

SOME DEVELOPMENTS IN THE FIELD BAG CHECK SYSTEM OF COLLECTING HUNTING STATISTICS

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The field bag check system of collecting hunting statistics originated in Missouri some years ago, and was reported for that state by Crawford (1950). Several other states have reportedly adopted the system, and the Fish and Wildlife Service has used bag checks in collecting waterfowl and dove kill data for several years. Crawford reported the basic advantages of this system over others applicable to the collection of kill data. Of foremost importance is the departure from the dependence on the memory of the hunter that is inherent in those methods based on the collection of accumulative data for the entire season. Also, with this system, data are available as the season progresses, as opposed to a delay of several months after the close of the season with most other systems. In addition, the bag check takes advantage of the large number of hunter contacts normally made in the field by the field force to provide a large volume of kill data at little additional expense.

The field bag check was initiated in Florida during the 1950 - 51 hunting season, at which time the forms and analytic procedures were tested and revised. The system was put into full scale operation during the 1951 - 52 hunting season. The data from this single year's operation cannot be considered conclusive, yet it is believed that a number of the findings are worthy of consideration by others who are using or planning to use this system. The writer makes no claim to infallibility and is fully aware that further work may produce results that necessitate changes in the techniques here presented.

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TECHNIQUES AND ASSUMPTIONS

The items of information collected from each hunting party contacted are as follows:

1. Number of hunters in the party:
 - a. with resident licenses.
 - b. with non-resident licenses.
 - c. exempt by law.
2. Man hours hunted by the party.
3. Game hunted.
4. Whether finished or not finished hunting for the day.
5. Total game killed for the day.
6. Total game crippled for the day.

Separate tabulation is made for each different combination of species hunted and for the completed and incompleting day. Although many interesting comparisons may be made from the data thus tabulated, the estimation of total kill is considered the primary goal, and this discussion is limited accordingly.

Total kill is essentially the product of two factors:

1. Mean kill per hunter, which is the product of:
 - a. kill per hunter-day, and
 - b. the average number of days per hunter devoted to the species which may be:
 - 1) Calculated as the product of the percentage of the total hunting pressure in man days that was exerted for that species (as represented by the percentage of bag check contacts that were made for that species) and the average number of days all game was hunted per licensee (as determined from another survey), or
 - 2) determined directly from another survey.
2. The number of hunters, which is equal to the sum of:
 - a. the number of licensees and
 - b. the number of unlicensed hunters.

Adapting these definitions to the bag check data, the following formulae may be developed for total kill:

$$(1) \quad K = \left[\left(\frac{k}{d} \right) N \right] \left(1 + \frac{n_1}{n} \right) \left[\left(d_t \right) \frac{c}{C} \right]$$

or

$$K = \left[\left(\frac{k}{d} \right) N \right] \left(1 + \frac{n_1}{n} \right) \left(d_s \right) \tag{2}$$

Where:

K = Total kill.

k/d = Mean kill per day, as determined from the bag check.

N = Total number of licenses.

n = Number of licensees contacted on the bag checks.

n_1 = Number of unlicensed hunters contacted on the bag checks.

d_t = Mean number of days all species were hunted per licensee, as determined from another survey.

d_s = Mean number of days the individual species was hunted per licensee, as determined from another survey.

c = The number of bag check contacts for the individual species.

C = The total number of bag check contacts.

A major departure from the Missouri system will be noted in these formulae. That system assumes the percentage of contacts that are made for each species (c/C) to represent the percentage of hunters that pursue that species during the season. As each hunter contact represents one hunter day, or a portion thereof, the total number of contacts must represent hunter days and a percentage of that total must be expressed as percentage of hunter days. As the percentage of hunters pursuing a species is obviously not equal to the percentage of the total hunting pressure that is expended for that species, this assumption is considered by the writer to be invalid.

Inherent in formula (1) is another assumption that is considered by the writer to be dangerous; an assumption of random contactability, in the field, of hunters of different species. Considering the different habitats frequented by these species, it would indeed be surprising if random sampling were obtained. The Florida data indicate this differential contactability in the examination of the bag check data itself (in a number of comparisons including differences in the percentage of contacts made during the hunt) (Table 1) and in the comparison with the results of the post-season mail survey (Table 2).

At the time this system was being set up, this non-randomness was suspected and it was felt that formula (2) should be used and that it was essential that a sound method of determining hunting pressure be developed. A post-season mail survey was selected to furnish this information, with survey and analytic techniques adapted to the combination of the results with those from the bag check.

One of the primary points to be considered was the treatment of combination hunting — two or more species being hunted during the same day. Here it was necessary to decide whether to consider a day of combination hunting as a day for each of the components of the combination or to allot a portion of the time hunted during the day to each species. It is believed that satisfactory techniques have been developed for the proportionate allocation of time to the components, if such treatment proves necessary. However, examination of the returns from the mail survey and experience in conducting personal interviews have led to the conclusion that the best results are obtained by asking, "On how many days did you hunt each species?" Thus, the former of the two alternatives is used. An additional advantage of this decision is that this procedure requires much less time spent in the tabulation and analysis of the bag check data than would the proportionate allocation of the day to each species.

The treatment of incidental kill (game killed while the entire hunting effort is being directed towards another species) is another factor for which techniques must be arbitrarily selected. At the time the analysis was made of the 1951 - 52 bag check, no satisfactory method of treating incidental kill had been devised, and this kill was given no consideration in the estimates from those data. Through subsequent thinking and analysis the writer concluded that incidental kill should be included with the combination kill. There are several reasons for this decision. First, with the treatment selected for combination hunting, this treatment will not affect the estimates of kill per day for the species receiving the hunting effort. Secondly, it is certain that the presence of incidental kill in the bag of a hunter is likely to cause the officer making the check to record the hunter as "combination hunting," and it is almost impossible to set up field procedures that will eliminate this factor. Also, the most satisfactory techniques for the analysis of the mail survey include the assumption that all kill is accompanied by hunting effort.

The determination of average daily bag is complicated by the fact that a large number of the field contacts represent a partial days hunting. The Fish and Wildlife Service circumvented this problem in the waterfowl bag checks by collecting data only for those parties that had finished hunting. This solution has some merit, but the writer feels that, particularly for upland hunting, a large volume of data is thus unnecessarily passed up.

The Missouri system makes use of the assumption that the contacts are taken at random and that therefore the average length of time hunted before the contact is made should equal one half of the average length of the completed day. The

Table 1. Breakdown of the 8,940 hunter contacts made on the 1951-52 bag check.

Species	Number of Contacts at end of hunt (complete day)	Number of Contacts during hunt (incomplete day)	Per Cent of Species contacts made during hunt
Pure Hunting			
Deer	1575	2796	63.97
Turkey	165	178	51.90
Squirrel	344	331	49.01
Quail	577	758	56.78
Dove	464	770	62.40
Duck	70	80	53.33
Coot	4	7	63.64
Goose	5	1	
Total	3204	4921	
Combination hunting			
Deer	177	147	45.37
Turkey	294	197	40.12
Squirrel	193	153	44.22
Quail	110	97	46.86
Dove	27	24	47.06
Duck	106	62	36.90
Coot	85	60	41.38
Goose	0	0	
Total	464	351	

Table 2. Comparison of relative hunting pressure as determined from the mail survey and from the bag check.

Species	Percentage of Licensees Hunting Species		Percentage of Total Hunter days		Percentage of Contacts		Percentage of Equivalent Days
	Mail Survey		Mail Survey		Contacts		
	1950 - 51	1951 - 52 ^a	1950 - 51	1951 - 52 ^a	A ^b	B ^c	
Deer	28.58	25.83	11.96	15.34	47.63	52.52	46.09
Turkey	30.16	19.70	9.62	7.26	8.46	9.33	9.31
Squirrel	61.09	58.79	26.81	23.13	10.36	11.42	11.32
Quail	48.44	49.74	26.82	25.15	15.64	17.25	14.59
Dove	35.54	39.88	12.41	14.60	13.04	14.37	13.14
Ducks	19.74	25.69	8.21	9.58	3.23	3.56	3.58
Coots	9.17	12.38	3.80	4.34	1.58	1.74	1.91
Goose	1.37	2.08	0.38	0.60	0.06	0.07	0.08
Total	224.09	234.09	100.01	100.00	100.00	110.26	100.02

^a Analysis of the 1951 - 52 mail survey is not yet complete, and these figures are subject to change.

^b A = Considering, in the total, each combination day as one day for each contact.

^c B = Considering, in the total, each combination day as one day.

writer agrees with this conclusion on the basis of this assumption, but when setting up the present system felt that the validity of the assumption should be tested. For this reason the data for the completed day was kept separate from the data for the incomplete day. The average length of time hunted for the completed day is compared to the average length of time hunted for the incomplete day and for all contacts in Table 3.

It will be noted that the departure of the average time hunted for all contacts from the theoretical fifty per cent of the completed day is in part due to the high incidence of contacts made at the completion of the day and in part due to the deviation of the length of incomplete day upwards from fifty per cent of the length of the complete day contacts, both of which indicate a non-random contactability during the hunt day. It is possible that this same non-random contactability causes an underestimate of the average length of completed day, yet until further evidence may be accumulated, it is felt that this figure should be considered to represent the average length of hunt day.

The method that was selected for determining the average daily bag may be reduced to the formula:

$$\text{Kill per day} = \frac{\text{Total reported kill}}{C_1F_1 + C_2F_2 + C_3} \quad (3)$$

Where:

- C_1 = Number of contacts made during the hunt for pure hunting.
- C_2 = Number of contacts made during the hunt for combination hunting.
- C_3 = Number of contacts made after the completion of the hunt.
- F_1 = Percentage of length of complete day represented by the length of incomplete day, for pure hunting.
- F_2 = Percentage of length of complete day represented by length of incomplete day, for combination hunting.

It will be noted that an assumption is made and a definition is established by the use of this formula. The assumption is of a random contactability between hunters pursuing only the species in question and the hunters pursuing that species in combination with other species. By the concept of a differential contactability between hunters of different species, it is very likely that this is an invalid assumption, and it would not be made if data were available to establish a system of weighting that would eliminate this differential. The importance of this bias varies directly with the relative amount of combination hunting for any species.

The definition is that of a hunt day, as represented by a contact. There is the choice of defining a contact as equal to a hunt day (and correcting the kill for the incomplete days by the ratio between the length of the complete and the length of the incomplete) or defining the contact for the incomplete day as its length equivalent of a hunter day. For several reasons, it was decided that the latter definition was more satisfactory for use throughout the analysis. Thus, $C_1F_1 + C_2F_2 + C_3$ [as in Formula (3)] is considered to be the number of equivalent days represented by the total number of contacts for any one species.

Table 3. Lengths of complete and incomplete hunter day, as determined by the hunter bag check, 1951 - 52.

Species hunted	Average hours per complete day	Average hours per incomplete day	Average hours per contact	Percentage of length of complete day represented by length of incomplete day
Deer				
alone	6.355	4.144	4.941	65.21
combination	6.282	3.711	5.116	59.07
Turkey				
alone	3.988	3.483	3.726	87.34
combination	5.796	3.695	4.953	63.75
Squirrel				
alone	3.416	2.712	3.071	81.06
combination	4.821	2.967	4.001	61.54
Quail				
alone	4.874	2.608	3.587	53.51
combination	5.514	3.814	4.717	69.17
Dove				
alone	3.130	2.151	2.519	68.72
combination	2.815	3.500		^a
Ducks and Coots				
alone	3.247	2.607	2.955	80.29
combination	4.583	2.000		^a

^a Insufficient contacts.

ACCURACY

The determination of accuracy is of primary concern in any survey. To date, statistical techniques have not been set up for the determination of the limits of accuracy of the bag check data, but statisticians have indicated that such treatment is not impossible. Statistical treatment is most acutely needed in the determination of the significance of differences and correlation between strata. At its present stage of development, the bag check system is essentially a "judgement sample" and no attempt will be made to define the limits of accuracy. An indication of the accuracy of the data may be seen by the comparison with the results of the mail survey (Table 4).

Table 4. Comparison of "kill per day" as determined from the bag check and from the mail survey.

Species	Mail Survey		Bag Check 1951 - 52
	1950 - 51	1951 - 52 ^a	
Deer	0.0438	0.037	0.0399
Turkey	0.1338	0.144	0.1405
Squirrel	2.1009	2.560	2.2770
Quail	3.1245	3.520	3.9560
Dove	3.6378	3.820	3.8730
Duck	1.4286	1.820	1.5580
Coot	3.1736	3.200	2.9790
Goose	0.3730	0.204	

^a Analysis incomplete, and figures subject to change.

The mail survey is set up and analyzed in accordance with accepted procedures for mail surveys. Unfortunately, the final phase of the 1951 - 52 mail survey (the enumerative followup of a portion of the non-respondents) is not yet complete, and all present estimates from that survey are subject to the bias of non-response. For this reason, no estimate of the accuracy of the preliminary estimates from the mail survey may be made, and no attempt is here made to estimate hunting pressure and total kill.

The most important weaknesses in the system as now used are: 1) the delay in securing information on hunting pressure, and 2) the non-random contactability of hunters of different species. As has been shown this non-randomness affects the accuracy of the results of the present survey only in the combination of the data for pure hunting and the data for combination hunting, yet the presence of that non-randomness necessitates a more intensive mail survey, and is therefore partially responsible for the delay in securing information on hunting pressure. Future effort will be devoted towards correcting this non-randomness.

The present survey was compiled on a statewide basis as the sample was not sufficiently large for accurate estimates to be made in another manner. Estimates will be made on a regional basis when the volume of returns warrant such procedure.

SUMMARY

The bag check system of collecting hunting statistics was put into full scale operation in Florida during the 1951 - 52 hunting season. A total of 8,940 hunters were contacted through this system. Although data from one year cannot be considered conclusive, it is believed that a number of the findings are worthy of consideration.

1. Examination of the system revealed that the percentage of total contacts that were made for any one species is theoretically equivalent to the percentage of the total man days of hunting that was expended for that species — rather than equal to the percentage of hunters that pursued that species during the season, as has been previously assumed.
2. Non-random contactability of hunters of different species prevents the use of "percentage of contacts" in any capacity until this non-randomness may be corrected.
3. Separate tabulation of "length of time hunted" for the complete hunt day and for the incomplete hunt day disproves the assumption that the field contacts are taken at random through the day and average one half a hunt day.
4. Several definitions were arbitrarily established for use in the Florida system:
 - a. A day of combination hunting was treated as one day for each of the components.
 - b. A contact was defined as its length equivalent of a hunter day.
 - c. "Combination hunting" was defined as including all days on which effort and/or kill was made for two or more species.
5. Primary weaknesses of the system here presented are:
 - a. The non-random contactability of hunters in the field.
 - b. The considerable delay in securing estimates of hunting pressure.

LITERATURE CITED

Crawford, Bill. 1950. The field bag check method of determining hunting success, pressure, and game kill. Proc. Annu. Conf. Southeast Assoc. Game and Fish Comm.