



AMERICAN WOODCOCK AND COMMON SNIFE

RESEARCH AND MANAGEMENT

WEST VIRGINIA - 1969*

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* A compilation of recent Pittman-Robertson reports and manuscripts in press. (Manuscript formats are not consistent due to varying style requirements of the journals, periodicals, and agencies to whom these reports have been submitted.) Prepared for distribution at the Third Woodcock Workshop, Orono, Maine, June 30 - July 2, 1969.

JOB SUMMARY REPORT*

State: West VirginiaProject No.: W-37-R-11 & 12Name: Migratory Bird InvestigationsWork Plan: IVTitle: American Woodcock Population
Dynamics StudiesJob No.: 2Title: WOODCOCK BANDING STUDIES
IN THE CANAAN VALLEYJob No.: 3Title: EFFECTS OF HUNTING ON WOODCOCK
POPULATIONS IN CANAAN VALLEYPeriod Covered: July 1, 1965 - March 31, 1969

ABSTRACT: A banding program was initiated in 1964 to obtain information on vital statistics characterizing woodcock populations in the Canaan Valley of West Virginia. Band recoveries during the subsequent five hunting seasons (1964-1968) indicated that adult male woodcock were least likely to be shot, while immature males stood the greatest chance of being harvested. Shot recoveries of woodcock banded as "residents" in the Canaan Valley denoted an overall (combined years as well as age and sex groups) recovery rate of almost 23 percent. When consideration was given to crippling losses and non-reported bands, a kill rate of about 30 percent was postulated. Various population estimates implied that this harvest rate did not have any detrimental effect on the Valley's "resident" population of approximately 1,300 woodcock. Mortality rates, based on existing band recoveries, suggested that overall annual mortality was approximately 75 percent; however, age ratios in the reported kill, corrected for differential vulnerability, indicated that only 1.08 immatures per adult were produced annually. This is a much higher mortality rate than can be counterbalanced by the production rate. Marked disparities between productivity, mortality, and the relatively stable "resident" population require further investigation.

* Background, objectives, procedures, and findings are found in the attached manuscript which was presented at the 25th Northeast Fish and Wildlife Conference at White Sulphur Springs, West Virginia, February 11, 1969.

RECOMMENDATIONS: The following activities are recommended for the Canaan Valley Woodcock Study during 1969 and 1970:

1. Band 300 woodcock during the period April 15 - September 20.
2. Band 150 woodcock in October and early November, with emphasis on the 2-week interval after the special September season and prior to commencement of the regular hunting season.
3. Discontinue woodcock banding during the September hunting season and during the period November 15 - April 15.
4. Make a special effort to contact hunters during the September hunting period and the first 7 days of the regular season.
5. Design a hunting survey questionnaire on the outside of a wing-collection envelope addressed to "Canaan Valley Woodcock Research Study, West Virginia Department of Natural Resources, Elkins, West Virginia 26241."
6. Assign specific hunting areas to Department personnel and other cooperators during the 7-day September season.
7. Convert all banding and hunting records to IBM cards.
8. Complete cover mapping of woodcock habitat in the Valley; determine the location and amount of area utilized by woodcock.

Note: The American Woodcock Population Dynamics Studies (Work Plan IV - a part of West Virginia's Pittman-Robertson Project W-37-R) will terminate field activities after the 1970 hunting season. Data analysis and writing the final report covering this Work Plan will commence in January 1971; thus, completing more than 7 years of obtaining basic statistics characterizing woodcock populations in the Canaan Valley. It is hoped at that time the U. S. Bureau of Sport Fisheries and Wildlife will be in a position to initiate a cooperative-progressive research program directed toward testing the effects of hunting regulation changes on this woodcock population.

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Date: April 15, 1969

CHARACTERISTICS ASSOCIATED WITH "RESIDENT" WOODCOCK POPULATIONS
IN THE CANAAN VALLEY OF WEST VIRGINIA*

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Population dynamics of American woodcock (Philohela minor, Gmelin) are virtually unknown when compared with information accumulated for most of the more heavily harvested game birds. Sheldon (1967:140) reviewed this species' biological characteristics and stated: "Our knowledge of woodcock reproduction and survival is sketchy." This paper provides information on vital statistics characterizing woodcock populations inhabiting West Virginia's Canaan Valley.

* This study was conducted by the West Virginia Department of Natural Resources in cooperation with the U. S. Bureau of Sport Fisheries and Wildlife and is a contribution of Pittman-Robertson Project W-37-R.

ACKNOWLEDGEMENTS

Credit for conceiving this study is due James M. Ruckel, Administrative Assistant and P-R Coordinator, West Virginia Division of Game and Fish, and Fant W. Martin, Associate Professor, Louisiana State University, Baton Rouge, Louisiana. Aelred D. Geis, Associate Director, Migratory Bird Populations Station, Laurel, Maryland, provided invaluable assistance with data analysis and critically reviewed resulting interpretations. Editorial review was provided by Beverly R. Shipe, Migratory Bird Populations Station, Laurel, Maryland; Merle H. Markley, Bureau of Sport Fisheries and Wildlife, Washington, D. C.; and Robert D. McDowell, University of Connecticut, Storrs, Connecticut. Special appreciation is expressed to T. R. Samsell, Director, West Virginia Department of Natural Resources; Peter E. Zurbuch, Chief, West Virginia Division of Game and Fish; and Francis B. Schuler, Regional Federal Aid Supervisor, Bureau of Sport Fisheries and Wildlife, Boston, Massachusetts, for their administrative assistance with this costly research endeavor. George E. Hanson, Fish Research Biologist, Bureau of Sport Fisheries and Wildlife, Princeton, Indiana, and Walter A. Lesser, Game Biologist, West Virginia Division of Game and Fish, were instrumental in pioneering woodcock interest in West Virginia and "planted the seeds" that developed into the present woodcock research program.

DESCRIPTION OF STUDY AREA

Geography - Picturesquely located in the mountains of northeastern West Virginia, the Canaan Valley is cigar-shaped (about 13 miles in length while varying from 2 to 4 miles in width) and situated about 3,200 feet above sea level. This magnificent valley was named after one of the most luxuriant lands described in the Bible

(Weedfall and Dickerson 1965). The landscape of the basin, with its low smooth hills and wide stream bottoms, presents a sharp contrast to the steep, rocky mountain slopes which surround it.

The Blackwater River and its tributaries meander through the Valley. This river was named for its dark hue, apparently due to tannic acid from the peaty soils and marshes (Ludlum 1962). The divide, separating waters which flow to the Gulf of Mexico from those which flow to the Atlantic Ocean, is at the crest forming the eastern rim of the Canaan Valley.

Well-drained soils occupy the gently sloping ridges in the southern portion of the Study Area, while the northern half is composed mostly of poorly drained, organic soils. Vegetation common to more northern environments abounds in the Canaan Valley in spite of its relatively southern latitude ($39^{\circ}05'$). Eastern hemlock (Tsuga canadensis), red spruce (Picea rubens), balsam fir (Abies balsamea), sugar maple (Acer saccharum), yellow birch (Betula lutea), aspen (Populus grandidentata and P. tremuloides), alder (Alnus rugosa), hawthorn (Crataegus spp.), and Spiraea spp. are dominant types of forest growth.

Climate - Elevation, geographic location, prevailing winds, and rather frequent alternation of air masses (originating in the Gulf and in Canada) account for the Valley's climate and frequent day-to-day changes in weather (Weedfall and Dickerson 1965). Thornthwaite (1948) classified the climate of the Study Area as cold and humid; just two steps warmer than his "tundra" classification. This classification also includes small areas in the mountains of western North Carolina and northern Pennsylvania and larger areas in

New York, New Hampshire, Vermont, and Maine.

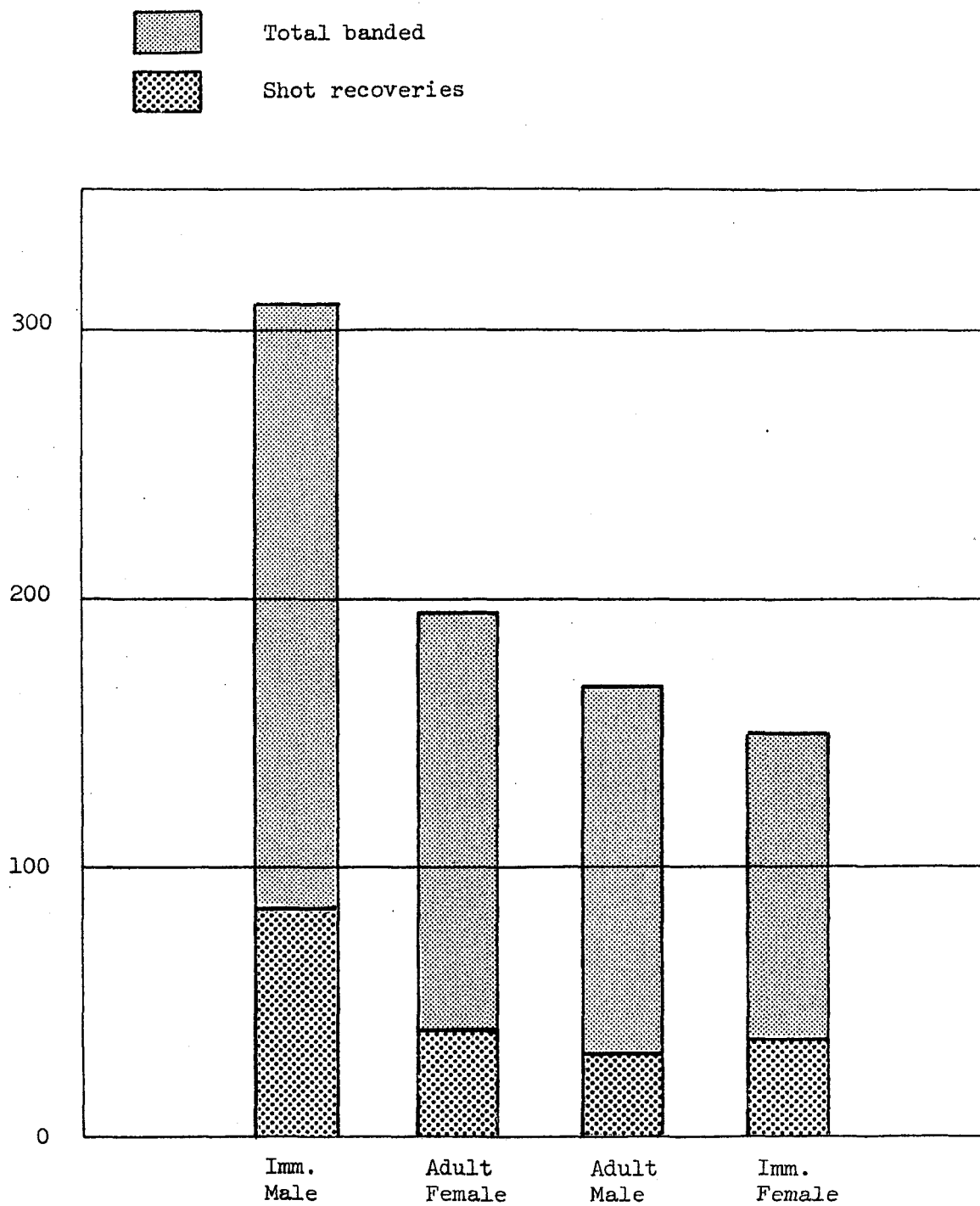
All of West Virginia lies in a cloudy belt, and summer showers on the Study Area are due mostly to currents of moist tropical air sweeping northeastward from the Gulf. Summer evenings are typically cool, dew formation is common, and ground fog is frequent in the early morning. Summer afternoons are relatively cool and comfortable; daily maximum temperatures average between 75° and 78°F. Average annual precipitation (53.53 inches) is rather evenly distributed throughout the year (snowfall averages 120 inches per season), with the Valley receiving more than surrounding areas as a result of being in the wind "shadow." The frost-free season normally extends from June to September (Weedfall and Dickerson 1965).

DISCUSSION OF PROCEDURES AND RESULTS

Recoveries of marked animals provide vital statistics characterizing wildlife populations (Quick 1963). To determine the effect of hunting on "resident" Canaan Valley woodcock populations, a banding program was initiated in 1964. During the period 1964-1968, 1,355 woodcock were banded (Table 1) after being captured in ground traps, mist nets, or by night-lighting techniques (Rieffenberger and Kletzly 1967). This paper, however, involves only those 831 woodcock banded during the "summer" (April 15-September 20).

From these 831 bandings, 196 recoveries have been reported, of which 190 were shot (Tables 2a and 2b). Of the six non-hunting mortalities, three occurred on the Study Area from banding operations. All but three of the 190 shot recoveries were from the Valley (Figure 1). The importance of woodcock hunting in the Canaan Valley

Figure 1. -- Shot Recoveries from Canaan Valley "Summer"
Woodcock Bandings (1964-1968)



(or lack of hunting pressure elsewhere) is exemplified by these returns. Hunters were interviewed throughout the fall, and from these contacts an estimated 94 percent of the kill (1,900 woodcock) was reported. From this reported (retrieved) kill, the total woodcock harvest during the 4 years was estimated to be 2,100 (Table 3). As indicated above, hunting pressure was very heavy in the Canaan Valley; this woodcock population may experience the most intense hunting effort in North America.

Population Estimates - It was necessary to utilize indirect methods to estimate the number of "resident" woodcock using the Canaan Valley. These procedures have been employed in wildlife studies for many years and are explained by Kaczynski and Geis (1961), Geis and Taber (1963), and Davis (1963). Two approaches used in this study were based on bandings during the "summer" and their subsequent direct recovery during the first 7 days of hunting.

The "Lincoln Index" method utilized the relationship that:

$$\frac{\text{Woodcock Banded April 15-September 20}}{\text{Resident Woodcock Population}} = \frac{\text{Banded Woodcock Reported Shot}}{\text{Total Woodcock Reported Shot}}$$

Results from the "Harvest Rate" method depended on the accuracy of estimating the retrieved kill and the band reporting rates:

$$\text{Resident Woodcock Population} = \frac{\text{Estimated Woodcock Harvest (Retrieved Kill)}}{\text{Harvest Rate (Recovery Rate} \div \text{Reporting Rate)}}$$

It was assumed that woodcock captured in the Valley between April 15 and September 20 represented "summer residents." During early October, banding activities and field observations indicated an influx of immigrants. Unfortunately, during the first 3 years of this study (1965-1967), the woodcock hunting season did not open until mid-October. To obtain a more precise estimate of the "resident"

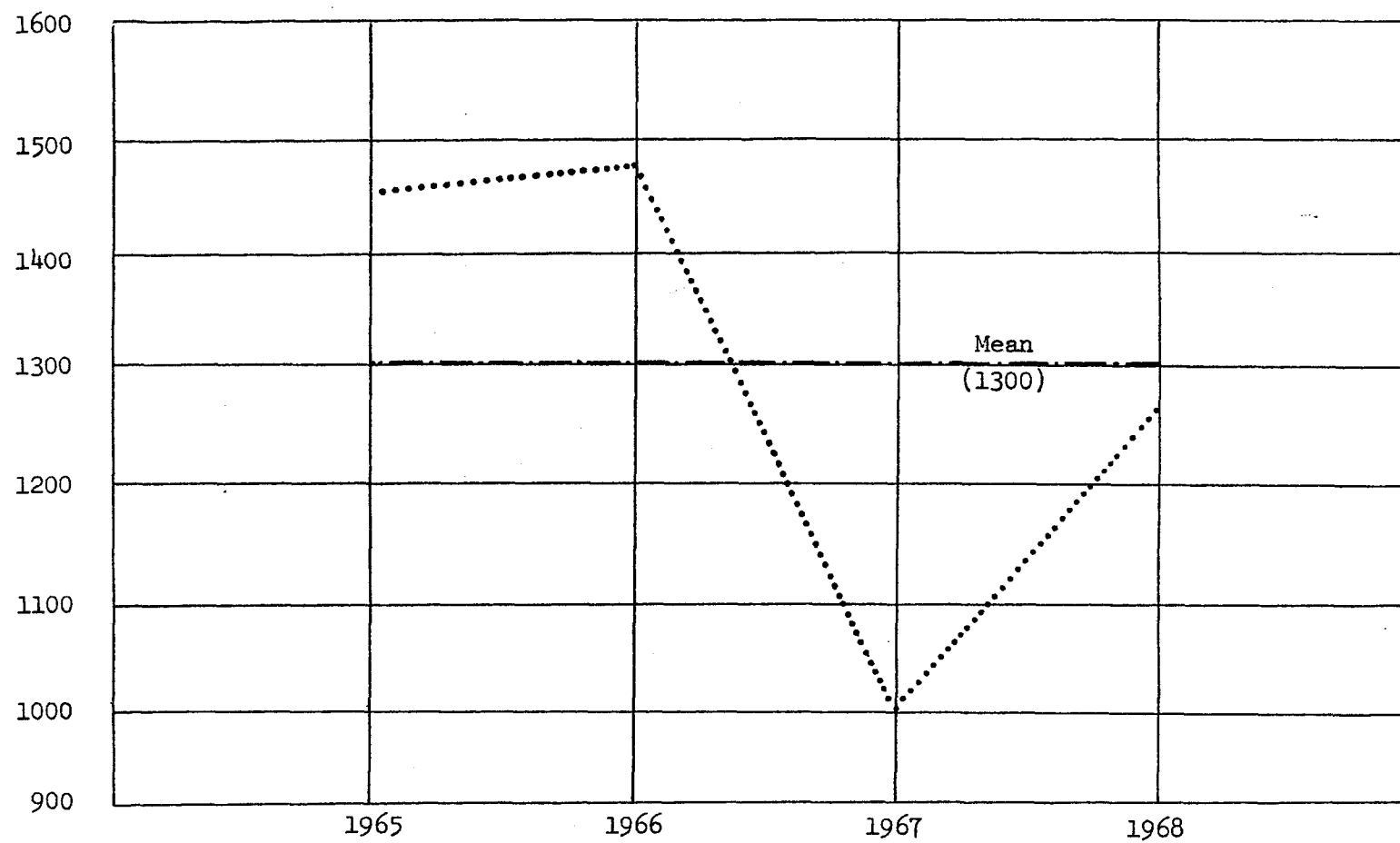
(summer) population, a 7-day special season was held earlier this past season (September 21-28, 1968).

Examination of recovery rate data (Tables 2a and 2b) suggested differences in hunting vulnerability - particularly between adult and immature males. Therefore, annual population estimates were calculated for each age and sex group. Even though the banded sample has been relatively good since 1966, and direct recovery rates correspondingly high, an inadequate number of recoveries during the first 7 days of hunting resulted in annual population estimates (calculated for each age and sex category) that were questionable. Further examination of recovery data revealed that differential hunting vulnerability was not as important during the first 7 days as it was later in the season. Therefore, age and sex categories were combined and total population size was estimated for each year (Table 4).

Information obtained from the 1968 special September hunting season, as well as returns and recoveries of birds banded after September 20, suggested that population estimates for 1965, 1966, and 1967 were exaggerated by 10 to 25 percent. This inflation was the result of immigration into the Valley between the end of "summer" (September 20) and commencement of the hunting season (mid-October). When population estimates for those 3 years (1965-1967) were reduced by 15 percent to compensate for this immigration, the resulting 4-year mean closely approximated the 1968 population estimate (Figure 2).

Information presented in Table 4 and Figure 2 suggests that the Canaan Valley woodcock population has been relatively stable

Figure 2. -- Canaan Valley "Resident" Woodcock Population Estimates
(1965-1968)



during this 4-year study. However, recognizing the sampling error present in these estimates, data for more years are necessary before it may be concluded whether or not this portrays the true population trend.

To obtain a population estimate not dependent on banding and recovery data, singing-ground routes were randomly distributed throughout the Valley. Counts were conducted on foot because Study Area road systems were not conducive to this type of random survey. Techniques and sampling methods will be described in a future publication. Expanded estimates from this survey indicated a singing male (or occupied singing-ground) count of 164 in 1967 and 127 in 1968. Identical routes conducted both years, however, showed a 4 percent increase in 1968. These surveys sampled 29 percent of the Study Area in 1967 and 38 percent in 1968.

Composition of the "Resident" Woodcock Population - Data from all

4 years were combined to obtain estimates of age and sex ratios in the pre-season population. Age and sex ratios in the kill during the first 7 days of hunting were adjusted for differential vulnerability using recovery rates obtained during the same period. Results from these calculations follow:

Age and Sex Categories	Total Reported Shot 1st Week (Adjusted)	Recovery Rate 1st Week	Population Index	Population Composition
Adult Male	137	.1159	1182	18%
Adult Female	224	.1099	2038	30%
Immature Male	257	.1536	1673	25%
Immature Female	207	.1149	1802	27%
Totals	825		6695	100%

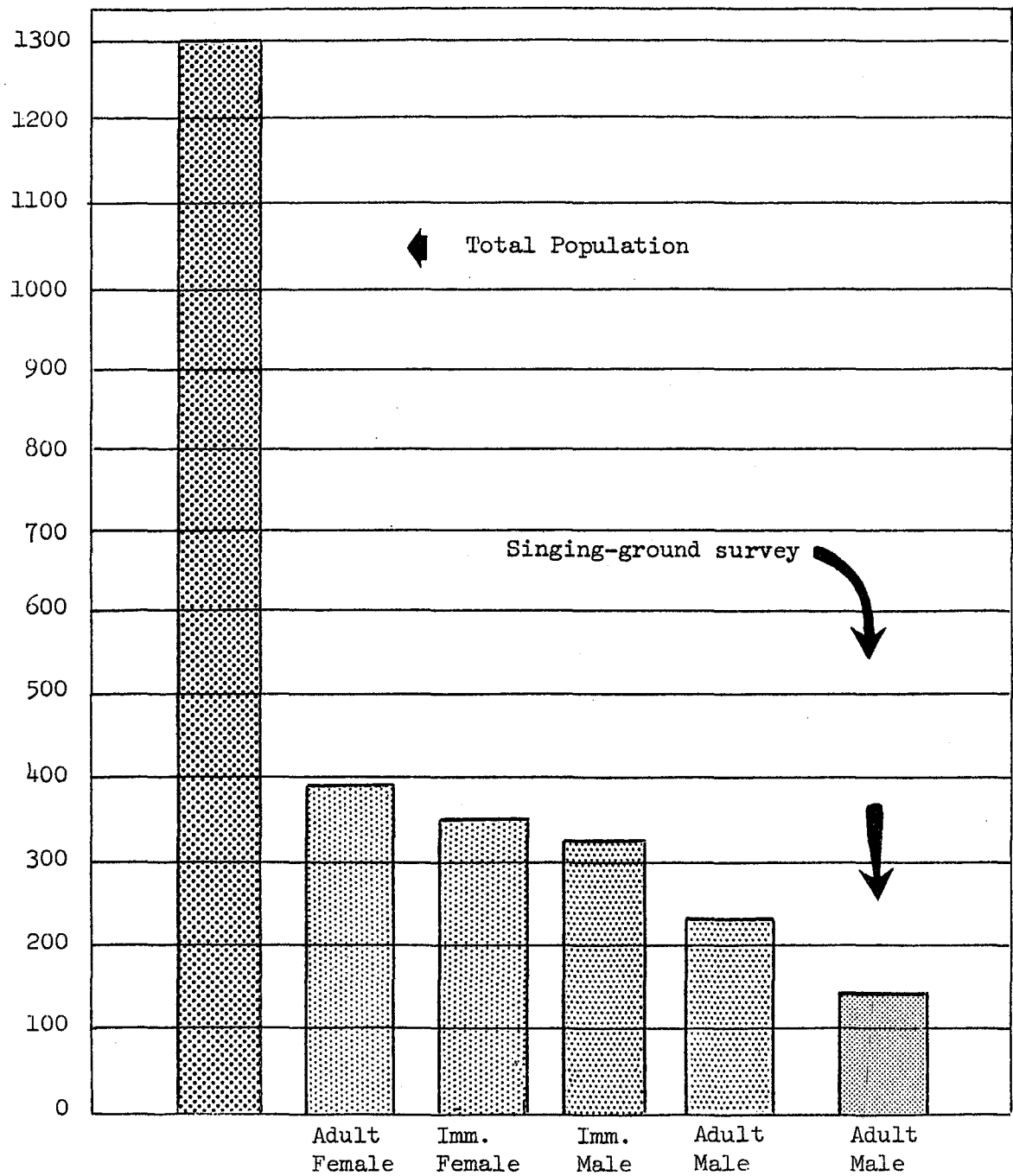
Canaan Valley's pre-season woodcock population, therefore, consisted of 48 percent adults and 52 percent immatures, resulting in an age ratio of 1.08 immatures per adult and 1.73 immatures per adult female. Combining data to obtain the above estimates assumes that age and sex ratios, as well as the population size, were similar during the 4-year period.

When the above proportion of adult males (18 percent) was applied to the adjusted population mean (1,300), the resulting adult male population estimate was 234. This was about 62 percent higher than the singing-ground survey mean population estimate for adult males (Figure 3) and supports Sheldon's (1967:47) contention that there may be surplus males in the spring breeding population. If this is true, however, it is not due to lack of openings in the Canaan Valley.

Mortality Estimates - Mortality rates are necessary to realistically appraise population trends and to evaluate the importance of hunting as a mortality factor. In this study annual mortality rates were determined for each age and sex group based on comparisons of band recovery rates as described by Geis and Taber (1963). This procedure compares band recovery rates from samples banded in different years to determine mortality occurring between banding periods. It assumes that the surviving sample of banded birds is subjected to the same shooting pressure each year as other surviving samples of banded birds that have lived long enough to enter the same hunting season (A. D. Geis 1969 pers. comm.).

Mortality estimates in this study are questionable due to the lack of second, third, and fourth year (indirect) recoveries.

Figure 3. -- Estimated Average Annual Composition of the
Canaan Valley Woodcock Population
(1965-1968)



For purposes of this paper, a "crude" mortality rate for each age and sex category was determined. These were then weighted with population composition data to obtain an overall mortality rate estimate of .753.

Comparison of this mortality rate (75 percent) with the annual population increment (52 percent) implies that the "summer" population is, in fact, not maintaining itself. (The proportion of the population dying is greater than the population's annual recruitment.) From these production and mortality rates, this population would be expected to decline rapidly. For example, had the "resident" population determined for 1965 (1,454) been associated with the mortality and production rates discussed above, the "summer" population would have dwindled to 205 woodcock by 1968. However, 310 birds were banded during the "summer" and the indirect population estimate for 1968 was 1,270.

The inconsistency of population, production, and mortality data suggests two things: First, mortality estimates are probably biased on the "high side" because of some woodcock not returning to the Study Area after their first summer. Presumably, these birds would be subjected to lower shooting pressure which would cause later year recovery rates to be depressed, thus exaggerating the estimated mortality. Secondly, it is likely that woodcock populations breeding in the Canaan Valley receive some recruitment of birds produced elsewhere. Insight into the relative importance of these two explanations will, hopefully, be obtained in future years.

Proportion of Annual Mortality Resulting from Hunting - By comparing mortality rates with kill rates, an estimate of the proportion of annual mortality due to hunting can be obtained (Geis 1968). Table 5 indicates that about 30 percent of adult males, adult females, and immature female deaths can be directly attributed to hunting, while immature male hunting mortality was about 33 percent higher. Since mortality rate estimates were probably exaggerated, the estimated proportion of total deaths due to hunting may be even higher than this analysis suggests. High hunting pressure in the Canaan Valley provides a unique opportunity to evaluate the extent to which shooting can replace non-hunting mortality for woodcock. It will be interesting to reconstruct Table 5 after additional kill and mortality rate data have been obtained, and then to change hunting regulations to test the effects of these changes.

SUMMARY

Major points resulting from the Canaan Valley woodcock study were:

- (1) Annual "resident" (summer) populations appeared to be relatively stable and approximated 1,300 woodcock, of which 52 percent were immatures.
- (2) At least 30 percent of all woodcock deaths each year were due to hunting; immatures were more likely to be shot than adults, with immature males substantially more vulnerable than adult males.
- (3) Mortality estimates, based on existing band recovery data, indicated a 75 percent mortality rate for the entire population; adult males had the lowest rate of any age or sex group.

- (4) Annual mortality rates were much greater than would be expected from the observed production rates and the relatively stable "resident" population estimates.

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Table 1. -- Summary of the Canaan Valley, West Virginia woodcock bandings (1964-1968)

Year	Banding Periods	Age and Sex Categories								Age & Sex Unknown	Annual Totals
		Adult Male	Adult Female	Adult Unk.	Adult Totals	Imm. Male	Imm. Female	Imm. Unk.	Imm. Totals		
1964	Spring	-	-	-	-	-	-	-	-	-	-
	Summer	0	4	0	4	3	3	0	6	0	10
	Fall	-	-	-	-	-	-	-	-	-	-
	TOTAL	0	4	0	4	3	3	0	6	0	10
1965	Spring	-	-	-	-	-	-	-	-	-	-
	Summer	8	9	0	17	29	14	0	43	0	60
	Fall	7	6	0	13	17	7	0	24	4	41
	TOTAL	15	15	0	30	46	21	0	67	4	101
1966	Spring	-	-	-	-	-	-	-	-	-	-
	Summer	45	52	2	99	42	25	2	69	2	170
	Fall	27	34	1	62	41	20	1	62	1	125
	TOTAL	72	86	3	161	83	45	3	131	3	295

Table 1. -- Summary of the Canaan Valley, West Virginia woodcock bandings (1964-1968) - continued

Year	Banding Periods	Age and Sex Categories								Age & Sex Unknown	Annual Totals
		Adult Male	Adult Female	Adult Unk.	Adult Totals	Imm. Male	Imm. Female	Imm. Unk.	Imm. Totals		
1967	Spring	3	-	-	3	-	-	-	-	0	3
	Summer	56	54	0	110	116	51	4	171	0	281
	Fall	43	30	0	73	55	34	0	89	0	162
	TOTAL	102	84	0	186	171	85	4	260	0	446
1968	Spring	22	16	0	38	-	-	-	-	0	38
	Summer	55	76	1	132	119	58	1	178	0	310
	Fall	33	31	0	64	62	28	1	91	0	155
	TOTAL	110	123	1	234	181	86	2	269	0	503
1964-68 Totals	Spring	25	16	0	41	-	-	-	-	0	41
	Summer	164	195	3	362	309	151	7	467	2	831
	Fall	110	101	1	212	175	89	2	266	5	483
BANDING TOTALS		299	312	4	615	484	240	9	733	7	1355

Table 2a. -- Summary of shot recoveries from summer-banded adult woodcock in the Canaan Valley, West Virginia (1964-1968)

Age and Sex Categories	Summer Banded	Number Banded	DIRECT SHOT					INDIRECT SHOT				TOTAL SHOT	
			First Week	After 1st Week	Out of Valley	Total	Percent	Hunting Season 2	Season 3	of Recovery 4	5	Number	Percent
Adult Male	1964	0	-	-	-	-	-	-	-	-	-	-	-
	1965	8	0	0	0	0	0.00	0	1	0		1	12.50
	1966	45	5	0	0	5	11.11	2	1			8	17.78
	1967	56	11	1	0	12	21.43	2				14	25.00
	1968	55	3-[2=Sept. 1=Oct.	5	-	8	14.55					8	14.55+
TOTAL		164	19	6	0	25	15.24	4	2	0	-	31	18.90
Adult Female	1964	4	0	0	0	0	0.00	1	1	0	0	2	50.00
	1965	9	1	0	0	1	11.11	0	0	0		1	11.11
	1966	52	10	1	0	11	21.15	2	2			15	28.85
	1967	54	4	1	0	5	9.26	0				5	9.26
	1968	76	6-[4=Sept. 2=Oct.	10	-	16	21.05					16	21.05+
TOTAL		195	21	12	0	33	16.92	3	3	0	0	39	20.00
Combined Adults	1964	4	0	0	0	0	0.00	1	1	0	0	2	50.00
	1965	17	1	0	0	1	5.88	0	1	0		2	11.76
	1966	99*	15	1	0	16	16.16	4	3			23	23.23
	1967	110	15	2	0	17	15.45	2				19	17.27
	1968	132*	9-[6=Sept. 3=Oct.	16*	-	25	18.94					25	18.94+
TOTAL		362	40	19	0	59	16.30	7	5	0	0	71	19.61

* Includes 2 birds (2 in 1966, 1 in 1968) banded as sex unknown; one of which is also included as a direct recovery (1968)

Table 2b. -- Summary of shot recoveries from summer-banded immature woodcock in the Canaan Valley, West Virginia (1964-1968)

Age and Sex Categories	Summer Banded	Number Banded	DIRECT SHOT					INDIRECT SHOT				TOTAL SHOT		
			First Week	After 1st Week	Out of Valley	Total	Percent	Hunting Season	2	3	4	5	Recovery	Number
Immature Male	1964	3	0	0	0	0	0.00	1	0	0	0		1	33.33
	1965	29	3	2	0	5	17.24	0	0	0			5	17.24
	1966	42	11	4	0	15	35.71	2	2				19	45.24
	1967	116	21	3	1	25	21.55	4					29	25.00
	1968	119	12-[^{7=Sept.} _{5=Oct.}	18	-	30	25.21						30	25.21+
	TOTAL	309	47	27	1	75	24.27	7	2	0	0		84	27.18
Immature Female	1964	3	1	0	0	1	33.33	0	0	0	0		1	33.33
	1965	14	3	0	0	3	21.43	0	0	1			4	28.57
	1966	25	4	0	0	4	16.00	1	1				6	24.00
	1967	51	3	2	0	5	9.80	2					7	13.73
	1968	58	7-[^{2=Sept.} _{5=Oct.}	9	0	16	27.59						16	27.59+
	TOTAL	151	18	11	0	29	19.21	3	1	1	0		34	22.52
Combined Immatures	1964	6	1	0	0	1	16.67	1	0	0	0		2	33.33
	1965	43	6	2	0	8	18.60	0	0	1			9	20.93
	1966	69*	15	4	0	19	27.54	3	3				25	36.23
	1967	171*	24	5	2*	31	18.13	6					37	21.64
	1968	178*	19-[^{9=Sept.} _{10=Oct.}	27	0	46	25.84						46	25.84+
	TOTAL	467	65	38	2	105	22.48	10	3	1	0		119	25.48

* Includes 7 birds (2 in 1966, 4 in 1967, 1 in 1968) banded as sex-unknown; one of which is also included as a direct recovery (1967).

Table 3. -- Summary of the Canaan Valley, West Virginia woodcock harvest (1965-1968)

Year	Period	AGE AND SEX CATEGORIES						Total Woodcock Aged	Total Reported Shot	Total Estimated Harvest
		Adult Male	Adult Female	Adult Total	Imm. Male	Imm. Female	Imm. Total			
1965	First 7 days of hunting (Oct.)	23	35	59*	46	44	94*	153	188	235
	Season Total	53	58	113*	81	63	148*	261	296	370
1966	First 7 days of hunting (Oct.)	46	81	127	81	68	151*	278	300	325
	Season Total	88	122	210	128	115	246*	456	491	530
1967	First 7 days of hunting (Oct.)	35	35	70	52	33	85	155	159	175
	Season Total	112	143	255	124	76	200	455	482	520
1968	First 7 days of hunting (Sept.)	6	15	21	25	14	39	60	60	65
	First 7 days of hunting (Oct.)	14	37	51	29	29	58	109	117	125
	Sept. & Oct. Periods Combined	20	52	72	54	43	97	169	177	190
	Season Total	123	198	321	162	129	291	612	631	680
Season Total For Combined Years		376	521	899	495	383	885	1784	1900	2100

* Totals include 2 adults and 7 immatures of unknown sex.

Table 4. -- "Resident" woodcock population estimates in the Canaan Valley, West Virginia based on summer bandings (April 15 - September 20) and direct shot recoveries during the first 7 days of hunting (1965-1968)

Year	SAMPLE SIZE		Lincoln Index	Harvest Rate	Mean of Methods	Adjusted Mean*
	Banded	Recovered				
1965	60	7	1611	1808	1710	1454
1966	170	30	1700	1776	1738	1477
1967	281	39	1146	1207	1178	1177
1968	310	15	1240	1300	1270	1270
MEAN OF COMBINED YEARS			1424	1523	1474	1300

* Reduced 15 percent in 1965, 1966, and 1967 to compensate for immigration.

Table 5. -- Calculations for determining the estimated proportion of the Canaan Valley, West Virginia "resident" woodcock mortality due to hunting (1965-1968)

Age and Sex Category	Direct Recovery Rate	Band Reporting Rate	= Harvest Rate	+ Crippling Loss (20% of HR)	= Kill Rate	÷ Mortality Rate	= Hunting Proportion of Annual Mortality
Adult Male	.152	.94	.162	.032	.194	.66	29%
Adult Female	.169	.94	.180	.036	.216	.75	29%
Immature Male	.243	.94	.259	.052	.311	.76	41%
Immature Female	.192	.94	.204	.041	.245	.81	30%

JOB SUMMARY REPORT

State: West Virginia

Project No.: W-37-R-11

Name: Migratory Bird Investigations

Work Plan: IV

Title: American Woodcock Population
Dynamics Studies

Job No.: 1

Title: BREEDING WOODCOCK POPULATION

Period Covered: February 1, 1965 to May 30, 1968

ABSTRACT: *Thirty-eight to 51 randomly distributed singing-ground survey routes have been used in determining the status of woodcock breeding in West Virginia during the past 4 years (1965-1968). Routes comparable between successive years have been used to determine annual changes in the breeding population. The mean number of woodcock heard per stop has varied considerably between years, but recognizing the sampling error associated with these estimates, it is doubtful if any significant change has occurred.*

A randomly designed experimental survey of singing male woodcock in the Canaan Valley Study Area was initiated in 1967 and conducted again in 1968. The mean number of woodcock heard per stop in 1968 was 0.60 compared to 0.77 in 1967. However, no change occurred in comparable routes conducted both years. Expansion of these indexes suggests a population of about 146 singing males (or occupied singing grounds) in the Study Area.

OBJECTIVES: (1) Obtain an index to the size, relative distribution, ecological density, and annual changes in woodcock breeding populations throughout the State; (2) obtain an estimate of adult males breeding within the Canaan Valley Study Area.

PROCEDURES: Forty-five randomly distributed singing-ground survey routes were used in obtaining an index to the 1968 woodcock breeding population from the original 52 routes established in 1965. Six new routes were also conducted in 1968. Specific techniques used in establishing and conducting these routes were determined in cooperation with the U. S. Bureau of Sport Fisheries and Wildlife. The mean number of singing males heard per stop was used to obtain indexes to the relative size, density, distribution, and annual variation in the number of woodcock breeding. The Canaan Valley was gridded, and from a possible 213 census points, 82 (a sample of almost 40 percent of the Study Area) were checked for occupied singing grounds in 1968.

FINDINGS: During the period April 10 to May 5, 1968, woodcock singing-ground routes were conducted throughout West Virginia. From a possible selection of 62 random routes, 51 were conducted (including those considered to be constant zeros). Results from 1968 are compared with previous year's findings in Table 1.

To better ascertain changes in woodcock breeding populations, it is necessary to use routes that are comparable between years. Results from these calculations (Table 2) denoted the same trend as was indicated from all routes. However, the magnitude of change between years was considerably different.

Data collected in Canaan Valley suggested the breeding male population was about 127 in 1968 compared to approximately 164 in 1967 (Table 3). However, analysis of 41 comparable stops showed virtually no change in the woodcock breeding population between years (Table 4).

RECOMMENDATIONS: Complete stratification of the State into ecological zones or forest associations to increase the efficiency of singing-ground surveys. This will probably require the addition of another five random routes in both

1969 and 1970 to overcome existing gaps within different strata. It is also recommended that the Canaan Valley Woodcock Singing-Ground Survey be continued in 1969 and 1970 with a sample of new routes being randomly selected each year. The pre-season adult male population in the Study Area will be compared with estimates obtained from direct recoveries of banded birds to determine the reliability of different population estimates.

Prepared by: /s/ Robert C. Kletzly
Biologist II

/s/ William H. Goudy
Supvr. of Game Research

Date: March 26, 1969

Approved by: /s/ William H. Goudy
Supvr. of Game Research

And

/s/ James M. Ruckel
P-R Coordinator

Table 1. -- Summary of West Virginia Woodcock Singing-Ground Surveys
as determined from ALL randomly distributed routes*
1965-1968

Year	Number of useable routes conducted	Number of useable stops	Number of woodcock heard	Number of woodcock heard per stop	Annual change in woodcock heard per stop
1965	45	385	39	.101	---
1966	43	333	42	.126	+25%
1967	38	263	29	.110	-13%
1968	51	364	48	.132	+20%
TOTALS	177	1345	158	.117 (Mean)	

* Includes data from routes considered to be constant zeros.

Table 2. -- West Virginia Woodcock Singing-Ground Survey results
as determined from COMPARABLE random routes*
1965-1968

Year	Number of comparable routes between years	Number of comparable stops	Number of woodcock heard	Number of woodcock heard per stop	Annual change in woodcock heard per stop
1965- 1966	26	173	1965 = 17 1966 = 18	1965 = .098 1966 = .104	+6%
1966- 1967	34	228	1966 = 28 1967 = 22	1966 = .123 1967 = .096	-22%
1967- 1968	34	221	1967 = 18 1968 = 26	1967 = .081 1968 = .118	+46%

* Includes data from routes considered to be constant zeros.

Table 3. -- Results from the Canaan Valley Woodcock Singing-Ground Survey in 1967 and 1968

Year	Number of stops	Number of woodcock heard	Number of woodcock heard per stop	Expanded number of singing males in Valley
1967	61	47	0.77	164
1968	82	49	0.60	127
TOTALS	143	96	0.67 (Mean)	146 (Mean)

Table 4. -- Results from comparable Singing-Ground Routes in the Canaan Valley 1967 and 1968

Route number	Number of stops	Woodcock heard		Percent change between years
		1967	1968	
17	3	1	0	
18	3	2	4	
27	3	2	6	
28	3	2	3	
32	3	4	2	
34	2	1	2	
38	1	0	0	
39	3	2	2	
40	3	0	0	
44	3	5	3	
47	3	3	3	
59	3	1	1	
87	2	2	1	
88	1	0	0	
103	3	1	1	
104	3	1	0	
TOTALS	41	27	28	+3.7

LOCAL MOVEMENT OF "RESIDENT" WOODCOCK IN THE CANAAN VALLEY OF WEST VIRGINIA*

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Game and Fish Division
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Recapture of woodcock, resident in an area, provides information on their mobility, home range, habitat requirements, dispersal, and vulnerability to capture techniques. This article reports on general mobility and vulnerability to capture of woodcock handled during the summer of 1967 in the Canaan Valley of West Virginia. It excludes birds captured on singing grounds.

From April 15 through September 20, 1967, 288 different woodcock were captured in ground traps, with mist nets, or by nightlighting techniques. Of these, 95 individuals (33 percent) were also recaptured one or more times totaling 126 handlings after their original capture.

Differential age and sex vulnerability to capture and recapture is indicated in the following table:

Age and Sex Category	Number of Individuals		Number of Times Recaptured				Total Recap- tures	Percent of Individuals Recaptured
	Captured	Recaptured	1	2	3	4		
Adult Male	53	11	9	2	0	0	13	20.8
Adult Female	57	15	14	1	0	0	16	26.3
Immature Male	120	56	38	16	1	1	77	46.7
Immature Female	58	13	9	2	1	1	20	22.4
TOTALS	288	95	70	21	2	2	126	33.0

*This study was conducted by the West Virginia Department of Natural Resources in cooperation with the U. S. Bureau of Sport Fisheries and Wildlife and is a contribution of Pittman-Robertson Project W-37-R. Submitted to the Bureau for publication in a Special Scientific Report (December 1968).

If we assume woodcock sex ratios are equal at hatching, and that natural mortality is about the same for both sexes during their first summer; then, we must conclude from the above data that immature male woodcock are more vulnerable than immature females to both capture and recapture. Further, the recapture rate for immature males is double that for all other age and sex groups combined.

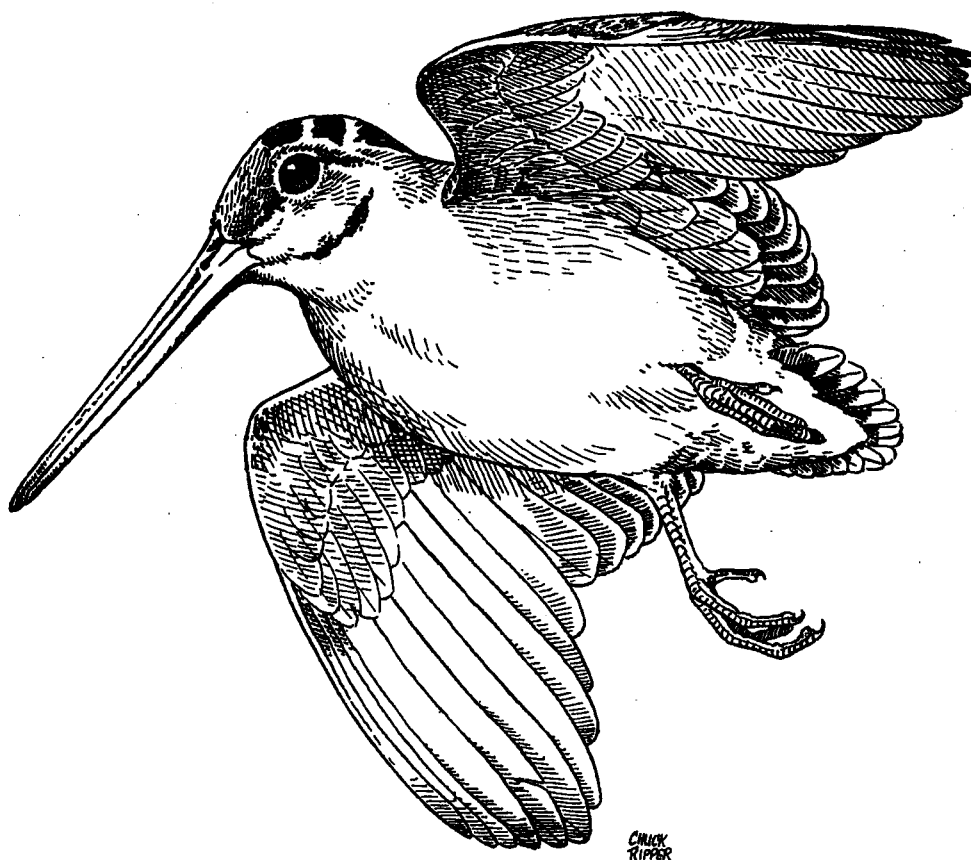
Woodcock mobility, as indicated by distances between each of the 126 recaptures, is presented below:

Age and Sex Category	Less than 1/2 mile	1/2 to 2 Miles	2 to 3-1/2 Miles	3-1/2 to 5 Miles	5 to 6-1/2 Miles
Adult Male	7	5	1	0	0
Adult Female	14	1	1	0	0
Immature Male	48	20	5	3	1
Immature Female	16	4	0	0	0
TOTALS	85	30	7	3	1

Immature males were by far the most mobile woodcock. Once capable of flight, they began to appear throughout the Study Area. Immature females and adults of both sexes exhibited some local movement but considerably less than immature males. In contrast, T. K. Prawdzik and G. A. Ammann (Personal communication - 1968; Mich. Dept. of Cons., Lansing) reported a significant "local" movement of an adult female in northern Michigan. This woodcock was banded, with her brood of four chicks, on May 11, 1966. She was recaptured 65 days later 40 miles southeast of where she had nested and apparently had reared a brood. However, E. R. Clark (Personal communication - 1968; Mig. Bird Pop. Station, Laurel, Md.) did not find

any summer movement between his two "resident" woodcock populations in Maine which were only about 20 miles apart. We wish to emphasize, however, that the majority of the Canaan Valley birds (even immature males) were repeatedly taken at or close to the point of their original capture.

Banding activities are expanding throughout much of West Virginia with emphasis on woodcock populations encompassing the Canaan Valley. This could provide important information on immigration and emigration, thereby establishing a more positive definition of "local" or "resident" woodcock populations.



WOODCOCK IDENTIFICATION
(A PROBLEM ASSOCIATED WITH INTERPRETING
RESULTS OF MAIL QUESTIONNAIRE SURVEYS)*

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Mail questionnaire surveys provide natural resource administrators, research biologists, and wildlife managers with information important in formulating conservation policies, establishing effective regulations, and determining management practices. Realizing the value of this information, the West Virginia Department of Natural Resources conducted a pilot mail questionnaire survey in 1963. Its primary purpose was to obtain information on deer harvest, hunting pressure, and hunter attitudes. The last of six questions was: "Which of the following did you hunt last season (1962)?" A list of eight game birds and mammals followed, one of which was "woodcock." The remainder of this paper deals with interpretation of results obtained from West Virginia residents who responded positively to "hunted woodcock in 1962."

The sample included all 197,462 resident hunting and fishing license buyers - stratified by the two different types of licenses. Post card questionnaires were mailed to 7,328 (3.7 percent) of the license buyers, of which 875 (11.9 percent) were undeliverable. Of the 6,453 hunters contacted, 4,183 (64.8 percent) responded after three contacts. This

* This study was conducted by the West Virginia Department of Natural Resources in cooperation with the U. S. Bureau of Sport Fisheries and Wildlife and is a contribution of Pittman-Robertson Project W-37-R. Submitted to the Bureau for publication in a Special Scientific Report (December 1968).

amounted to a 2.1 percent sample of the license buyers.

Following normal statistical procedures, sample data were expanded to determine the total number of woodcock hunters. These calculations suggested that over 20,000 Mountain State residents hunted woodcock in 1962; however, it was suspected that this figure was much too large. To test the reliability of the original data, 100 individuals who indicated that they hunted woodcock were personally interviewed.

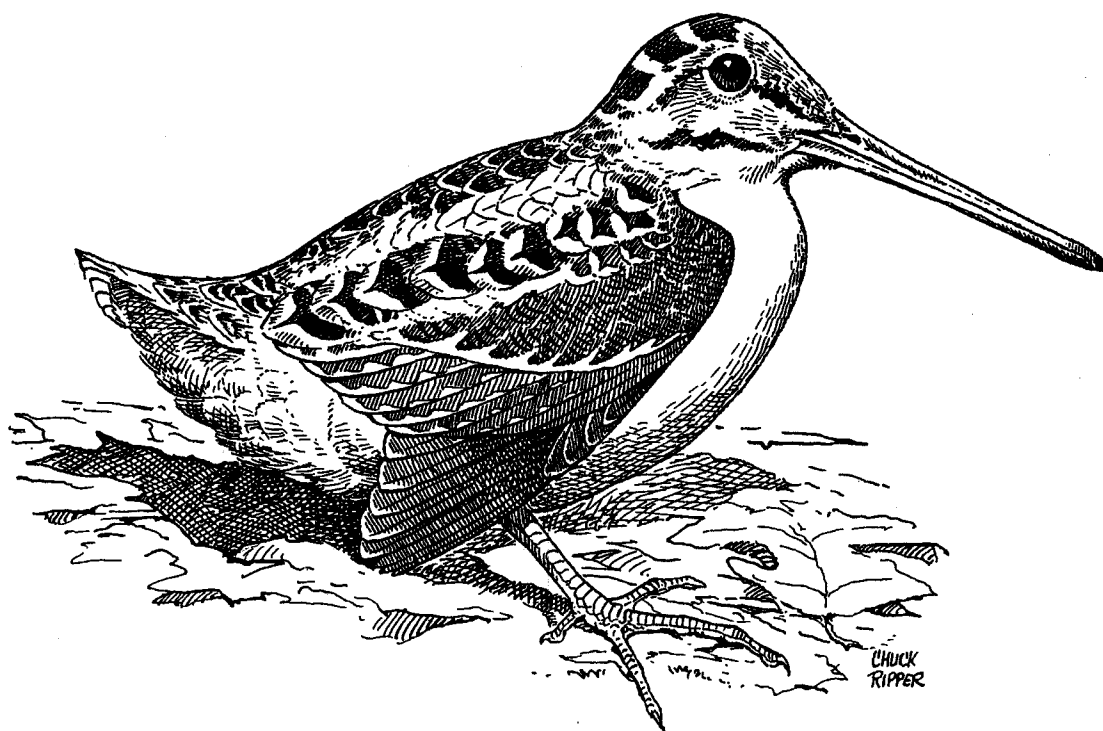
The following procedure was used to make this test:

- (1) A systematic sample (with a random start) of 100 individuals, who answered "yes" to hunted woodcock during the 1962 season, was selected for interview.
- (2) These hunters were shown a series of six game bird pictures, including one of a woodcock.
- (3) Those who could identify a woodcock were then asked a series of six other questions concerning their woodcock hunting experiences.
- (4) These data were then used to calculate a corrected figure for the total number of West Virginia woodcock hunters and their kill in 1962.

Eighty-three of the original 100 hunters selected were located, and all were willing to cooperate in the interview. Twenty-four (28.9 percent) of the 83 could identify the picture of a woodcock. Forty-one percent of these individuals said they hunted woodcock during the 1962 season. Thus, these data suggest the number of resident woodcock hunters should have been less than 2,500 rather than the original estimate of more than 20,000.

Through these interviews, it was found that many Mountain State residents identified the word "woodcock" in the questionnaire with their local term for the pileated woodpecker (wood hen). Others thought "woodcock"

and "woodchuck" (ground hog) were synonymous. Using the mean number of woodcock killed by sample hunters (who correctly identified the picture), it was estimated the total kill by resident license buyers in 1962 was between 9,000 and 13,000. It is interesting to note, these same data also suggest that Mountain State natives intentionally harvest about 3,000 pileated woodpeckers annually!



A NIGHTLIGHTING TECHNIQUE FOR CAPTURING WOODCOCK AND SNIPE*

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ABSTRACT: *A nightlighting technique for capturing American woodcock and common snipe is described. Equipment consists of battery-powered lights and a hand net. Birds are located with a floodlight and "held" with a spotlight until netted. Concentrations of woodcock and/or snipe can be located by searching open fields at night. Areas in which birds are found can be revisited at weekly intervals without disrupting their habits. Mowed strips increase efficiency of locating birds. Over 1,800 woodcock and 200 snipe have been captured in West Virginia using this technique.*

American woodcock (Philohela minor Gmelin) and common snipe (Capella gallinago delicata) often spend the night in open fields. A preference is shown for moist ground with closely cropped ground cover interspersed with clumps of sedges (Cyperaceae) and rushes (Juncaceae). These birds normally remain from dusk to dawn enabling banders to search for them at any hour of the night. Early methods of nightlighting, which located woodcock by eyeshine, were developed in Louisiana during winter months when herbaceous cover was low, thus leaving birds exposed (Merovka 1939). Many workers have difficulty spotting eyes of woodcock,

* This study was conducted by the West Virginia Department of Natural Resources in cooperation with the U. S. Bureau of Sport Fisheries and Wildlife and is a contribution of Pittman-Robertson Project W-37-R. Submitted to The Journal of Wildlife Management for publication (June 1969).

and snipe eyes do not reflect light (Glasgow 1958). This report discusses the development and use of a brighter light, allowing searchers to look for the form of a bird rather than eyeshine.

MATERIALS AND METHODS

Description of Equipment - A 12-volt motorcycle battery, carried by a shoulder strap, provides the source of power (Figure 1). Receptacles wired to terminals facilitate exchanging batteries. Wiring is uniform to allow the jacks to be used as parallel connectors when recharging batteries. Batteries weighing 7 pounds will last 2-1/2 hours; while smaller (5 pound) batteries last 1-1/2 hours under normal use. Acid spillage is minimized by coiling the air-vent tube.

The light combines a floodlight and a spotlight with a selective trigger (Figure 2). An automobile headlight (#4001) and an aircraft landing light (#4509) are focused and clamped over holes cut in a plywood jig. Insulated copper wire is soldered to light terminals and to a 3-position switch (#2X466). Connections are wired so that switch positions are: Forward = floodlight, center = off, and rear = spotlight. A 3-foot lead wire is attached to a plug which inserts into the battery-mounted receptacle.

Paraffin softened in hot water is molded to form a hand grip covering the wiring and enough of the lamp bases for firm support. Fiberglass tape is wrapped around the hardened paraffin core and tucked between protuberances at the base of the lights. Resin is applied to the wrapping, making certain that bases of the handles are saturated to insure a firm bond with the lights. After the resin sets, rough places are sanded and a second coat applied. Rear surfaces of the lights are painted black to prevent back-lighting.

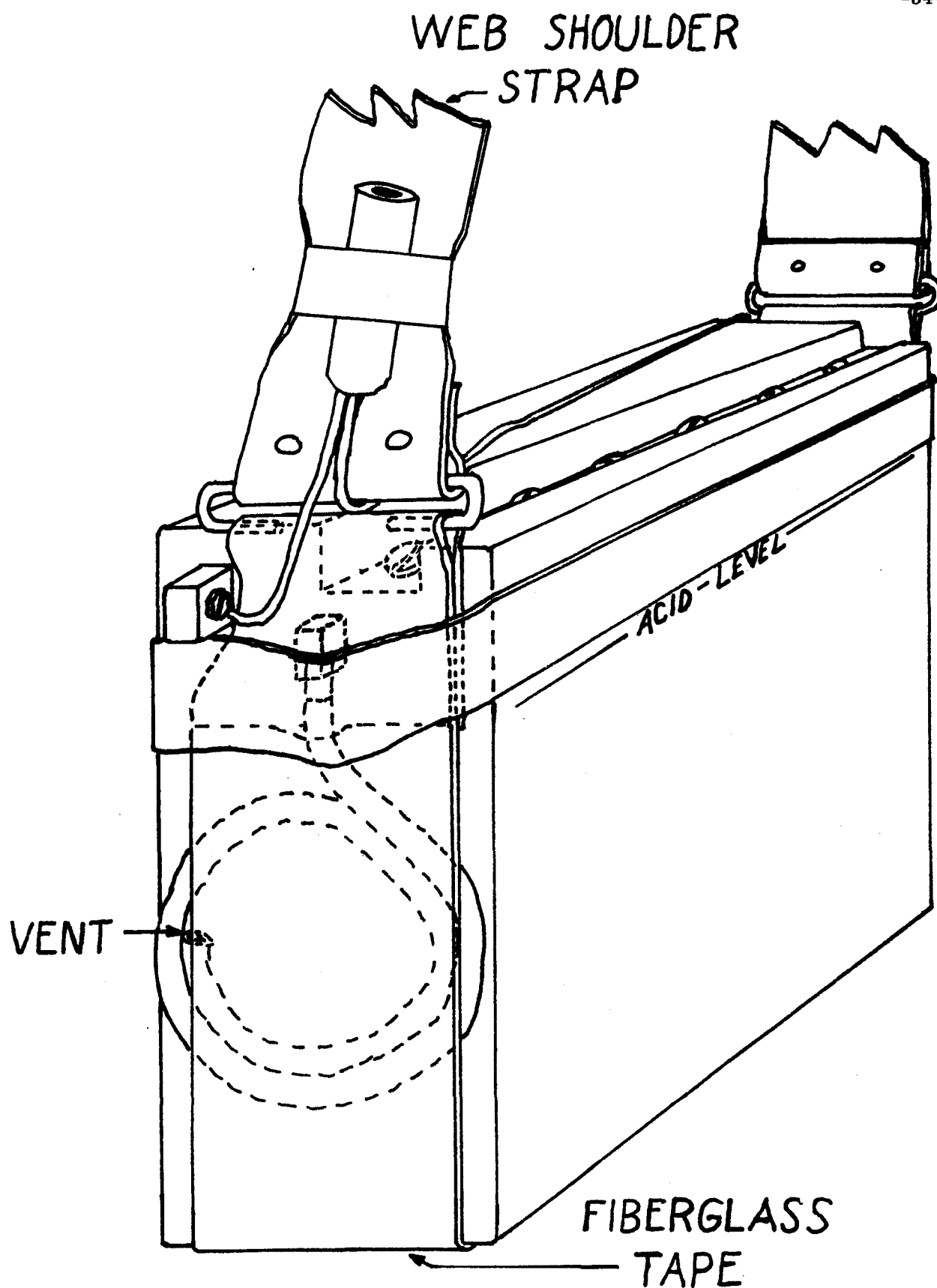


Figure 1. -- Portable power source used for nightlighting woodcock and snipe in West Virginia

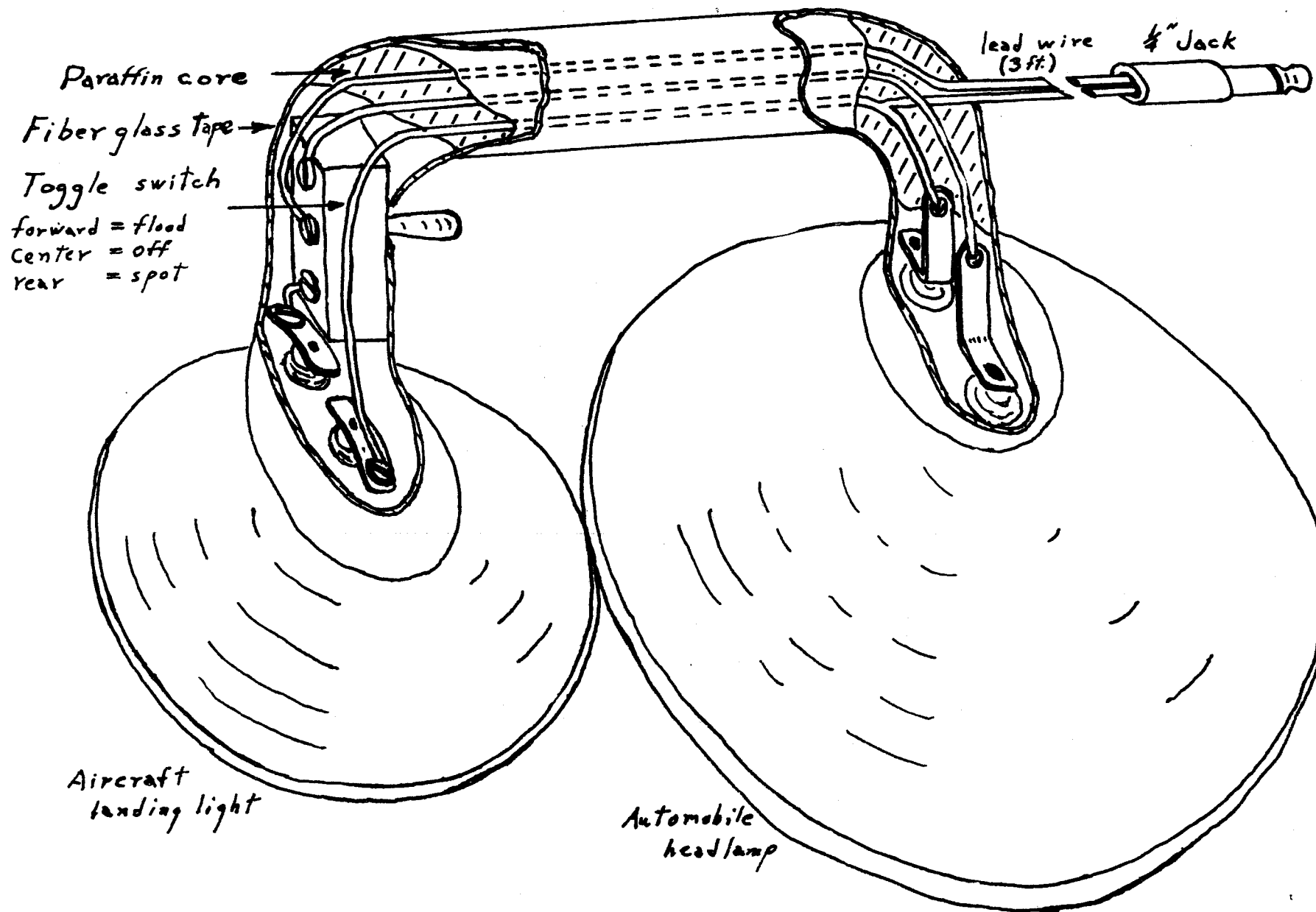


Figure 2. -- Combination flood-spotlight developed for nightlighting woodcock and snipe in West Virginia.

Black-plastic tape is applied to lamp rims where paint will not cling.

Nets are fashioned by bending a 1/8 inch by 3/4 inch by 8 foot aluminum bar into a round bow. Sharp bends are made 3 inches from the ends and filed so they can be inserted into the handle. The handle consists of a 3/4 inch by 8 foot aluminum tube flattened at the end to receive the bow. Two 1/8 inch holes are drilled and rivets inserted to eliminate wobbling. A finger grip hilt is carved from a 1/2 inch by 3/4 inch by 6 inch board and fastened by tape or rivets about 6 inches from the handle butt. Bow and handles are painted black to reduce reflection. Dark-dyed, 3/4 inch square mesh netting is laced to the bow leaving a 6-inch bag. A bag deeper than this forewarns the bird and frequently fouls in vegetation (Figure 3).

Description of Capture Technique - Banding teams search for woodcock and/or snipe by following a pattern which allows the best coverage of an area. Walking speed varies with ground cover density. Lights are cast ahead and about 20 feet to each side.

When a woodcock flushes, the nearest man pulls the trigger switch from his floodlight to his spotlight and trains it on the flying bird. Other members of the crew switch their lights off. More than one light seems to give woodcock a fix on the ground. With a single beam they often become confused and land nearby. Snipe do not respond in this manner when flushed.

Birds sighted on the ground or "knocked down" by the spotlight are approached quietly. The light is held at arms length to minimize back-lighting. The other hand holds the net vertically (the hilt enables netters to determine which way the net faces while keeping their eyes on the bird) with the butt pressed against the forearm. Once the range is closed, the net is slowly lowered to horizontal

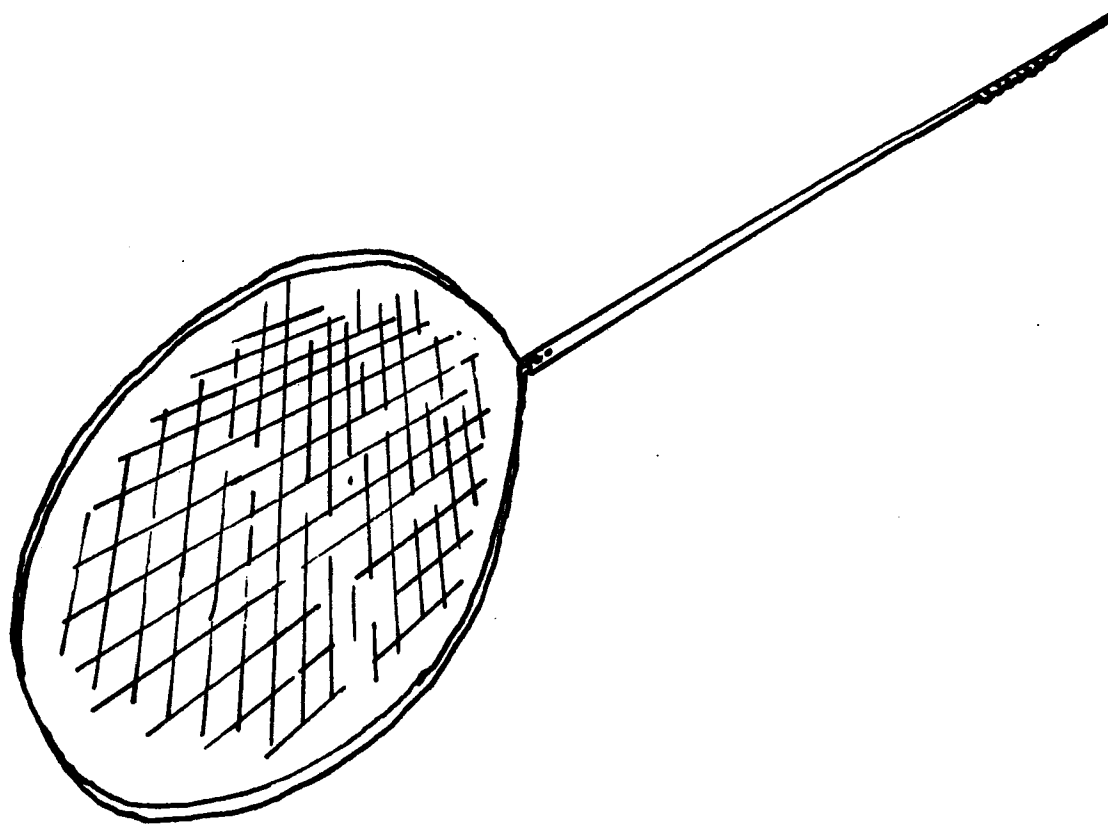


Figure 3. -- Long-handled net used for capturing woodcock and snipe during nightlighting operations in West Virginia.

directly above the bird and dropped. If a bird flushes at the last second, the wide net will usually still enclose him.

A vehicle may be used to search fields when conditions permit such travel. The same light or a more powerful one connected to the automotive electrical system is used. The simplest method is for a spotter to perch on the cab of a pickup truck. Upon sighting a bird, he taps the roof. The driver then stops, shifts to neutral, gets out, and nets the bird; while the spotter continues to keep his light on the bird.

RESULTS AND DISCUSSION

Nightlighting from a vehicle has advantages over foot operations. Woodcock and snipe do not appear to be alarmed by a vehicle even on clear-moonlit nights, when it is very difficult to approach them on foot. The brighter light and higher vantage point facilitates spotting birds, and the engine's noise tends to muffle the netter's approach.

Mortalities can be held to a minimum by not swatting with the net. Five hundred seventy-two woodcock were nightlighted in the Canaan Valley, West Virginia, during 1968 with only two mortalities. One hundred seventy-eight snipe were captured in the same area during a 2-year period with no known losses.

Fields with suitable nocturnal woodcock and/or snipe habitat are scarce in many areas. Fields located near diurnal cover with suitable soil conditions but having dense herbaceous growth, can be treated by mowing. This sometimes lures woodcock and snipe into using them. Strips 3- to 8- feet wide should be mowed to produce a lawn-like affect. The narrower width is adequate if grasses and forbs are less than 2-feet tall. In taller, overhanging growth,

the swath needs to be wider. Spacing of strips is regulated by density of the ground cover. Where there are naturally occurring openings, strips should be at close intervals so that woodcock are more apt to use them than the natural openings.

Woodcock habitually use the same areas. Results in one part of a field are often better than in other portions. In fields where this occurs, maintenance mowing should be confined to the favored portion to reduce the area to be searched. Straight strips permit rapid movement because woodcock and snipe can usually be seen well ahead of a vehicle. Even if there are many natural areas used by woodcock or snipe in a field, mowed strips serve as handy navigational aids.

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- Merovka, L. J. 1939. The woodcock in Louisiana. Louisiana Conservation Review, 8 (4): 10-14.

WOODCOCK BANDING ON THE CAPE MAY PENINSULA, NEW JERSEY*

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The technique of capturing American woodcock (Philohela minor Gmelin) by the use of lights and long-handled nets is well known. Many woodcock have been banded in this manner on both their natal areas (Rieffenberger and Kletzly 1967) and wintering grounds (Glasgow 1958). However, little was known of the practicality of this method when dealing with migrants. Four years of fall banding in the Canaan Valley of West Virginia resulted in several hundred woodcock captures, which implied that the nightlighting technique should work well elsewhere.

An attempt to ascertain the success of this method on large numbers of migrating woodcock was made in the Cape May region of southern New Jersey during late November 1968. This was a cooperative effort of biologists from West Virginia, New Jersey, Maine, and the Bureau of Sport Fisheries and Wildlife.

METHODS

During the day fields were scouted, and those having the appearance of being suitable for woodcock were charted (Figure 1). Past experience has shown that low ground vegetation with scattered, taller cover was

* Submitted to Bird Banding for publication (June 1969).

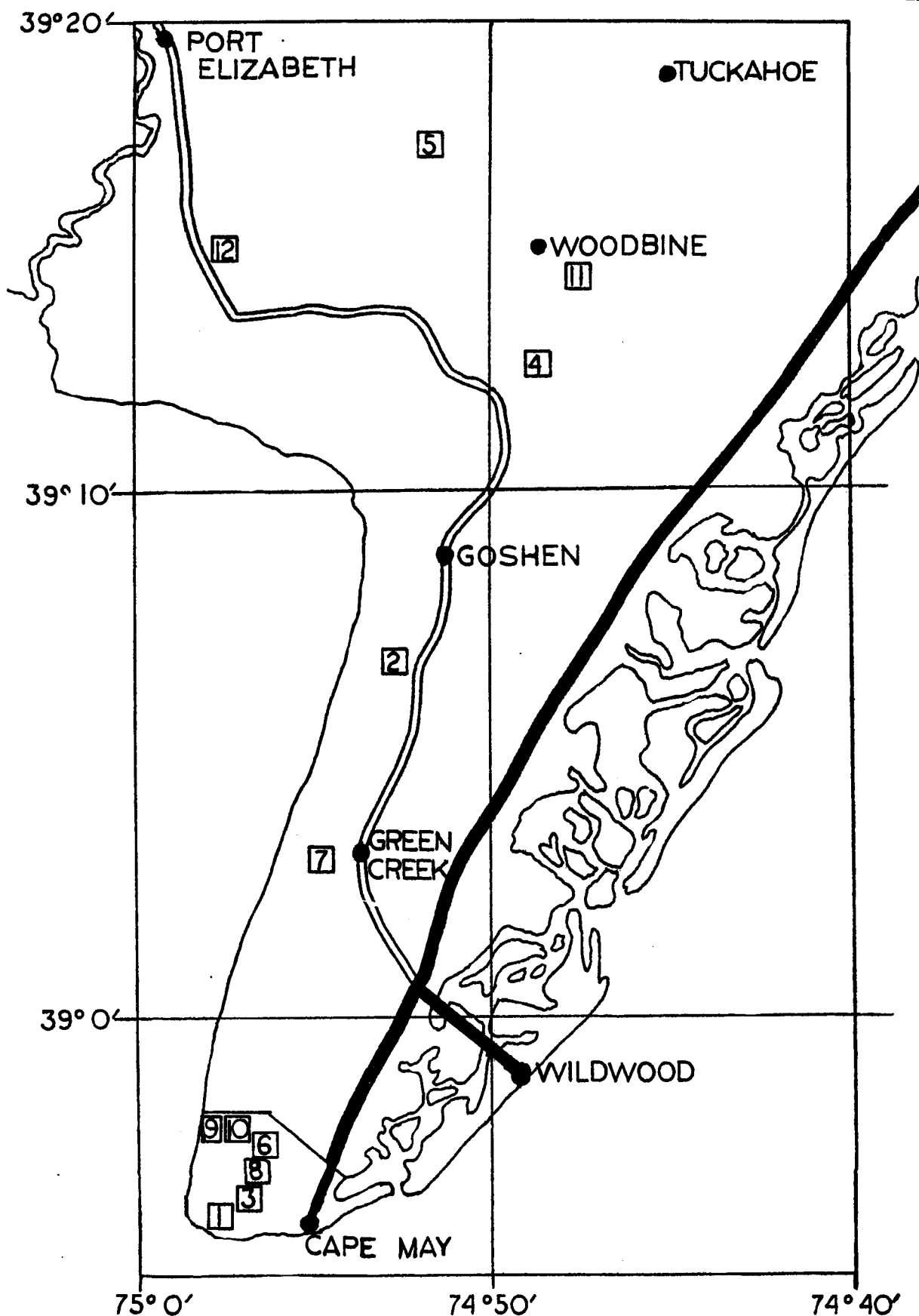


Figure 1. -- Location of fields searched for woodcock on the Cape May Peninsula, New Jersey (November 1968).

desirable. When these criteria were observed, landowners were contacted for permission to "check out" these areas at night.

After dark, a return trip was made to the chosen fields. Biologists, equipped with long-handled nets and spotlights powered by motorcycle batteries, then started a systematic search of the fields. A fast walk was maintained until such time as woodcock were observed on the ground or flushed; then, a slower pace and more thorough investigation was in order. Where cover or soil conditions were suited only to foot travel, and many woodcock were present, the entire field was covered. If the field contained large numbers of woodcock, had low ground cover, and firm soil conditions; it was left without further attempts to capture birds on foot. The landowner was then reapproached, and permission was requested to drive a pick-up truck through the field.

On the return trip, usually the next night, one biologist would drive the truck slowly up and down the field, while another either stood on a large tool chest in the rear or sat on the roof of the cab. From this vantage point a hand-held powerful spotlight (200,000 candlepower) was used to scan the ground directly in front and to one or both sides. The width of a swath was determined by density and type of ground cover and by how closely the second swath paralleled the first. When the observer spotted a woodcock, he tapped on the roof keeping his spotlight on the bird. The driver stopped the truck (leaving it in neutral), got out, grabbed a net, and put it over the bird. While the netter was retrieving his catch, the spotter would cast about for other woodcock. It was not uncommon to see additional birds squatting quietly nearby. Three of these "eyewitnesses" were the most caught at one stop. Ground cover usually allowed for a visibility radius of about 23 feet or approximately one-twentieth of an acre. When multiple catches were made, the birds were put in a holding cage and not banded until all were caught. Singles were banded and released immediately. Birds held

any length of time in cages suffered from bloodied scalps and feces-matted plumage. Age and sex determinations were made under the bright spotlights.

RESULTS

Six hundred forty-four woodcock were banded in 12 nights (Table 1). Nineteen of these were recaptured at a later date in the same fields (Table 2). There were also nine mortalities. Most of the mortalities occurred on nights when the capture technique was being introduced to biologists unaccustomed to the procedure. Three common snipe (Capella gallinago delicata) were also captured and banded.

Twenty-four birds were caught while making an initial nightlighting trip through miscellaneous fields checked only once. These fields yielded woodcock captures at the rate of 0.9 per man hour. Eighty-two woodcock were found in 25 man hours or 3.3 per man hour (Table 3).

Ninety-six woodcock were banded while walking in fields searched on foot after being found to contain large numbers of birds. This method located 379 woodcock in 36 man hours or 10.5 per man hour. However, the catch was only 2.7 per man hour (25 percent). Woodcock observed per acre ranged from 1.1 to 16.3 with a mean of 7.7 found using each acre (Table 4).

Nightlighting from a vehicle was the most successful technique of capturing woodcock. Five hundred forty-three of 1,186 woodcock observed (46 percent) were captured in 120 man hours. All 19 of the repeats and the three snipe were also taken in this manner. The capture rate ranged from 2.7 to 6.2 woodcock per man hour on a nightly basis, with the mean being 4.5 per hour (Table 5). This was well above the mean of 2.7 per hour caught in fields searched on foot. The best ratio of birds caught to birds found was also in fields nightlighted from a vehicle. The mean number of woodcock found per acre in a vehicle (1.9) is not

comparable with the 7.7 woodcock observed per acre walking; local concentrations as high as four per one-twentieth of an acre were not uncommon.

DISCUSSION

Fields had a wide range of cover types. The region had many truck farms, and most of the fields were sown to rye as a winter cover crop. Fortunately, woodcock held this form of vegetation in low esteem as nocturnal habitat. Pasture lands were few and far between and usually heavily grazed, but all had a few woodcock utilizing them. Abandoned lands, or fields from which a crop had been removed in early summer and remained untilled, were the most common type checked. Hayfields, excepting those with very dense growths of alfalfa, all yielded woodcock (Appendix).

Weather conditions prevailing during nightlighting operations are provided in Table 6. Note that the highest ratios of woodcock captured (to those found) occurred on very windy nights when there was no moonlight. Woodcock were more reluctant to fly in high winds and the sound of a biologist's approach was masked by its noise.

Moonlight reduced the catch much less when a vehicle was used than when afoot.

Fields with heavy stands of dead weed stalks interfered with visibility and stealth when nightlighted on foot. When nightlighting operations were conducted from a truck, it was not necessary to approach a bird as cautiously because the sound of the idling engine muffled movements.

Fields that contained grasses as the dominant type of ground cover, ranked at the bottom on a catch per man hour basis when nightlighted from a truck.

Alfalfa fields produced the best catches and the highest number of birds found. The ratio of birds caught (to those found) tended to be highest in fields with invading grasses. The larger the openings between stools of alfalfa, the easier it was to spot woodcock before they flushed, and there were no dry stalks to snap underfoot at a critical moment.

SUMMARY

Large numbers of woodcock migrating toward winter range can be captured and banded by nightlighting. Working from a slowly moving vehicle and using its engine as a power source was more successful than walking with battery-powered lights. Woodcock did not flush as readily with the approach of a truck as from a man walking. The brighter light, higher vantage point, and muffled engine noise afforded by use of a vehicle; made woodcock easier to sight and approach.

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- Rieffenberger, J. C. and R. C. Kletzly. 1967. Woodcock nightlighting techniques and equipment. p. 33-35. In Woodcock Research and Management, 1966. Bureau of Sport Fisheries and Wildlife, Special Scientific Report -- Wildlife No. 101. iv + 40p.

Table 1. -- Woodcock age and sex groups by date of capture on the Cape May Peninsula, New Jersey
(November 1968)

November 1968	Age and Sex Categories										Total Woodcock Captured*	Immature per Adult Ratio		
	HY		HY		HY		AHY		AHY				AHY	
	Male No. %	Female No. %	Male No. %	Female No. %	Male No. %	Female No. %	Male No. %	Female No. %	Male No. %	Female No. %				
18	2 33	4 67	6 100	0 -	0 -	0 -	0 -	0 -	0 -	6	---			
19	14 47	11 37	25 84	4 13	1 3	5 16	30	5.0						
20	33 49	25 38	58 87	3 5	5 8	8 13	66	4.4						
21	39 54	22 31	61 85	7 9	4 6	11 15	72	5.5						
22	37 65	15 26	52 91	5 9	0 -	5 99	57	10.4						
23	20 55	13 36	33 91	2 6	1 3	3 9	36	11.0						
24	16 47	4 12	20 59	10 29	4 12	14 41	34	1.4						
25	24 61	9 23	33 84	6 16	0 -	6 16	39	5.5						
26	33 49	23 34	56 83	8 12	3 5	11 17	67	7.5						
27	86 54	32 20	118 74	26 16	14 20	40 26	158	3.0						
28	20 62	8 25	28 87	4 13	0 -	4 13	32	7.0						
29	32 48	29 44	61 92	3 5	2 3	5 8	66	12.2						
TOTAL	346 53	195 30	551 83	78 12	34 5	112 17	663	4.9						

* Includes 19 repeats (see Table 2).

Table 2. -- Nineteen woodcock which were recaptured in the same field where banded on the Cape May Peninsula, New Jersey (November 1968)

Age and Sex	Number	Date Banded (November)	Date Repeated (November)
Hatching Year			
Male	1	19	20
	1	20	28
	1	20	29
	5	22	25
	1	22	27
	1	25	27
	1	26	29
Hatching Year			
Female	1	20	28
	1	21	27
	2	21	29
	1	22	29
	1	25	27
After Hatching Year			
Male	2	24	27

Table 3. -- Miscellaneous fields checked only once for woodcock utilization on the Cape May Peninsula, New Jersey (November 1968)

Date (November)	Woodcock Found	Total Caught	Man Hours	Birds/hour Found Caught	
18	15	6	3	5.0	2.0
19	1	0	2	0.5	0.0
20	3	2	1	3.0	2.0
21	35	7	4	8.8	1.8
22	0	-	2	---	---
23	25	7	8	3.1	0.9
24	3	2	2	1.5	1.0
25	0	-	2	---	---
29	0	-	1	---	---
TOTAL	82	24*	25	3.3	0.9

* 29% of the woodcock found.

Table 4. -- Fields nightlighted on foot to capture woodcock on the Cape May Peninsula, New Jersey
(November 1968)

Field Number	Dates Searched (November)	Woodcock Caught By Age & Sex					Woodcock found	Percent caught	Acres searched per night	Man hours	Woodcock caught per man hour	Woodcock found per man hour	Woodcock found per acre	
		HY-M	HY-F	AHY-M	AHY-F	Total							min.	max.
1	19, 20, 28, 29	12	6	2	2	22	67	33	3.6	10	2.2	6.7	1.1	8.3
2	23, 25, 28	25	8	3	1	37	188	20	4.6	12	3.1	15.6	10.2	16.3
3	19, 20, 28, 29	8	5	2	1	16	47	34	1.8	6	3.2	7.9	2.8	11.1
5*	21	2	1	0	0	3	30	10	3.0	2	1.5	15.0	10	
7*	19	7	3	2	0	12	30	40	6.0	2	6.0	15.0	5	
10	20, 28	1	5	0	0	6	17	35	2.7	4	1.5	4.2	2.6	3.7
Summation for 7 nights		55	28	9	4	96	379	25	48.8	36	2.7	10.5	7.7 (Mean)	

* A vehicle was used after the first night.

Table 5. -- Fields nightlighted from a vehicle to capture woodcock on the Cape May Peninsula, New Jersey
(November 1968)

Field Number	Dates Searched (November)	Woodcock Caught By Age & Sex				Total	Woodcock found	Percent caught	Acres searched per night	Man hours	Woodcock caught per man hour	Woodcock found per man hour	Woodcock found per acre	
		HY-M	HY-F	AHY-M	AHY-F								min.	max.
4	20, 21, 25, 27, 28, 29	27	8	3	3	41	72	57	9.1	15	2.7	4.8	0	2.7
5	24, 27	22	8	11	4	45	106	42	9.0	12	3.7	8.8	5.1	11.8
6	26, 29	14	12	3	0	29	70	41	9.1	6	4.8	11.7	2.7	4.9
7	20, 23, 25, 28	35	32	5	1	73	143	51	15.5	19	3.8	7.5	1.0	3.4
8	26, 29	16	15	4	2	37	69	54	8.2	6	6.2	11.5	1.8	6.6
9	26, 29	11	9	2	1	23	44	52	2.7	5	4.6	8.8	4.1	12.2
11	21, 22, 25, 27, 29	102	56	17	4	179	396	45	36.4	33	5.4	12.0	1.3	2.7
12	26, 29	62	20	21	13	116	286	41	126.5	24	4.8	11.9	0.3	1.9
Summation for 10 nights		289	160	66	28	543	1186	46	610	120	4.5	9.9	1.9 (Mean)	

Table 6. -- Weather conditions, and their effects on woodcock captures, during nightlighting operations on the Cape May Peninsula, New Jersey (November 1968)

Date (November)	Cloud cover			Air movement				Temperature		Moon		Number of woodcock caught*	Woodcock caught per man hour	Percent of woodcock caught
	Overcast	Partly cloudy	Clear	Very windy	Windy	Breeze	Calm	Cold	Warm	Light	After moonset			
18	X						X		X		X	6	2.0	40
19			X		SW			X			X	30	3.0	37
20			X	WNW				X			X	66	3.0	56
21	X				W			X			X	72	5.1	38
22			X	SW				X			X	57	5.7	57
23			X				X	X			X	36	2.2	29
24	X			SW					X		X	34	4.2	54
25			X		NW			X		X		39	3.2	31
26		X			SW			X		X	(First Quarter)	67	5.6	42
27	X					W			X	X		158	4.8	39
28		X		S					X	X		32	2.7	27
29		X			W			X		X		66	2.2	44

* Includes 19 repeats

APPENDIX

Acreage and vegetative cover of fields utilized by woodcock at night on the Cape May Peninsula, New Jersey, November 1968. See Figure 1 for location of each field.

A. Abandoned Cropland:

Dominant species in these fields were ragweed (Ambrosia spp.) and goldenrod (Solidago spp.). Their dead stalks formed an overstory 1-1/2' to 2' high. Much of the ground was covered by a mat of chickweed (Stellaria spp.).

Field 1 (3.6 acres) - Minor species: Crabgrass (Digitaria sp.), mints (Labiatae), dock (Rumex sp.), panic grass (Panicum sp.), and primrose (Primula sp.).

Field 2 (4.6 acres) - Minor species: Little bluestem (Andropogon scoparius) and clover (Trifolium spp.).

B. Abandoned land which was clipped annually:

Field 3 (1.8 acres) - Dominant species: Orchard grass (Dactylis glomerata) and bluegrass (Poa sp.). Minor species: Chickweed, mullein (Verbascum thapsus), plantain (Plantago spp.), crabgrass and panic grass.

Field 4 (9.1 acres) - Dominant species: Clover, orchard grass, crabgrass, and chickweed. Minor species: Plantain and panic grass.

Field 5 (9.0 acres) - Dominant species: Crabgrass, and sorrel (Rumex acetosella). Minor species: Ragweed and little bluestem.

C. Alfalfa Meadow:

Dominant species: Alfalfa (Medicago sativa). This had grown to a height of 6" to 8" since last harvested. There was no closed overstory. Chickweed formed a mat over much of the open space between stools.

Field 6 (9.1 acres) - Minor species: Bluegrass and mint.

Field 7 (15.5 acres) - Minor species: Plantain, mint, and peppergrass (Lepidium sp.).

Field 8 (8.2 acres) - Minor species: Plantain, panic grass, mullein, bluegrass, and orchard grass.

Field 9 (2.7 acres) - Minor species: Plantain, panic grass, and mullein.

Field 10 (2.7 acres) - Minor species: Plantain and bluegrass.

Field 11 (36.4 acres) - Minor species: Dock and clover.

Field 12 (126.5 acres) - Minor species: Dock and clover.

