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A STATISTICAL EVALUATION OF FACTORS INFLUENCING AERIAL SURVEY RESULTS ON BROWN BEARS[1]

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Aircraft are becoming increasingly important in assessing the abundance and status of big game species. While past studies have demonstrated many applications of aerial surveys, these studies have given little consideration to animal behavior patterns, observer abilities and other factors which may bias biological interpretations. Riordan (1948), Buechner *et al.* (1951, Banfield *et al.* (1955) and others have enumerated a number of aerial survey variables and suggested their possible influence on survey results. However, with the exception of limited data presented by Edwards (1954), Buechner *et al.* (op. cit.) and Sumner (1948), only subjective evaluations

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have been made of such variables. Generally, these workers found aerial counts low compared to ground counts. Bevan (1961), reporting on an experimental design testing the variability of observers in estimating numbers of spawning pink salmon (*Oncorhynchus gorbuscha*) found a variance of 50 per cent between estimates and concluded that even for trend analysis, observations should be limited to one observer.

In parts of coastal Alaska, concentrations of brown bears (*Ursus arctos*) along streams during the spawning migrations of salmon (*Oncorhynchus* sp.) lend themselves to population analysis by aerial observation. However, analysis of data from surveys conducted over the past four years revealed inconsistencies in the number and composition of the bear populations studied (Erickson, 1961). The discrepancies appeared to be attributable to factors such as: differences in the abilities and experience of observers, the time of day and dates the surveys were flown, weather conditions, fish abundance, and other considerations. Similar perplexing inconsistencies have plagued aerial surveys of other big game species in Alaska.

The purpose of this study was to provide a statistical evaluation of a number of measurable survey variables as tested on a brown bear population.

The study was carried out between July 31 and August 16, 1962, in the Chignik-Black Lakes drainage of the Alaska Peninsula (Figure 1). This drainage encompasses approximately 600 square miles and exhibits alpine and sub-alpine areas which typify Alaska Peninsula eco-types (Figure 2. These types are predominantly open tundra at the southern tip of the Peninsula trending to more dense alders, (*Alnus* sp.) willows, (*Salix* sp.) and cottonwoods (*Populus balsamifera*) at the base of the Peninsula. The drainage exhibited other attributes suiting it particularly to the study objectives. Past surveys had shown the system to consistently contain a sizable bear population. Relatively accurate salmon catch and escapement data were also available for the system (Alaska Department of Fish and Game Annual Reports). The year-to-year consistency of the latter was especially advantageous to fulfilling study objectives since an aberrant situation during the study would raise questions as to the applicability of the findings to future and past surveys.

METHODS AND PROCEDURES

The primary design of the study consisted of three replicates of a 3-by-3 Latin square testing for differences between observers, dates, and times of day. One pilot and aircraft were used throughout the

Figure 1. Map of Black-Chignik Lakes Study Area

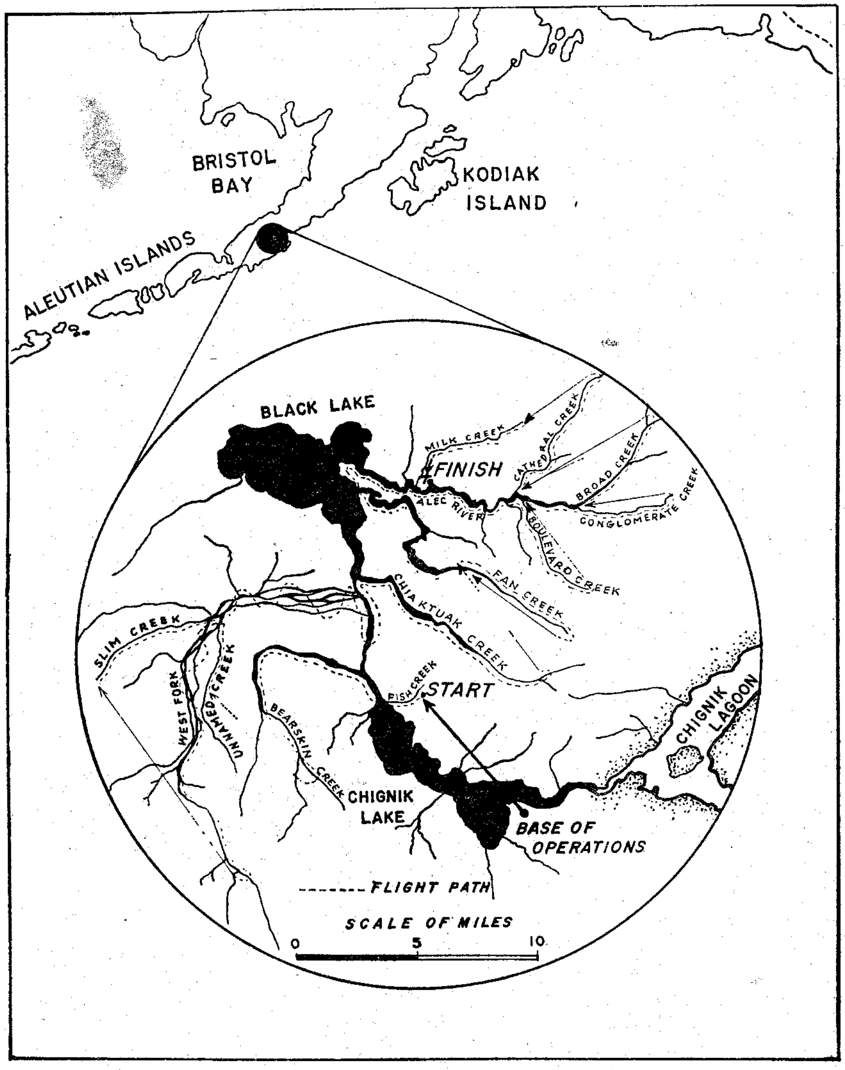


Figure 1 Map of Black-Chignik Lakes Study Area.

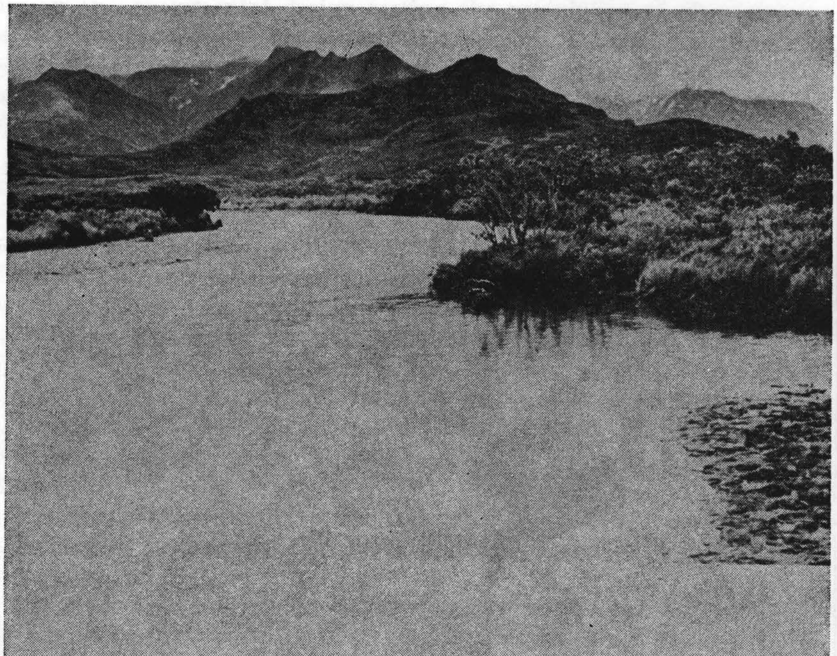


Figure 2. General Physiognomy of the Study Area.

study with the same flight procedures and flight course for each observation period (Figure 1). The pilot was experienced in flying game and fish surveys with several thousand hours of low level game observations. The aircraft was a Piper "150" supercub Model PA-18. This aircraft has a very low (45 mph) stalling speed and permits tandem seating, a feature we consider superior to side-by-side seating as favored by Riordan (op. cit.) and others. This view is held since (except frontally) both the pilot and observer can view things equally. Consequently, the pilot need only maneuver so he can see, to put the observer into proper position for observing and recording. This is particularly difficult with side-by-side seating since the pilot is trying to position the observer on an area he cannot see himself. A further disadvantage of side-by-side seating is that in making circles or "S" turns only the pilot or observer views portions of the area surveyed.

The observers were Department of Fish and Game employees, including the senior author. The observers varied in their working experience with bears: Observer C was without previous experience, observer A had considerable experience observing bears from the ground and observer B had extensive experience observing bears from both the ground and from the air.

Flight periods began precisely at 5:00 a.m., 11:00 a.m., and 5:00 p.m. A.S.T., and each survey continued until completion of the flight course approximately 2½ hours later. For the most part, course legs were flown upstream against prevailing air flows into the drainage basin (Figure 1). This procedure permitted slower ground speeds. Air speeds with flaps extended approximated 60-70 mph. Flight altitude was maintained insofar as possible at 200 feet above the ground.

Bears were tallied on the first passage over the flight course only. That is, bears seen during reflight over portions of the flight course were not counted even if known to have escaped notice. Flight procedures consisted of flying each transect leg in a manner thought most productive for observing bears. Whenever possible this consisted of a series of shallow "S" turns pivoting upon the stream being surveyed. This procedure permitted both the observer and pilot to view all portions of the transect course. All bears sighted by either the pilot or observer were tallied and close circling passes were made to permit their classification as sows with cubs, sows with yearlings or "other bears." The latter were further classified as small, medium, and large. To reduce bias the pilot did not participate in population element classification. The location of each observation was also plotted by composition symbol.

The project design specified that all three surveys for a given day had to be completed to qualify that day in a survey square. Weather caused incomplete surveys to be flown on August 1, 2 and August 15. It was not possible to fly surveys on or between August 8 and August 12. Completion of the survey design was as shown in Table 1.

In addition to testing for differences between observers, dates and times of day, observations were recorded to investigate certain weather factors and bear movements. Weather data were taken at camp quarters at the outlet of Chignik Lake and an estimate of wind velocity was recorded by the pilot when passing over Black Lake at approximately the mid-period of each survey.

Ten simultaneous air and ground counts were made within prescribed areas to ascertain the efficiency of air surveys. The procedure for these was to have a ground observer go to a lookout site one hour in advance of the aerial survey crew and with the aid of binoculars locate bears within test areas and plot their movements. The air crews, similarly, plotted the locations of bears observed, and executed a sharp dip and ascent over them to alert the ground observer of the sightings.

Table 1. Survey Design

Hours	Square 1			Square 2			Square 3		
	July 31	August 3	August 4	August 5	August 6	August 7	August 13	August 14	August 16
0500-0800	A	B	C	B	C	A	C	A	B
1100-1400	B	C	A	C	A	B	A	B	C
1700-2000	C	A	B	A	B	C	B	C	A

A, B, and C are observer designations.

Prior to the execution of the test surveys several steps were taken to standardize procedures. For the period July 23-26 the observers were together at McNeil River on the Alaska Peninsula to observe at close hand the concentrations of bears that gather there and to standardize criteria for classifying identifiable population elements. On July 18, 21, 22, 26 and 28 preliminary evening surveys were flown of the Black-Chignik Lakes drainage to measure fish and bear abundance and distribution and to establish the survey flight course and procedures. A survey was also flown on August 19, three days following completion of the test surveys, to measure the abundance and distribution of bears at that time.

RESULTS

Counts of Bears as Affected by Observer Differences, Days and Hourly Influences

Analysis of the primary design by standard analysis of variance is shown in Table 2 (Steel and Torrie, 1960). This is an examination of the total bears counted during each observation period and is designed to investigate the relation of the observed population to observers, dates, and times of day. A shown in Table 2, this analysis

Table 2. Standard Analysis of Variance of Total Counts

	Square 1				Square 2				Square 3			
Hours	1	2	3	Total	1	2	3	Total	1	2	3	Total
0500	94A	81B	62C	237	81B	65C	86A	232	54C	54A	61B	169
1100	67B	16C	40A	123	43C	44A	48B	135	29A	30B	18C	77
1700	118C	34A	91B	243	95A	113B	70C	278	76B	72C	76A	224
Total	279	131	193	603	219	222	204	645	159	156	155	470

A, B, and C, are observer designations.

Source	d.f.	s.s.	m.s.	F
Squares	2	1854	927.0	4.50*
Days within squares	6	3748	624.7	3.03
Hours within squares	6	10279	1713.2	8.32**
Observers	2	1010	505.0	2.45
Error	10	2059	205.9	
Total	26	18950		

**significant at 1% level
*significant at 5% level

indicates that large differences exist (.01 probability level) in the number of bears observable during different times of the day. Peak activity occurred during the evening observation period and fewest bears were available during the mid-day period. Differences in total bears counted between observers were not significant at the .05 probability level. The bear population diminished slightly toward the close of the study as shown by differences (.05 probability level) in square totals. However, no differences were evidenced between days within individual squares.

This analysis is subject to the necessary assumptions of analysis of variance testing, i. e., the observations are assumed to be normally distributed and the effects additive. Also, the design does not measure interaction. Hence, it is necessary to assume that no interaction exists between these variables.

Compositional Considerations as Related to Observers

During this survey bears were classified into the following categories: 1) sows with cubs, 2) sows with yearlings, 3) cubs, 4) yearlings or 5) "other bears." The other bear category simply included individuals not included in the other four categories. Although obvious differences in size usually permitted ready classification of family groups as being cub or yearling groups, there existed some gradation from very small cubs to large yearlings. The overlap between large cubs and small yearlings was hypothesized to cause subjective classification and thus these individuals may have been classified differently by the observers.

The chi-square test of independence was used to investigate whether classification was consistent from observer to observer. Table 3 indicates, at the .01 probability level, that classification was not independent of observer. The percentages of cubs and sows with cubs recorded by the three observers were directly related to the observers' previous experience in working with bears: the greatest percentages of these components were recorded by the observer most experienced and the lowest percentages by the observer least experienced. Although there was no manner of testing the classification accuracy of individual observers against known population elements, the population composition recorded by observer C seems inconsistent with a natural population structure, *i.e.,* a larger percentage of yearlings than of cubs is not normal considering expected mortality from cubs to yearlings. This perhaps indicates that compositional classification is more accurate when the observers are experienced.

The relation of time period to classification was also investigated

Table 3. Chi-square Test of Independence Between Observer Classifications

Observer	Sows with cubs		Sows with yearlings		Cubs		Yearlings		Other bear		Total
	obs.	exp.	obs.	exp.	obs.	exp.	obs.	exp.	obs.	exp.	
A	80	76.1	66	64.9	161	164.5	129	120.8	116	125.6	552
B	105	89.4	52	76.2	232	193.1	98	141.8	161	147.5	648
C	52	71.5	84	60.9	119	154.4	149	113.4	114	117.9	518
Total	237		202		512		376		391		1718

Total Chi-square = 68.1
significant at 1% level

Percentage occurring in each class

Observer A	14.5	12.0	29.1	23.4	21.0
Observer B	16.2	8.1	35.8	15.1	24.8
Observer C	10.0	16.2	23.0	28.8	22.0

using chi-square tests of independence. The hypothesis being tested is whether classification was independent of time of day. The hypothesis of independence was not rejected (.5 probability level) indicating that the time period a survey was flown had no influence on classification.

The consistency of classification from square to square, for each observer, was checked by chi-square analysis to determine if classification was independent of square influence. This analysis showed that for observers B and C the hypothesis of independence was not rejected at the .05 probability level, indicating that for these two observers, classification was fairly constant throughout the entire survey. Classification was not independent of square influence (.05 probability level) for observer A. As the survey progressed, this individual's data were found to show an increased percentage of cubs and a corresponding decreased percentage of yearlings. The authors feel that the consistency of observers B and C indicates that the population remained fairly constant and that the differences found for observer A are a reflection of his increasing experience and a changing of his classification habits.

In the following section on wind considerations, it will be shown that wind velocity has complicated the interpretation of differences in classification due to observer ability.

The Effect of Wind and other Weather Factors

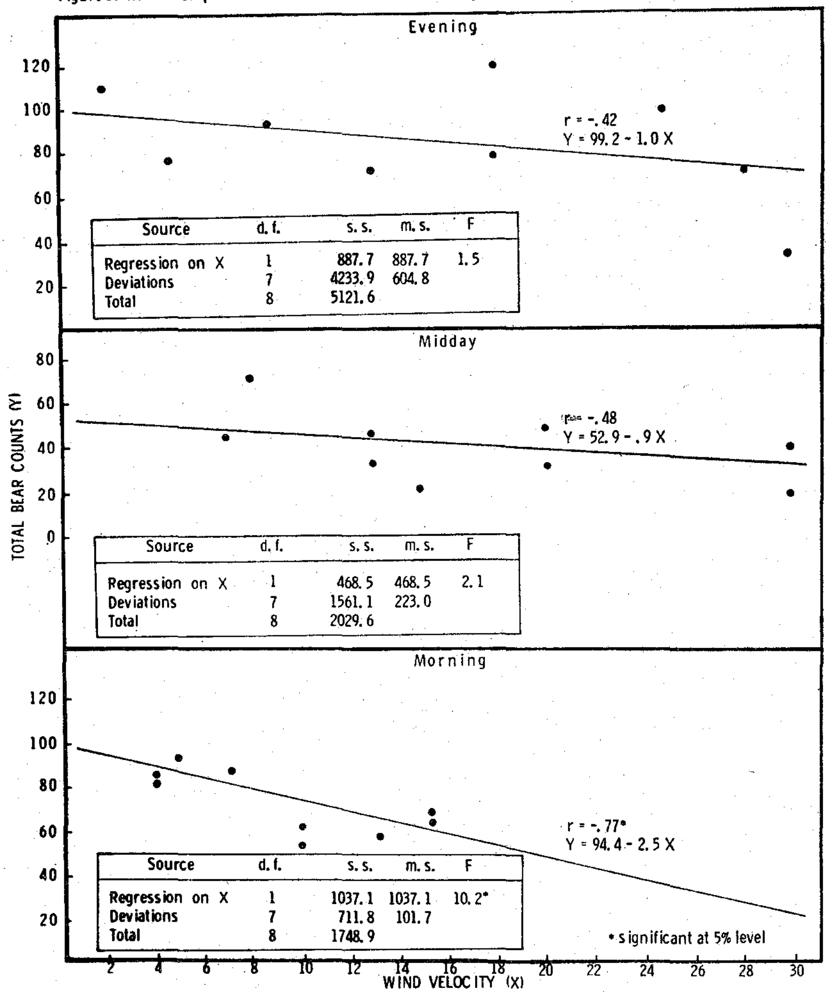
As stated previously, the wind velocity over Black Lake was estimated by the pilot during each observation period. At this location the wind condition was somewhat typical of the flight path as a whole; however, great differences in the wind velocity were often encountered on the survey route due to differences in terrain. These differences in wind velocity over the flight path, and the estimated nature of the measured wind over Black Lake have no doubt caused some additional variation to be included in these data.

As has been shown, differences in bear numbers did occur between time periods. Evidently this was caused by the animals' activity patterns. It was observed also that wind velocity seemed to adversely affect the number of bears seen during an observation period. To investigate this possibility the number of bears counted during each observation period was plotted against wind velocity (Figure 3). These data were grouped by time periods because of the known differences in bear numbers between time periods (Table 2).

Correlation coefficients were computed between wind velocity and bear numbers for each time period to measure the degree of association (Figure 3). Although a negative correlation between the number of bears observed and wind velocity was shown for all time periods, only in the morning period was the correlation (.05 probability level) significant. Even so, however, the correspondence in direction for all periods, considering the variable nature of small-sample correlation coefficients, indicates that bear counts were adversely affected by increasing wind velocities.

The relation of wind velocity to bear numbers was also assumed to be linear and a linear regression equation was computed for each time period (Figure 3). Again, only the morning observation period showed a significant regression at the.05 probability level. The total unadjusted sum of squares for the Y variable (total bear counts) can be partitioned into variance due to regression and deviations from regression. The variance due to regression is a measure of the variation which is contributed because of the relation of wind velocity to total bear counts. The deviations from the regression

Figure 3. Relationship of Total Bear Counts and Wind Velocity For Each Time Period



Evening

Source	d. f.	s. s.	m. s.	F
Regression on X	1	887.7	887.7	1.5
Deviations	7	4233.9	604.8	
Total	8	5121.6		

Midday

Source	d. f.	s. s.	m. s.	F
Regression on X	1	468.5	468.5	2.1
Deviations	7	1561.1	223.0	
Total	8	2029.6		

Morning

Source	d. f.	s. s.	m. s.	F
Regression on X	1	1037.1	1037.1	10.2*
Deviations	7	711.8	101.7	
Total	8	1748.9		

sum of squares is a measure of the deviation of actual bear counts from the regression line. The mean square for deviations is of particular interest as this value is somewhat indicative of the relative stability of the various observation periods. That is, this variance demonstrates the uniformity of early morning bear counts and the relatively low winds at this time as contrasted to the erratic wind velocities and less consistent bear counts obtained for the midday and evening periods.

A further consideration of wind effect is its relation to bear classification. That is, did increased wind cause increases or decreases in certain classification categories? To investigate this, the relation of wind velocity and arcsin $\sqrt{\text{percent}}$ for each bear category was investigated by computing correlation coefficients and linear regression equations. A comparison of these statistics is shown in Table 4: only the relation of wind and arcsin $\sqrt{\text{per cent sows with cubs}}$ constitutes a significant correlation and regression at the .05 probability level. However, to fully assess this relationship it is necessary to consider possible effects of observer and/or time period variations.

As discussed in the analysis of compositional factors, chi-square examination indicated that time periods and classifications of bears were independent. Since time period had no effect on classification it follows that the effect of wind, as related to time periods, was also independent of classification.

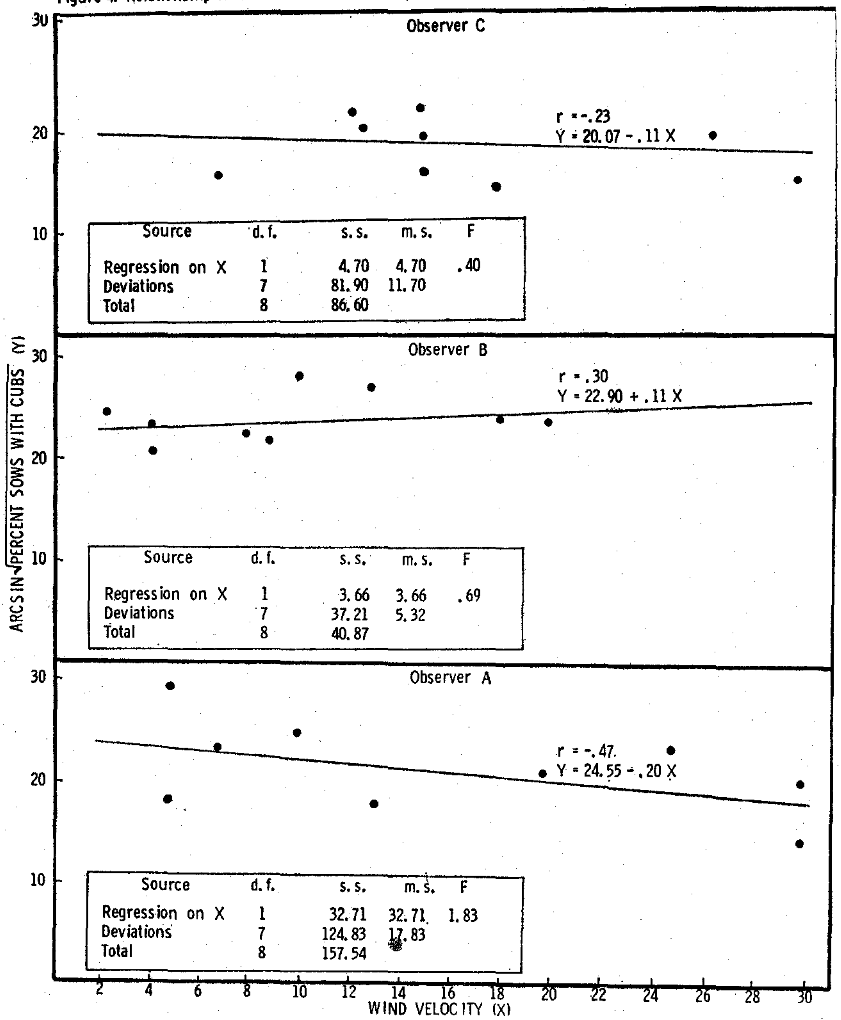
Separation of the effect of wind and observer differences, as related to bear classifications, is more difficult. As shown in the analysis of composition, classification was not independent of observer, i.e., differences existed in the manner in which observers classified bears. Therefore, the wind and arcsin $\sqrt{\text{per cent sows with cubs}}$ relationship was separated by observer to determine if wind velocity influenced all observers equally. Examination of Figure 4 shows that when the data are so separated, none of the relationships constitute a significant (.05 probability level) correlation or regression, and both negative and positive regressions and correlations exist. Therefore, any effect of wind velocity on classification is doubtful. It seems

Table 4. Correlation and Regression Coefficients Examining Wind and Classification Relationships

	Correlation coefficient	Regression coefficient	F ratio
Wind and arcsin $\sqrt{\text{percent yearlings}}$	.24	.17	1.50
Wind and arcsin $\sqrt{\text{percent sows with yearlings}}$	.25	.13	1.64
Wind and arcsin $\sqrt{\text{percent cubs}}$	-.34	-.28	3.36
Wind and arcsin $\sqrt{\text{percent sows with cubs}}$	-.40*	-.19	4.61*
Wind and arcsin $\sqrt{\text{percent other bear}}$	.32	.23	2.81

*significant at 5% level

Figure 4. Relationship of Arcsin√Percent Sows With Cubs and Wind Velocity For Each Observer



probable that the significant negative correlation between wind velocity and arcsin √per cent sows with cubs for all of the data is simply a manifestation of observer differences. That is, examination of Figure 4 shows substantial differences between observer classifications in the average per cent sows with cub category. When these differences are pooled they evidently cause the significant negative correlation previously observed.

Comparisons were also made between the number and classifications of bears observed under varying cloud, temperature and light conditions. These measurements were recorded at field headquarters. Cloud comparisons were based on the percentage of cloud cover. All measurements were taken at approximately the mid-point of the flight periods. None of these factors indicated consistent effects which would have bearing on either the number or the population makeup of bears observed.

Comparison Between Air and Ground Counts

On ten occasions observers were stationed at vantage points on areas overlooking a portion of the regular flight path. The areas to be simultaneously counted from the air and ground were specifically defined prior to the flights. The results of these flights are summarized in Table 5. The "total known bears" consists of bears which were distinguished, and are not necessarily the actual number of bears present in the simultaneous count areas. Obviously great differences exist between the number of bears sighted from the air and from the ground. The area of Upper West Fork is the only location where air counts exceeded ground counts. Considering the averages for all counts, air observers counted about 47 per cent of the known bears in the sample areas. However, it should be noted that the air counts varied from 0 to 88 per cent of the known bears.

The number of bears observed on individual flights was highly variable and, as would be expected, the mean number of bears observed by air crews was in direct relation to cover density (Table 5). Surprisingly though, greatest variations in these limited counts were for areas with sparse cover.

In addition to the preceding evidence, additional data were obtained further demonstrating the incompleteness of these aerial counts. The variations between individual counts are themselves suggestive of this. Perhaps more revealing, however, is the infrequency with which bears of individual character were observed. Three of these will serve to illustrate: a sow with four cubs, a sow with four yearlings and a lone three-legged bear. During the 27 survey flights the cubs were sighted 7 times, the yearlings once, and the lone bear twice. Furthermore, all were sighted in the same general location each time. While it is possible that the crippled bear may not always have been identified, and that the yearling observation may have been a misclassification of the cub litter, it is likewise possible that there may have been more than one four-cub litter in which case each group would have been observed less than the seven times indicated. While neither premise can be verified, it

Table 5. Comparisons Between Simultaneous Air and Ground Counts

Time	Date	Area	Ground Density	Ground count	Air count	Unobserved from ground	Unobserved from air	Total known bear
1713	August 9	Broad-Conglomerate	Moderate	26	11	1	15	27
1700	August 10	Broad-Conglomerate	Moderate	20	7	1	13	21
1915	August 16	Boulevard	Heavy	20	6	0	14	20
1935	August 16	Broad-Conglomerate	Moderate	4	3	3	4	7
0630	August 17	Boulevard	Heavy	6	5	3	4	9
0650	August 17	Broad-Conglomerate	Moderate	13	11	0	2	13
1835	August 17	West Fork	Light	9	14	7	2	16
1842	August 17	West Fork	Light	14	5	1	9	15
0640	August 18	West Fork	Light	5	7	5	3	10
0649	August 18	West Fork	Light	9	0	0	9	9
Totals				126	69	21	75	147

Cover class	Air count	Total known	Percent observed
Light	26	50	52%
Moderate	32	68	47%
Moderate - Heavy	11	29	38%

seems reasonable to assume that these records indicate that only a small proportion of the bears within the stream system were recorded on individual flights.

OBSERVATIONS OF BEAR MOVEMENTS WITHIN THE STUDY AREA

Table 6 shows the total number of bears that were observed on each system each day. The purpose of this examination was merely to investigate what intermixing, if any, occurred between streams during the study period. Presumably some of the fluctuations in counts of bears during the study may have been caused by wanderings of bears between streams. Table 6 indicates that this factor is probably a minor consideration and that unilateral population exchange was slight. Within a few exceptions, the fluctuations of the bear numbers on each stream would seem to be caused by factors other than population movement between streams. The first observations on Fan and West Fork creeks are certainly large as compared to other observations on these creeks. However, there is little indication that these animals shifted directly to any of the other survey streams, so they perhaps moved to areas not on the flight path. The observations for the rest of the streams generally fluctuate together, although certain streams do suggest peak activity.

Table 6. Daily Bear Counts For Individual Streams

	July	August								
	31	3	4	5	6	7	13	14	16	Total
Fish Creek	7	4	12	10	1	1	2	1	4	42
Chiaktuak Creek	32	25	31	37	38	18	28	39	35	283
Fan Creek	53	5	7	6	10	6	7	10	9	113
Boulevard Creek	35	18	36	30	33	32	25	16	21	246
Alec River	5	2	12	9	6	19	2	14	13	82
Conglomerate Creek	11	19	17	9	13	15	11	9	5	109
Broad Creek	18	11	10	18	23	28	20	16	5	149
Slim Creek	11	11	12	30	34	35	16	4	2	155
West Fork	88	26	41	52	46	35	39	36	49	412
Cathedral Creek	0	1	0	0	0	0	0	0	0	1
Milk Creek	1	7	7	6	9	10	3	3	0	46
Bear Skin Creek	18	2	8	12	9	5	6	8	2	70
Unnamed Creek	0	0	0	0	0	0	0	0	10	10
Total	279	131	193	219	222	204	159	156	155	1718

DISCUSSION

This study serves to demonstrate some of the influences which must be considered when using aerial observations for population analysis of brown bears. The findings do not negate the use of aerial surveys but show that with attention to standardization of controllable variables and with awareness of the limitations in the use of aircraft, aerial observations provide perhaps the only feasible means for extensive population assessments. Also, the findings of this study suggest that similar influences may have bearing on the results of aerial surveys of other game species.

Observations of Bear Movements Within the Study Area

It has been shown that the number of bears available during morning, mid-day and evening periods varied greatly. While the average number of bears counted during any one time period is obviously not an enumeration of all bears present, the question does arise as to when and how many flights should be made to make the data comparable on a yearly and area basis. Using the estimated variance of the mean for each time period, it is possible to compute the approximate number of replicate flights needed to estimate the true time period means within 10 per cent, with only a

5 per cent chance of being wrong (Cockran, 1953). These computations indicate that it would take 15 morning, 65 mid-day and 33 evening flights to meet these requirements. While such large samples are not encouraging, this analysis does indicate when flights should be made, and what sample sizes are necessary to detect changes in levels of abundance between areas and years.

Daily bear counts during the study period were shown to be relatively consistent, with preliminary and post surveys indicating that sizable bear numbers were available from at least July 10 to August 19. The existence of bear concentrations is assumed to be dependent on salmon availability. Because of the great differences in the timing of salmon migrations on the Alaska Peninsula, periods of bear concentrations are variable between systems. Therefore, prior knowledge of bear and salmon relationships is necessary before initiating surveys of this nature.

Despite the fact that the observers differed both in their experience with bears and in aerial counting, no differences in their ability to count total bears (with the same pilot) were detected. Although not tested in the study, the authors feel that as long as the pilot has extensive experience in low level game and fish surveys, his ability to sight bears probably has a minor influence on survey results.

Observers did not classify bears similarly into identifiable population components and it appears that the major discrepancies in classification resulted between cub and yearling litters. Therefore, it appears that beyond simple classification of bears as family groups and "other bears," compositional classifications between observers cannot be considered accurate. This study and work by Bevan (op. cit.) indicates that, wherever judgment considerations are concerned, results of estimates or classifications by several observers cannot be considered reliable. For these reasons, aerial surveys intended for comparisons of population structure or of estimated population size between areas or years should, insofar as possible, be made by one observer. Even here, however, compositional findings for an individual observer should be considered of only relative value unless some means can be devised for testing classification accuracy.

Certain weather conditions also affected survey results. Temperature, light intensity and cloud cover gave no evidence of influencing counts; wind velocity apparently influenced the number of bears observed, but not compositional status. It is uncertain whether the wind influenced the bears, the aerial survey procedures, or both. There is little question that wind had at least some effect on survey procedures. Increased winds and air turbulence are closely associated. Flight configuration and maneuvers under such conditions were of necessity different than under low wind and non-turbulent conditions. The air speed factor alone may have been of considerable importance. Turbulence did not affect survey coverage but may have affected the survey crews' comfort and state of mind, although none of the observers experienced air sickness.

As has been reported by Sumner (op. cit.), Edwards (op. cit.) and Watson and Scott (1956), air counts were low compared to ground counts. Our simultaneous air and ground counts were made under conditions fairly typical for the Alaska Peninsula; approximately half of the bears known to be present in survey areas were observed from the air. These observations and other considerations indicate that fewer bears were seen on these surveys than were actually present in the study area.

SUMMARY

A statistical evaluation of a number of variables affecting aerial surveys on brown bears was carried out in the Chignik-Black Lakes area of the Alaska Peninsula, Alaska. The primary design consisted of three replicates of a 3-by-3 Latin square testing for differences between observers, dates and times of day. Analysis of variance tests showed that real differences (.01 probability level) existed in total bear counts between hourly periods within days. Peak activity occurred during the evening sampling period (5 to 7:30 p.m.) with least activity occurring at mid-day (11 a.m. to 1:30 p.m.). Differences in total bear counts between observers and between days within squares were not statistically significant at the .05 probability level. However, differences, at the .05 probability level, were found between replicate squares. Wind velocity was found to adversely affect the numbers of bears counted during observation periods with lowest counts associated with increased wind velocities.

Chi-square examinations for independence of compositional classification and observer abilities, times of day and dates were considered. Observers did not consistently classify bears in the same categories (.05 probability level). However, classification was independent of time period or date influence at this probability level. The proportion of cub groups, yearling groups and "other bears" counted was not influenced by wind velocity.

Total counts for the morning surveys were less variable than for other time periods. Therefore, if survey results are to be used for comparisons between areas or years, this time period would give most uniform comparisons. Also, if classification comparisons are to be meaningful they should be restricted to individual observers whose classification habits are consistent.

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