In the Susitna Dam studies conducted by Miller (1987), the CMR sightability for black bears was 34% (Miller et al. 1998:Table 3). Most of the H-T detection probabilities illustrated for black bears in Fig. 5.1.1 of the ISR were >0.34 in spite of the fact that CMR techniques, as described above for brown bears, were more intensive so all black bear groups should have higher detection probabilities in CMR surveys than during MRDS techniques. Additionally, the forest overstory in a large portion of the Large Carnivore Study area (downstream of Devils Canyon) would be expected to reduce observability of black bears compared to the riparian habitats where black bears primarily occur in the vicinity of the proposed impoundment where earlier studies occurred. The fact that the mean detection probability for black bears in the MRDS studies (0.493, page 7 of ISR 10.8 Part A) was higher than the average sightability for black bears during CMR surveys in the 1980s (0.34) suggests the H-T detection probabilities were overestimated for black bears. This may be because few of the black bears that were present in the forested habitats in the western and southern portions of the Study Area, were seen during MRDS surveys.

The MRDS density and population estimates for the Large Carnivore Study Area appear to be even less appropriate for estimating proposed project impacts on black bears than brown bears. We do not understand how the black bear density surface map (Figure 5.1-5) can be used to determine black bear density in the project area or how many bears there are in the project impact area. The darker areas on this density surface map are claimed to represent higher black bear densities and, based on the incorrectly labeled scale,[10] the darkest areas appear to match densities >1 bear/km^2. A population density of 1/km^2 would match the highest density ever reported for black bears (in Virginia, see Pelton 2003: 548). Earlier black bear studies in the area of the proposed Susitna Dam reported densities of 0.09 bears/km^2 or 88.5/1,000 km^2 (Miller 1987, Miller et al. 1997a). Two black bear studies on the Kenai Peninsula in Alaska reported densities of 0.20-0.29 black bears/km^2 (reported in Miller et al. 1997a: Table 4). The Kenai Peninsula represents good black bear habitat (even by Alaska standards), while the darkest areas on the density surface map (Fig. 5.1-5) occur in areas that any knowledgeable bear biologist would classify as marginal habitat. We conclude that the density surface map incorrectly depicts black bear density in the Large Carnivore Study area. In contrast, the ISR (Part A Page 7) reported "*The study team used the model to predict the number of black bears in 1-km cells (Fig 5.1-5). Model fit diagnostics indicated a good fit. The deviance explained by the model was high (38.1 percent), indicating a good predictive model*." We believe if a bear expert had been involved in this research project rather than only biometricians, it would have been recognized that a model predicting black bear densities of >1/km^2 in any part of Alaska was not a credible model.

The FSP (page 10.8-6) states that "*Distance sampling using line transects surveyed from small airplanes (Becker and Quang 2009) is the primary method currently employed by ADF&G to obtain regional estimates of bear population density in southern Alaska*." We question this statement. The most recent Bear Survey and Inventory reports for Game Management Units 13, 14, and 16, (Petlier 2011 a,b; Schwanke 2011) make no mention of Becker and Quang (2009) or the brown bear density estimates reported by AEA. The ISR (Part A, Page 3) reports that Becker and Quang's MRDS transect approach was used during 2003 and 2004 in a combined 13A and

[10] The scale for both species on the density surface maps is incorrectly labeled "Estimated abundance" when it should be "estimated density" since it is a density surface map.

13B study area, yet this decade-old study was not cited by Schwanke (2011) in her report on brown bear management in Unit 13 and no results from this work are reported in the ISR. ADF&G management biologists may not be using results obtained from MRDS applications because the study area is too large and variable to be useful in a management context. The "Talkeetna Study Area" which is the same as the ISR Large Carnivore Study Area, integrates results across multiple GMUs and Subunits (13E, 16A, 16B), each with different habitat conditions (e.g., no/low to high salmon availability). Concentrated food sources like salmon dramatically influence bear densities (Miller et al. 1997a, Hildebrand et al. 1998, Schwartz et al. 2003). Consequently, a density estimate incorporating large portions of both Unit 13 and Unit 16 is of little or no value to a management biologist for either area. Furthermore, management biologists in Units 13, 16, and 9 likely recognize that the population and density estimates are too low to be credible.

Objective 2. Evaluate bear use of streams supporting spawning by anadromous fishes in habitats downstream of the proposed dam that may be altered by the Project.

This objective would be more precisely stated if it was made clear that bear "use" was not going to be examined during this study but rather the ratio of salmon consumption to consumption of terrestrial plant and animal foods. Results of carbon and nitrogen isotope analyses are not reported in the ISR, but preliminary results for both bear species are reported in Part B of the ISR (June 2014). These preliminary results are consistent with previous studies in Alaska where black and brown bears are sympatric (e.g., Fortin et al. 2007) and suggest much higher use of salmon by brown bears than black bears which exhibit higher use of plants.

No bear hair was collected in 2013 on the Susitna River above Devils Canyon because of access issues. This is unfortunate as 1980s data collection efforts were based on the invalid assumption that Chinook salmon did not migrate above Devils Canyon. It is unclear if hair above Devil's canyon will be collected in 2014.

Objective 3. Describe the seasonal distribution of, and habitat use by, wolves in the study area using existing data from ADF&G. (See separate wolf comments for evaluation of this objective.)

Objective 4. Synthesize historical and current data on bear movements and seasonal habitat use in the study area, including the substantial body of data gathered by radio-tracking during the 1980s, as a continuation of the 2012 wildlife studies (AEA 2012).

It is not clear what the phrase "…current data on bear movements and seasonal habitat use in the study area" refers to. To our knowledge, there are no ongoing studies on these issues for either bear species in any portion of the Large Carnivore Study Area or adjacent to this area. A brown bear study was initiated by management staff in GMU 13A but was terminated and no report is available. Even if a report on this 13A study were available, it is unlikely that it would provide insights on movements and seasonal habitat use in the area of the proposed impoundment. We conclude that the ISR will not provide any new information on bear movements and seasonal habitat use in the study area so this objective will not be achieved.

More sophisticated analysis of movement and habitat use data is now possible with new software and GPS technology that did not exist during the earlier studies conducted in the 1980s (Miller 1987). It is unfortunate that GPS collars were not employed in the current bear studies. Insights gained from GPS collar technology play an important new role in the current AEA-funded Susitna Dam impact assessment studies for moose and caribou. The same should have been done for bears.

The ISR for bears correctly captures many of the main conclusions from earlier Su-Hydro studies (Miller 1987) with the exception of the denning comments mentioned below in the section on errors.

Errors in ISP and ISR and related documents

We believe that the Final Study Plan in Section 10.8.5 (Consistency with Generally Accepted Scientific Practice) incorrectly asserts "*Distance sampling using line transect surveys from small airplanes (Becker and Quang 2009) is the primary method currently employed by ADF&G to obtain regional estimates of bear population density in southern Alaska*" (Page 6). It would be more accurate to state that this approach (termed here Mark-Recapture Density Sampling or MRDS technique) is under development for bears in Alaska. There is no publication or report that correctly uses the technique to report bear density in Alaska or anywhere else because the two publications that employed MRDS did not use the point independence reanalysis (Becker and Quang 2009, Walsh et al. 2010). Point independence reanalysis is used for the first time for bear data in the ISR. Therefore this technique, as currently envisioned for use in Susitna studies, has not been subjected to peer review[11] and does not meet the criteria established by AEA for Susitna Dam studies that techniques must be "consistent with generally accepted scientific practice."

ADF&G has deployed the MRDS technique in high density populations in parts of GMU 9 (the Alaska Peninsula) during 1999-2005, but we are unaware of any publication or report describing the methods for obtaining these estimates. Consequently, they are impossible to evaluate. There is a brief mention of the density estimation results derived from these surveys in the biannual brown bear Survey and Inventory report for GMU 9 (Riley and Butler, 2011). The density estimate using the MRDS technique in Unit 9 was 110 bears/1,000 km^2 (Riley and Butler 2011). This estimate is significantly lower than previously reported density estimates for similar habitats on the Alaska Peninsula and Kodiak Island (Miller et al. 1997a, Van Daele 2011, see Table 1 above).

The conclusion that the MRDS technique is better described as "under development," rather than established science, is also supported by new analyses of old data collected using this technique. Data collected during 2000-2003 in the 26,490 km^2 Large Carnivore Study Area (also called the Talkeetna Study area) resulted in a population estimate of 575.9 brown bears (SE = 78.7) (Becker and Quang 2009:219). Recent re-analysis of these same data resulted in an increase in

[11] Becker (ADF&G, personal communication) reports that publications on point independence reanalysis of MRDS data are in preparation. Similar techniques have been used for other species and are reported in the literature.

the population estimate to 841 brown bears (SE = 161.7) with a 95% CI of from 578.7 to 1,221.5) (ISR Part A, page 8). The initial population estimate made by Becker and Quang (2009) is not within the 95% CI of the most recent population estimate reported in the ISR using exactly the same data but different analytical techniques.[12] Although the new analysis resulting in higher density estimates appears more in line with previous studies for interior GMU 13, these estimates still appear low based on the amount of salmon-rich habitat in eastern GMU 13E, 16A, and 16B (Susitna River downstream from Devils Canyon representing about half of the Large Carnivore Study Area). This problem is discussed above and illustrated in Table 1.

The only adequately documented use of the MRDS technique to estimate brown bear numbers was a study by federal biologists in Bristol Bay on the Togiak National Wildlife Refuge in GMU 18 (Walsh et al. 2010). This published study is not mentioned in the ISR or the RSP. It is briefly mentioned in the Survey and Inventory report for GMU 18 where the Togiak Refuge estimate was extrapolated to all of GMU 18 to obtain a Unit-wide population estimate (Perry 2011). The density estimate reported was 40.4 bears (all ages)/1,000 km^2 (Walsh et al. 2010), which is consistent with previous non-quantitative estimates for this area. However, the new analytical techniques which resulted in a 40% increase in estimates reported by Becker and Quang (2009) probably would, if recalculated to include point independence, result in a corresponding dramatic increase in the number of bears estimated in the Togiak Refuge in GMU 18. Walsh et al. (2011:56) concluded:

> …the [Becker and Quang 2009] method can only detect total population change between two surveys of 38% or larger (Table 7). This level of power is less than needed to address current management needs for the Togiak NWR (i.e. changes of ~20% or less over 5 y). Thus, while the method currently has limited value for monitoring bear populations similar to that of the study area, it shows promise for populations of greater density with equal or greater detectability. Based on density estimates (Miller 1993), this potentially includes all nonforested habitat in the coastal regions up to ~ 100 km inland from the Alaska Peninsula to the panhandle regions in southeastern Alaska.

The ISR also erroneously states, "ADF&G does not consider bear dens to be "sensitive locations," (ISR section 10.8.4.1.2 Downstream surveys [for bear]), citing a letter from M. Burch, ADF&G, to AEA, dated December 10, 2011). With reference to black bears, at least, both the statement that bear dens are seldom reused and that they are not sensitive areas are incorrect. Schwartz et al. (1987:288) noted "Reuse of dens [by black bears] was common in all 3 study areas." The areas studied by Schwartz et al. (1987) included the Susitna Dam area and the lower Susitna River (below Devils Canyon), Prince William Sound, and the Kenai Peninsula. Schwartz et al. 1987:289) also noted that "*The high reuse of natural cavity dens* [by black bears] *in SRB [Susitna River Study Area] was unexpected considering the characteristics of these dens, many of which appeared drafty and cold and frequently incompletely sealed by the snowpack.*" Dismissing the importance of denning habitat is also inconsistent with observations made in earlier Su-hydro studies. Miller (1987:44) observed:

[12] The new analytical techniques uses a DSM (detailed Density Surface Model) developed by Miller et al. (2013) and Generalized Additive Models (GAMs) (Wood 2006).

> *Most [brown] bears showed a tendency to den in the same general location year after year but considerable variation was observed. Den sites used in different years by the same individual were separated by a mean distance of 3.8 miles (Table 42).*

With respect to black bear dens, Miller (1987:67) reported:

> These data demonstrate a high rate of reuse of individual dens by bears in the upstream Su-Hydro area compared with other study areas (Schwartz et al., in press) and suggest that good den sites may be limited in the upstream study area.

And Miller (1987:62) reported:

> Forty-four different dens were found in the vicinity of the Watana Impoundment: 55% of these were dug, 41% were in natural cavities, and 2% were of unknown cavity type (Table 75). Of these dens, 55% would be flooded by the proposed impoundment and 46% would not be flooded (Table 75).

Miller (1987:63) concluded:

> These data suggest that the Watana Impoundment would probably result in a reduction of acceptable denning sites for black bears resident in this area. This factor might become limiting for black bear populations in this area if populations remained at pre-impoundment levels.

Another error in the ISR occurs in Part A (page 10), where it states: "*Black and brown bears are <u>highly territorial</u> and tend to use the same high-quality foraging areas <u>throughout a season</u> (Barnes 1990)*" (emphasis added). Bears were also mistakenly identified as territorial on page 10 of the ISR with regard to the hair snaring studies. In fact, neither black or brown bears are "territorial." Territoriality is defined when a species defends the area it occupies (a territory) from encroachment by others of the same species. Both bear species have large and overlapping home ranges and both species tend to reuse high quality foraging areas within their home ranges during a season. Although not territorial, bears may defend a personal space against crowding by other bears. It is also incorrect to say that bears use the same area <u>throughout</u> a season unless a "season" is atypically defined as the period when a certain food source is available (such as berries in a particular spot or a temporally short run of a single species of salmon as occurs in Prairie Creek near the proposed Susitna impoundment [Miller 1987]).

Recommendations

1. Bear studies should be redesigned to permit direct estimation of the number of bears in the area likely to be impacted by the proposed impoundment, rather than the current study area which is approximately 20 times larger. The method currently being used does not provide an abundance or a density estimate for either species of bear in the area that will be impacted by the impoundment. CMR, hair-snaring DNA studies, and/or Resource Selection Function studies based on data from radio-marked bears are all appropriate techniques that should be considered to provide useful information for evaluating project impacts on bears. Depending on techniques used, this would require 2-4 years of study with the quickest result from DNA

hair snaring studies (e.g., Kendall et al. 2009, Boulanger et al. 2002). This is particularly important for brown bears. The estimates derived by Miller (1987) for black bears are unlikely to have changed much in the Susitna Dam area. In contrast, efforts have been ongoing for decades to reduce the number of brown bears in GMU 13 so earlier estimates may no longer apply to the current population (Miller et al. 2011).

2. Redesigned bear studies should include radio-tracking bears using GPS transmitters to permit determination of bear use of project impact areas more precisely than was possible during 1980s studies using VHF collars. This study requires more than three years.
3. If AEA chooses not to redesign bear studies as recommended above, then it is essential that available data from the current study be evaluated in such a way that abundance and density estimates can be directly compared to earlier Susitna Dam studies (Miller 1987). To do that, existing spatial analysis results for density must be used to generate population and density estimates for an area that makes sense in terms of where the proposed project will impact bears. Most appropriately, this will involve estimating abundance and density not just for the entire 26,490 km^2 Large Carnivore Study Area, but also for the same 1,317 km^2 study area used to estimate bear abundance and density estimates in 1985 (Miller 1987) and in 1995 (Miller 1997b). For the 1,317 km^2 study area, bear estimates (all ages) were 35.6 (95% CI =33.0-40.1) in 1985 and 53.7 (95% CI=47.4-63.1) in 1995 (Miller 1997b). For “independent bears” estimates were 24.7 (95% CI=20.9-31.3) in 1985 and 30.7 (95% CI=25.4-39.7) in 1995 (Miller 1997b).
4. Although we believe the density and abundance estimates generated by this project are not biologically credible (probably because of incorrect data inputs), the idea of generating a density surface map from observational data has merit at least for other species and perhaps, if done correctly, for bears as well. The spatial modeling fort this project has apparently resulted in densities being assigned to all 1-km^2 cells in the Large Carnivore Study Area based on covariates where bears were seen. Smoothing software from this database was used to generate the density surface maps where shading indicated a purported gradient of bear density. A more valuable way to use these data than difficult-to-interpret shadings on a map, would be to build tables showing the number of 1-km^2 cells in different density categories (e.g., 0-4.9/1,000 km^2 , 5-9.9, 10-14.9, 15-19.9, 20-24.9, etc.). This tabular data could be used to derive population and mean density estimates for a subportion of any study area (including a portion of the Large Carnivore Study Area surrounding the proposed impoundment or the 1,317 km^2 study area where abundance and density was estimated by Miller (1987)). We suggest that the midpoint of each density category could be used to derive these estimates. It may be possible to derive a variance for such estimates based on Coefficient of Variation surface maps such as are displayed in the ISP using the same 1-km^2 cell approach. We recommend that AEA contract to do something like this for the existing 1-km^2 data set for some portion of the Large Carnivore Study Area that is geographically pertinent to impact assessment studies for the proposed project. This will also be a useful test of the validity of the results generated by the MRDS approach used in this project and reported in the ISR.
5. Regardless of whether the above is done, we recommend that AEA acquire the databases used to generate the results shown in the ISR which generated the density surface and related maps so that they can be independently evaluated for problems that lead to apparent non-credible results. According to the FSP, AEA paid for the spatial analyses used to generate these products and therefore should have a right to have them. Available information

presented in the ISR is inadequate to evaluate problems. We don't even know which covariates were found pertinent to the final model used to construct the density surface map and which covariates were determined to be non-significant. Neither do we know the Akaike's Information Criteria (AIC) scores for any of these covariates. This information is necessary to evaluate the results.

6. All maps in the ISR should be modified to show geographic features to permit viewers to orient themselves within the Large Carnivore Study area. The needed features include the proposed Susitna Dam impoundment and major rivers. For brown bears this includes Figures. 5.1-11 and 5.1-12 and the corresponding maps for black bears.
7. Regardless of the approach to future bear studies, the project on Wildlife Harvest Analysis (ISR Chapter 10.20) should include analysis of kill density by harvest reporting units (UCUs) in the entire Large Carnivore Study Area. This will facilitate interpretation of the logic of density surface area plots in the ISR. Recommendations for presentation of harvest data for brown and black bears are in our comments for Project 10.20.
8. The reports on bear and population density estimation techniques are too complex for those without current advanced training in biometrics. Our review of the ISR required consultation with several Alaskan biometricians, including some who have studied the techniques in question. That level of complexity is contrary to the intended purpose of the study reports. The purpose is to inform FERC, the concerned public (and professional wildlife biologists) of study progress so that the suitability of techniques to accomplish stated objectives can be evaluated. The one published paper cited as the authority for these techniques and results is also highly technical and complex (Becker and Quang 2009). If AEA is going to make a case that research reports—and associated comment periods—are ultimately adequate to support a FERC license application, reports must be presented in a way the interested and reasonably well-educated public can understand. Other study reports for terrestrial species were adequately comprehensible, but this was not the case for the bear portion of the Large Carnivore ISR that involved estimating bear abundance, density and creating the final products based on spatial modeling.
9. If the experimental MRDS approach continues to be employed in Susitna Dam impact assessment studies, power analyses must also be conducted to determine what level of change would be detectable utilizing a subsequent application of the approach (e.g., post dam construction) in the same study area. Walsh et al. (2010) conducted a rigorous power analysis, without which, the management utility of any technique cannot be evaluated.
10. A sensitivity analysis should also be conducted. This will permit evaluating the impact on final results of not observing a subset of randomly selected bear groups on the estimate of bear population size. The same kind of sensitivity analysis should be done to evaluate the impacts of having seen additional groups on the final results.
11. ADF&G chose to use an experimental technique for these studies even though a more comprehensive model for impact assessment studies has long been available to ADF&G (e.g., Flynn et al. 2012, Miller 1987). Meaningful information on changes in bear abundance, population composition, and additional information on bear use of the potential impact area could have been obtained by replicating the studies of Miller (1987) using the same study area. This study area was used to conduct 2 density estimates using CMR techniques in 1985 and 1995 (Miller 1997b). Replicating this work would provide useful information on changes and trends in the bear population. More pertinent information on dam impacts could also have been attained using Resource Selection Function techniques

(e.g., Boyce et al. 2002, Manley et al. 2008, Flynn et al. 2012), or DNA hair sampling techniques (e.g., Woods et al. 1999, Kendall et al. 2009, Proctor et al. 2012).

12. Authors must be explicit about the units with which they are estimating bear numbers and bear density. Although it is not explicitly stated, the ISR estimates actually represent bears of all ages. This was based on extrapolations from mean group size observed. Absent explicit description of the units for population or density estimates, they are of little value in making spatial or temporal comparisons with other study areas.
13. Results of the MRDS technique should include search intensity (minutes searched/km^2) and associated variability based on covariates (e.g., vegetation type or elevation). This facilitates comparisons with results of other techniques such as the CMR approach. The search intensity for CMR studies in the Susitna study area ("MidSu") was 1 min/km^2 (Miller et al. 1997a: Table 3).
14. Publications on the MRDS technique to estimate bear abundance should be submitted to wildlife journals and not just statistical journals that are not typically read by non-quantitative wildlife biologists. Bear biologists, for example, would be more likely to recognize that the density estimates in the density surface maps are way too high for Alaska and to question the high detectability probabilities values reported in the ISR. In contrast, referees for statistical/mathematical journals are likely to be unfamiliar with important aspects of bear biology and to focus on the math involved.
15. Tables should be provided based on number of bears seen by group size (including groups of newborn, yearling and 2 year-old cubs) and mean and median group size. This is the only information on population composition the MRDS technique can provide. This information is also useful in evaluating the extrapolation for number of groups seen to total number of bears in the population. It is also potentially very useful to evaluate whether the MRDS technique systematically under-samples groups of females with newborn cubs which are the last to exit dens in the spring (Miller 1990) and stay at high elevations near their den sites for an extended period following emergence (Miller 1987).
16. Tabular data for the MRDS technique should show range and means for detectability based on important covariates, especially group size, distance, snow cover, and vegetation. This information is important to permit evaluation of suspected overestimation bias in detectability.
17. The authors should display the locations, elevations, and dates of their MRDS transects on a study area map and in tables so that readers can see where and when transects were flown. This is necessary to evaluate likely bias in the categories of bears likely to be seen such as females with newborn cubs who tend to remain at high elevation near dens during spring.
18. The analysis of isotopes in bear hair to detect salmon use by bears should include sample collection times relative to timing of salmon use and bear molting.
19. Neither the final study plan nor the ISR have any objective associated with evaluating the impacts of proposed roads and transmission lines that will be required to support the proposed project. Although bears can and will cross these corridors, the corridors will likely result in negative impacts on movements by avoidance reactions and increased access to currently remote areas of GMU 13 for hunters and other recreationists which will increase mortality from legal hunting, defense of life and property kills, and illegal kills. There is a huge body of literature on the adverse impacts of roads and access corridors on brown bears including: Simpson (1986), Mattson et al. (1987), McLellan and Shackleton (1988), Kaswork and Manley (1990), Gibeau et al. (2002), Chruzez et al. (2003), Waller and

Servheen (2005), Cook et al. (2006), Graves et al. (2006), Graves et al. (2007), Clevenger and Huijser (2011), Proctor et al. (2012). This impact was also observed by Schwanke (2011:145): "[Brown bears in Unit 13] *are wary of motorized vehicles*."

20. There is nothing in the study plan or ISR that is designed to identify appropriate kinds or levels of mitigation for adverse impacts of the project on bears. Although current ADF&G management objectives for brown bears are to reduce their abundance in the hope this will increase moose availability for hunters (Schwanke 2011), the objective for FERC and federal land managers may not and should not correspond.
21. Persons conducting the investigations and author(s) of the study reports should be identified by name as was done in the earlier ADF&G reports on Susitna dam studies conducted during 1980-1986 (e.g., Miller 1987). At least a "prepared by" statement should be included in these reports. Anonymous reports do not have the credibility that comes with reports by people willing to identify themselves as responsible for the studies and conclusions.
22. Impact assessment studies should not be considered adequate unless study plans incorporate post-project studies to determine actual impacts on bear movements, use of habitats, and changes in numbers and reproductive parameters, and should include allocation of funds for that work. Post-project studies should use GPS collars to permit statistically valid comparisons with data from currently ongoing pre-project studies.

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APPENDIX A. The Mark-Recapture Distance Sampling (MRDS) technique: General principles and commentary.

Using line transects (distance sampling) techniques to estimate the abundance of objects, including wildlife, is a well-established technique with an extensive and growing literature. It is a sampling technique designed to provide information on abundance in a small area that can be extrapolated to a larger area of interest to estimate abundance in the larger area. At its most basic level, a line along a transect or elevational contour is established in an area of interest and the perpendicular distance of objects of interest from this line are obtained. These distances are summed in various ways to determine the effective area that has been sampled or, in some cases, an effective transect width is set and assumptions are made about the visibility of the objects within this width. Visibility may be affected by things that make it more or less easy to see the object, such as vegetation or object size, and these are termed covariates that affect visibility.

The MRDS technique combines the line-transect concept with mark-recapture-techniques (Laake et al. 2008). Mark-recapture techniques also have a long history supported by extensive literature. Mark-recapture techniques are a way of estimating the number of the animals that are not directly observed through analysis of the ratio of marked to unmarked animals observed. Mark-recapture is conducted by putting a known number of marked objects in an area and subsequently determining the ratio of marked to unmarked objects that are recaptured in some way (such as visual sightings). As long as the number of marks available for recapture is known (termed population closure), then the total number of objects in the population can be calculated from the ratio of marked to unmarked individuals obtained during recapture efforts. Establishing population closure for objects that can move around (like animals) is something that must be addressed by persons using capture recapture methods; Miller et al. (1997a) did this in the Susitna study area using radio telemetry.

The MRDS technique as described for bears by Becker and Quang (2009) uses line intercept techniques to establish the distance from the transect line at which bears are seen from an aircraft. It combines this with capture-recapture techniques using two observers in an aircraft who are isolated from each other (looking for bears without communicating between themselves). Only one observer may see a bear, both observers may see a bear, or both observers may miss a bear. When one observer sees a bear, it is treated as a "marked" bear. If the other observer also sees the bear, it is treated as a recapture (resighting) of a marked bear, and if the other doesn't see it that is the same as a marked bear not having been "resighted." The most critical assumption in this technique may be that the sightings by each observer are <u>independently</u> <u>obtained</u>; a sighting by one observer must not influence the likelihood that the other will also see the bear. The importance of this assumption was evaluated by Benson (2010). Violations of this assumption will lead to a systematic underestimation bias.

The MRDS technique uses the capture-recapture data from the observers to calculate a detection probability for each observation. Data on the physical characteristics where the sighting occurred (slope, aspect, vegetation cover, etc.) are also obtained and subjected to an analysis to determine which are important to include in detectability models. Spatial Modeling (Miller et al. 2013) may be used to construct a density surface map based on bear observations obtained.

There are numerous potential advantages to the MRDS technique. One is that it eliminates the need to make assumptions about population closure. Another is that it allows a series of randomly distributed transects in a large study area to be evaluated to determine animal abundance in the entire study area. In contrast, results from more traditional mark-resight techniques (e.g., Miller et al. 1997a) are valid only for the study area for which population closure is established which, typically, is small compared to areas that are of management significance (such as a Game Management Unit). In cases where the area of interest is already relatively small, such as for the Susitna Dam impact area, the CMR or other techniques such as DNA hair sampling techniques may be more appropriate as they directly estimate bear numbers and density in the specific area of interest such as around the proposed Susitna Dam project (e.g., Miller 1987, 1997b). Techniques to downscale bear estimates obtained from large areas like the Large Carnivore Study Area to smaller areas such as the Susitna Dam impact area, in contrast, have not yet been developed to our knowledge.

The independent dual observer approach technique can calculate a Horvitz-Thompson (H-T) detection probability (hereafter detectability). Typically, detectability declines with increasing distance from the transect, and also can be low near the transect (such as under the aircraft). Becker and Quang (2009) plotted this detectability for one category of bears (single walking bear) and it followed this pattern. The most single walking bears were seen about 150 m from the transect line (Becker and Quang 2009:Figure 1). The median distance for a single walking bear seen from the transect line was 444 m and the differences between the two observers in the probability of seeing this bear can be plotted (Becker and Quang 2009: Figure 3). The maximum detectability is the peak of this curve and (for the single walking bear) was 85.3% for the pilot and 77.0% for the observer. These values as well as peak detection distance will vary for different covariates (e.g., group sizes, vegetative cover, snow cover, distance from the transect, bear activity type, etc.). Well-established mathematical techniques are used to determine which covariates contribute significantly to the overall model used to estimate bear abundance and Becker and Quang reported that those listed were the most important.

The value for overall detectability is lower than the reported value for maximum detectability. Becker and Quang (2009) and ADF&G in the ISR determined a detectability for each group of bears seen based on covariates and plotted these values ("Estimated H-T Probabilities") in Figure 5.1-1 (page 20 of the ISR for black bears) and Figure 5.1-7 (page 26 for brown bears). It is not straightforward to compare detectability using MRDS directly to other ways of calculating sightability. Sightability in most studies involving physically marked animals is calculated based on the number of marks seen divided by the number of known marks present (e.g., Miller 1997a:Table 3 for many CMR studies around Alaska). The ISR reports that a total of 145 brown bear groups and 351 black bear groups were used in the multiple-covariate distance-sampling model to calculate a population estimate of 841 brown bears (SE = 161.7) and 1,262 black bears (SE = 169) in the Large Carnivore Study Area based on data obtained during 2000-2003. The ISR estimated the median probability that a brown bear group was observed as 0.485 (range 0.109-0.829) (page 8) and for black bear groups as 0.493 (range 0.0976-0.9097) (page 6).

Because we are concerned that detectability may be systematically overestimated by the MRDS technique when applied to bears, we have made some comparisons to our calculated sightability for groups reported in the ISR with other estimates of sightability in Alaskan studies using CMR techniques. Sightability will be overestimated if the observations of one observer increase the likelihood of the other observer seeing the bear (Benson 2010). If sightability is overestimated, population size will be underestimated.

Earl Becker (ADF&G personal communication, 25 August 2014) asserted that the detection probabilities reported for the MRDS technique are not directly comparable to those obtained by capture-mark-resight (CMR) techniques such as those reported by Miller et al. (1997a). However even if not directly comparable, it is safe to say that in all cases and for any distance from the aircraft that the CMR sightability values should be **higher** than the detection probabilities reported using MRDS as described for bears by Becker and Quang (2009). This is because both techniques use identical aircraft and 2 observers but the sightability of a bear at whatever distance it occurs from the airplane (e.g., at whatever point in the detectability curve) should be higher for CMR techniques because:

1. With CMR techniques the pilot and observer are not and need not be independent; they are free to communicate with each other and cooperate in finding as many bears as possible including following tracks and counting bears discovered incidental to the initial bear seen; [13]
2. More intensive search techniques should always result in higher sightability values than less intensive ones. With CMR techniques the flight patch is not a straight line but is typically a circulating pattern designed specifically to maximize the likelihood of seeing a bear from one of many angles in the circle and includes circulating in tighter circles in likely areas where bears could occur, including areas where bear tracks are seen. With CMR techniques the design of searches need only assure that there is no bias in the likelihood of seeing marked or unmarked individuals. This search pattern implicitly accounts for the covariates mentioned in the Becker email above and would result in CMR **methods under any circumstance documenting more bear sightings—not less—than** when flying a straight line transect. In other words, although the detectability and sightability values are based on different kinds of data, the detectability from the strip technique (apples) should always be lower than the sightability from the CMR techniques (oranges), regardless of covariates or distance from the aircraft. The CMR techniques are not limited to a strip of a set width; a bear is counted regardless of how far it is from the aircraft when originally sighted.
3. With CMR techniques there is not an elevational limit for searches allowing teams to search at or above 5,000 feet elevation in mountainous areas where females with newborn cubs are likely to occur in spring (Miller 1987). These CMR search teams actively look in the vicinity of dens (typically conspicuous in snow banks) and find females with new born cubs in the spring (females with newborn cubs are the last to exit dens in the spring [Miller 1990]). In contrast, for the MRDS techniques used in the ISR, flight lines are along randomly established elevational contours limited to <5,000 feet elevation in mountainous areas so these transects are likely to undersample the segment of the population composed of females with newborn cubs. Females with newborn cubs may be 15-30% of the population. Miller (1990: Table 3) reported the mean exit date for females

[13] In a personal conversation with Becker on 10/23/14 about how sightability is increased by following tracks, sometimes for miles, he said that the aircraft pilots who are big game guides frequently do find bears from his transects by observing tracks and following them visually. If this is the case than tracks should be examined as a covariate influencing detectability during his surveys.

with newborn cubs as May 15 with a range from April 23 to June 2. Becker and Quang (2009) report only that their surveys were done during "mid-May to early June" but do not report the actual dates of their surveys so it is impossible to know the significance of a potential bias against females with newborn cubs.

4. With CMR techniques, when a bear is seen at any distance from the aircraft, it is counted along with any bears seen incidental to flying to see the first spotted bear. It appears that bears seen incidental to the first bear using the Becker and Quang (2009) approach cannot be counted because counting them they would confuse calculation of the detectability curves which are critical to this technique.
5. Neither the ISR or Becker and Quang (2009) provide data on their search intensity (effort). However, for CMR techniques in the 1985 Susitna Hydro study, search effort was reported as 1 minute/km^2 per replication with a sightability of marked bears in the study area of 24% (Miller et al. 1997a:Table 3). This was typical for other studies in generally similar habitats such as on the north side of the Alaska Range (AKR-1 and AKR-2 in Miller et al. 1997). We suspect that bear surveys as part of the ISR were conducted at a lower intensity than those for the CMR techniques.

Although the above points indicated that CMR should produce sightabilities higher than the detectabilities reported using the MRDS approach, in almost all of the Horvitz-Thompson (H-T) detection probabilities in Figure 5.1-7 of the ISR are greater than the overall sightability of 24% reported for Su-Hydro CMR studies in 1985 (Miller et al. 1997a:Table 3). This is consistent with the conclusion that the MRDS technique currently in use by AEA and reported in the ISR overestimates detectability, leading to underestimates of population size and density. An explanation is not clear, but it most likely involves lack of independence between observers which would lead to underestimation bias (Benson 2010).

WOLVES

Comments on: Distribution, Abundance, and Habitat Use by Large Carnivores, Study Plan Section 10.8, Initial Study Report, (Parts A, B and C), and Prepared for AEA, Susitna-Watana Hydro by Alaska Department of Fish and Game, Palmer, AK. June 2014. (No authors named) 38 pp (part A); and

Revised Study Plan, Wildlife Resources, 10.8. Distribution, Abundance, and Habitat Use by Large Carnivores Study, Final Study Plan, Section 10.8, Susitna-Watana Hydroelectric Project, FERC Project No. 14241, AEA, pages 10.8-1 to 10.8-13 . July 2013. (Please note the Large Carnivore Revised Study Plan was approved by FERC without modification and is thus equivalent to the Final Study Plan.)

Purpose of these comments: The Initial Study Report (ISR) and Revised Study Plan (RSP) for the wolf portion of the Large Carnivore portion of the Susitna-Watana project was reviewed to:

1. Evaluate progress toward the study objectives identified in the ISR and in the RSP;
2. Evaluate whether the data collection and analysis techniques are adequate to achieve the stated objectives;
3. Evaluate whether the stated objectives and study plans are adequate to evaluate the impacts on wolves of the proposed project with a view to assuring that adequate information is available to determine both impacts and appropriate kinds and levels of mitigation for impacts;
4. Evaluate and contrast earlier wolf studies on the same project by Ballard et al. (1984) to determine if these results are or will be integrated into the current project; and
5. Make recommendations for improving data collection or analysis to permit more meaningful evaluations of project impacts.

Objectives for Large Carnivores Project—Wolf portion only considered here (RSP pages 10.8-1 to 2). (Analyses of progress toward these objectives is provided in a separate section, below, by objective):

1. Estimate the current populations of [~~brown bears, black bears, and~~] wolves in the study area, using existing data from ADF&G.

2. [pertains to bears]

3. Describe the seasonal distribution of, and habitat use by, wolves in the study area using existing data from ADF&G.

4. ~~Synthesize historical and current data on bear movements and seasonal habitat use in the study area, including the substantial body of data gathered by radio-tracking during the 1980s, as a continuation of the 2012 wildlife studies(AEA 2012)~~. [Note: There is no mention made here of using historic information on wolves collected as part of earlier Su-Hydro studies—see recommendation #2 below. The reference to AEA 2012 is to a report that also does not mention wolves. Analysis of the historical information on wolves should be an objective for Large Carnivore Studies.]

General overview comments:

The RSP/FSP proposes to use existing routinely-collected data to evaluate the impacts of the proposed project on wolves. However, there are no existing data or routinely collected data on wolves for the area that would be impacted by the project on either the number of wolves (Objective 1) or on the seasonal distribution of, and habitat use by wolves (Objective 3). Available data for these objectives are 30 years old and no longer valid because management emphasis for wolves has changed dramatically in this area. Completion of this study plan will not result in information that will inform AEA or FERC on the project's impacts on wolves. The ISR states (page 2) that for wolves, the "…study involves office-based analysis of existing ADF&G data on wolves from GMU Subunits 13E and 13A, and from adjacent Subunits 14B, 16A, and 20A, as available" (emphasis added). The ISR (page 5) asserts that historical data with be "synthesized" "…with data from other recent and current monitoring by ADF&G of wolves in GMU Subunits 13, 13b, 13e, 14b, 16, NS 20, as a continuation of AEA's wildlife studies that were begun in 2012 (AEA 2012a)." However, no data are "available" on project impacts on wolves and there are no data from other recent and current wolf monitoring in any of these subunits. We conclude that these statements in the ISR and RSP/FSP are meaningless and misleading insofar as it implies that such data might be "available" or be in process of being collected.

There are routinely collected data on numbers of wolves in Unit 13 and other units. However, these data are collected for a geographic area (Game Management Unit or Subunit) that is too large to be of utility in evaluating project impacts on wolves. A study on a smaller geographic area in the vicinity of the proposed project is needed to evaluate these impacts. Such a study was conducted by Ballard et al. (1984) but to our knowledge there are no new studies of wolves in the project area since then. We are not aware of any new studies involving radio-marked wolves in Unit 13 or the other subunits mentioned since the aborted effort in Units 13A and 13B described by Golden and Rinaldi (1008). Given the extremely heavy hunting pressure on wolves throughout GMU 13 (Schwanke 2012), we acknowledge that it would be extremely difficult to conduct a movement or habitat use study for wolves at the appropriate scale to determine project impacts using conventional techniques (radio telemetry) (Golden and Rinaldi 2008).

There are no methods being proposed or used for AEA's current wolf studies that will accomplish Objective 3 ("Describe the seasonal distribution and habitat use by wolves in the study area using existing data"). Unit 13 is now a wolf intensive management area and the objective is to "…maintain a post-hunting and trapping season population of 135-165 wolves (3.2-3.9 wolves/1,000 km^2) in the available habitat unitwide." (Schwanke 2012:93). This objective is about half the estimated number of wolves during the 1970s (275-300) (Schwanke 2012:92 from Ballard et al. 1987). In the late 1990s, there were approximately 520 wolves in Unit 13 (Schwanke 2012).

No estimates of wolf numbers in the project area were presented in the ISR and we believe it is highly unlikely that the ongoing routine monitoring work in Unit 13 will result in accomplishment of Objective 1 (Estimate the current number of wolves in the project area using existing data).

Analysis of accomplishments by Objective:

Objective 1. Estimate the current populations of ~~brown bears, black bears, and~~ wolves in the study area, using existing data from ADF&G.

ADF&G proposes to use existing data collection procedures to estimate current populations of wolves "in the study area". However, these routinely-collected data pertain to the number of wolves in various Subunits of Unit 13 (at best) and will not generate any estimates of the number of wolves in the study area for large carnivores illustrated in Figure 3-1 (page 19 of the ISR, Part A) or--as impact assessment studies should do-- in the much smaller area of actual impact of the proposed Susitna-Watana Dam and associated corridors.

Correspondingly, the ISR provides no estimates of numbers either for the illustrated Large Carnivore Study Area or for a more pertinently drawn and smaller impact study area for the Susitna-Watana Dam project and associated transportation and transmission corridors. The ISR reports that it has "made progress" in summarizing trends in wolf populations (ISR Part A, page 11) but the only progress reported is on a scale much larger than the dam impact area (either in Figure 3.1 or in a more pertinently-drawn study area). There is no indication that future reports will present data at a pertinent scale for project impacts. The progress reported in the ISR is taken directly from the Survey and Inventory Report for the whole of GMU 13 (e.g. Schwanke 2009, 2012).

Ballard et al. (1984: 21) reported (for both Watana and the then-proposed Devils Canyon impoundments):

> The number of wolves inhabiting areas which could be impacted by the proposed project has fluctuated from 25 in spring 1983 to 47 in fall 1983 (Table 3). Both hunting and trapping have regulated the number of wolves occupying the area. Mostly wolf mortality occurred during the months of January through April primarily from aircraft assisted ground shooting (Table 2, Fig. 3). Territory sizes of 9 wolf packs in the Susitna River Basin ranged from 124 mi^2 to 803 mi^2 (322 km^2 to 2081 km^2) and averaged 452 mi^2 (1171 km^2)(Table 4). Some territory sizes may not be adequately described because some packs have only been located a few times… and
>
> Generally, wolves restrict their movements to elevations less than 4,000 ft/1300 m. For example, the Watana Pack had only 2 of 56 (3.6%) observations at elevations greater than 4,000 ft/1300 m elevation in 1982.

By far the largest pack documented by Ballard et al. (1984) was the Watana Pack. This pack, if it still exists, is the pack that would be most impacted by the currently proposed project. The current Study Plan will not be able to document if this pack (or any other pack described by Ballard et al. 1984) still exists or its current size.

Since the studies by Ballard et al. (1984), there have been intensive and successful efforts to reduce the numbers of wolves in GMU 13 by increasing harvests (Schwanke 2012). This kind of disruption makes it impossible to assume that the packs, territories or wolf numbers described in earlier studies bear any resemblance to what currently exists in the project impact area. Since there are no ongoing studies to determine this, it appears that Objective 1 for wolves will not be achieved.

Objective 3. Describe the seasonal distribution of, and habitat use by, wolves in the study area using existing data from ADF&G.

No results are reported for this objective. The existing study plan is to use routinely collected wolf management data but these data are not specific to the Large Carnivore Study area illustrated in Figure 3-1 (page 19 of the ISR, Part A) or, as they should be, to the smaller area within which wolves will be impacted by the proposed project.

It is true that currently it is extremely difficult to conduct radio-tracking studies of wolves in GMU 13 because of very heavy hunting pressure caused by the designation of GMU 13 as an intensive management zone for wolves. The rapid elimination of radio collared wolves led to the cancelation of wolf studies in Subunits 13A and 13B designed to evaluate impacts of vehicles on wolves (Golden and Rinaldi 2008). This problem existed to a lesser extent during the earlier Su-hydro studies which is the reason Ballard et al. (1984) did not include illustrations of the pack territories they studied. It may be the case that there is no way Objective 3 could be achieved under the current regulatory system for wolves in GMU 13 and it is puzzling why this objective was included if no effort was going to be made to achieve it.

Since the studies by Ballard et al. (1984), there have been intensive and successful efforts to reduce the numbers of wolves in GMU 13 by increasing harvests (Schwanke 2012). This kind of disruption makes it impossible to assume that the distribution, abundance, movements, or territories for wolves that were described in earlier studies still exist. Since there are no ongoing studies to "describe seasonal distribution of, and habitat use by wolves", it appears that Objective 3 for wolves will not be achieved.

Objective 4. Synthesize historical and current data on <u>bear</u> movements and seasonal habitat use in the study area, including the substantial body of data gathered by radio-tracking during the 1980s, as a continuation of the 2012 wildlife studies(AEA 2012). [underscore added]

This objective refers to bears and includes no reference to use of the historical data for wolves in the Susitna Dam impact area reported by Ballard et al. (1984) as part of earlier impact assessment studies. There are no analyses of historical wolf data in AEA 2012. Although the historical data is of reduced pertinence given the history of intensive wolf harvest in GMU 13 (Schwanke 2012), some effort to extrapolate from these data to impacts of the current study is potentially pertinent and should be included as an objective.

Errors in RSP and ISR and related documents

The FSP refers to ADF&G memorandum to AEA dated November 22, 2011, in support of the contention that "*…ongoing monitoring work will be sufficient,…so no additional field surveys* [of wolves] *are deemed necessary for the Project. Hence, desktop analyses of existing ADF&G data will be used to meet the study objectives for wolves*." (RSP page 10.8-6) However, these objectives include estimating the numbers of wolves in the Study Area (Objective 1) and determining the seasonal movements of, and habitat use by wolves of the study area (Objective 3). Ongoing routine monitoring work conducted by ADF&G is not sufficient to accomplish either of these objectives at a scale that is necessary to evaluate project impacts on wolves. At best, this monitoring will suffice to estimate the numbers of wolves in a Subunit; current estimates by Schwanke (2012) provide estimates only for all of Unit 13 and not even harvests are reported by subunit. In fact, the ISR does not report on either Objective 1 or 3, but instead reports on trends in wolf numbers at much larger geographic scales (GMU or GMU Subunit). Further, the ISR makes no effort to evaluate current use by wolves of the impoundment impact area or the number of wolves in this area.

Recommendations:

1. Objectives 1 and 3 for wolves should not have been stated in the RSP/FSP if there was going to be no effort made to achieve them. Listing these objectives is deceptive to the licensing process for the proposed project. We acknowledge that for wolves these objectives would be difficult to achieve given the current heavy hunting pressure on wolves throughout GMU 13. This hunting pressure resulted in the need to cancel an earlier project (Golden and Rinaldi 2008) based on radio-collared wolves because radio marked animals were so quickly killed that no data of value could be obtained. We recommend that the AEA acknowledge that Objectives 1 and 3 for wolves as currently stated are unattainable for the area within which wolves will be impacted by the proposed project, or for the Large Carnivore study area delineated in the RSP/FSP and ISR. We further recommend that an appropriately-sized wolf study area centered on the project area be identified and methods proposed to identify ways to determine project impacts on wolves in this area, or to propose some other way to mitigate for adverse project impacts on wolves. <u>This should be identified as a significant variance from the Final Study Plan.</u> Wolves are species of concern to federal authorities who must consider the license application regardless of what the State of Alaska's management objectives. As apex predators in the ecosystem, wolves play a vital role in regulating not only potential overabundance of large carnivores that frequently results in habitat damage, but also positively affects many other species of plants and animals through what is known as a trophic cascade effect (Hebblewhite et al. 2005, Hebblewhite and Smith 2010, Ripple and Beschta 2011).

2. The wolf studies should have included an objective to synthesize the historical and current data on wolf movements and seasonal habitat and prey use in the Suitna-Watana project study area, including the substantial body of radio-tracking data gathered during the 1980s. The moose, caribou and bear studies included such an objective and the wolf studies should too, given the importance of wolves as apex predators in ecosystems (see above references). Ballard et al. (1984) conducted extensive studies on wolves in the Susitna-Watana Dam area and made impact assessments. Although the situation has changed substantially for wolves

in the project area since these earlier studies, these data should be utilized for this project[1]. Perhaps AEA might choose to accept, for the purposes of mitigation, the impacts assessed in the earlier studies. Additional pertinent information on Susitna-Watana Dam area wolves also was presented in Ballard et al. (1987). Although not specifically stated in AEA documents, we speculate that the decision to exclude historical data for wolves may result from the fact that GMU 13 is now designated by the State of Alaska as an Intensive Management Area. This means that the state's objective for wolves is to significantly reduce them. The Alaska Energy Authority, FERC, the Bureau of Land Management (BLM) and Cook Inlet Region, Incorporated should all have a vested interest in project impacts to wolves given their important role in the ecosystem and in wildlife management in Alaska's most popular hunting district.

3. The Large Carnivore Study area illustrated in Fig 3-1 (page 19 of the ISR, Part A) is misleading both as an area within which wolves will be impacted by the proposed project, and as an area within which routinely-collected wolf data are obtained. This figure includes parts of 3 different subunits in 2 different units, covering an order of magnitude more area than would be relevant to project impacts. Ballard et al. (1984) reported that in 1984, just the Watana pack ranged over an area of 1,246 km^2. An area five times this large would still be only approximately 25% of the Large Carnivore Study Area identified in the ISR and RSP/FSP. Future study reports should be more precise about what constitutes a realistic study area for wolf impacts.

4. At a minimum, future reports should include information on the number of wolves harvested in the geographic area that would be impacted by the proposed project and corresponding corridors and transmission lines. These data are already available.

5. Neither the RSP nor the ISR have any objective associated with evaluating the impacts on wolves of the proposed roads and transmission lines that will be built to support the proposed project. Because these corridors will provide improved human access to the impoundment area, they will exacerbate already heavy human harvests and cause displacement by avoidance reactions of wolves (Ballard et al. 1984).

6. Nothing in the RSP or ISR identifies appropriate kinds or levels of mitigation for adverse impacts of the project on wolves. These impacts are pertinent to the FERC, BLM, and CIRI given their important role in the ecosystem and wildlife management decisions.

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[1] Ballard et al. (1984) analyzed the results of studies of 42 radio-collared wolves in 13 different packs during 1981-1983 in the Devils Canyon and Watana impoundment zones and presented pack histories of their movements based on 649 radio-locations plus more sightings. Moose represented 61% of documentable wolf diet and caribou 30%. This report concluded that wolves would be impacted by lower wintering densities of moose and caribou in the impoundment zone and by disturbance from inundation and facilities development affecting wolves far from the impoundment zone.

7. Persons conducting the investigations and author(s) of the study reports should be identified by name as was done in the earlier ADF&G reports on Susitna dam studies conducted during 1980-1986 (e.g. Ballard and Whitman 1987). Anonymous reports do not have the credibility that comes with reports by people willing to identify themselves as responsible for studies and conclusions.

8. Impact assessment studies should not be considered adequate unless study plans incorporate (including allocation of funds) post-project studies to determine actual impacts on wolf movements, habitat use, and changes in numbers and reproductive parameters. Post-project studies should be incorporated into the study plan.

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WOLVERINE

Comments on: Wolverine Distribution, Abundance and Habitat Occupancy. Study Plan Section 10.9, Initial Study Report (Part A Sections 1-6, 8-9), Prepared for AEA, Susitna-Watana Hydro by Alaska Department of Fish and Game and ABR, Inc. June 2014. (No authors named). 10 pp (Part A); and

Final Study Plan, Wildlife Resources, 10.9. Wolverine Distribution, Abundance and Habitat Occupancy, Section 10.9, Susitna-Watana Hydroelectric Project, FERC Project No. 14241, AEA. 10 pp. July 2013.

Purpose of these comments: The Initial Study Report (ISR) and Final Study Plan (FSP) for the wolverine portion of the Susitna-Watana project was reviewed to:

1. Evaluate progress toward the study objectives identified in the ISR and in the FSP;
2. Evaluate whether the data collection and analysis techniques are adequate to achieve stated objectives;
3. Evaluate whether stated objectives and study plans are adequate to evaluate the impacts on wolverine of the proposed project with a view to assuring that adequate information is available to determine both impacts and appropriate kinds and levels of mitigation for impacts;
4. Evaluate and contrast earlier wolverine studies on the same project by Whitman and Ballard (1984) to determine if these results are or will be integrated into the current project; and
5. Make recommendations for improving data collection or analysis to permit more meaningful evaluations of project impacts.

Objectives for Wolverine Project (FSP pages 10.-1). (Analyses of progress toward these objectives are provided in a separate section, below, by objective):

1. Estimate the current population size of wolverines.
2. Establish a population index for wolverines.
3. Describe the distribution of wolverines in late winter.
4. Describe habitat use by wolverine in late winter.

These objectives are inadequate to achieve the goal of the wolverine project as stated in the ISR (AEA 2012: 4) inserted below:

> *The overall goal of this study is to collect pre-construction baseline population data on wolverines in the Project area (reservoir impoundment zone; facilities, laydown, and storage areas; access and transmission line routes) to enable assessment of the potential impacts from development of the proposed Project. This information will be used to estimate impacts on habitats used seasonally by wolverines.*

The objectives are not specific to a study area, whereas the goal is correctly specific to the "Project area". It appears that the study design is to estimate population size in (Objective 1) and establish a population index for (Objective 2) the Wolverine Study Area (WSA) depicted in Figure 3.1 (page 7) of the ISR. No basis is offered for the location of the WSA depicted in

Figure 3.1 and it appears to include far too much area to the west and north of the proposed project and far too little area to the east and south of the project area. This may be because the goal is to include all 3 access routes under consideration but since only one of these will be selected, it is more appropriate to center the WSA on the proposed project area. We note that none of the other terrestrial mammal studies configured their study areas to encompass all access routes under consideration.

General overview comments

Wolverine are elusive animals occurring at very low densities, making them difficult to study. In southern parts of their range, at least, they are threatened by climate change that reduces the amount of snow and ice they depend on for transportation and denning (Ruggiero et al. 2007, Copeland et al. 2007).

The only thing that will certainly be accomplished during this project are occupancy modeling (OM) surveys which determine whether established quadrats are occupied based on tracks observed during winter surveys. Two iterations of OM surveys were accomplished in winter 2012-2013 and comprise the entirety of data reported in the ISR. No progress is reported on the application of the Sample Unit Probability Estimator (SUPE) beyond development of the sampling grid (25 km^2 blocks) and description of the vegetation in each block. The SUPE application, if completed, will provide an estimate of abundance and density of wolverine in the WSA.

A good model for impact assessment studies for wolverine by ADF&G biologists was available in the ADF&G studies of Lewis et al. (2012) designed to evaluate impacts of a proposed road in southeastern Alaska. This model is more appropriate to meet objectives of the current study on Susinta-Watana Dam impacts as it involved GPS-equipped wolverine to evaluate habitat use in the proposed impact area. The current study will add no new information on habitat use by wolverine in the project area although this is identified as an objective.

Analysis of accomplishments by Objective

Objective 1. Estimate the current population size of wolverines.

The ISR suggests that the OM results may “potentially” result in a minimum estimate of wolverine population size. It is unclear how this can be accomplished with OM modeling. OM is based on the number of quadrats in which wolverine tracks are observed, and generates presence/absence data based on whether tracks are seen. However, this fails to quantify wolverine as one individual may leave tracks in many quadrats. Similarly, two or more wolverine may leave tracks in one quadrat. The ISR reported that OM surveys detected wolverine tracks in 23 of 25 sample units but provided no illustration of which sample units these were. In order to evaluate project impacts on wolverine, it is necessary to show where wolverine are found relative to the proposed project.

If snow conditions permit application of the SUPE technique, it will likely result in an estimate of the “current” population size of wolverine in the WSA and address Objective 1(Becker et al.

2004, Golden et al. 2007). The SUPE technique involves following the tracks in the snow until the individuals leaving the tracks are seen thereby allowing corrections on numbers of individuals involved in leaving tracks that are not possible with just OM data.

The WSA, however, is inappropriately sized and situated for the proposed project. The current study should focus on deriving an estimate of the numbers of wolverine in the project area using a biologically meaningful definition of the area of impact of the proposed project. A biologically meaningful definition of impact area would likely encompass some distance from the proposed project where the distance was a function of the mean home range size of wolverine in the study area.

Objective 2. Establish a population index for wolverines.

The intention of this objective is unclear. Based on the ongoing studies, a population index using OM (presence/absence) data collected during winter may be developed. The ISR does not describe any efforts to establish the relationship of this index to actual population size. Neither does the ISR indicate that power analysis will be used. Power analysis is necessary for any index to be useful in a management context because it determines the amount of change that can be detected. In illustration, the ISR reported that OM surveys detected wolverine tracks in 23 of 25 sample units. If, in the future, similar OM surveys detected tracks in 20 or 25 sample units, would that indicate a declining or increasing trend that could be attributed to the proposed project? If not, then it is unclear how establishment of a population index is pertinent to evaluating the project's impact on wolverine. A power analysis is essential to determine whether an observed change represents a statistically significant trend and would allow for calculation of confidence intervals around that conclusion.

We understand why ADF&G is interested in development of a large-area population index for wolverine given its utility for management purposes. It is difficult, however, to determine how development of an index will inform AEA or FERC on the proposed project's impacts on wolverine. At a minimum, the pertinence of this index to the licensing of the project needs to be explained.

Objective 3. Describe the distribution of wolverines in late winter.

The ISR provides no indication of how this objective will be accomplished. The OM modeling describes presence/absence of tracks in a 25 km^2 quadrat but such information at the scale of the illustrated WSA (Figure 3.1) provides no information of value about wolverine distribution in late winter that is pertinent at the scale of the proposed project. Absent an explanation of how this objective will be accomplished with the OM and SUPE techniques described for this project, we conclude that this objective most likely will not be accomplished at a level of resolution that is pertinent to evaluation of impacts on wolverine of the proposed project.

Objective 4. Describe habitat use by wolverine in late winter.

There is no indication of any techniques that will accomplish this objective in the FSP or ISR. Habitat use can best be described by radio telemetry studies and it is unfortunate that this study did not add to the habitat use data obtained using VHF collars by Whitman and Ballard (1984) by putting out some GPS collars on wolverine in the study area. The goal of the study as described is based on a habitat use evaluation so we conclude that the goal cannot be reached except to the degree that data obtained by Whitman and Ballard (1984) can be used. It is a failureof study design that the stated objectives for the wolverine study did not include integration of the earlier Whitman and Ballard (1984) results.

Recommendations

1. Perform a power analysis on any trend index developed as part of these studies.
2. Abundance estimates should be derived for a study area that is appropriately sized and situated for the area of likely impact of the proposed project on wolverine. The same area should be used for whatever technique is used to accomplish objectives 3 and 4 if any effort is made to accomplish these objectives. As noted above, we do not believe that Objectives 3 and 4 can be accomplished using the identified techniques at a scale that is pertinent to evaluate project impacts on wolverine. All objectives should be focused on a study area that is biologically meaningful for wolverine in terms of the proposed project. A biologically meaningful definition of impact area would likely encompass some distance from the proposed project where the distance was a function of the mean home range size of wolverine derived from another study since pertinent data are not proposed to be collected on this parameter in the current study.
3. It is essential that previous Su-Hydro wolverine studies (e.g., Whitman and Ballard 1984) be incorporated into the current study for the final report. It was overlooked to state this as an objective but it needs to be done regardless. The 1980s Susitna-Watana Hydro studies obtained data from 22 radio-collared wolverine which were periodically re-located to determine habitat use, movements, seasonal shifts in elevation and home ranges. No information of this type is being collected as part of the current Susitna-Watana Dam project studies for wolverine.
4. Neither the ISP nor the FSP have any objective associated with evaluating the impacts on wolverines of the proposed roads and transmission lines that will be built to support the proposed project (this is, however, identified as a “goal”). Because these corridors will provide improved human access to the impoundment area, they will exacerbate impacts associated with human presence.
5. There is nothing in the ISR or FSP designed to identify appropriate kinds or levels of mitigation for adverse impacts of the project on wolverine. The most likely sources of adverse impacts identified by Whitman and Ballard (1984) result from loss of scavenging opportunities on moose carcasses caused by impoundment-induced declines in moose populations near the proposed impoundment, and from increased human-caused mortality resulting from improved access.
6. Persons conducting the investigations and author(s) of the study reports should be identified by name as was done in the earlier ADF&G reports on Susitna dam studies conducted during 1980-1984 (Whitman and Ballard1984). Anonymous reports do not have the credibility that

comes with reports by people willing to identify themselves as responsible for the studies and conclusions.

7. Impact assessment studies should not be considered adequate unless study plans incorporate (including allocation of funds) post-project studies to determine actual impacts on wolverine numbers and movements.
8. The bioclimatic envelope for wolverine was described by Copeland et al. (2010). It involves factors such as temperature, snow persistence, linkage of snow corridors, snow cover in denning areas, etc. The existing bioclimatic envelope for wolverine in the dam impact area should be described and contrasted with this.

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WILDLIFE HARVEST ANALYSIS Study Plan Section 10.20

Comments on: "Wildlife Harvest Analysis, Study Plan Section 10.20, Initial Study Report, (Part A Sections 1-6, 8-9), Prepared for AEA, Susitna-Watana Hydro by ABR, Inc. June 2014. (No authors named).

Purpose of these comments: Initial Study Report (ISR) and Final Study Plan (FSP) for the Wildlife Harvest Analysis Study portion of the Susitna-Watana project was reviewed to:

1. Make recommendations for improving data collection or analysis to permit more meaningful evaluations of project impacts and the accuracy of other reports especially 10.8 (Large Carnivores).

Objectives for Wildlife Harvest Analysis Study (ISR, page 1):

2. Identify past and current harvest effort for large and small game including furbearers, harvest locations, access modes and routes.
3. Compare current harvest locations of large and small game, including furbearers, with data on the seasonal distribution, abundance, and movements of harvested species, using the results of other, concurrent Project studies on big game and furbearers (Sections 10.5-10.11).
4. Provide harvest data for use in the analyses to be conducted for the recreation and subsistence resource studies (Sections 12.5 and 14.5, respectively).

General overview comments

No results for this project were reported in the ISR. At the AEA meetings to discuss the ISRs held on October 21, 2014, we made a recommendation on how to present harvest information for bears. This comment is designed to further explain that recommendation.

Recommendation

The ISR for bears in the Large Carnivore report (Study Plan Section 10.8) illustrates a large carnivore study area (Fig. 3.1 in that report) that we assert in our comments is inappropriate and too large for Watana-Susitna large carnivore studies. We also assert that the density surface maps illustrated for brown bears in Figure 5.1-11 (page 30 of that report) incorrectly depicts the density range for brown bears in the illustrated density surface map. Among other reasons, this challenge was based on disbelief that the bear density in salmon rich habitats in the southern-most portion of the large carnivore study area (depicted as low density in the large carnivore report) was correctly depicted. Areas with available salmon should have higher, not lower, densities than interior areas. Our assertion was challenged by the authors of that portion of the Large Carnivore Study during the October 21 meeting on the basis that: 1) no data were available showing lower densities in this portion of the study area, and 2) perhaps bear densities were lower even though these areas were rich in salmon. This challenge contradicted published reports that areas where brown bears have access to salmon have much higher densities than areas where they do not (Miller 1993, Miller et al. 1997, Hildebrand 1998, Schwartz 2003).

Correspondingly, at that meeting we recommended that the Wildlife Harvest Analysis Study include an analysis of the number brown of bears killed by hunters in the Large Carnivore Study Area. This should be done in the following way:

1. For a number of years treated collectively (e.g., 5 or more years), determine the number of brown bears killed by hunters in each Uniform Coding Unit (UCU) in the Large Carnivore Study area. All bears killed by hunters are assigned to a UCU during sealing, so reports of number of bears killed by UCU for the period selected can easily be generated (this was done by Miller 1993).
2. If desired, this can be done separately for spring and fall seasons but it is our belief that it would be most informative to compile harvest data for both spring and fall seasons combined. The survey data illustrated in Figure 5.1-11 of the ISR for bears were collected during spring but the bears seen during these surveys inhabit and are killed in UCUs throughout the study area.
3. Plot or report kill densities for UCUs or groups of adjacent UCUs from these bear harvest data that can be compared to the density surface map in Figure 5.1-11 in the Large Carnivore ISR. Although we acknowledge that bear harvest density is an imperfect metric to population density, it should reflect population density if bear population density differences are largest throughout the Large Carnivore Study Area. This plot should inform the disagreement about whether bear density in the southern portions of the large carnivore study area are indeed lower than in interior areas.
4. If UCUs for brown bear kills are grouped for this analysis, the groups of UCUs should be based on whether or not salmon are present in the groupings.
5. Do the same thing for black bears as a way of evaluating the accuracy of the black bear density surface map presented in Figure 5.1-6 of the Large Carnivore ISR. If groups of UCUs are used for analysis of black bear kill density, the groups should be based on whether the habitat is forested.

We note that the Study Area for the Wildlife Harvest Analysis (Figure 3-1, page 4) does not include portions of GMU 16B (Skwentna and Yentna Rivers). Correspondingly, for the above recommendations to be accomplished, the study area for wildlife harvest analysis will have to be expanded to the south and west to include all of the Large Carnivore Study Area (especially the northern part of GMU 16B). Although not as pertinent, it is worth noting as well that the depicted Harvest Analysis Study Area includes all of GMUs 13A and 13B and that large portions of these subunits are not included in the Large Carnivore Study Area described in Study 10.8. This is because the Large Carnivore study area was based on an earlier study reported by Becker and Quang (2009) that was conducted prior to the initiation of Su-hydro studies, and therefore does not correctly describe the area within which Susitna-Watana project impacts will affect large carnivores.

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