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BLACK DUCK DISTRIBUTION, HARVEST CHARACTERISTICS, AND SURVIVAL

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UNITED STATES DEPARTMENT OF THE INTERIOR
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BUREAU OF SPORT FISHERIES AND WILDLIFE
Special Scientific Report—Wildlife No. 139

UNITED STATES DEPARTMENT OF THE INTERIOR
Fish and Wildlife Service
Bureau of Sport Fisheries and Wildlife

**BLACK DUCK DISTRIBUTION,
HARVEST CHARACTERISTICS,
AND SURVIVAL**

By

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PREFACE

In 1967 an analysis of green-winged teal banding and other population data was published (Moisan et al., 1967). The present publication containing similar but more extensive material on the black duck, represents the second of a projected series of reports based on data accumulated in the files of the Bureau of Sport Fisheries and Wildlife over the past five decades. Analyses of mallard data are currently underway and are expected to form the basis for additional reports in the series. The objectives of the series are: (1) to make data available to those with special interest in the biology of migratory game birds, (2) analyse them for information of significance to management and (3) show where additional research is needed.

We hope that the present report meets these objectives for the black duck. It is based on a manuscript prepared at the Migratory Bird Populations Station in 1964; revised by Aelred D. Geis in 1968; and later, by others. Some of the important conclusions have been published by Martinson, Geis and Smith (1968).

Note.--The present address of Robert I. Smith is
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APPENDIX TABLES AND MAPS

Because of their bulk these are provided on microfiche (see inside back cover). They are included for those interested in detailed information on distribution of recoveries and derivation of kill in States and Provinces.

List of Appendix Tables

Appendix tables B1 through B50 show the percent distribution of recoveries in each State and Province from banding in minor reference areas. Each table contains one or more banding areas and presents data for one or more banding periods. Percentages based on direct or indirect recoveries are shown separately or, in some cases, combined. Recoveries of immature and adult black ducks are shown separately and combined. Tables pertaining to each reference area are shown in the following list (see discussion on pages 12-13). Tables B51 through B57 contain information on distribution and sources of harvest in individual States and Provinces utilizing weighted and unweighted recoveries from summer and winter reference areas.

<u>Table</u>	<u>Banding area</u>	<u>Banding period</u>
B1	Maritimes	Summer
B2	Maritimes	October
B3	Labrador and Eastern Quebec	Summer
B4	Labrador and Eastern Quebec	October
B5	Northern Quebec, Southern Quebec, St. John and St. Croix Rivers, and Western Maine	Summer
B6	Northern Quebec	October
B7	Southern Quebec	October
B8	St. John and St. Croix Rivers	October
B9	Western Maine	October
B10	Vermont and New Hampshire, and Coastal Massachusetts	Summer
B11	Vermont and New Hampshire	October
B12	Coastal Massachusetts	October
B13	Southern New England and Long Island	Summer

List of Appendix Tables (con.)

<u>Table</u>	<u>Banding area</u>	<u>Banding period</u>
B14	Southern New England and Long Island	October
B15	Lake Champlain	Summer
B16	Lake Champlain	October
B17	Chesapeake and Delaware Bays	Summer
B18	Chesapeake and Delaware Bays	October
B19	Eastern Lake Ontario	Summer
B20	Eastern Lake Ontario	October
B21	Western Lake Ontario	Summer
B22	Western Lake Ontario	October
B23	Western James Bay	Summer
B24	Western James Bay	October
B25	Upper Great Lakes	Summer
B26	Upper Great Lakes	October
B27	Western Lake Erie	Summer
B28	Western Lake Erie	October
B29	Eastern Lake Michigan	Summer
B30	Eastern Lake Michigan	October
B31	Western Lake Michigan	Summer
B32	Western Lake Michigan	October
B33	Upper Mississippi River	Summer
B34	Upper Mississippi River	October
B35	Northwest	Summer
B36	Maritimes	December, Jan.-Feb., Mar.-Apr.

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<u>Table</u>	<u>Banding area</u>	<u>Banding period</u>
B37	Maine	November, Jan.-Feb., Mar.-Apr.
B38	New England and Eastern Long Island	November, December, Jan.-Feb., Mar.-Apr.
B39	Western Long Island and Hudson River	November, December, Jan.-Feb., Mar.-Apr.
B40	Mid-Atlantic	November, December, Jan.-Feb., Mar.-Apr.
B41	Mid-Atlantic Coastal	November, December, Jan.-Feb., Mar.-Apr.
B42	Southeast	November, December, Jan.-Feb., Mar.-Apr.
B43	Lake Ontario	November, December, Jan.-Feb., Mar.,-Apr.
B44	Lake Erie	November, December, Jan.-Feb., Mar.,-Apr.
B45	Upper Ohio River	November, December, Jan.-Feb., Mar.-Apr.
B46	Tennessee River	November, December, Jan.-Feb., Mar.-Apr.
B47	Lake Michigan	November, December, Jan.-Feb., Mar.-Apr.
B48	Upper Mississippi River	November, December, Jan.-Feb., Mar.-Apr.
B49	Lower Mississippi River	Jan.-Feb.
B50	Western	November, December, Jan.-Feb., Mar.-Apr.

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Tables B51 and B52 show the number of recoveries in each State and Province from each reference area - basic information used in calculating weighted derivation of the kill in Tables B53 through B57. The weighting of band recoveries is discussed on pages 10 and 11.

Table

B51 Recoveries used in calculating weighted derivation of kill, and total kill in States and Provinces from black ducks banded in summer reference areas.

B52 Recoveries used in calculating weighted derivation of kill and total adult kill in States and Provinces from black ducks banded in winter reference areas.

Tables B53 through B57 show the reference area source of the harvest by States and Provinces for the entire hunting season and by hunting season month. These tables are discussed on page 40.

B53 Summer reference area source of the black duck kill by States and Provinces. (Shown as percent weighted recoveries derived from minor reference areas.)
[States and Provinces of recovery shown alphabetically on microfiche 2 and 3. For Alabama through New Hampshire see last 16 images on microfiche 2; for New Jersey through Wisconsin see first 17 images on microfiche 3.]

B54 Winter reference area source of the black duck kill by States and Provinces. (Shown as percent weighted recoveries derived from minor reference areas.)
[States and Provinces of recovery shown alphabetically on microfiche 3, images 132-152.]

B55 Summer reference area source of the black duck kill in Canadian Provinces by hunting season month. (Shown as percent weighted recoveries derived from minor reference areas.)
[Provinces of recovery shown alphabetically on microfiche 3, images 153-160.]

List of Appendix Tables (con.)

Table

- B56 Summer reference area source of the black duck kill in the United States by hunting season month. (Shown as percent weighted recoveries derived from minor reference areas.)
[States and Provinces of recovery shown alphabetically on microfiche 3 and 4. For Connecticut through Michigan see last 12 images of microfiche 3; for New Hampshire through Wisconsin see first 18 images on microfiche 4.]
- B57 Winter reference area source of the black duck kill in States and Provinces by hunting season month. (Shown as percent weighted recoveries derived from minor reference areas.)
[States and Provinces of recovery shown alphabetically on microfiche 4, last 16 images.]

List of Appendix Maps

These maps show the actual number of recoveries from bandings in minor reference areas by degree block of latitude and longitude. Maps pertaining to each reference area are shown in the following list. (See discussion on pages 12-13).

<u>Map Number</u>	<u>Banding location</u>	<u>Banding period</u>	<u>Type of recoveries</u>
<u>Maritimes</u>			
C1	New Brunswick	Summer	Total
C2	Newfoundland	October	Direct
C3	Newfoundland	October	Indirect
C4	Nova Scotia	Summer	Total
C5	Prince Edward Island	Summer	Total
<u>Labrador and Eastern Quebec</u>			
C6	Labrador	Summer	Total
C7	Labrador	October	Direct
C8	Labrador	October	Indirect
C9	Quebec	Summer	Total
C10	Quebec	October	Direct
C11	Quebec	October	Indirect
<u>Northern Quebec</u>			
C12	Quebec	Summer	Total
<u>Southern Quebec</u>			
C13	Quebec	Summer	Total
C14	Quebec	October	Direct
C15	Quebec	October	Indirect
<u>St. John and St. Croix Rivers</u>			
C16	Maine	Summer	Total
C17	Maine	October	Direct
C18	Maine	October	Indirect
C19	New Brunswick	Summer	Total
C20	New Brunswick	October	Direct
<u>Western Maine</u>			
C21	Maine	Summer	Total
C22	Maine	October	Direct
C23	Maine	October	Indirect
<u>Vermont and New Hampshire</u>			
C24	New Hampshire	Summer	Total
C25	Vermont	Summer	Total
<u>Coastal Massachusetts</u>			
C26	Massachusetts	Summer	Total
C27	Massachusetts	October	Direct
C28	Massachusetts	October	Indirect

List of Appendix Maps (con.)

<u>Map number</u>	<u>Banding location</u>	<u>Banding period</u>	<u>Type of recoveries</u>
<u>Southern New England and Long Island</u>			
C29	Connecticut	Summer	Total
C30	Connecticut	October	Direct
C31	Connecticut	October	Indirect
C32	Massachusetts	Summer	Total
C33	Massachusetts	October	Direct
C34	Massachusetts	October	Indirect
C35	New York	Summer	Total
C36	New York	October	Direct
C37	New York	October	Indirect
<u>Lake Champlain</u>			
C38	New York	Summer	Total
C39	New York	October	Direct
C40	New York	October	Indirect
C41	Vermont	Summer	Total
C42	Vermont	October	Direct
C43	Vermont	October	Indirect
<u>Chesapeake and Delaware Bays</u>			
C44	Delaware	Summer	Total
C45	Delaware	October	Direct
C46	Delaware	October	Indirect
C47	Maryland	Summer	Total
C48	Maryland	October	Direct
C49	Maryland	October	Indirect
C50	New Jersey	Summer	Total
C51	New Jersey	October	Direct
C52	New Jersey	October	Indirect
C53	Pennsylvania	Summer	Total
<u>Eastern Lake Ontario</u>			
C54	New York	Summer	Total
C55	New York	October	Direct
C56	New York	October	Indirect
C57	Ontario	Summer	Total
<u>Western Lake Ontario</u>			
C58	New York	Summer	Total
C59	New York	October	Direct
C60	New York	October	Indirect
C61	Ontario	Summer	Total
C62	Ontario	October	Direct
C63	Ontario	October	Indirect

List of Appendix Maps (con.)

<u>Map number</u>	<u>Banding location</u>	<u>Banding period</u>	<u>Type of recoveries</u>
	<u>Western James Bay</u>		
C64	Ontario	Summer	Total
	<u>Upper Great Lakes</u>		
C65	Michigan	Summer	Total
C66	Michigan	October	Direct
C67	Michigan	October	Indirect
	<u>Western Lake Erie</u>		
C68	Michigan	Summer	Total
C69	Michigan	October	Direct
C70	Michigan	October	Indirect
C71	Ohio	Summer	Total
C72	Ohio	October	Direct
C73	Ohio	October	Indirect
	<u>Eastern Lake Michigan</u>		
C74	Indiana	Summer	Total
C75	Indiana	October	Direct
C76	Michigan	Summer	Total
C77	Michigan	October	Direct
C78	Michigan	October	Indirect
	<u>Western Lake Michigan</u>		
C79	Illinois	Summer	Total
C80	Illinois	October	Direct
C81	Illinois	October	Indirect
C82	Indiana	Summer	Total
C83	Indiana	October	Direct
C84	Indiana	October	Indirect
C85	Wisconsin	Summer	Total
C86	Wisconsin	October	Direct
C87	Wisconsin	October	Indirect
	<u>Upper Mississippi River</u>		
C88	Minnesota and Wisconsin	Summer	Total
	<u>Northwest</u>		
C89	Manitoba and Minnesota	Summer	Total
	<u>Maritimes</u>		
C90	Nova Scotia	Jan.-Feb.	Total
C91	Prince Edward Island	Jan.-Feb.	Total
C92	Prince Edward Island	Mar.-Apr.	Total

List of Appendix Maps (con.)

<u>Map number</u>	<u>Banding location</u>	<u>Banding period</u>	<u>Type of recoveries</u>
	<u>Maine</u>		
C93	Maine	Jan.-Feb.	Total
C94	Maine	Mar.-Apr.	Total
	<u>New England and Eastern Long Island</u>		
C95	Connecticut	November	Direct
C96	Connecticut	November	Indirect
C97	Connecticut	December	Direct
C98	Connecticut	December	Indirect
C99	Connecticut	Jan.-Feb.	Total
C100	Connecticut	Mar.-Apr.	Total
C101	Massachusetts	November	Direct
C102	Massachusetts	November	Indirect
C103	Massachusetts	December	Direct
C104	Massachusetts	December	Indirect
C105	Massachusetts	Jan.-Feb.	Total
C106	Massachusetts	Mar.-Apr.	Total
C107	New York	November	Direct
C108	New York	November	Indirect
C109	New York	December	Indirect
C110	New York	Jan.-Feb.	Total
C111	New York	Mar.-Apr.	Total
C112	Rhode Island	November	Direct
C113	Rhode Island	November	Indirect
C114	Rhode Island	December	Direct
C115	Rhode Island	December	Indirect
C116	Rhode Island	Jan.-Feb.	Total
C117	Rhode Island	Mar.-Apr.	Total
	<u>Western Long Island and Hudson River</u>		
C118	New York	November	Direct
C119	New York	November	Indirect
C120	New York	December	Direct
C121	New York	December	Indirect
C122	New York	Jan.-Feb.	Total
C123	New York	Mar.-Apr.	Total
	<u>Mid-Atlantic</u>		
C124	Delaware	December	Indirect
C125	Delaware	Jan.-Feb.	Total
C126	Delaware	Mar.-Apr.	Total

List of Appendix Maps (con.)

<u>Map number</u>	<u>Banding location</u>	<u>Banding period</u>	<u>Type of recoveries</u>
<u>Mid-Atlantic</u>			
C127	Maryland	December	Direct
C128	Maryland	December	Indirect
C129	Maryland	Jan.-Feb.	Total
C130	Maryland	Mar.-Apr.	Total
C131	New Jersey	December	Indirect
C132	New Jersey	Jan.-Feb.	Total
C133	New Jersey	Mar.-Apr.	Total
C134	North Carolina	Jan.-Feb.	Total
C135	North Carolina	Mar.-Apr.	Total
C136	Pennsylvania	Jan.-Feb.	Total
C137	Pennsylvania	Mar.-Apr.	Total
<u>Mid-Atlantic Coastal</u>			
C138	New Jersey	Jan.-Feb.	Total
C139	New Jersey	Mar.-Apr.	Total
C140	Virginia	November	Direct
C141	Virginia	November	Indirect
C142	Virginia	December	Direct
C143	Virginia	December	Indirect
C144	Virginia	Jan.-Feb.	Total
<u>Southeast</u>			
C145	South Carolina	November	Indirect
C146	South Carolina	Jan.-Feb.	Total
<u>Lake Ontario</u>			
C147	New York	November	Direct
C148	New York	November	Indirect
C149	New York	December	Direct
C150	New York	December	Indirect
C151	New York	Jan.-Feb.	Total
C152	New York	Mar.-Apr.	Total
C153	Ontario	November	Direct
<u>Lake Erie</u>			
C154	Michigan	November	Indirect
C155	Michigan	December	Indirect
C156	Michigan	Jan.-Feb.	Total
C157	Michigan	Mar.-Apr.	Total
C158	Ohio	November	Direct
C159	Ohio	November	Indirect
C160	Ohio	December	Indirect

List of Appendix Maps (con.)

<u>Map number</u>	<u>Banding location</u>	<u>Banding period</u>	<u>Type of recoveries</u>
	<u>Lake Erie</u>		
C161	Ohio	Jan.-Feb.	Total
C162	Ohio	Mar.-Apr.	Total
C163	Pennsylvania	November	Direct
C164	Pennsylvania	November	Indirect
C165	Pennsylvania	December	Indirect
C166	Pennsylvania	Jan.-Feb.	Total
C167	Pennsylvania	Mar.-Apr.	Total
	<u>Upper Ohio River</u>		
C168	West Virginia	December	Indirect
	<u>Tennessee River</u>		
C169	Alabama	December	Direct
C170	Alabama	December	Indirect
C171	Alabama	Jan.-Feb.	Total
C172	Tennessee	December	Direct
C173	Tennessee	December	Indirect
C174	Tennessee	Jan.-Feb.	Total
	<u>Lake Michigan</u>		
C175	Indiana	November	Indirect
C176	Indiana	Mar.-Apr.	Total
C177	Michigan	November	Direct
C178	Michigan	November	Indirect
C179	Michigan	December	Indirect
C180	Michigan	Mar.-Apr.	Total
C181	Wisconsin	November	Indirect
	<u>Upper Mississippi River</u>		
C182	Illinois	November	Direct
C183	Illinois	November	Indirect
C184	Illinois	December	Direct
C185	Illinois	December	Indirect
C186	Illinois	Jan.-Feb.	Total
C187	Illinois	Mar.-Apr.	Total
C188	Indiana	November	Direct
C189	Indiana	November	Indirect
C190	Indiana	December	Indirect
C191	Indiana	Jan.-Feb.	Total
C192	Indiana	Mar.-Apr.	Total
C193	Tennessee	November	Direct
C194	Tennessee	November	Indirect
C195	Tennessee	December	Indirect
C196	Tennessee	Jan.-Feb.	Total

INTRODUCTION

Importance of the Black Duck

The black duck, Anas rubripes (Brewster), is the most important game duck in the Canadian Provinces from Ontario eastward, and traditionally has been the primary game duck on the east coast of the United States. About one-fourth of the duck kill in the Atlantic Flyway consists of black ducks (table 1). The species is especially important in coastal States north of Maryland where it contributes about one-half the total harvest (table 2). In the Southeast and in States between the Appalachian Mountains and the Mississippi River, it makes up a smaller proportion of the bag. Among these States it is most important in Michigan, Ohio, Indiana, Kentucky and Tennessee. Westward from the Mississippi River Valley black duck numbers decline sharply, but the species is seen on the prairies occasionally.

The black duck's sporting qualities place it high in the esteem of hunters even where it is not numerically important in the harvest. Its wariness, large size, and palatability, all contribute to making it a favored game duck in eastern marshes, rivers and ponds from Quebec and Ontario to the Carolinas.

Previous Studies

During the 1930's and 1940's, many black ducks were banded at the Austin Ornithological Research Station at Cape Cod, Massachusetts. Results of this banding work were summarized by Hagar (1946). After interpreting additional banding data, he published a second report Hagar (1954) discussing the breeding ground origins of black ducks wintering along the Atlantic coast and band recovery distributions from pre-hunting season bandings in Canada. These data indicated that the harvest in New England and the Maritime Provinces was derived from breeding areas east of those supplying other harvest areas. Hagar proposed a northeastern harvest unit which, on the basis of its unique characteristics, could be managed as an area distinct from the remainder of the Atlantic Coast States.

Addy (1953) summarized the distribution of black duck band recoveries and delineated regional subdivisions, each having a population with unique distribution characteristics. Addy recognized a northeastern unit (eastern New England, the Maritimes and Labrador) as one of five divisions associated with the Atlantic Flyway and defined four divisions for the Mississippi Flyway. He also discussed the frequency with which black ducks banded in the Maritime Provinces were recovered in New Jersey and other States along the mid-Atlantic coast. His conclusions were not in complete agreement with those of Hagar (1954) regarding the independence of the Northeast as a harvest unit. The work of both Hagar and Addy pointed to the need for additional bandings in many areas.

Wright (1954) brought together much information concerning the life history and ecology of this species. He discussed summer and winter ranges, habitat preferences, food habits, fall migrations, and hunting. Nesting cycle statistics, based upon his field studies in New Brunswick, were included and a life equation for a black duck population was presented. These data and those presented by Bellrose and Chase (1950) represent the first published estimates of mortality and production rates for the species.

Lemieux and Moisan (1959) published results of banding work conducted at several stations in Quebec. In their analysis, two populations were recognized and comparisons between them emphasized differences in distribution, recovery rates and mortality rates. Black ducks banded at several southern Quebec locations had higher recovery and mortality rates than those banded in eastern Quebec at Baie Johan Beetz.

Stewart (1958) brought together available information on black duck distribution. He delineated summer and winter ranges from data gathered by breeding ground and winter surveys in Canada and the United States from 1952 to 1956.

Report Objectives

This report has two major objectives. The first is to make available black duck banding and other population data to those interested in particular population segments or discrete harvest areas. The money and effort expended on the banding program, and the interest in management of this species require that the data be put on record. It is impractical to present data for each banding station separately, but in no instance are data combined when different recovery distribution characteristics are apparent.

The second major objective is to extract information of management significance. We recognize that hunting regulations are the management tool that can be most readily applied. Full recreational utilization of the resource probably will require that future harvest management be based on smaller units than existing administrative flyways. Thus both major objectives make it necessary to distinguish all identifiable populations.

With these objectives in mind, all data in the files of the Migratory Bird Populations Station were examined to:

1. Define summer and winter population units having unique harvest characteristics.

2. Determine shooting pressure associated with these population units, noting differences between units, and investigate how factors such as time period, hunting regulations, hunter behavior, and hunter distribution affect shooting pressure.
3. Determine the rate of hunting kill among population units, noting variation between age and sex groups, and determine how shooting pressure and population size affects the kill rate.
4. Determine the size and geographic distribution of the harvest for each population unit, noting variation between different age and sex groups, and investigate factors affecting size and distribution of the kill.
5. Estimate mortality rates for all populations and for different age and sex groups and evaluate the effect of hunting on mortality rates.
6. Examine relationships between production and mortality.
7. Define harvest areas in which the kill is derived from populations different from those in other areas.
8. Measure the relative importance of various breeding and wintering areas for black ducks killed in each State or Province and in selected harvest areas.
9. Estimate the size of the continental population, using all available data.

History of Study and Acknowledgments

This report represents the efforts of many people. Initial study plans were made by Aelred D. Geis, and data analysis began in 1958 under Geis and Samuel M. Carney. In 1959, Fant W. Martin succeeded Carney and examined the black duck banding and recovery information relating to the winter banding period. Results of this work were presented at the Northeast Wildlife Conference in 1960.

In 1959, a fire in the Bird Banding Laboratory damaged and destroyed many important black duck records. No progress was made on the study during 1960 and 1961 while the records were being reconstructed. In 1962, Robert I. Smith was assigned to the study and conducted the analysis of banding and recovery data relating to all periods other than winter. He prepared the tabulations and figures of banding and

recovery data, compiled population estimates which were used as a basis for weighting, described the reference areas of banding and assisted in the preparation of a first draft of the manuscript. Geis wrote sections of the text dealing with sources of information, procedures, hunting kill, mortality rates, production rates, sex ratios, and size of the population, and revised the original manuscript. John P. Rogers was responsible for final preparation of the manuscript for publication.

Only late in the study was the staff large enough to permit continuous work by one or more persons. During this period, Robert P. Shanahan prepared most mortality and recovery rate tables, and the summary of hunting regulations. He also assisted in preparing many figures. Charles F. Kimball made a detailed analysis of trapping repeat records to determine if periods of population stability and movement could be defined. However, results were inconclusive and have been omitted from this report. Stephen V. Goddard, R. Kahler Martinson, and John A. McCann also assisted in the preparation of various parts of the report and staff members of the Section of Waterfowl Population Studies and the Bird Banding Laboratory assisted in preparing recovery distribution maps. Walter F. Crissey, R. Kahler Martinson, C. Edward Addy, Michael Sorensen, Joseph A. Hagar, Van T. Harris, Merle H. Markley, E. H. Dustman, T. S. Baskett and Joseph T. Young reviewed the manuscript and offered many helpful suggestions. Mrs. Mary C. Hill assisted with many aspects of manuscript preparation; Mrs. Edna D. Fritter and Mrs. Michael K. Rackel typed most tables and the text. The work of these people, as well as that of the many waterfowl banders, is gratefully acknowledged.

MAJOR SOURCES OF INFORMATION

This report is based chiefly on banding and recovery data, breeding ground and winter population surveys, mail questionnaire surveys of waterfowl hunters, and duck wing collection surveys. All available information from these sources was examined, and used when pertinent to this study.

Banding and Band Recovery Information

Banding data processed in the Banding Laboratory from 1922 through February 28, 1960, were utilized in this study, as were recovery data through January 15, 1961. In a few instances more recent data were included. State and Provincial governments were responsible for most of the 264,838 bandings listed in table 3. Some banding data were excluded from the analysis because essential information was lacking or questionable. For example, two groups of birds banded at game

farms in early years were excluded because we suspected that the birds were hand-reared.

The distribution of summer and pre hunting season banding stations is shown in figure 1. Much black duck breeding range is relatively inaccessible and in northern Ontario, central Quebec, Labrador and Newfoundland banding can be accomplished only at great expense. As a result, populations in these areas were poorly sampled. The paucity of banded samples from northern areas must be considered in interpreting the results.

Distribution of winter banding stations is shown in figure 2. The southern portions of the winter range lack adequate banded samples. Here, black ducks receive proportionally less attention because other species predominate. Also, their distribution along small wooded streams and swamps make them less accessible for banding than other species which frequent coastal bays and rivers. Nevertheless, banded samples taken during the winter are probably better distributed, and more adequately represent the total population, than bandings on the breeding ground.

Winter and Breeding Ground Surveys

To interpret available banding and harvest data fully, an understanding of the distribution of the black duck population was necessary. The winter waterfowl survey, conducted each January, provided information about winter distribution. This survey attempts a total waterfowl count largely depending on observations made from small aircraft. The degree to which it approaches this ideal varies with duck distribution and nature of the habitat; thus, the survey provides only a rough approximation of the number and distribution of ducks in winter. The implications of using resultant totals to weight band recoveries will be considered in another section. Winter survey data for the period 1948-62 were used in this study.

Several sources were used to derive relative densities of black ducks throughout their breeding range. From 1953-56, full scale aerial breeding ground surveys were conducted experimentally in Ontario, Quebec, and Labrador. They were subsequently discontinued because of technical and operational difficulties but pertinent data from them were used in this study.

A standardized breeding ground survey has not been conducted in the Maritime Provinces or in the Eastern United States. Where available, ground or aerial observations of pairs or broods were used. Otherwise, assumptions were made regarding comparability to surveyed areas.

Knowledge of black duck distribution on the breeding range is still inadequate.

Mail Questionnaire Survey of Waterfowl Hunters

A mail survey of waterfowl hunters has been conducted each year since the 1952-53 hunting season by the Bureau of Sport Fisheries and Wildlife. Data for the period 1952-62 were used in this study.

The primary objective of the survey during earlier years was to estimate total kill of all ducks for each administrative flyway with a sampling error not to exceed 5 percent. In recent years, attempts were made to obtain similar accuracy for major States and certain groups of States within each flyway. The survey is conducted as follows: Names and addresses of a sample of hunters are obtained by the Post Office Department at the time Federal Migratory Bird Hunting Stamps are sold. The hunter is asked to fill out a "Hunter Contact Card." One portion of this card listing the hunter's name and address is returned to the Bureau of Sport Fisheries and Wildlife. The other portion is retained by the hunter and used during the hunting season to record his kill. At the end of the season, the hunter is sent a questionnaire inquiring about his waterfowl hunting success.

Post Offices where the samples of hunters are obtained are selected randomly in each State. The number of hunters contacted annually in each State originally was proportional to duck stamp sales in the previous year. After 1961 a different allocation of the sample was made to improve the accuracy of the estimates and to provide a sample for use in the wing collection survey discussed below. Prior to 1958, questionnaires were sent annually to about 35,000 hunters, of which approximately 24,000 responded. From 1958 to 1963, the survey was gradually expanded until 87,000 hunters were contacted and 55,500 completed questionnaires obtained.

Investigations in four study areas indicated that the waterfowl hunting kill reported by hunters on questionnaires was exaggerated, so procedures were developed to correct this error. This subject was discussed in detail by Atwood (1956).

Beginning in 1961, species composition, which had been obtained from the mail questionnaire survey, was obtained from a duck wing collection survey. Changing the procedure for ascertaining species composition of the kill apparently did not introduce a bias, because both methods yielded similar results for the black duck.

Duck Wing Collection Survey

A sample of duck wings representative of the total duck kill is collected by mail each year while the hunting season is in progress. The wings are used to (1) determine age and sex ratios in the kill for most species (however, a method of determining the sex of immature black ducks from wings has not been developed); (2) ascertain species composition of the kill; (3) obtain information on changes in the species, sex, and age composition of the kill during the season; (4) determine distribution of the duck kill by periods within the season, days of the week, and hours of the day; and (5) obtain a variety of other types of information.

Immediately before the opening of the hunting season, hunters to be sampled are sent 10 or 20 postage-paid envelopes and are asked to return one wing from each duck they kill during the season. An air-mail post card, requesting additional envelopes, is included for those hunters who exhaust their supply. Hunters whose kills are sampled in this manner are selected largely from respondents to the Bureau's Mail Questionnaire Survey of the previous year. Hunters sampled are over 15 years old and have reported bagging at least one duck. Additional hunter contacts come from lists of respondents to previous year's wing surveys and, in a very few instances, from lists of hunters who reported bagging a banded bird. An attempt is made to adjust the Duck Wing Survey sample to the geographical distribution of duck hunters. This was not possible in a number of States because a sufficient number of names was not available.

This survey was first conducted in the Mississippi Flyway in 1959 and was expanded to the Atlantic Flyway in 1960. Since 1961 the survey has been conducted in all four flyways, annually contacting 30,000 to 40,000 hunters who returned from 43,000 to 91,000 wings. Wing survey data from 1960-62 were used in this study.

PROCEDURES

Banding Data Used in the Analysis

Birds are captured in many ways for banding, and bands are recovered and reported to the Bird Banding Laboratory in an even greater variety of ways. Banding and recovery data were stored on punched cards, and the records were screened to insure that only apparently healthy black ducks, captured by standard trapping techniques, banded with standard Fish and Wildlife Service bands, and released without further handling or marking, were used in this analysis.

Table 4 summarizes black duck recoveries according to means of obtaining them. The four major categories were: shot, found dead, caught in traps other than banding, and caught in banding traps. Hunting accounted for 80 to 85 percent of the total bands recovered in all areas.

In this study, distribution of recoveries is used mainly to show geographic or chronologic distribution of the hunting kill. Thus, in most cases, only recoveries from shooting mortality during the hunting season are used. Birds reported shot between September 1 and February 29, or found dead between October 1 and January 31, were assumed to be hunting mortalities. Recoveries obtained in other ways were used in a few cases to examine specific questions. For example, recoveries of black ducks caught in traps set for fur animals were used to calculate mortality rates. This source of recoveries was more important in the 1930's and 1940's than in recent years. Recoveries of banded black ducks obtained during duck trapping operations and from Indians and Eskimos in far northern areas in the spring and summer were included where pertinent.

In this report recoveries of banded birds in the first hunting season after banding are called "first hunting season" recoveries. More restrictively, "direct" recoveries refer to first hunting season recoveries of birds banded during the summer or preseason banding periods. Recoveries taken in hunting seasons subsequent to the first one after banding are termed indirect recoveries or, more specifically, second, third, or later season recoveries. This terminology is used also when discussing recovery rates. For example, "first hunting season" recovery rate is the proportion of banded birds taken during the first hunting season after banding.

As noted above, the primary source of band recoveries is hunters, most of whom report the bands directly to the Bureau. Some hunters turn bands over to conservation agency employees for reporting, either because it is more convenient, or the employees solicit them. Still other bands are reported by bird banders, who are known locally to hunters. Table 5 lists the proportion of total recoveries from States and Provinces submitted by conservation agency employees or bird banders. When this proportion is high in an area, frequency of band receipts and rate of recoveries may not be comparable to other areas, since conservation agency employees and bird banders are more likely to report recoveries than the average hunter. This, of course, affects the distribution of recoveries and also tends to inflate the overall rate of recovery. Normally some recoveries will be reported by conservation agency employees in almost all areas. No recoveries were omitted from the analysis because of the source of the report; therefore, a potential lack of comparability in this respect should be kept in mind.

Exact time and location of band recoveries cannot always be determined from recovery letters. During the study period Bird Banding Laboratory policy was to use the date of the letter as a recovery date if more exact information could not be obtained. "Letter dates" were considered to be applicable to a particular hunting season if the letters were postmarked between September 1 and February 29. We sometimes used records with inexact dates, locations, or both for certain subjects being examined.

Delineating Reference Areas of Banding

Data from adjacent banding locations were often combined for study purposes. This was done because banding locations were too numerous to be studied separately and combined data yielded more meaningful results. By comparing recovery distributions from adjacent banding locations, we determined whether or not they related to the same population and could reasonably be combined. Using this procedure, summer and winter reference areas of banding were delineated. This resulted in some relatively small reference areas. The data show that populations with different recovery distributions may be closely associated, geographically. Reference areas of banding represent specific geographic areas containing populations which, for purposes of this study, could be distinguished on the basis of recovery patterns; they are not intended to represent distinct management units.

Summer reference area boundaries ideally should be determined from recoveries of ducks banded on the breeding ground during May, June, and July. However, because few black ducks were banded during this period, most reference areas were determined by first and later hunting season recoveries from August and September bandings. Bandings during the hunting season were not used, and resulted in exclusion of the following data: banding done after August 31 in Newfoundland, Labrador and Keewatin; after September 5 in Quebec; after September 10 in Manitoba; and after September 15 in Ontario.

Winter reference areas of banding were determined from recoveries of ducks banded in January and February. No bandings were available for these months in South Carolina and Arkansas so December bandings were used for these States.

Banding data prior to 1946 were not used in delineating summer and winter reference areas because of questionable sex and age determinations. In subsequent years the cloacal examination technique (first proposed for ducks by Hochbaum, 1942) gave more reliable sex and age data.

Summer and winter reference areas are presented in figures 3 and 4. They will be referred to by name and number in various sections of this report.

The Weighting of Banding Data

Weighting was necessary when band recovery data from several reference areas or populations were combined for analysis. Two procedures were employed, depending upon the analysis. In one procedure, recovery and mortality rates for the entire continental black duck population were based on rates calculated for each reference area of banding. Because the number of black ducks differed from one reference area to the next, the individual rates related to varying proportions of the total population and could not be directly summed to calculate a reliable mean. Instead each rate was multiplied by the proportion of the total black duck population represented by that rate. The sum of these products was a weighted recovery or mortality rate for the entire population.

A second and somewhat more involved weighting procedure was used to estimate the proportion of the black duck kill in each State or Province relating to each summer or winter reference area. In this case, recoveries, rather than rates, from all banding areas were combined. The total number of recoveries in this procedure contained inequalities relating to amount of banding and rate of harvest as well as population size. Thus, a few recoveries could represent a relatively large population segment, or many recoveries could represent a small population segment. Weighting factors to correct these inequalities and the data used in calculating them are recorded in tables 6, 7, and 8. In these tables, an estimate of the relative size of the population within a reference area is divided by the number of recoveries to determine the size of the population represented per recovery. This value is then multiplied by the first year recovery rate to arrive at a weighting factor representing the relative kill per recovery. For areas where small numbers of birds are present and large numbers have been banded over the years, the weighting factors are sometimes less than one. The larger weighting factors shown in the last columns in tables 6, 7, and 8 indicate those areas for which relatively few recoveries represented large segments of the total population.

The criteria that must be met for weighted band recoveries to reflect properly the relative size and sources of the kill in each harvest area are as follows:

1. All reference areas contributing to the kill in the harvest areas under consideration must be represented by enough recoveries to reflect accurately the distribution of the kill.
2. The size of each population contributing to the kill must be known. As noted previously, information on the size of the black duck population in various reference areas is crude. Estimates in tables 6, 7, and 8 were based on sketchy breeding population data (see Breeding Ground Surveys, p. 5). They were obtained before estimates of the overall level of the continental population were available. Despite inexact data, the use of weighted band recoveries produces more meaningful results than if no adjustment were made for differences in population size. Since relative differences in population size are the significant considerations, no "adjustments" were made in tables 6-8 to make the total population for all areas agree with estimates obtained later in the study.
3. The same proportion of banded birds shot is reported in all areas. Information is lacking on the extent to which hunters from different parts of the black duck range report bands. However, table 5 shows that in different areas, markedly different proportions of bands are reported by conservation agency employees. Since their activities tend to be concentrated in areas within the State where banding has been done, the relative importance of summer or winter populations represented by banded birds is exaggerated and constitutes a source of bias.

Procedures Used in Estimating Annual Mortality Rates

Mortality rate estimates for various black duck populations played an important part in this study. Mortality rate is defined as the proportion of individuals in a population dying from all causes within a given period. It is calculated by dividing the number that die during the defined period by the size of the population alive at the beginning of the period. The period used in this study usually extended from the beginning of one hunting season to the beginning of the next.

Two procedures for estimating mortality rates were used. The first is the composite dynamic method (Hickey, 1952). It assumes that the number of band recoveries obtained each year is proportionate to the number of deaths during that year. The second method, called the relative recovery rate method, is based on a comparison of band recovery rates (proportion of banded birds recovered during a stated period).

It assumes that differences in rates of band recovery reflect differences in the size of the population still alive and, therefore, available for recovery. By comparing recovery rates in a given year from bandings during two prior years, relative size of populations that the rates represent can be estimated. In some instances, mortality estimates based on both procedures are presented since they are based on different assumptions. Disagreement between estimates obtained by the two methods serve as a warning that fundamental assumptions are not being met or that sampling error may be large. The relative recovery rate method was the only one applied to short spans of years since the composite dynamic method required that the entire life span be represented.

The mechanics of calculating mortality rates by both procedures are illustrated in Appendix A.

SUMMER AND WINTER REFERENCE AREAS OF BANDING

In the section on Procedures, the purpose and method of delineating reference areas of banding were discussed. In this section data relating to these areas are summarized. One group of reference areas was established for summer and another for winter banding periods (figures 3 and 4). Recovery data from bandings during the summer period^{1/} were used to delineate summer reference areas, and data from bandings in January and February were used to delineate winter reference areas. Bandings during the early part of the hunting season (prior to November) were related to summer reference areas while those in November and December and in spring (March and April) were related to winter reference areas.

The terms major and minor reference areas are used frequently in this report. Major reference areas comprise banding locations with similar distant recovery distribution patterns. Differences among the patterns at or near the banding locations were ignored. Minor reference areas are subdivisions of major areas, and their boundaries coincide with State or Provincial boundaries. For example, if 3 States or portions of 3 States constitute a major reference area, it is divided into 3 minor areas. Use of minor reference areas is based on the recognized tendency for banded birds to be taken within the State or Province of banding with greater frequency than elsewhere.

^{1/} See definition of banding periods on page 25.

The recovery distribution for each major reference area is discussed briefly below. Data relating to minor reference areas are summarized in tables 9 and 10. Appendix maps and tables showing the distribution of recoveries from bandings in each minor area are presented on microfiche attached to the inside back cover of this report, and are listed by number in tables 9 and 10. Those wishing to examine data for particular minor reference areas may view these on standard microfiche viewers now available in many libraries. If necessary, they can be viewed also with a binocular dissecting microscope. References to these tables and maps are distinguished from references to tables and figures in the text by the prefix "B" for appendix tables, and "C" for appendix maps. In the interest of clarity and brevity, appendix tables and maps will not be cited in the following discussions of reference areas; tables 9 and 10 furnish convenient indexes to them.

Appendix tables B1 through B50 show the percent distribution of recoveries among States and Provinces from bandings in each minor reference area, the percentage of recoveries in Canada and each flyway, and the number of recoveries used to determine distribution. Maps in Appendix C show the location of recoveries by degree blocks of latitude and longitude for each minor reference area having 20 or more recoveries from a particular banding period. Numbers in small circles along the coast line on these maps show degrees of latitude and longitude, and should not be confused with recovery totals, which are not encircled.

Tables 9 and 10 include estimates of the population in each summer or winter minor reference area. Winter estimates are average January survey figures for the years 1950 to 1960. Summer estimates, whenever possible, utilized data from May or June aerial surveys conducted in 1954, 1955, or 1956. In some cases an average figure for the 3 years was used. Because aerial survey data were not available for many portions of the breeding range, estimates of black duck densities in unsurveyed areas were usually assumed to be the same as in adjacent surveyed areas.

First hunting season recovery and mortality rates also are presented in tables 9 and 10. Mortality rates were calculated by the composite dynamic method and are based on data from black ducks banded from 1946 to 1960.

Definition of Major Summer Reference Areas of Banding

Maritimes (1)^{1/}: Newfoundland, Nova Scotia, Prince Edward Island and southeastern New Brunswick. Most recoveries from summer bandings

^{1/} Number indicates location of area in figure 3.

in the Maritimes except Newfoundland, were in the Province of banding. Distant recoveries of birds banded in all Provinces of the reference area were concentrated along the coast from Maine to Maryland. No other summer reference area exhibited a recovery pattern so completely coastal in distribution. September bandings in Newfoundland, although not counted as summer bandings, had a similar coastal pattern of recoveries.

Labrador and Eastern Quebec (2): Labrador, Quebec east of 68° longitude, and northern New Brunswick. Northern New Brunswick had no banding locations but was arbitrarily assigned to this area. Distant recovery patterns from bandings in Labrador and Eastern Quebec generally resembled those of the Maritimes. Major recovery areas were coastal Provinces and States from the Maritimes to North Carolina, with concentrations in New England and the Mid-Atlantic States. The recovery distribution differed from that of the Maritimes reference area in that a higher proportion of the recoveries were south of the Province of banding. Recoveries from bandings in Labrador and Eastern Quebec were not as coastal in distribution as those from Maritime bandings, but the difference was small. September and October bandings in Labrador and Eastern Quebec were not used to determine the reference area but the recovery distribution from them agreed very closely with that from summer bandings.

Northern Quebec (3): Includes that portion of Quebec north of 50° latitude and west of 67° longitude, islands in eastern James Bay, and a very small segment of Ontario south of James Bay.

Northern Quebec black ducks apparently moved south across Lake Ontario and the St. Lawrence River to their wintering ground along the coast from Long Island to Virginia. These birds evidently were not subjected to shooting pressure along this migration route until they reached the Atlantic coast. Birds summering in northern Quebec were recovered in November in all States from New York to Virginia.

Southern Quebec (4): Quebec west of 68° longitude and south of 50° latitude, except for a small area in the southwest corner of the Province which is included in the Western Lake Ontario reference area.

Unlike Northern Quebec birds, about half the harvest of Southern Quebec black ducks was within Quebec. Recoveries in the United States were concentrated between Cape Cod and Chesapeake Bay; only a few were in interior New England and New York. Recoveries occurred in New Jersey and Maryland early in the hunting season, indicating that part of the population migrated to the coast in early fall. This suggests a rapid movement to the coast from the St. Lawrence River.

St. John and St. Croix Rivers (5): Southwestern New Brunswick and eastern Maine. Birds banded here were recovered in coastal States from Maine to North Carolina. In this respect, the reference area resembles the Maritimes and Labrador - Eastern Quebec reference areas but it differs from them in that Nova Scotia was not a major harvest area. Birds banded in southwestern New Brunswick were recovered throughout the hunting season in both northern and southern States. The area contributed to the Maine harvest in December, which suggests that some of its birds winter relatively far north.

Western Maine (6): Maine north and west of the St. John and St. Croix Rivers Area. Thirty-seven percent of recoveries from bandings in this reference area was in Maine. The remaining recoveries were concentrated in coastal areas from Maine to Maryland with a few occurring as far south as Florida. As with black ducks from eastern Maine (reference area 5), there was a tendency for these birds to winter over a wide latitudinal range. However, the recovery distribution differed from that for eastern Maine in not being strictly coastal. Many western Maine black ducks were harvested along the St. Lawrence River or in interior New England and New York. A few recoveries occurred in the Mississippi Flyway and in such States as New Jersey and Maryland in October and November.

Vermont and New Hampshire (7): All of New Hampshire and Vermont east of 73° longitude. The recovery pattern for birds banded in this area was similar to that for western Maine, except for fewer recoveries in the Maritime Provinces. Recoveries from Vermont and New Hampshire bandings were scattered along the St. Lawrence River, south through New England and New York, and along the coast from Maine to the Carolinas. Many recoveries occurred in New Jersey.

Coastal Massachusetts (8): Coastal portions of Massachusetts east of 71°10' longitude. Sixty-eight percent of all recoveries from bandings in this area were in Massachusetts as were 78 percent of the direct recoveries of immatures. Direct recoveries from October bandings followed a similar pattern.

Southern New England and Long Island (9): Interior Massachusetts, Connecticut, Rhode Island, and Long Island, New York. Recoveries were heavily concentrated in the States of banding and south to Chesapeake Bay. A relatively high frequency of indirect recoveries, along the St. Lawrence River to the north, indicated that migrants from northern breeding areas were banded during the summer in this reference area.

Lake Champlain (10): The western edge of Vermont and the eastern edge of New York. Recoveries were concentrated locally, and north along the St. Lawrence River. Southward recoveries occurred in Long

Island, New Jersey, and Delaware and Maryland coastal areas. Recoveries were scattered along the coast south to Florida and in interior Maryland and Pennsylvania. The recovery distribution for the Lake Champlain area most closely resembled that of the New Hampshire - Vermont reference area, but differed by extending further south and west and contributing less to the New England harvest.

The recovery rate for immatures banded at Tomhannock Reservoir, New York, was only one-third of that for Lake Champlain immatures, indicating that they were subjected to much less hunting pressure. In calculating weighting factors, it was assumed that Lake Champlain bandings were most representative of this population.

Chesapeake and Delaware Bays (11): New Jersey, Delaware, the southeast corner of Pennsylvania, and the Chesapeake Bay region of Maryland and Virginia. As was the case with summer bandings on Long Island, indirect recoveries sometimes occurred north of the banding location. Most birds banded during summer in the Chesapeake and Delaware Bay areas were recovered in the same area, and apparently winter there.

Eastern Lake Ontario (12): Central New York plus Ontario east of 78° longitude. This was the easternmost reference area in which some summer populations did not migrate to the east coast. Many recoveries from this area occurred in interior portions of the Atlantic Flyway and about 5 percent were in the Mississippi Flyway. Most east coast recoveries were south of New England and concentrated in Maryland, New Jersey, and Delaware.

Western Lake Ontario (13): Extends northward from the western half of Lake Ontario and the eastern half of Lake Erie, including western New York and portions of Ontario and Quebec north to 49° latitude between 78° and 81° longitude. Recoveries were similar in distribution to those from Eastern Lake Ontario except that a greater proportion (about 15 percent) occurred in the Mississippi Flyway. Since the 1920's, when a major banding effort was made at Lake Scugog in Ontario, this has been recognized as a transition area between Atlantic and Mississippi Flyways. Some populations migrate to the Ohio and Mississippi River Valleys and others to the mid-Atlantic coastal region.

Western James Bay (14): Ontario south and west of James Bay including the area north of 48° latitude and east of 84° longitude. The recovery distribution resembled that of the Western Lake Ontario reference area (13). Recoveries were in the Lake Erie and Lake Ontario areas and along the mid-Atlantic coast from Long Island to Virginia. The distribution differed from that of bandings on the

east side of James Bay (3) in that a greater proportion of recoveries occurred in Ontario, the Great Lakes area, and the Mississippi Flyway.

Upper Great Lakes (15): Western Ontario, north to 53° latitude and the northern half of Michigan, excluding that part of Michigan's Upper Peninsula west of 86° longitude. Since there were no bandings in the Ontario portion of this reference area, population estimates (used for weighting purposes) were based on recoveries from bandings in northern Michigan.

Thirty-five percent of the recoveries were in Michigan, the rest were scattered in all States of the Mississippi Flyway and to a lesser degree, the entire Atlantic Flyway south of New England. The distribution of recoveries by flyway revealed that 81 percent occurred in the Mississippi Flyway and 10 percent in the Atlantic Flyway. No other reference area exhibited such a widespread harvest distribution.

Western Lake Erie (16): The northern half of Ohio and southeastern Michigan, to Ontario north of the west end of Lake Erie. Recoveries were concentrated in the Lake Erie area and southward along the Ohio and Tennessee Rivers in the Mississippi Flyway. There were very few recoveries in the Atlantic Flyway and most were in the southern part. Although the distance between this area and the Western Lake Ontario reference area (which includes eastern Lake Erie) is not great, there was a pronounced difference in the distribution of recoveries. Black ducks in this area were oriented toward Mississippi Flyway wintering grounds while most of those in the Western Lake Ontario area migrated toward the Atlantic coast.

Eastern Lake Michigan (17): Southwestern Michigan and northern Indiana west to 87° longitude. There was a strong tendency for banded birds in this area to be recovered locally. In contrast to those banded in adjacent northern Ohio and southeastern Michigan, birds in this area apparently did not move south to winter.

Western Lake Michigan (18): The western Upper Peninsula of Michigan, eastern Wisconsin, northern Illinois, and northwest Indiana. Recoveries were concentrated in the banding area and south into the lower Ohio and Mississippi River Valleys. Since there are few breeding black ducks in Illinois and Indiana, most bandings in these States must represent migrants from the north.

Upper Mississippi River (19): Western Wisconsin and all of Minnesota except a small portion in the northwest corner. Recoveries from bandings in this area were concentrated in the Mississippi River Valley from Minnesota to Tennessee.

Northwest (20): The northwest corner of Minnesota and the Provinces of Manitoba, Saskatchewan and Alberta. Bandings were essentially confined to Minnesota and Manitoba. Banded black ducks from this area were mostly adult males that apparently had wandered from their breeding areas in the late summer but a few immatures were banded in Minnesota. No population estimate was made for the area. These ducks tended to move eastward through the Great Lakes and be recovered in both Atlantic and Mississippi Flyways.

The remaining areas shown in figure 3 were defined to permit summarization of October bandings. Their location is adequately described in figure 3, and is omitted here.

Definition of Major Winter Reference Areas of Banding

Maritimes (1)^{1/}: Newfoundland, Nova Scotia, Prince Edward Island, New Brunswick, and Quebec east of 69° longitude. Black ducks banded in the Maritimes in winter were rarely recovered farther south in subsequent years. Because there was little shooting pressure to the north, recoveries were in the area of banding, except for a few in Newfoundland from bandings on Prince Edward Island. Many black ducks wintering in the Maritimes probably breed there. Summer bandings suggest, however, that some populations breeding in Labrador and Eastern Quebec also winter in the Maritimes.

Maine (2): Only the State of Maine is included in this reference area. Eighty percent of recoveries from winter bandings occurred within the reference area, and 11 percent occurred in Canada.

Fall banded birds (November) were recovered in coastal areas south to North Carolina, but approximately 40 percent of both direct and indirect recoveries were in Maine. A similar recovery distribution occurred with spring bandings. In addition, some spring banded birds were recovered in the Maritimes and Quebec, indicating spring migration through Maine of birds breeding to the north.

A much greater proportion of the Maine wintering population consists of black ducks that breed in Maine and in eastern Quebec than is the case with populations wintering in the Maritimes or on the New England coast farther south. No other major harvest area utilizes the Maine winter population, and it provides most of the adult black duck harvest in the State in November and December.

1/ Number indicates location of area in figure 4.

New England and Eastern Long Island (3): New Hampshire, Massachusetts, Rhode Island, Connecticut, and Long Island east of 73° longitude. During the latter stages of this study, it became apparent that recoveries from black ducks banded in Connecticut had a somewhat different pattern than those banded elsewhere in this major reference area. They were concentrated along the St. Lawrence River, suggesting that birds moved south from interior Quebec. In contrast, recoveries from winter bandings along the Massachusetts coast and on eastern Long Island were concentrated in coastal areas from the Maritimes to New Jersey. These birds apparently moved south from Labrador, eastern Quebec, and the Maritimes. Thus, the winter population of coastal Massachusetts and eastern Long Island has a breeding ground origin more closely related to the Maritimes (1) population than to those of Maine or Connecticut. Recoveries from winter bandings in Rhode Island produced a pattern intermediate between Massachusetts and Connecticut.

Birds banded during winter in Massachusetts and subsequently shot in spring and summer in northern areas were examined separately from birds shot in the fall. These recoveries gave additional insight into the breeding ground origin of this winter population. Of 22 birds shot in the spring and summer, 18 were taken in the Maritimes, eastern Quebec, or Labrador, 1 in central Quebec, 1 in Maine, and 2 in the James Bay region.

Western Long Island and Hudson River (4): Quebec west of 69° longitude, Ontario east of 76° longitude, Vermont, and New York (including Long Island) east of 76° and west of 73° longitude. During the winter banding period, black ducks within this area were concentrated near western Long Island; consequently, almost all banding was done on Long Island. Recoveries indicated that the birds move southward in the fall from both northern coastal and interior breeding areas. They showed, further, that the interior migratory routes predominated and that this area wintered more ducks from the interior than did areas to the north and east. The distribution of band recoveries for the area differs from that for New Jersey in the number of recoveries from interior locations. Fifteen percent of the direct and indirect recoveries of birds banded in November on western Long Island occurred in Maryland and Virginia. Black ducks banded in December also were recovered in these States.

Mid-Atlantic (5): Pennsylvania east of 77° longitude, New Jersey west of 75° longitude, Delaware west of 75°10' longitude, Maryland west of 75°30' longitude, all of Virginia except a small part east of Chesapeake Bay, and North Carolina.

The Delaware River, Delaware Bay, Susquehanna River, and Chesapeake Bay are in the area but the coasts of the States involved, with the exception of North Carolina, are excluded. The coastal portion of the mid-Atlantic region is treated as a separate reference area although recoveries from inland bandings show that black ducks migrating south along the coastal route constitute an important part of the inland bay and river population. Nevertheless, the inland bay and river population originates chiefly in Canadian breeding areas from the Maritimes to west of James Bay. Most of these birds cross the southern St. Lawrence River or Lake Ontario during their flight south.

A larger proportion of black ducks recovered in Maryland was derived from spring bandings in that State (70 percent) than from winter bandings (59 percent), a reversal of the expected situation. Birds banded in spring apparently are not harvested south of Maryland, but rather constitute a population different from the one present in the winter. This difference is manifested in migration routes used: Maryland birds banded in winter tend to use the coastal route more than those banded in spring. Differences are shown by the harvest areas to the north. Winter bandings in Maryland resulted in an equal distribution of recoveries between Ontario and Quebec. Ontario was more important for recoveries from spring bandings. Similarly, 10 percent of the recoveries from winter bandings were in New Jersey, as contrasted with only 4 percent from spring bandings.

Mid-Atlantic Coastal (6): The eastern half of New Jersey, small portions of Delaware and Maryland adjacent to and including the Atlantic coast, and coastal Virginia east of Chesapeake Bay. Black ducks wintering in this area originate in Quebec and the Maritimes, move through New York, or along the New England coast, and southward along the Atlantic coast. The distribution of recoveries from winter bandings resembled that from bandings in the inland portion of the mid-Atlantic region (5) and western Long Island (4) and was considered to be intermediate between these two.

One-fourth of the recoveries from winter bandings in Virginia was in Canada, a high proportion in relation to bandings in other mid-Atlantic States. Only one-third was in Virginia - a relatively low proportion.

Southeast (7): South Carolina, Georgia, and Florida. Fall and winter banding was done only in South Carolina but it was assumed that Georgia and Florida birds were part of the same winter population. More banding is needed to test this assumption. Black ducks wintering here originate primarily in Ontario and migrate through both the Atlantic and Mississippi Flyways. There was a noticeable lack of recoveries along a direct route between Lake Erie and South Carolina,

suggesting the possibility of a non-stop flight to the mid-Atlantic coast followed by a movement along the coast to South Carolina. A relatively small proportion (20 percent) of the recoveries from winter bandings were in the State of banding. A few recoveries from New England and the Maritime Provinces indicated that a segment of the Southeastern population originates in northeastern coastal areas.

Lake Ontario (8): Ontario north of Lake Ontario, the eastern tip of Lake Erie, the western half of New York, and the western half of Pennsylvania except a small segment west of the 80° longitudinal line. Recoveries from winter bandings were concentrated around Lake Ontario, suggesting that the banded birds may have originated close to their wintering area. Only a few recoveries were obtained west or northwest of this reference area. The Lake Ontario winter area appears to be relatively distinct from reference areas to the east and west. Areas to the west were important to the harvest in northern States of the Mississippi Flyway, while those to the east contributed more heavily to the kill in Atlantic Coast States.

Recovery distributions of birds banded locally in November and December, and in March and April indicated transient populations. These birds moved through western New York to the Atlantic Coast where Maryland, Virginia, and the Carolinas were important recovery areas.

Lake Erie (9): Ontario adjacent to Lake Erie and Lake Huron, eastern Michigan, northern Ohio, and the western edge of Pennsylvania. Black ducks banded in this area winter primarily on the western half of Lake Erie as shown by a concentration of recoveries there. The population apparently originated in breeding areas in Ontario and to a lesser degree, Quebec. Recoveries south of winter banding locations were frequent, and oriented more to the Mississippi than to the Atlantic Flyway.

Upper Ohio River (10): West Virginia, southern Ohio, and northern Kentucky east of 87° longitude. Recoveries from a small sample banded in West Virginia during December were used to define the area. They were distributed near Lake Erie and along the upper Ohio River.

Tennessee River (11): Southeastern Kentucky, eastern Tennessee and all of Alabama. Most of the Tennessee and Cumberland River drainages are included. Black ducks wintering here originated in Ontario and migrated south through Michigan and Ohio. Recoveries outside the banding area were concentrated in the vicinity of Lake Erie.

Slightly more than one-fourth of the recoveries from winter banding in Tennessee occurred in Ontario, nearly equal to the number obtained in Tennessee; approximately 20 percent were in Michigan and

Ohio. Thirty percent of recoveries from winter bandings in Alabama occurred in Ontario, 20 percent in Michigan, and 20 percent in Alabama. The distribution suggests that much of the hunting pressure directed at these birds occurs prior to their arrival on the wintering area. This seems to be true also for black ducks wintering in Virginia and the Carolinas. This is in contrast to winter reference areas to the north where the greatest hunting pressure occurs on the wintering grounds.

Lake Michigan (12): Lakes Michigan and Superior including adjacent portions of Michigan and Indiana, plus all of Wisconsin. Due to a limited number of band recoveries, insight into recovery distribution of wintering black ducks in this area was obtained from indirect recoveries of December bandings in western Michigan. Most of these were within or adjacent to the State of banding.

Due to low hunting pressure to the north there were too few recoveries to clarify the breeding ground origins of this winter population. However, since summer bandings in western Michigan suggested a nonmigratory summer population, the winter population may be locally derived.

Upper Mississippi River (13): Illinois, Indiana (except adjacent to Lake Michigan), western Kentucky, western Tennessee, and eastern Missouri. Black ducks wintering here originate in Manitoba and Ontario and arrive by way of Minnesota, Wisconsin and Michigan. Some black ducks breeding in Wisconsin and Minnesota probably winter in this area.

Lower Mississippi River (14): Arkansas, Louisiana, and Mississippi. Limited bandings in Arkansas and Louisiana led to establishment of this reference area, which had an average winter count of 22,490 black ducks. Additional bandings will be necessary to determine the population characteristics of birds using this area in the winter.

Western States (15): All the area to the west of those previously described. Only a few black ducks were banded here: in the winter in Oklahoma, in December and in the spring in western Missouri, and in November in South Dakota. This area is west of the main black duck wintering range and the few individuals occurring there represent a very small population, not warranting further discussion.

HUNTING REGULATIONS AND THE NUMBER OF HUNTERS

Hunting Regulations

It is appropriate to review hunting regulations and hunter numbers before discussing the harvest. Table 11 summarizes hunting regulations

from 1927 to 1963. Regulations in the United States and Canada were similar until 1946, when bag limits became more restrictive in the United States. Seasons were of similar length until 1959, when they were shortened in the United States but not in Canada. Opening and closing dates for three representative areas in Canada, and five representative States are shown in table 11 so that they may be related to changes in season length. During the 37-year period hunting regulations varied greatly; season lengths fluctuated, while bag limits became progressively smaller.

Number of Hunters

Table 12 lists annual duck stamp sales, 1934-62, by States in the Atlantic and Mississippi Flyways. The table also gives total duck stamps sold in 17 States that are especially important in the black duck harvest. In each of these States black ducks made up at least 20 percent of the duck kill or represented at least 5 percent of the United States black duck harvest. Taken together these States accounted for about 80 percent of the United States black duck harvest and nearly half of the hunters in the Atlantic and Mississippi Flyways. Numbers of hunters in the 17 States ranged from 102,905 in 1935 to 633,115 in 1955. Comparison of duck stamp sales (table 12) with hunting regulations (table 11) indicates that changes in numbers of duck stamps sold generally paralleled changes in basic regulations. Sales were largest when regulations were liberal and smallest when regulations were restrictive.

In Canada, with no special license for waterfowl hunting during the period considered in this study, the number of duck hunters was less accurately known. However, a 1961 economic survey of hunting and fishing (Benson, 1963) reported 118,080 waterfowl hunters in Ontario, 38,750 in Quebec and 36,800 in the Maritimes. This is a total of 193,630 waterfowl hunters in the three most important black duck harvest areas in Canada. In the same year, the Atlantic and Mississippi Flyways contained 761,120 hunters, or 3.9 for each hunter in eastern Canada.

In the United States hunters must purchase Migratory Bird Hunting Stamps (hereafter called duck stamps) for legal hunting of ducks and geese. Therefore, the number of duck stamps sold annually in the 17 States mentioned above can be used as a basis for estimating the number of hunters of black ducks. Table 13 classifies duck stamp purchasers according to various hunter-activity and hunter-success groups in the 1960-61 season for ten States where the kill of black ducks was important. The figures were calculated from mail questionnaire data. A small percentage of duck stamp buyers are stamp collectors who do not hunt ("nonhunters" in table 13), and a fairly large percentage are hunters who failed to go afield. For

example, in New Jersey 2.5 and 3.2 percent of the duck stamps purchased in 1960 and 1961, respectively, were bought by nonhunters, chiefly stamp collectors, while 22.2 percent in 1960 and 28.6 percent in 1961 were bought by those who intended to hunt but did not. Inactive hunters in other States accounted for a smaller proportion of total duck stamp sales, but never fell below 10 percent. Generally, about 20 percent of the duck stamp buyers did not hunt.

Of the stamp buyers who hunted, one-fourth to one-third bagged nothing. At the other end of the success scale, a very small percentage of hunters bagged 11 or more ducks during the season and were responsible for over half the kill. For example, in New Jersey 6.9 percent of the duck stamp purchasers accounted for 55.8 percent of the harvest in 1960, and 9.3 percent accounted for 55.7 percent of the harvest in 1961. In Maine, 13.5 percent of the duck stamp purchasers reported 56.2 percent of the kill in 1960 and 16.3 percent accounted for 68.8 percent of the harvest in 1961. In other States, the distribution of the kill among hunters was similarly disproportionate. In general, approximately 20 percent of the duck stamp purchasers were responsible for about 80 percent of the harvest. It appears that fewer than 100,000 waterfowl hunters in the United States are responsible for over 80 percent of the total black duck kill.

RATE OF HUNTING KILL

Uses of Recovery Rate Data

Band recovery rate (the percentage of banded birds reported shot or found dead during the hunting season) provides an index to the proportion of a population killed by hunting. Rates for different populations can be compared to indicate differences in shooting pressure and to measure the effect of changes in regulations on rate of kill. Band recovery rates are important also in indicating differences in the rate of kill among age and sex components of a population. A measure of the extent to which one age and/or sex group is more likely to be shot than another when related to the age and sex composition of the harvest provides a means of determining the age and sex structure of an entire population. Recovery rates also can be used for calculating total mortality rates from all causes.

The interpretation of recovery rates is complicated by the fact that not all bands are reported. Geis and Atwood (1961) estimated that only 49 percent of the banded black ducks taken by hunters are reported. If the report rate was constant at all times and for all areas, the bias could easily be removed. However, Geis and Atwood found that the rate varies both geographically and chronologically. Their study, which was based on mail questionnaire survey data, was not sufficiently detailed to investigate factors contributing to this

variation. However, they suggested that the band reporting activities of conservation agency employees and bird banders was an important factor. To investigate this point recovery records in the Bird Banding Laboratory were examined, during the present study, to determine the proportion coming from these two groups. The results are summarized in table 5 which shows a marked geographic and chronologic variability in the proportion of bands reported by conservation agency employees and bird banders in each State. For example, within the Maritime Provinces the proportion of band reports coming from these groups was high for Prince Edward Island but low for Nova Scotia. Annual variation was large for Prince Edward Island but small for Nova Scotia: over half the Prince Edward Island reports in 1960 but only 4 percent in 1961 and 1962 were from these groups.

In the United States the proportion of band reports coming from conservation agency employees and bird banders was greater in the early fifties than in the late fifties and early sixties. The downward trend may have come from an awareness that actively soliciting and reporting bands decreases the usefulness of banding data. A special form is now provided to conservation agency employees and bird banders in order to emphasize the special nature of solicited band reports and make it easier to record the circumstances of collection.

The band recovery rate, when adjusted for unreported bands, provides a measure of the proportion of a population harvested. When this is further adjusted to allow for crippling loss, an estimate of the rate of hunting kill is obtained.

Summary of Band Recovery Rate Information

Recovery rates of black ducks banded in minor summer and winter reference areas are summarized in tables 14-17. Data for bandings prior to 1946 and for 1946-60 are presented in separate tables because of differences in the reliability of age determinations. Before 1946 aging was less accurate so data for adults and immatures are combined; after 1946 it was more accurate so these data are presented separately. For summer reference areas (tables 14-15) birds banded during a "summer period" from May through September (or to the beginning of the hunting season if earlier than September 30) and an "October period" (the month of October or from the beginning of the hunting season through October 31) were treated separately. For winter reference areas (tables 16-17) data are presented separately, when possible, for five banding periods: November, December, January 1-15, January 16 through February, and March through April.

In addition to recovery rates for first and second hunting seasons, rates for all hunting seasons combined are presented for the period

prior to 1946 (tables 15 and 17). This was not done for more recent bandings because insufficient time had elapsed to permit return of all recoveries. Each of the combined recovery rates in tables 15 and 17 may be multiplied by 2.816 to account for crippling loss and non-reporting of bands. The product is an adjusted recovery rate, approximating the proportion of total deaths caused by hunting. Derivation of the factor 2.816 is discussed further in the section dealing with hunting as a mortality factor.

First hunting season recovery rates from ducks banded in the December and January 1-15 periods are often very low because these birds were banded near the end of the first hunting season.

Differences Among Populations in Band Recovery Rates

As mentioned previously, band recovery rates can be used to compare shooting pressures encountered by birds banded in different reference areas. Recovery rates from pre-hunting season bandings in summer reference areas are summarized in table 18. Only rates based on samples of 150 or more recoveries are included. First hunting season recovery rates of immatures ranged from a low of .060 for summer bandings in Quebec to a high of .216 for those in Nova Scotia.

First hunting season recovery rates of adults ranged from .049 for summer bandings in the Western James Bay area to .132 for the Western Lake Erie area. Because few adults were banded in summer, not many reference areas furnished information on them. Generally, however, areas with high recovery rates for immatures had high rates for adults.

Birds banded in summer in the Maritimes, southern Quebec, New England, and the Lake States tended to have high recovery rates, while those banded in Western James Bay, eastern Quebec (Baie Johan Beetz), Upper Great Lake (Seney National Wildlife Refuge), and southern areas, such as Delaware and Maryland, had low rates. Recovery rates for Labrador and Newfoundland bandings also were low, but the samples were too small to be conclusive.

It is apparent that various summer populations of black ducks are subjected to markedly different shooting pressures. Populations breeding in a zone extending from Nova Scotia on the east to Wisconsin on the west and including the northern United States and southern Canada were subjected to heavier shooting pressures than those in more northern areas and at the southern edge of the breeding range. Southern Quebec falls within this zone while northern Michigan is north of it; its northern boundary evidently coincides with the northern limits of relatively dense human populations.

First hunting season recovery rates from winter-banded birds (January 16 through February) also suggest that black ducks banded in various winter areas of reference were subjected to pronounced differences in shooting pressure (table 19). Rates for winter banded males ranged from about .025 for bandings in Virginia, western Long Island, and Massachusetts to about .063 for New Jersey, Pennsylvania, Maryland, Rhode Island and New York. First hunting season recovery rates of females showed similar differences. Sometimes adjacent areas had quite different shooting pressures. For example, shooting pressure on adults of both sexes was high in eastern Long Island and very low in western Long Island.

First Hunting Season Recovery Rates By Age Classes

Black duck band recovery rates are shown by age classes for minor summer reference areas of banding in table 14. Table 18 summarizes first hunting season recovery rates of immatures and adults for areas having at least 150 bandings in each age and sex class. It also presents weighted average recovery rates for each age and sex. These rates are not identical to those in table 14 because birds of unknown sex were excluded and birds classified as "juveniles" were included where it was felt that this age category was synonymous with "immature" (see definitions at the end of this section).

Immatures tended to have higher first hunting season recovery rates than adults, indicating greater vulnerability to shooting. Only four of 17 comparisons in table 18 showed similar recovery rates for immatures and adults. In three cases (eastern Quebec, the Maine portion of the St. John - St. Croix River area, and Delaware) this was because immatures had an unusually low recovery rate, and in one case (Michigan in the Western Lake Erie area) because adults were recovered at an unusually high rate. Continentwide, immatures were 1.52 times more likely to be shot than adults (see weighted averages - table 18).

Weighted averages for the United States show that immatures were 1.21 times more likely to be shot than adults. By subtracting United States averages from overall averages we obtained average recovery rates for Canada of .054 for immatures, and .024 for adults, indicating that immatures were 2.25 times more likely to be shot than adults. This difference between the United States and Canada is related to a marked difference in distribution of the kill of immatures and adults, which is discussed later.

When October bandings are considered, differences between adult and immature recovery rates are less pronounced. Weighted recovery rates for birds banded in October were .090 for immatures and .068 for adults, indicating immatures were 1.32 times more likely to be taken than adults. This suggests that, by October, immature black ducks are less vulnerable to the gun than earlier in

the season. The change could be due to: (1) a learning process, in which immatures become warier as the hunting season progresses; or (2) elimination by shooting, of many of the more vulnerable immatures by October; or (3) a combination of 1 and 2.

In four minor summer reference areas there were sufficient bandings for comparison of first hunting season recovery rates of locals (flightless young) and immatures (flying young). The rates were similar in three of the areas, (New Brunswick in the Maritimes area, western Maine, and Maryland), and different in one (Nova Scotia) where they were substantially higher for immatures (table 14). This suggests that generally, locals and immatures have similar recovery rates and that very little mortality occurs between the time when young are 5 - 8 weeks old (about when they are banded as locals), and the time they are classed as flying young (average age when banded unknown but probably 12 to 15 weeks). Had mortality been high during this period, it should have been reflected by lower recovery rates for locals. Stotts and Davis (1960), studying black ducks in Maryland, observed a very low mortality among ducklings, supporting the conclusion from band recovery rates.

The term "juvenile" was formerly applied rather loosely to both fledged and unfledged young ducks hatched in the year of banding. In 1949 it was eliminated in favor of two other terms: "local" to designate young which were flightless and, therefore, known to be reared in the area of banding; and "immature" to designate young capable of flight, whose area of origin was unknown. Five summer reference areas contained sufficient samples of banded "juveniles" and "immatures" to permit a comparison of first hunting season recovery rates (table 14). In all cases, recovery rates for juveniles were lower than for immatures. In eastern Quebec, the Lake Ontario portion of New York, and the Upper Great Lakes portion of Michigan, juveniles had a slightly lower recovery rate; coastal Massachusetts, and Lake Champlain area of New York, showed a sharply lower rate. The term "juvenile" was used at a time when aging was less accurate than in recent years and the lower rates may be due to inclusion of improperly aged adults in this category. Another factor may be the generally restrictive regulations in effect in the late forties when the term was widely used compared to the mid-fifties when it was not. In the Lake Champlain area, the difference can be related to "immatures" banded on Lake Champlain where shooting pressure was heavy and "juveniles" banded a little to the south on Tomhannock Reservoir where shooting pressure was lighter.

Band Recovery Rates By Sex

Among summer banded black ducks first hunting season recovery rates tended to be similar for immature males and females but were

frequently different for adult males and females. The rates were higher for adult males in some areas and for adult females in others (table 18).

In areas where recovery rates for adults of both sexes are available for comparison, weighted average rates are .080 for males and .076 for females. However, these overall rates mask an important difference: when rates for the United States only are considered, weighted averages are .057 for males and .049 for females, indicating that males are about 1.21 times more likely to be shot in the United States than females; in contrast, weighted averages for Canada were .021 for males and .027 for females, indicating that females are 1.29 times more likely to be shot in Canada than males.

Winter bandings also provided data on first hunting season recovery rates of adult males and females (table 19). They show that the males tended to have higher recovery rates than the females: weighted averages were .052 for males and .043 for females. Males banded in the mid-Atlantic States had markedly higher recovery rates than females. Interpretation of first hunting season recovery rates is more complicated for winter than for summer bandings because of the long interval between the time of banding and recovery in the following hunting season. Differences in recovery rates may reflect differences between males and females in survival during this interval as well as differences in shooting pressure.

First hunting season recovery rates of males and females banded in winter areas of reference during banding periods other than "winter" (January 16 through February) are quite similar for the two sexes (table 16). Average rates for November bandings were .049 for males and .050 for females; for December they were .022 for males and .026 for females. As expected, these rates are lower than those for summer reference area bandings because the birds were banded after hunting began and, thus, were available to hunters for only part of the hunting season. In the following year when the birds were exposed to a full hunting season, the recovery rates were consistently higher for males than for females. As with winter bandings, these differences may reflect a higher kill rate or greater mortality of females than males in the interval between banding and the following hunting season. Mortality rate data presented later indicate that differences in survival are at least partially responsible.

In summary, it cannot be ascertained from available data whether differences exist between adult male and adult female kill rates on a continent-wide basis. First hunting season recoveries from summer and hunting season bandings suggest generally similar kill rates, but these data are not conclusive because of the small number and poor distribution of adult summer bandings. Bandings in winter reference areas generally resulted in higher recovery

rates for males except in some mid-Atlantic States. First year recoveries from winter (January 16 - February) and spring bandings (March - April) and second year recoveries from all other periods consistently show higher recovery rates for males but this may be influenced by a higher male survival rate during the interval between banding and recovery.

It is clear that adult females are shot at a higher rate than adult males in Canada, while adult males are shot at a higher rate in the United States.

Relationship Between Hunting Regulations and Band Recovery Rates

Recovery rates for black ducks banded in summer were examined to see whether they were affected by hunting regulations (season lengths and bag limits). There was a strong tendency for recovery rates of immatures to increase when regulations were liberalized and decrease when they were restricted. This was true for 25 of 32 comparisons shown in table 20. The positive relationship is statistically significant when evaluated by a sign test (Snedecor, 1956).

Six similar comparisons for adults were ambiguous. Also, there was no uniform trend in 55 comparisons of recovery rates for winter and spring bandings with changes in regulations. These data suggest that regulations influence kill rate of black ducks during their first hunting season but not thereafter.

GEOGRAPHIC AND CHRONOLOGIC DISTRIBUTION OF THE BLACK DUCK KILL

Geographic Distribution of the Hunting Kill

Data on distribution of the kill were available from three sources: (1) weighted band recoveries from bandings in summer areas of reference, (2) weighted band recoveries from bandings in winter areas of reference and (3) the mail questionnaire survey of waterfowl hunters.

Distribution of the kill among States and Provinces based on weighted band recoveries from summer and winter bandings of birds in various age categories is shown in table 21. Data for immatures include only first hunting season recoveries. All later recoveries of birds banded as immatures and all recoveries of birds banded as adults are included in the adult category. Recoveries of black ducks banded in summer areas of reference show that about 33 percent of the continental kill was in Canada, 52 percent was in the Atlantic Flyway and about 15 percent was in the Mississippi Flyway.

As compared to summer bandings, data from winter bandings indicate a lower kill in Canada and a higher kill in the Mississippi Flyway. In part, this may be related to the fact that summer banded birds include immatures which tend to be taken in breeding areas to a greater extent than adults. However, when recoveries of summer and winter banded birds of the same age (adults) are compared, the former are still taken in greater numbers in Canada: 26.3 percent of summer banded adults and 18.6 percent of winter banded adults. Recoveries of summer banded birds may overestimate the kill in Canada because most banding occurred near areas of relatively heavy shooting pressure. On the other hand, recoveries of winter banded birds may underestimate the kill in Canada and overestimate the kill farther south. Almost twice as many males as females were banded during the winter banding period. Adult males tend to be shot at a lower rate than adult females in northern areas. Thus, the sex shot least frequently in Canada is over-represented in the sample of winter banded birds.

Inadequate banding data and incorrect weighting factors probably contribute to the discrepancies between summer and winter distributions shown in table 21. For example, recoveries from summer bandings suggest that Quebec has a substantially greater harvest than Ontario, while those from winter bandings suggest the opposite. Also, data from summer bandings suggest a much lower kill in the Mississippi Flyway than is the case with winter bandings. Differences in the relative size of the kill in Ontario and Quebec, and in the Atlantic and Mississippi Flyways can be explained further by: (1) more black ducks in western Ontario than population surveys indicated, and (2) the occurrence of populations in Ontario not represented by summer bandings.

The distribution of the black duck hunting kill in the United States according to mail questionnaire and wing collection surveys for 1954-62 is presented in table 22. In compiling this table the total duck kill in each State was first determined from questionnaire data; the proportion consisting of black ducks was determined from questionnaire data from 1954 through 1959 and from the wing collection survey from 1960 through 1962. The two types of surveys generally yielded comparable data.

A comparison of questionnaire data with information from band recoveries (table 23) revealed some discrepancies. For example, band recoveries indicated a substantially lower black duck kill in Florida and Louisiana than the mail questionnaire survey. This was probably because Florida and mottled ducks were not separated from black ducks in questionnaire reports. The mail questionnaire survey showed that New York and Michigan were the two most important black duck harvest States. In contrast, weighted band recoveries suggested that New Jersey and Maryland were the most important harvest States. The greatest discrepancy between banding and survey data concerns the

importance of the Maryland black duck kill. According to the mail survey the Maryland kill was less than 5 percent of the United States total. Weighted summer bandings, on the other hand, indicated that it was 11.4 percent, and winter bandings, 15.9 percent of the total. The mail survey also showed a substantially lower kill in New Jersey than did weighted band recoveries.

These discrepancies may be related to the sampling intensity of the mail survey. This was designed to obtain reliable estimates of total duck kill on a flyway-wide basis with samples distributed among States in proportion to duck stamp sales. Maryland had a relatively low duck stamp sale and, because most of the harvest was taken by a small fraction of those buying duck stamps, it is possible that Maryland hunters were not adequately sampled.

A more detailed picture of the distribution of the black duck kill can be obtained from the relative numbers of weighted band recoveries in each degree block of latitude and longitude in the United States (figures 5-7). These data suggest the same pattern of distribution as shown for States and Flyways in table 21. There was a heavy kill of immatures (figure 5) in southern Quebec along the St. Lawrence River while the adult kill (figure 6) tended to be concentrated in the mid-Atlantic States. Recoveries from bandings in the wintering areas (figure 7) showed a relatively greater kill in the Mississippi Flyway than did bandings in summer reference areas. Scattered recoveries across southern Manitoba, North Dakota, South Dakota, and Minnesota suggest that there may be more breeding black ducks in Manitoba and western Ontario than the breeding ground survey data indicated.

Effects of Age, Sex, and Type of Recovery on Geographic Distribution of Recoveries

Table 24 summarizes recoveries in three latitudinal zones (northern, central and southern) according to age, sex, and type of recovery, for black ducks banded in summer areas of reference. Types of recoveries are direct (first hunting season) and indirect (later hunting season). Because banded samples of adults were small, few summer reference areas had adequate data for all ages, sexes, and types of recoveries. However, all available data are shown. The northern recovery zone generally is north of mid-New York; the middle and southern zones are divided roughly by a line at the latitude of northern New Jersey.

Direct and indirect recoveries of adult males and females were not always distributed similarly. Although some differences are probably real, others are undoubtedly due to small sample sizes and it is difficult to generalize concerning them. Some adults apparently moved south in late summer and were banded in southern areas, so that indirect or later hunting season recoveries occurred north of first

hunting season recoveries. Evidence of this, particularly for coastal Massachusetts and the Chesapeake and Delaware Bay areas is shown in table 24.

Distributions of first and later hunting season recoveries of male and female black ducks banded as locals, juveniles, or immatures can be compared in table 24 for areas also having data for adults. Additional recovery distributions of birds banded as locals, juveniles, and immatures are presented in table 25 for areas lacking sufficient adult bandings to provide comparisons. The distribution of direct recoveries of immature males and females was very similar, suggesting no difference between sexes in the distribution of the hunting kill. Direct recoveries of birds banded as immatures tended to be concentrated in northern areas, while indirect recoveries were more widely distributed. This is a result of the heavy harvest of immatures on or near breeding areas, as noted previously. Immatures banded in coastal Massachusetts, Long Island, and in Illinois did not have this typical recovery pattern. Evidently, birds banded in these three areas included migrants from the north. They provided direct (first hunting season) recoveries near where they were banded but only indirect (later hunting season) recoveries in the northern areas where they originated.

The extent to which migrants, rather than residents, were banded in other summer reference areas in the United States was examined by comparing for immatures the percentage of direct and indirect recoveries occurring more than 140 miles north of the banding area (table 26). The distance of 140 miles north of the banding area (approximately two degrees of latitude) was selected to reduce the effect of random wandering of immatures prior to the hunting season. All areas having at least 20 direct and indirect recoveries for at least one sex are shown. The comparison revealed that a slightly greater proportion of indirect than direct recoveries consistently occurred in northern areas. Thus, it appears that some "northern" birds regularly move early to southern areas and are banded there in summer. These bandings, therefore, do not entirely represent birds reared in southern production areas. However, this had little overall effect on recovery distributions based on weighted recoveries; southern summer reference areas contributed only small numbers of birds and received little weight.

It is also possible that some birds produced in southern areas and banded there may actually move to more northern areas in later years. It is generally believed that males are more likely to move than females and data from bandings in Maryland support this. Eight percent of immature males but only 1.7 percent of immature females banded in Maryland were shot in northern areas in later years. In most other areas, however, no marked sex difference was apparent.

Generally, more adult females than males were shot in northern areas (table 24). Many females are occupied with rearing young until late in the season, and remain in the vicinity of summer banding areas to molt. As noted previously, the banding sites are often near areas where shooting pressure is high.

Males, on the other hand, conclude their breeding activities earlier than females and wander away from the breeding areas in summer. They tend to be recovered north of the banding areas more often than females (table 27). In 6 of 8 comparisons in table 27 more males than females were taken over 300 miles north of the banding areas. These data showing that adult males move northward in summer and early fall do not negate the fact that, overall, more adult females than males are shot in the north.

Wintering ground bandings provide additional information on the geographic distribution of the kill of adult males and females. They show that females were shot more often than males north of winter banding areas but more males were shot within the banding areas (table 28). Table 28 also shows that a greater proportion of birds banded in eastern than in western winter reference areas were recovered in the State of banding. Western Long Island was an exception to this, apparently because shooting pressure was low in this wintering area. Recoveries south of the banding areas were relatively few and were usually in an adjacent State.

First hunting season recoveries from winter bandings were distributed in the same manner as later hunting season recoveries as indicated by Massachusetts banding data (table 29). This, plus the high proportion of recoveries in the banding areas, indicates that black ducks have a strong tendency to return to the same wintering area each year. A smaller proportion of winter banded females than males were recovered within States of banding (table 28) but this is because females sustained a heavy kill in northern areas prior to and during the southward migration. The attachment to a wintering area probably applies equally to both sexes.

In addition to geographic differences in the kill of adult males and females there are also chronologic differences. Table 30 shows that the kill was low in September, high from October to December (with a peak in November) and low in January. A larger proportion of adult females than males was killed in September and October but the reverse was true in November, December, and January. The kill of adult males in January exceeded that of September by approximately 3 times but the difference was slight for females.

The relative likelihood of adult males and females being shot in each month from September through January is shown in table 31.

In September and October males were less likely to be shot than females but in November, December and January they were more likely to be shot.

The figures in table 31 were obtained by multiplying the percent recoveries in each month (from table 30) by the weighted average recovery rates for adult males and females banded in the summer (table 18). This yielded indexes of monthly rates of kill for each sex. Dividing the monthly rates for males by those for females gave figures representing the likelihood of males being shot as compared to females. These figures relate to the probability of being shot and not to frequency of occurrence in the bag. The latter depends on the sex composition of the population as well as the relative probability of being shot.

Duck wing survey data provide information on sex and age composition of the kill for each month of the hunting season (table 32). Immatures predominated in the October kill in all States listed except New Jersey. This is the southernmost State with an October season and shooting may begin before many immatures arrive from the north.

Sex ratios in the monthly kill indicate that adult males move into northern States such as New York and Ohio in October, and into States farther south, such as Maryland, in November. Adult females contribute more to the kill in New York and Ohio during the second month of the hunting season but, even then, males predominate, and they increase in importance in the last weeks of the hunting season.

The predominance of adult males over adult females in the kill on wintering areas may be due to the lesser abundance of females there. Females appear to move southward later than males; they linger in the vicinity of the breeding areas, where they are subjected to heavy shooting pressure.

Variations in the Distribution of Recoveries

Data from selected summer and winter reference areas with relatively large banded samples over many years were used to examine variations in the distribution of recoveries between years or groups of years. The recovery distributions are shown by State and year in tables 33 through 42. The results of Chi-square tests of homogeneity to determine whether the distributions varied significantly are presented immediately following each of the above tables (see tables 33.1 - 42.1). States and Provinces were often combined to provide sufficient recoveries to conduct the tests. In 5 of the 10 Chi-square tests, overall differences between years were significant at the 95 percent level or above.

Chi-square tests were conducted also to reveal harvest areas where there were significant departures from the average during a particular year or group of years. A few such areas were found, although the overall data did not show statistically significant variation. The few departures from the average in these few areas were overwhelmed by many comparisons in the overall test. Generally, annual changes in the distribution of recoveries appeared to be fairly common but long term changes in one direction were not.

Of the many factors that could alter the distribution of recoveries some, such as changes in the distribution of suitable habitat or the number of hunters, usually operate gradually and can be detected only over relatively long periods. Others, such as weather or changes in hunting regulations, may cause annual changes. An investigation of these factors was beyond the scope of this study. For example, to determine the influence of weather would be a major study in itself.

THE NUMBER OF BLACK DUCKS KILLED BY HUNTING

Size of the Retrieved Hunting Kill in the United States

The retrieved hunting kill of black ducks in the United States from 1952-62, based on data from the Mail Questionnaire Survey of waterfowl hunters, ranged from a high of 662,000 in 1955 to a low of 265,200 in 1961 (table 43). The average annual kill from 1952 through 1960 was 480,800 black ducks. The 1961-62 kill is omitted to facilitate later comparisons with recovery data, few of which are derived from birds banded in these years.

In 1952 and 1953, the kill in the Mississippi Flyway was slightly greater than that in the Atlantic Flyway. However, the reliability of estimates for these years is somewhat questionable because the Mail Questionnaire Survey was in its infancy and samples of hunters were not as representative as in subsequent years.

From 1954 to 1960, approximately 60 percent of the U.S. black duck kill occurred in the Atlantic Flyway, 40 percent in the Mississippi Flyway and 0.05 percent in the Central Flyway. The average harvest in the Central Flyway was only 1,800 during the period 1952 through 1959. The black duck kill in the Mississippi Flyway decreased in 1961 and 1962 with very restrictive regulations. The proportion of the total harvest in the Atlantic Flyway increased markedly to 76 percent in 1961 and 84 percent in 1962.

Crippling Loss in the United States

According to information supplied by hunters in the Mail Questionnaire Survey, approximately 20 percent of all ducks shot down are

not retrieved (table 44). To evaluate these voluntary reports of crippling loss a study was made in which hunters were watched by hidden observers. The observations indicate that voluntary reports underestimate the loss. In the Atlantic Flyway observations showed that 38 birds were knocked down but not retrieved for every 100 birds bagged by hunters - a 27.5 percent crippling loss. It is assumed, therefore, that in addition to the average annual retrieved kill of 480,800 black ducks in the period 1952-60, there was an annual unretrieved kill of about 182,000. Thus, the annual black duck kill from hunting in the United States averaged about 662,800.

Size of the Kill in Canada

Canada did not conduct a mail questionnaire survey comparable to that of the United States during the period covered by this study. However, with kill statistics for the United States and data on kill distribution from weighted band recoveries, an indirect measure of the retrieved hunting kill in Canada can be obtained.

Recoveries from summer bandings are the best source of information on kill distribution. The distribution of weighted recoveries from summer bandings shown in table 21 indicates that 33.4 percent of the black duck kill occurred in Canada. However, as noted previously (see Geographic Distribution of the Hunting Kill) some summer populations contributing to the kill in the Mississippi Flyway and Ontario were not represented by banded samples. Because of this, weighted band recoveries do not indicate as large a kill as actually occurred in these areas. To minimize the influence of this factor as much as possible, recoveries in Quebec and the Maritimes were related to those in the Atlantic Flyway, and recoveries in Ontario to those in the Mississippi Flyway. The kill was then estimated separately for these two Canadian areas.

Weighted band recoveries in Quebec and the Maritimes were 45.8 percent of those in the Atlantic Flyway, and in Ontario they were 66.8 percent of those in the Mississippi Flyway. Thus, the retrieved kill was estimated to be 127,500 in Quebec and the Maritimes, and 134,400 in Ontario, giving a total of 261,900^{1/} for the average annual retrieved black duck kill in eastern Canada. This indicates that 35.3 percent of the North American kill was in Canada: a ratio of one black duck bagged in Canada for every 1.84 in the United States.

^{1/} The first mail questionnaire and wing collection surveys conducted in Canada for the 1967-68 season yielded a black duck harvest estimate of 300,000.

Average Size of the Total Hunting Kill

When the Canadian kill was added to that of the United States, the retrieved black duck harvest in North America, 1952-60, amounted to 742,700 annually. When 38 unretrieved birds per 100 bagged were added to this figure, an average annual kill of 1,025,000 black ducks was obtained.

Comparison of Hunting Kill With Hunting Regulations, Hunter Numbers, Population Levels and Kill Rates

The years, 1952-62, are separable into periods with different regulations, population sizes, and annual harvests, as shown in table 45. In both the Mississippi and Atlantic Flyways 55 day seasons with 4-bird daily bags were permitted, 1952-54, and 70 days with 4-bird bags, 1955-58. Regulations were much more restrictive, 1959-62, with 20 - 30 day seasons, and bag limits of 1-3 black ducks in the Mississippi Flyway and 40 - 50 days and 3-4 ducks in the Atlantic Flyway.

Hunters were most numerous during the period with most liberal regulations and least numerous when regulations were most restrictive. However, differences in the size of the kill cannot be explained solely by the number of hunters afield. A 27 percent increase in season length from 55 days (1952-54) to 70 days (1955-58) was accompanied by only about a 2 percent increase in hunters, while the hunting kill increased about 12 percent. Further, although both the number of hunters and the kill declined in 1958-62, the decrease in kill (45 percent) was greater than the decrease in hunters (35 percent). The lack of close agreement between hunter numbers and size of kill is probably related to the fact that a relatively small proportion of hunters take most of the harvest. They may be less influenced by changes in season lengths and bag limits than are less successful hunters.

Black duck population trends in the United States were ascertained from winter surveys and pre-season population indexes (winter survey plus hunting kill). No consistent trend in population size in the 1952-54 period is evident, but a steady decline is apparent for 1955-58. During 1959-62, except for one year, the downward trend of the previous interval continued. The average population level in 1959-62 was only 67 percent of the 1952-54 level, and only 77 percent of the 1955-58 level.

The progressive decline in the black duck population, shown in table 45, began in the period with 70-day seasons. Associated with these long seasons is an average kill rate index (.48) 26 percent higher than the averages for preceding and following periods.

Except for a decrease in the bag limit from 8 to 6 birds in 1959, Canadian regulations changed little during the three periods shown in table 45.

Band recovery data provide additional information on kill rates during these periods. Table 46 presents recovery rates for immature black ducks banded in summers during the three periods considered in table 45. Data on adults were excluded because they were too few for analysis. Recovery rates were not weighted because the available bandings represented only a small portion of the total population. Further, no adjustments were made for differences in the proportion of banded birds bagged but not reported since information was not available for all periods. Preseason population index values in table 46 were obtained by dividing the average unweighted recovery rate for the period into the retrieved kill in the United States. The recovery rates include recoveries in Canada, but kill data relate solely to the United States. Methods and results of calculating preseason population indexes differ in tables 45 and 46 and are not directly comparable. Nevertheless, the banding data shown in table 46 generally support the information shown in table 45. Band recoveries indicate a somewhat lower recovery rate during 1959-63 than during 1952-54, which may be due to changes in band reporting rates rather than differences in rate of kill (Martinson, 1966).

Both tables show that kill rates were highest in 1955-58 when 70-day seasons and 4-bird daily limits prevailed and lowest in the 1952-54 and 1959-63 periods when regulations were more restrictive. Although derived by different methods, preseason population indexes in both tables show a much lower population level during 1959-63 than in the preceding period.

SOURCE OF KILL IN HARVEST AREAS

In examining black duck recoveries thus far, emphasis has been placed on the distribution from various banding locations. Of equal or possibly greater importance to management is an understanding of the proportion of the kill in each harvest area derived from populations of various summer and winter reference areas. A harvest area is defined as a location where the kill is derived from more or less distinct reference areas of banding.

Weighted band recoveries were used to measure the relative contributions of reference areas of banding to each harvest area (see section on Procedures). These measurements may contain errors to the extent that some populations contributing to a harvest area were unbanded or the size of a particular population was underestimated. For example, if winter surveys miss more of the total wintering population in southern States than in northern States (which is likely),

the total harvest in areas deriving part of their kill from the South, and the relative importance of southern areas contributing to that kill will be underestimated.

Summary of Available Data

The following discussions are based on a large volume of weighted band recoveries. Appendix tables B51 and B52 show the number of recoveries in each State and Province from each reference area. These tables are important for understanding the interpretation of weighted recoveries; they show that, in some cases, relatively small numbers of recoveries greatly influenced results due to the weight assigned to them.

The analysis of weighted band recoveries was designed to: (1) identify the reference area source of birds harvested in various parts of the United States and Canada, and (2) determine source of kill by months during the hunting season for States, Provinces, or other selected harvest zones.

Table B53 shows data for minor summer reference areas by States and Provinces for immatures and adults; table B54 shows data on adults for minor winter reference areas; table B55, minor summer reference areas by months for immatures and adults in each Province; table B56, the same for States; table B57, minor winter reference areas by months for adults in States and Provinces. Because tables B55, B56, and B57 are based only on recoveries that could be assigned to a particular month, they do not utilize all recoveries listed in tables B51 and B52.

The types of harvest areas discussed below are as follows: (1) parts of States, (2) parts of several States combined, (3) entire States, and (4) groups of States. These harvest areas are not necessarily convenient management zones. Rather, they are useful to indicate the extent to which the hunting kill in each State or Province affects populations from various summer and winter reference areas, and in interpreting the effects of regulations on various segments of the black duck population.

Definition of Major Harvest Areas

Major harvest areas were defined on the basis of the summer areas of reference from which their kill was derived. Winter areas of reference were not used because they reflect the source of the adult harvest only, and recoveries from winter bandings tend to be concentrated close to the banding area (table 47), producing a unique harvest pattern for each winter reference area.

States and Provinces in which the kill was derived from similar summer area sources were grouped together to form 10 major harvest areas (figure 8). Table 48 lists the summer reference area source of the kill in each State or Province within these harvest areas. States and Provinces were assigned entirely to one harvest area except that Long Island was placed in a different area than mainland New York in recognition of distinctly different sources of harvest. The two areas have had different waterfowl hunting regulations since 1953.

Three major harvest areas were recognized in Canada: the Maritimes, Labrador - Quebec, and Ontario. They differ from harvest areas in the United States in that the kill in each was derived largely from summer reference areas located within its boundaries.

Of the seven major harvest areas in the United States, Coastal New England derived more of its kill from the Maritimes, Labrador - Eastern Quebec, and Western Maine than did any other U.S. harvest area. The Vermont - New York (excluding Long Island) harvest area was separated from New England because more of its kill was derived from reference areas within its own boundaries and from Southern Quebec.

The Mid-Atlantic harvest area differed from Coastal New England in a lesser contribution from the Maritimes, Labrador and Eastern Quebec, and Western Maine summer reference areas, and a greater contribution from Northern Quebec.

The North and South Carolina harvest area differed from the Mid-Atlantic in that a slightly larger fraction of its kill was derived from Western Lake Ontario, the Upper Great Lakes area, and Southern Quebec. It differed from States to the south and west in that it derived a larger part of its kill from Labrador, Eastern Quebec and Southern Quebec, and a smaller part from the Upper Great Lakes.

The Interior harvest area includes West Virginia, Georgia and Florida in the Atlantic Flyway, and all Mississippi Flyway States except Minnesota, Wisconsin, and Iowa. The most important source of black ducks was the Upper Great Lakes summer reference area but Western Lake Ontario also was well represented. Three recoveries from Northern Quebec (two in Ohio and one in Michigan) carried considerable weight due to the small number of bandings there and the large population represented. These recoveries suggest the possibility that the source of kill in Michigan and Ohio may differ slightly from other Interior States. An additional difference for Michigan was the contribution received from the Eastern Lake Michigan reference area. This was the only State in the Interior area that had a significant breeding population within its boundaries.

Wisconsin, and Minnesota - Iowa resembled the Interior harvest area in that the Upper Great Lakes was an important source of harvest. They differed because in the Wisconsin harvest area more than half the kill was derived from Western Lake Michigan and, in the Minnesota - Iowa harvest area, the Upper Mississippi River was an important source of harvest. More information is needed on these two harvest areas in order to verify the sources of kill as depicted above. As in previous discussions, we assume that black duck populations harvested in these States were poorly represented by banded birds and that a large part of the kill was derived from unbanded populations in western Ontario and possibly Manitoba.

The harvest areas defined above would not be satisfactory as management units because the kill in each is not derived from sufficiently distinct reference areas. Reference areas often contributed significantly to the kill in more than one harvest area although in different proportions. This is shown in table 48 by the percentages of the kill in each harvest area that were derived from different reference areas, and the percentages from each reference area that occurred in different harvest areas. These figures show that black ducks banded in summer reference areas frequently moved in several directions and were shot over a wide range of harvest areas. They give some insight into the effect that increasing or decreasing the kill in one harvest area might have on the harvest of a particular summer population.

To delineate harvest areas in which the kill was derived almost entirely from different portions of the breeding ground, it was necessary to divide North America into two units as shown in figure 8. In constructing these Units, States and Provinces were assigned entirely to one or the other except for Ontario. The Eastern Unit includes Canada from the James Bay Region east plus all Atlantic Flyway States except West Virginia, Georgia, and Florida. The remainder of the United States and Canada was placed in the Western Unit. When divided this way, weighted recoveries from summer bandings indicated that about 5.9 percent of the kill in the Western Unit was derived from production areas in the Eastern Unit, and about 12.5 percent in the Eastern Unit was derived from production areas in the Western Unit. These percentages are not exact because available tabulations did not permit the kill in Ontario to be divided between the two units. Therefore, the kill in Ontario was assigned entirely to the Eastern Unit. This probably exaggerated the contribution of the Western Unit to the kill in the Eastern Unit and minimized the contribution of the Eastern Unit to the West.

Derivation of the Kill Within Some Important Harvest States

In order to examine possible differences in source of kill within their boundaries, New England, New York, New Jersey and Michigan were subdivided into potential harvest zones (figure 9). For purposes of this discussion the six New England States were considered as a unit,

which was divided into coastal and interior zones. The Coastal Zone derived most of its kill from the Northern Quebec, Southern Quebec, and Labrador - Eastern Quebec reference areas with smaller contributions from the Maritimes and reference areas within New England, such as Western Maine, and Vermont and New Hampshire (table 49). The greatest difference between Coastal and Interior Zones was the complete lack of recoveries from Northern Quebec in the Interior. The significance of this is poorly understood, at present, because too few birds have been banded in Northern Quebec; there may be large sampling errors involved here. Otherwise, both Zones received important contributions from the same reference areas, except that the Maritime contribution was less important in the Interior than in the Coastal Zone while contributions from the other areas mentioned were more important. A truly coastal ecological unit (Hagar, 1954) was not clearly delineated by this treatment of the recovery data, which may minimize the differences between coastal and interior New England discussed by Hagar (1954).

The summer area sources of black ducks killed in New York were not sufficiently distinct to support the six zones shown in figure 9. However, it was possible to combine these into three harvest zones in which birds killed originated from relatively distinct summer reference areas. The first of these is Long Island: birds from Labrador - Eastern Quebec, Northern Quebec, and Western Maine were more important in the kill here than for other parts of New York. Other summer reference areas (except Southern Quebec) which were important elsewhere in New York, were of little or no consequence on Long Island. The Hudson River and Lake Champlain Zones, in which 63 and 93 percent, respectively, of the ducks killed came from Southern Quebec, were combined to form a second zone. The three western New York harvest zones (figure 9) formed a third zone. They differed from other zones in that most of their kill came from more western summer reference areas, such as Eastern and Western Lake Ontario and Western James Bay. Among these three western zones, Lake Erie (area 8) was distinctive in that nearly the entire harvest was derived from Western Lake Ontario and Western James Bay.

New Jersey was divided into a Coastal and Interior Zone. As in New England, these two zones received contributions from the same summer reference areas but in different proportions. Northern Quebec, the St. John - St. Croix Rivers, and the Maritime Provinces were the most important sources of birds harvested in Coastal New Jersey, while Labrador - Eastern Quebec, Southern Quebec, Eastern Lake Ontario, Western Lake Ontario, and Western James Bay were slightly more important in Interior New Jersey.

In Michigan the Upper Peninsula Zone derived nearly all of its kill from the Upper Great Lakes reference area, part of which lies within the boundaries of the harvest zone. The other two zones also

received significant contributions from the Upper Great Lakes but, in addition, the Southeastern Zone, which includes the Detroit River and Lake St. Clair, received major contributions from Western Lake Erie and Western Lake Ontario reference areas, and the Lower Peninsula Zone from Eastern Lake Michigan and Western Lake Erie.

Table 50 presents winter reference area sources of kill in the zones discussed above. Black ducks shot in Coastal New England were derived from quite different winter areas than those shot in Interior New England. New England, Eastern Long Island and Maine were major winter reference areas for birds harvested in the Coastal Zone, while Mid-Atlantic, Mid-Atlantic Coastal and the Southeast were major winter areas for ducks killed in the Interior Zone. Vermont derived a larger fraction of its kill from the Mid-Atlantic Coastal wintering area than was the case in other portions of the Interior.

In tables 49 and 50 the last column shows the proportions of total weighted recoveries taken in various parts of each harvest zone. The proportions of the total New England kill of adult black ducks in Coastal and Interior Zones, based on wintering ground bandings (65.8 and 34.2 percent, respectively) agree closely with those based on summer bandings (65.6 and 34.4, respectively). This close agreement suggests that all breeding and wintering areas contributing to the New England harvest were represented by banded birds and that the values used to weight recoveries were reasonably accurate.

The winter area derivation of the kill in New York harvest zones was not quite as distinct as the summer area derivations because of the importance of the Mid-Atlantic winter area for all except the Long Island and Lake Erie Zone. However, the same three harvest zones can be related to both summer and winter area sources of kill.

Winter banded birds killed in Coastal and Interior New Jersey originated almost entirely from populations in the two winter reference areas (Mid-Atlantic and Mid-Atlantic Coastal) in which New Jersey lies. Only 5.2 percent of the kill in the Interior came from the Mid-Atlantic Coastal winter area, which includes coastal New Jersey, while 81.9 percent came from the Mid-Atlantic winter area, which includes portions of interior New Jersey. This demonstrates the tendency of wintering black ducks to return to the winter areas where they were banded.

The three harvest zones defined in Michigan on the basis of summer areas of reference were also distinguished on the basis of winter areas of reference.

Changes in Source of Kill During the Hunting Season

The summer and winter reference area sources of the kill by month in various States and Provinces are given in appendix tables B56 and B57. A number of States were omitted because too few

recoveries were available. Marked changes in derivation of the kill occurred as the hunting season progressed. These changes indicate when birds from various reference areas arrive in harvest areas. A specific example is provided by data on sources of the monthly kill in the Coastal and Interior New England harvest zones described above (table 51). There was a marked change in the relative importance of various summer reference areas as the season progressed. In the coastal zone, the Western Maine reference area became less important, while Northern Quebec showed a marked increase in importance. However, individual recoveries from Northern Quebec were heavily weighted because the relatively few birds banded are believed to represent a large population. The few recoveries obtained probably do not accurately measure the contribution from this reference area. Labrador - Eastern Quebec, and the St. John - St. Croix Rivers area showed increased importance in Interior New England as the season progressed while the importance of Southern Quebec, Western Maine, and Vermont - New Hampshire declined. Perhaps the most interesting statistics in the monthly kill in Coastal and Interior New England pertain to the relative size of the kill in each zone by month. The data suggest a pronounced shift in the location of the kill from Interior to Coastal areas as the season progressed.

Tables B56 and B57 show that birds from northern summer reference areas already are present in substantial numbers in southern harvest areas when the hunting seasons open. Thus, although significant changes in sources of kill occur as the season progresses, populations contributing to the harvest are generally represented throughout the entire hunting season.

MORTALITY RATES

Summary of Available Information on Mortality Rates

Information on annual mortality from all causes is essential in understanding population dynamics. In this study, estimates of annual mortality rates, based on band recovery data, were made for all samples of banded black ducks large enough to provide meaningful information. The conditions under which the estimates were made, and the two methods used, are discussed in Appendix A. These mortality rates do not include losses that occurred between hatching and the time birds were banded or experienced their first hunting season. Estimates were made for birds banded during an "early" period, before 1946, and for a "later" period, from 1946 through 1960.

Table 52 shows mortality rates for birds banded in minor summer reference areas during "summer" and "October" banding periods (defined on page 25). Rates are calculated separately for locals, immatures and adults.

Table 53 presents mortality rates for birds banded in minor winter reference areas. Estimates are presented for males and females banded during five different periods: November; December; January 1-15; January 16 through February and March and April.

Data from bandings during summer and from January 16 to February 28 were used to compare mortality rates for different ages, sexes, reference areas and degrees of shooting pressure. Since these periods are relatively free of migratory movements the bandings are most likely to sample populations that are comparable from year to year.

Annual Mortality Rates by Age Classes

Annual mortality rates for black ducks banded in summer reference areas during the period 1946-60 are presented in table 54. This shows first year and subsequent mortality rates for birds banded as immatures, and rates for all years combined for birds banded as adults. The data in table 54 were compiled from mortality estimates, made by the composite dynamic method, in table 52. Among birds banded as immatures, first year mortality rates were consistently higher than for later years. The weighted average mortality rate for all immatures was .649 for the first year, and .404 for later years. For birds banded as adults, the weighted average for all years was .443. Because bandings of immatures were somewhat more representatively distributed than those of adults, the "later year" mortality rate for birds banded as immatures is probably a better estimate of the adult mortality rate.

The relatively high first year mortality rate indicates that young black ducks are more vulnerable than adults to shooting and other forms of mortality. Further, an examination of data in table 52 shows that during their second year, birds banded as immatures tended to have a slightly higher mortality rate than for all years after the first. Thus, survival of older adults tends to be higher than for "young" adults.

Annual Mortality Rates by Sex

Data from both summer and winter bandings show that females had consistently higher annual mortality rates than males (tables 55 and 56). The difference was apparent even in first year mortality rates of birds banded as immatures: in 15 of 19 comparisons in table 55, immature females had higher first year mortality rates than immature males. This table shows that the weighted average mortality rate during the first year was .619 for males, and .663 for females banded in summer, a difference of slightly more than

7 percent. These weighted averages were based on samples representing about 70 percent of the continental population of immatures.

Table 55 also shows weighted average first year band recovery rates for immatures (.117 for males and .115 for females) which suggest that the mortality differences were probably not due to differences in shooting pressure. First year mortality rates cover a period from the beginning of the first hunting season to the beginning of the next. During part of this period the birds are on the breeding ground for their first nesting season. Since mortality connected with nesting is believed to be greater for females than for males, it is likely that this is the reason for the difference in mortality rates.

Summer bandings provided two sources of data on annual mortality rates for adults: second and later year recoveries of birds banded as immatures (listed as later year recoveries in table 55), and all recoveries of birds banded as adults. A comparison of later year mortality rates for males and females banded as immatures in the 10 areas having such data revealed that for all but two, females had the higher rates. Weighted average annual mortality rates were .428 for males and .470 for females, a difference of approximately 10 percent. These banded birds represented about 30 percent of the continental black duck breeding population.

Birds banded as adults were compared in eight areas and females again had the higher mortality rates in all but two cases (table 55). Weighted average annual mortality rates were .403 for males and .433 for females. These banded birds represented approximately 35 percent of the continental black duck breeding population.

Recoveries from summer banded adults are probably inadequate for calculating adult mortality rates because of the poor distribution of summer banding locations with adequate samples of adults. Winter bandings probably provide a better source of data. Weighted average annual mortality rates based on recoveries of birds banded during the winter period (January 16 through February) were .375 for adult males and .469 for adult females (table 56). These data show that adult females have a mortality rate about 25 percent greater than adult males. This is more than twice the difference revealed by summer banding data but probably more accurately reflects the true situation.

Differences in Mortality Rates Among Reference Areas

Annual mortality rates of birds banded in both summer and winter minor reference areas varied considerably. First year mortality rates of immatures for example were less than .550 in six summer areas but exceeded .750 in five other summer areas (table 54). Other first year

mortality rates shown in table 54 were distributed between these extremes. Generally, immatures banded in the north, away from major centers of human activity had the lowest mortality rates and those banded in southern Canada and in northern United States had the highest. Even in these areas, however, immatures banded some distance from concentrations of hunters had low mortality rates. Thus, those banded in the Upper Great Lakes portion of Michigan, and the St. John - St. Croix Rivers area in Maine and New Brunswick, had relatively low mortality rates. Immatures banded in Maryland and Delaware, at the extreme southern end of the breeding range, also had low mortality rates. These birds probably are not subjected to hunting pressure until November and this may increase their survival rate, even in an area well known for its black duck hunting. These observations suggest that hunting pressure and mortality rates are related.

Among winter reference areas (table 56) the highest mortality rates for adult males were in the Maryland, New Jersey, and Pennsylvania portions of the Mid-Atlantic area, and the lowest rates were in Prince Edward Island, Connecticut, Massachusetts, the Virginia portion of the Mid-Atlantic Coastal area, and the Michigan portion of the Lake Erie area. The highest mortality rates for females were in Prince Edward Island, the Connecticut portion of the New England - Eastern Long Island area, the New Jersey portion of the Mid-Atlantic Coastal area, and the Delaware - Maryland portion of the Mid-Atlantic area. Reference areas with high adult male mortality rates sometimes had low adult female mortality rates and vice versa.

Effect of Hunting Mortality on Total and Nonhunting Mortality Rates

The effect of hunting mortality on survival is possibly the most important aspect of this study. An estimate of the magnitude of hunting mortality in relation to other causes of death can be obtained by comparing annual mortality rates with kill rates (recovery rates adjusted for crippling loss and for bands recovered but not reported). These estimates are presented in table 57 for immature and adult males and females banded in the summer, and for males and females banded in the winter.

It was assumed that 49 percent of the banded black ducks recovered were reported (see page 24) and that 27.5 percent of all black ducks killed by hunters were not retrieved (see page 37). To account for both the unreported and the unretrieved kill, the reported recovery rates were multiplied by 2.816. This gave estimates of the total hunting kill, which were then divided by the annual mortality rates for each sex and age group to obtain the proportion of total deaths due to hunting.

Based on summer bandings, hunting mortality accounted for about 50 percent of all deaths; the percentage was similar for immatures and adults of both sexes.

Hunting accounted for a smaller proportion of total deaths among birds banded in the winter than among those banded in summer. Factors contributing to this difference are: (1) it is likely that winter bandings sampled more birds from lightly shot northern breeding populations than did summer bandings; (2) it is certain that some birds died during the 7 months between the winter banding period and the next hunting season, thus reducing the number available to hunters. The proportion of total deaths due to hunting should be somewhat less for winter-banded than for summer-banded birds because most nonhunting mortality occurs prior to the first hunting season after banding for the former and after the first hunting season for the latter. This does not make mortality estimates based upon winter bandings less valuable as measures of adult mortality rates, but it does affect the usefulness of first hunting season recovery rates from winter bandings as a measure of the hunting pressure to which adults are subjected.

It is clear that mortality due to shooting accounts for a substantial portion of total deaths among black ducks. To what extent does hunting influence annual mortality rates? If hunting mortality is simply a substitute for other losses that would have occurred in the absence of shooting pressure, then it should have no effect on annual mortality rates. This hypothesis was tested, as suggested by Hickey (1952), by plotting the first hunting season band recovery rate against the corresponding mortality rate for each minor reference area. Figure 10 shows a highly significant direct correlation between first year mortality rates and first year recovery rates of birds banded as immatures. Figures 11 and 12 show this relationship separately for immature males and females. These figures indicate that shooting pressure influenced the survival of immature black ducks.

Further evidence of this relationship was obtained by comparing second year recovery rates from seven summer reference areas where first year recovery rates for immatures exceeded .15 (table 54), and the average first year mortality rate was .742, with those from nine areas where first year recovery rates were less than .10, and the average first year mortality rate was .531 (weighting each area equally). In each case the second year recovery rate reflects the proportion of the population that survived long enough to enter the second year. The average second year recovery rate (from data in table 14) was .029 for areas in the first group, and .033 for areas in the second group.

These second year rates pertain to samples of birds banded as immatures and recovered as adults. Unless corrected, they are not directly comparable to the corresponding first year recovery rates because immatures are more vulnerable to shooting than adults.

A correction factor can be derived from first year recovery rates of adults obtained during the same hunting season, and on the same groups of areas, as the second year rates given above. The average first year recovery rate for adults was .093 for areas in the first group, and .060 for areas in the second group. Thus, adults in areas with low immature first year recovery rates were only 0.64 times ($.060 \div .093$) as likely to be harvested as adults in areas with high immature first year recovery rates. When the second year recovery rate (.033), relating to immatures with a low first year recovery rate, was adjusted by this factor ($.033 \div .64$) to account for the difference in shooting pressure between the two groups of areas, it increased to .051. Comparison of this with the second year recovery rate of .029, relating to immatures with a high first year recovery rate, indicated that over 75 percent more birds survived to enter the second year in areas where the first year mortality rate was low, than in areas where it was high.

Figures 13, 14, and 15 portray the relationship between band recovery rates and annual mortality rates for adults (sexes combined), adult males, and adult females banded in summer areas of reference. The regression lines indicate that shooting pressure influenced survival among adults in those populations represented by banded samples. As pointed out previously, however, summer bandings represent only a small part of the adult population.

Figures 16 and 17 show regression lines based on data from winter bandings. There appears to be a relation between shooting pressure and mortality among winter banded males, but not females. The fraction of total deaths due to shooting was lower for winter banded adult females than for any other sex or age group banded in either summer or winter (table 57). Apparently this was due to a substantially greater non-hunting mortality between the winter banding period and the following hunting season for these females than for other sex and age groups. The influence of shooting pressure on survival of adult females is quite apparent for those banded in summer reference areas, but not for those banded in winter.

It is assumed that the relation between shooting pressure and survival as shown in figures 10 through 17 is linear. However, in part, it may be curvilinear.

For summer bandings of adults, the intersect of the regression line and the mortality rate axis in figures 14 and 15 (the point of zero hunting pressure) shows the same nonhunting mortality for both sexes in the absence of shooting pressure. Table 57 also shows this. However, for birds banded in winter, table 57 and the regression intersects in figures 16 and 17, show that the average nonhunting mortality of males and females is different. Thus, summer and winter banding data provide different estimates of nonhunting mortality for males and females. Several relatively small and heavily shot population segments

may have an undue influence on the data resulting from summer bandings. In contrast, winter bandings probably include a more representative sample of the entire black duck population. If this is the case, it is surprising that adult mortality rates based on summer bandings of females shown in table 57 were not higher than those from winter. However, table 57 presents the average weighted mortality rate, and, consequently, the Western James Bay reference area with its extremely low mortality rate but high population greatly depressed the average mortality rate. The unweighted adult female mortality rate based on summer bandings was .55 in contrast to an unweighted mortality rate of .44 for winter banded females. The graphic approach illustrated in figures 10 through 17 treats each reference area equally. Thus, graphs relating to summer bandings may exaggerate the importance of hunting as a mortality factor. They are influenced unduly by small populations such as those in the Lake Champlain portion of Vermont and the Western Lake Erie segment of Michigan having both heavy shooting pressures and high mortality rates.

In addition to illustrating the relation between recovery and mortality rates, figures 10 through 17 show the points plotted for each comparison, and except in figure 17, the 95 percent confidence intervals around the slopes of the lines. Statistical data for figures 10 through 17 are presented in table 58, which includes regression equations and correlation coefficients. This table also shows the probability that correlations between recovery rates and mortality rates were due to chance. In the regression equations, the last values are mortality rates expected with no shooting pressure (the point of intercept with the Y axis). The correlation coefficients are all positive and are statistically significant or highly significant except for adult females banded in winter.

It is unlikely that hunting mortality is entirely additive to nonhunting mortality. Certainly, some birds would have fallen victim to other forms of mortality had they not been shot. The relation between total mortality, hunting mortality, and nonhunting mortality is shown in figures 18 (immatures) and 19 (adults) for black ducks banded in the summer. The basic approach is a modification of the procedure proposed by Hickey (1952) to evaluate the importance of hunting mortality. The regression line (A) shows mortality rates at the various levels of shooting pressure indicated by recovery rates on the horizontal axis. At point (D) this line intersects the vertical (mortality rate) axis. Line (B) was extended horizontally from this point to indicate the theoretical level of nonhunting mortality that would occur with no shooting pressure. This is 39.8 percent for immatures and 21.6 percent for adults. Line (C) shows the level of nonhunting mortality under various degrees of shooting pressure. It was obtained by subtracting kill rate (recovery rate corrected for unreported bands and crippling loss) from mortality rate (line A).

Figures 18 and 19 show that as shooting pressure (recovery rate) increases, mortality rate (A) goes up, and nonhunting mortality (C) goes down. The extent to which hunting mortality replaces nonhunting mortality is shown by the vertical distance between line (B) and line (C). At any level of shooting pressure (recovery rate) mortality above line (C) may be attributed to hunting. For a heavily hunted immature population with a .20 recovery rate, the rate of hunting mortality would be .563, and hunting mortality would replace approximately 44 percent of the nonhunting mortality that theoretically would occur in the absence of shooting (figure 18).

Although more data are needed for adults, figure 19 suggests that hunting mortality replaces nonhunting mortality to a much lesser extent than for immatures. For both adults and immatures, however, it appears that a considerable portion of hunting mortality occurs in addition to, rather than in place of, nonhunting mortality.

Relationship Between Hunting Regulations and Annual Mortality Rates

Considering the strong correlation between band recovery rates and mortality rates of immature black ducks discussed above, and that band recovery rates are directly related to shooting pressure, it is difficult to ignore the implication that hunting regulations influenced survival. To test this, annual mortality rates for birds banded in different reference areas during years with different regulations were compared. To estimate annual mortality rates during a short span of years, it was necessary to use the relative recovery rate method (described in Appendix A). The use of the relative recovery rate method in this particular case, where first hunting season recovery rates of immatures banded in summer are related to the recovery rates occurring one year later, results in mortality indexes - not absolute estimates. Because the birds are immatures in the first recovery year but adults in the second, vulnerability to shooting is different and a bias is introduced. Nevertheless, the statistic obtained should be a valid index of mortality.

Table 59 compares mortality rates with hunting regulations for black ducks banded in summer areas of reference. In 15 of 25 possible comparisons, mortality rates changed in the same direction as regulations (i.e., mortality rates increased as regulations became more liberal and vice versa). A sign test indicated a probability of .21 that changes in mortality rates and regulations were unrelated. Although mortality rates usually increased with more liberal regulations, this relationship did not always apply.

No tendency was perceived for mortality rates of adults banded in winter (January 16 through February) to increase with liberalized regulations (table 60). In 6 of 11 cases, the relationship was opposite the expectation. In contrast, spring bandings (March and April) suggested

a relationship between regulations and survival. In four of five comparisons, mortality rates changed as expected with regulations. The probability that this was not due to chance is .82.

In summary, the relation between mortality rates and changes in hunting regulations was not as pronounced as the relation between recovery rates and mortality rates. When all evidence is considered, however, it is concluded that hunting regulations affected the survival of immature black ducks and some segments of the adult population.

Distribution of Mortality Within the Year

Recovery rates from bandings during different periods in the year can be compared to determine the variation in mortality that occurred between periods. To do this, a representative sample of the entire continental black duck population, or the same segments thereof, must be banded during each period.

The seven banding periods considered (two relating to summer areas of reference and five relating to winter areas of reference) are defined on page 25. It would be desirable to divide the summer period into shorter intervals, but this could not be done because of the small number of bandings. Bandings between November and May in winter reference areas probably provided a better sample of the continental population than did those in summer reference areas. There were more fall bandings in the Mississippi than in the Atlantic Flyway.

The recovery rates used for measuring mortality differences between banding periods are presented in table 61. This shows average second hunting season recovery rates for bandings in all periods, and first and second hunting season recovery rates for winter (January 16 through February) and spring (March and April) bandings. Second hunting season recovery rates from birds banded as immatures during September and October were also included in the table. However, these rates are not comparable to those from bandings in winter reference areas because of the higher first year mortality associated with immatures. The rates are based on bandings of 100 or more birds in each banding area from 1946-60. The overall average was obtained by weighting each sample equally.

Figure 20 shows the relation between these recovery rates to obtain an estimate of black duck survival from one period to the next. The points based on bandings of immatures fall below the "survival" line obtained from the bandings of all ages. This is explained by the high first year mortality rate of immatures, which causes a smaller fraction of the banded sample to be available for recovery during the second hunting season. All recovery rates compared relate to birds that were adult at time of recovery.

Differences in the rates reflect the mortality that occurred between banding periods. Second hunting season recoveries of winter banded males shown in figure 20 and table 61 were based on banding done approximately 20 months before the hunting season during which the recovery rate was measured. In contrast, first season recovery rates were from winter bandings made approximately 7 months before the hunting season.

The major conclusion drawn from the comparison of recovery rates of black ducks banded at various times of the year is that mortality during the hunting season occurred at a much higher rate than during the remainder of the year.

PRODUCTION RATES

With a fixed mortality rate, a population increases, decreases, or remains stable, according to the rate at which losses are replaced. Thus, knowledge of production rates is necessary for understanding the implications of black duck mortality rates discussed in preceding sections. To be most meaningful these production rates should apply to the same period as the mortality rates: from the beginning of one hunting season to the beginning of the next. Therefore, the proportion of young-of-the-year (immature/adult age ratios) in the prehunting season population was used to indicate production rates. Prehunting season age ratios were derived from age ratios in the hunting kill, revealed by the wing collection survey corrected for the greater vulnerability of immatures to shooting. The correction factors are based on immature/adult relative recovery rates from summer bandings. It was assumed that no significant mortality occurred between banding and recovery. Since most summer banding of black ducks was accomplished only a few weeks prior to the hunting season, this is probably a reasonable assumption.

Age ratios in the black duck hunting kill for 1960-62 in the Atlantic and Mississippi Flyways are given in table 62. During this 3 year span, there was a progressive decline from 2.00 immatures per adult in 1960, to 1.82 in 1961, and 1.35 in 1962. Marked differences between years also occurred in the ratios for individual States. Because of this variability, the ratio of 1.72 immatures per adult for the entire 3 years is not a reliable average. A more accurate average must await additional years of nationwide wing collection data.^{1/}

^{1/} Nationwide black duck age ratios of 1.46 for 1963, 1.38 for 1964, 1.47 for 1965 and 1.29 for 1966 hunting seasons became available following the completion of this manuscript. When these data are added to those above the average age ratio for 7 years becomes 1.54 immatures per adult.

Because black duck breeding habitat conditions appear to change little from year to year, it might be expected that production rates would be relatively stable. However, bag checks in Maine from 1948 through 1957 (Mendall and Spencer, 1961) showed age ratios in the bag ranging from 0.9 to 3.3 immatures per adult. The cause of these annual variations is unknown but some data suggest that they may be due to changes in vulnerability of immatures to shooting, rather than differences in the age ratio of the population (Geis and Carney, 1963).

Although preseason bandings were too few to yield precise measures of vulnerability to the gun, data for 1961 in the Atlantic Flyway indicated that immatures were about 1.4 times more likely to be shot than adults. Since the age ratio in the 1961 Atlantic Flyway kill was 1.75 (table 62), the age ratio in the population was estimated to be 1.2 immatures per adult ($1.75 \div 1.4 = 1.2$). For 1962, black duck bandings in New York and Maine provided a representative measure of relative recovery rates in the Atlantic Flyway. Excluding recoveries from Canada, the relative recovery rate was 1.0 in New York and 1.2 in Maine; for both States combined it was 1.1. Dividing this into 1.32 (the age ratio in the Atlantic Flyway kill for 1962) indicates an age ratio in the preseason population of 1.2: the same as in 1961, despite a decrease from 1.75 to 1.32 in the proportion of immatures in the kill (table 62).

The variability of age ratios in the kill for 1960-62 emphasizes the need for adequate pre-hunting season banding. If sufficient banding data were available, it might be possible to determine whether the downward trend in age ratios in the kill was due to changes in relative vulnerability or the age composition of the population.

An examination of differences among States in table 62 showed that age ratios in the kill in northern States were generally higher than in southern States. Preseason banding data for 1960-62 suggest that these differences also may be due to variation in relative vulnerability rates (Geis and Carney, 1963). In Maine, for example, banding data indicate that immatures were 1.6 times more vulnerable to the gun than adults. This would convert the 1962 age ratio observed in Maine from 1.7 immatures per adult in the kill to 1.1 immatures per adult in the population. The age ratio in the New York kill was 1.6 immatures per adult. Recoveries in New York from New York bandings showed that immatures were 1.6 times more likely to be taken than adults, while recoveries in New York from Maine bandings showed that immatures were 1.2 times more likely to be taken than adults. Assuming that the true figure is intermediate between these two values (1.4) then the age ratio of 1.6 in the New York kill represents an age ratio of 1.1 immatures per adult in the population. Among birds banded in both New York and Maine and taken in States south of New York, immatures were only 0.8 times as likely to be shot as adults. This suggests

that age ratios in the kill in southern States, which are consistently near one immature per adult, represent age ratios in the population of roughly 1.2 immatures per adult.

Annual changes in vulnerability to shooting were detected also in an examination of recovery rates of immature and adult black ducks banded in the Eastern Lake Ontario summer reference area between 1950 and 1960. The data showed that immature/adult relative recovery rates varied from year to year, indicating that changes in age composition of the kill were not due entirely to changes in the age composition of the population.

Although there are marked differences in age ratios in the kill even when differential vulnerability of immatures and adults is considered, differences in the age composition of the population are probably not as great as suggested by the kill.

The only available estimate of an average age ratio in the United States black duck kill is 1.72 immatures per adult, based on 1960-62 wing survey data (table 62). Let us assume that this was also the average age ratio in the black duck kill in the United States during the 1950's. This figure must first be adjusted for the vulnerability of each age based upon summer and pre hunting season bandings from these years. Within the United States average direct recovery rates were .068 for immatures and .056 for adults (table 54), suggesting that immatures were 1.21 times more likely to be shot than adults (.068 divided by .056). Therefore, an average age ratio of 1.72 immatures per adult in the kill would produce an estimated average age composition of the pre season population during the 1950's of 1.42 immatures¹/ per adult (1.72 divided by 1.21).

A stable population with an average of 1.42 immatures/adult annually would be maintained with an annual mortality rate of .587 for immatures and adults combined. The weighted average mortality rate based on birds banded as immatures in summer reference areas, considering their entire life span, was .552 (determined from data in table 50). An average of only 1.23 immatures per adult annually would be required to maintain a stable population with this mortality rate. This agrees very well with the 1.21 immatures per adult observed for the period 1960-66.

It is unfortunate that we lack production data truly comparable with mortality data. Mendall and Spencer (1961) observed an average age ratio in the Maine black duck kill of 1.9 immatures per adult during 1948-57. This ratio can be compared with an age ratio of 2.2 immatures per adult in Maine during 1960-62, based on wing survey

¹/ Using an average age ratio in the kill of 1.54 immatures per adult (see footnote page 54), the average age ratio in the pre season population becomes 1.21 immatures/adult.

data. Thus, age ratios in the kill during 1960-62 may have been higher than in preceding years. This seems likely in view of the lower age ratios observed for 1963-66. This explanation also supports the implications of the disagreement between the age ratio required to maintain a stable population during the 1950's (1.23 immatures/adult) and that observed during 1960-62 (1.42 immatures/adult).

So far in this discussion, only band recovery data for the United States have been considered. When band recoveries in both the United States and Canada are considered, the vulnerability to shooting of immatures as compared to adults is substantially greater than for the United States alone: 1.53 rather than 1.21. This indicates that between Canada and the United States, as between northern and southern States, vulnerability of immatures to shooting is higher in the north. Age ratios in the kill, therefore, should be much higher in Canada than in the United States.

Wing collection data for the 1960-62 hunting seasons were pooled to determine if there was a trend in age ratios as the season progressed. These data, for States having large enough samples, are found in table 32. They show that age ratios consistently become lower as the hunting season progresses. This decline in age ratios is too pronounced to reflect changes in the age composition of the population during the hunting season; therefore, it must denote changes in the relative vulnerability of immatures compared to adults.

SEX RATIOS

Most trapped or shot samples of black ducks show a preponderance of males. There is little doubt that males are more abundant than females in the population but the extent of preponderance probably is not measured accurately by these samples. Records of black ducks banded in winter areas of reference show that males made up a progressively larger fraction of the catch from fall through winter, and spring (table 63). Males also predominated in trapped samples from summer areas of reference. For all black ducks handled during banding operations in North America, sex ratios were 1.27 males per female during September and early October; 1.42 from November through January 15; 1.82 from January 16 through February; and 2.06 through March and April. There is no evidence that this reflects a change in the sex composition of the population. Studies by Boyd (1957) on the European green-winged teal, Anas crecca crecca L., and Bellrose et al. (1961) on the mallard and black duck indicate that males enter traps at a greater rate than females. Thus, it is likely that seasonal changes in the sex ratio of trapped birds reflect an increasing susceptibility of males to trapping.

A better measure of sex ratios is provided by the wing collection survey. This survey made it possible to determine the sex composition of adult black ducks taken in the Atlantic and Mississippi Flyways during the 1960-62 hunting seasons (table 64). Data for the 3 years were pooled because of small sample sizes in most States. For the few States where samples were large enough for annual comparisons, it was found that adult sex ratios were quite consistent in some but variable in others. Sex ratios of adults in New York, for example, were 1.95, 1.95, and 1.86 males per female in the 1960, 1961, and 1962 hunting seasons, respectively. In contrast they were 2.02, 1.16, and 2.61 during the 3-year span in New Jersey.

In both the Atlantic and the Mississippi Flyway adult sex ratios in the kill seem to be highest in a middle zone of States and lower north and south of this zone. This is consistent with information presented previously in this report where it was pointed out that some adult males apparently moved south earlier than adult females and were subjected to shooting in the middle zone early in the hunting season, while adult females were subjected to heavy shooting pressure in Canada and some northern States early in the hunting season. Much of this hunting pressure exerted on adult females is not measured by the wing survey because it does not include Canada. It is reflected, however, by New Hampshire and Vermont.

If we assume that traps are equally selective for males in all winter banding areas, there is a suggestion that northern wintering populations have a higher percentage of drakes than those in the South. There is also a suggestion of this in the sex ratios of adults shot in December in Maine, New York, and Ohio. The full significance of this cannot be determined until more is learned about the factors influencing trap selectivity and differences in shooting pressure.

By using band recovery rates for adult males and females banded pre-season and recovered in the United States, wing survey data can be adjusted for sex differences in vulnerability to hunting. The weighted average recovery rate, based on recoveries in the United States of adult males banded in the summer between 1946 and 1960, was .059. The comparable rate for females was .049. Thus, adult males were 1.2 times more likely to be shot in the United States than adult females. Assuming that this differential vulnerability is applicable to sex ratios in the adult black duck kill in the United States, 1960-62, the observed average sex ratio of 1.43 (table 64) males per female in the kill represents a sex ratio in the adult population of 1.19 males per female.

The adult sex ratio can be calculated also from annual rates of mortality for adult and immature males and females and the average annual rate of increase discussed previously. Immature black duck

mortality rates are .619 for males and .663 for females (table 55). For adults in the same summer reference areas, the mortality rates are .403 for males and .433 for females. The average production rate for 1960 through 1962 was about 1.4, based on wing collection age ratios adjusted for the greater vulnerability of immatures. Inserting these statistics in the formula presented by Wight, Heath, and Geis (1965), the adjusted sex ratio is calculated to be 1.21 males per female. The agreement between this and the preceding estimate (1.19 males per female), suggests that they are close to reality.

ESTIMATES OF BLACK DUCK POPULATION LEVELS

There are three sources of data on black duck population levels: breeding ground surveys, winter surveys, and indirect population measures based on banding data and kill estimates. Despite considerable effort, a technique for determining the distribution and size of the black duck breeding population is still in the developmental stage. One of the greatest difficulties encountered on surveys of the important breeding grounds in eastern Canada is proper timing of counts of breeding black ducks. Due to the broad north - south extent of this segment of the breeding range, variations in phenology are often encountered annually and between areas. Changes in the numbers of black ducks observed often appear to be more closely related to changes in phenology (or stage of the breeding cycle) than to actual changes in densities. New approaches to the interpretation of these survey data may make it possible to take phenology into account when comparing annual counts in various portions of the surveyed area (Chamberlain and Kaczynski, 1965).

Annual winter surveys of waterfowl have been conducted for more than 20 years. Winter counts of black ducks, from 1948 through 1963 are shown in table 65, and the average winter distribution during this period is shown in figure 21. The most significant aspect of the annual winter surveys is the progressive decline in black duck numbers from 1955 through 1962. There is reason to question the accuracy of individual counts, but the consistent downward trend in population levels during this 6-year span suggests that the continental population was decreasing.

Probably the best estimate of the average size of the black duck population can be obtained indirectly by dividing the hunting kill by the rate of hunting kill. The analysis of banding data provided an average rate of kill for 1946-60 based upon band recoveries in the United States (table 54). Since immatures and adults are killed at different rates, population estimates must be made for each age group. This is possible because the wing collection survey provides an estimate of the age composition of the kill. The necessary values to make these estimates are outlined in table 66. The values in this table representing rate, size, and age composition of the kill do not relate to

the same periods of years, but must be viewed as best estimates of the average situation during the 1950's. The average preseason population of adults was estimated at about 1.5 million and that of immatures slightly over 2 million, or a total average preseason population of about 3,738,000 black ducks. When compared to previously discussed estimates of the total United States and Canadian hunting kill, this indicates that an average of 27.4 percent of the population was harvested annually.

It is interesting to compare the indirect population estimate with that obtained by the winter survey. According to winter survey counts (table 65), the population averaged approximately 633,000 during the period 1952 through 1960. If the indirect population estimate is considered to be correct, the winter survey recorded about 40 percent of the average adult black duck population that was present the following summer. Actually, this percentage is probably even lower because it must be recognized that some adults present during the winter survey die before the following pre hunting season period. Further evidence that the winter survey is incomplete can be provided if it is assumed that the winter counts correctly represent the size of the breeding population, and that there was an average annual production rate similar to that used in table 66. With these assumptions, the preseason population is estimated to be approximately 1,525,000. Hunting in the United States and Canada would have removed about 67 percent of a preseason population of this size. This is clearly impossible and indicates that the winter surveys recorded only a portion of the population. Even though the winter survey records less than half the wintering population annually, it may count a relatively constant fraction each year. If further investigation proves this to be the case, winter counts of black ducks may be a meaningful measure of population trends.

Although indirect estimates provide better measures of population size than do the winter surveys, they cannot provide information on annual population trends for the black duck until there is an adequate preseason banding program to provide the necessary data on annual rates of kill.

SUMMARY, MANAGEMENT IMPLICATIONS AND RESEARCH NEEDS

Banding records, population surveys, mail questionnaire kill surveys, wing collection surveys and other data in the files at the Migratory Bird Populations Station were examined to obtain information about the black duck. The major source of data was nearly 265,000 black ducks banded before 1961.

The distribution of recoveries of birds banded at each station was examined, and data from stations showing similar distribution patterns

were combined to form banding areas of reference. Summer bandings and those in January and February yielded the most meaningful results, since black duck populations are relatively stable during these periods, and crude population data were available to assist in interpreting the banding data.

For each reference area of banding, distribution of the hunting kill, band recovery rates, and mortality rates are presented. Data from bandings during the hunting season in September and October were summarized by summer reference areas of banding. Bandings during November, December, March and April are presented with data from January and February bandings for the winter reference areas. Recovery distributions are described and compared with those from adjacent reference areas.

Band recoveries indicated differences in the distribution of the kill of adults and immatures, and adult males and females. Adult females and immatures of both sexes tended to be harvested to a somewhat greater degree on or near the northern breeding areas, and early in migration, than adult males. Adult males tended to be harvested to a somewhat greater degree in wintering areas. Therefore, changes in hunting regulations or other factors influencing the kill in northern areas are more likely to change the shooting pressure against adult females and immatures, while changes in the wintering areas are more likely to effect adult males.

Banding data revealed a tendency for black ducks to return to the same wintering area each year, particularly in the Atlantic Flyway. Although the data suggest that this tendency was greater for males than for females, it is believed that the characteristic is equally pronounced for both sexes. The difference shown by the banding data (a slightly lower proportion of total recoveries of females occurred within the State of banding) is probably due to a greater kill of females in northern areas prior to and during southward migration.

Differences in the proportions of adult males and females killed monthly during the hunting season were evident as would be anticipated from the geographic differences mentioned above. In September the proportion of total adult female recoveries was twice as high as for adult males. The proportion was lower in October but still higher than for males. A relatively greater proportion of total adult male recoveries occurred in November, December and January.

Characteristics of summer and winter populations in extreme southern Canada and the northern half of the United States were more adequately revealed by banding data than were characteristics of breeding populations in northern Canada and wintering populations south of Maryland in the United States. The paucity of banding data from northern Canada and southern United States seriously limits

knowledge of the characteristics of the continental black duck population. The few bandings available represent large numbers of birds that probably are subjected to different shooting pressures, and have different survival characteristics than the more adequately sampled populations in southern Canada and northern United States. A more adequately distributed banding effort is a primary need for future research on the black duck.

Duck hunting regulations and the number of hunters were summarized for each year. The greatest number of hunters were afield when regulations were most liberal. Kill statistics indicate that about 20 percent of the duck stamp buyers were responsible for 80 percent of the kill. There appeared to be one hunter of black ducks in Canada for about every four in the United States.

Comparisons of band recovery rates revealed marked differences in shooting pressure associated with various summer and winter populations. Summer populations in the Maritimes, southern Quebec, New England, and portions of States bordering the Great Lakes were subjected to relatively high shooting pressures as compared to those in extreme northern areas such as the James Bay region and eastern Quebec and in southern areas such as Delaware and Maryland. Among wintering populations, those in Massachusetts and western Long Island had the lowest shooting pressures, while those in the mid-Atlantic States and eastern Long Island had above average shooting pressures. Differences between sexes banded in the same area make generalizations about the distribution of shooting pressure difficult.

Comparison of direct recovery rates of immatures and adults banded prior to the hunting season indicates that immatures were 1.5 times more likely to be shot than adults (2.25 in Canada and 1.21 in the United States). Direct recovery rates from locals (flightless young) and immatures (flying young) were similar, suggesting little mortality between the time when young were old enough to band and the time when they were capable of flight. Summer bandings revealed that immature males and females were equally likely to be shot during their first hunting season. Preseason summer bandings were too few to show clearly whether adult females were more likely to be shot than adult males but they strongly suggest that females received greater shooting pressure.

Winter bandings indicate that males had a higher band recovery rate than females. This may not mean a greater shooting pressure against males because, during the long interval between the time of banding (January 16 through February) and recovery (hunting season beginning the next fall), more females die from causes other than hunting. Both summer and winter bandings show clearly that females were relatively more likely to be taken in Canada than in the United States, while adult males were more likely to be shot in the United States.

The difference in the distribution of the kill of immatures, adult males and adult females is apparently due to a difference in the speed and timing of migration which causes adult females and immatures to be taken to a greater extent than males in production areas and early in migration. Adult females of breeding populations in certain areas where shooting pressures are high were subjected to a much greater rate of kill than adult males, e.g., Vermont and south-eastern Michigan.

Hunting regulations influenced the rate of kill of immature black ducks, but this could not be demonstrated for adults. Little opportunity was afforded to examine the effect of regulations on adult kill rates because of the small numbers of adults banded pre-season.

Bandings and mail questionnaire survey data were used to determine the distribution of the hunting kill in North America. Ontario, Quebec, New York, New Jersey, Maryland, Michigan, Wisconsin and Ohio were major black duck harvest areas.

Annual variations in the distribution of the kill of black ducks banded in various summer and winter areas were examined. Statistically significant variations from year to year or during short periods were evident but long term trends were not the rule.

The retrieved black duck hunting kill in the United States between 1952 and 1962 varied from 255,200 in 1961 to 662,000 in 1955 with an average harvest of 480,800. Kill statistics, number of hunters, winter survey data and hunting regulations were compared to determine how they were interrelated. Changes in the hunting kill were associated with hunting regulations, size of the continental black duck population and the number of hunters. The hunting kill was greatest during 1955-58 when hunting regulations were most liberal. This period also had the greatest number of hunters and the highest rate of kill. The kill was lower during 1952-54, when somewhat more restrictive regulations were in effect, but still substantially higher than during 1959-62 when much more restrictive regulations were in effect.

According to the winter survey, the continental black duck population declined greatly between 1952 and 1962. It is believed that the survey data correctly reflect the population trend during these years. Although the population was at a lower level, and the kill much smaller in 1959-62 than in 1952-54, band recovery data show that kill rates were equally high in the two periods. The population decline was probably due to a high rate of kill associated with 70 day seasons and 4-bird bag limits during 1955-58. Failure of the black duck population to recover in recent years despite a lower kill is apparently due to a continued high kill rate.

An estimated 35 percent of the black duck kill in North America occurs in Canada and the remainder in the United States. Distribution of the United States total is 40 percent in the Mississippi Flyway and 60 percent in the Atlantic Flyway. In 1962, with very restrictive regulations in the Mississippi Flyway, the Atlantic Flyway proportion of the total United States kill increased to 84 percent.

It is estimated that for every 100 black ducks bagged an additional 38 were killed but not retrieved. Thus, a substantial unretrieved loss must be added to the retrieved bag. The hunting kill in the United States, including crippling loss, averaged about 662,000 annually during 1952-60. With the hunting kill in Canada added to that in the United States, the average annual kill in North America during the period 1952-60 was 1,025,000.

Harvest areas were defined as locations where the kill is derived from more or less distinct reference areas of banding. Most States and Provinces with significant wintering populations derived most of their adult kill from populations wintering within the State, particularly late in the hunting season. Some wintering populations had a low rate of kill as indicated by band recovery rates. It was not demonstrated that hunting regulations have influenced the kill rate of wintering black duck populations. If young birds migrate rather precisely to the wintering area of their parents, the shooting pressure in one wintering area will have no effect on the size of the populations in other wintering areas. On the other hand, if young birds move to wintering areas other than those of their parents, the advisability of using wintering areas as harvest units is questionable. We need to know the answer to this question.

The use of the summer reference area source of kill to define harvest areas is more logical than the use of winter reference areas since immature as well as adult black ducks are considered. In this study the United States and Canada were divided into 10 major harvest areas, in each of which the kill tended to come from populations different than those supplying other harvest areas. Frequently, significant proportions of the kill of a population from a single summer reference area occurred in several different harvest areas. Furthermore, in some instances, a relatively small proportion of the kill in a harvest area represented a large fraction of the kill relating to a particular summer reference area. Although the kill in Coastal New England and the mid-Atlantic States is derived from essentially the same summer populations, the proportions are different.

It was necessary to divide North America into two major zones in order to define harvest areas that did not share populations to a significant degree. The eastern zone included Canada east of 81° west longitude (north of Pennsylvania-Ohio border) plus all Atlantic Flyway States except West Virginia, Georgia and Florida. The western zone

included the remainder of the United States and Canada. When divided this way, weighted band recovery data indicated that only 5.9 percent of the western unit kill related to production areas in the eastern unit and only 12.5 percent of the eastern unit kill related to production areas in the western unit. The uniqueness of the populations would have been greater had the harvest within Ontario been divided along the 81° longitude line.

Derivation of the hunting kill in different parts of States was considered. In the New England States, the same summer populations tended to be taken in both coastal and interior areas, even though they were not equally important in each area. In contrast, the wintering ground derivation of the hunting kill in coastal and interior portions of the New England States was not the same: populations wintering south of New England were more important in the interior than on the coast. New York could be divided into three areas, in which the kill was derived from different summer and winter populations. Examination of the summer and winter area derivation of the monthly kill in each State and Province led to the generalization that birds from the more northern summer areas were present in the southern States when the hunting seasons opened in November. Related to this is the fact that wintering populations in southern States tended to be shot there throughout the hunting season.

Data from banding between 1946 and 1960 showed that the average first year mortality rate of black ducks banded as immatures was about .65. Based on winter bandings, adult males had an average annual mortality rate of about .38 during the same span of years. The annual mortality rate of adult females was about .47, although they were not well represented in any banding period.

Birds banded as immatures had a higher mortality rate in the second year after banding (the first year of fully adult life) than during later years. Females consistently had greater annual mortality rates than males. This was true even during the first year after banding of immatures. Since recovery rates were the same for immature males and females, the difference in survival must have been due to something other than shooting pressure: possibly a greater mortality of females during the breeding season. Both summer and winter bandings suggested that adult females had an annual mortality rate about 20 percent greater than for males.

The importance of hunting as a cause of mortality was investigated. About half of the total annual deaths of birds alive in late summer was due to hunting mortality. Furthermore, hunting mortality occurred largely in addition to, rather than in place of, nonhunting mortality. The effect of hunting regulations was studied by noting the relationship between changes in regulations and mortality rates for specific populations. Data from spring and summer banding showed that regulations influenced the survival of black ducks, but this was not indicated by

winter banding data. Probably the most important management implication resulting from this study is that hunting regulations affect shooting pressure and it, in turn, affects mortality rates. This relationship indicates that hunting regulations can be used to influence the status of the continental black duck population. Regulations did not demonstrably affect mortality rates of wintering populations. Evidence based on summer and spring banding coupled with deductive logic based on the strong correlation between recovery and mortality rates of males banded in the winter suggests that this should be the case. The relationships between hunting regulations, shooting pressure, and mortality rates of specific wintering populations should be given further study.

The distribution of mortality within the year was examined. The rate at which black ducks died was 4 to 5 times greater during the hunting season than during the remainder of the year. Because there was no evidence of unusual mortality during the late winter and early spring it appears that after the close of the hunting season black ducks survived at a relatively high rate. This finding reaffirms the importance of hunting as a mortality factor and further suggests that late winter and early spring nonhunting mortality is not serious when viewed on a continent-wide scale.

Information on annual production is essential in interpreting mortality rates of black duck populations. Age ratios in the kill have been measured throughout the United States since 1960, but prior to this such information was fragmentary. The data revealed marked annual fluctuations in the age composition of the kill. Preseason banding data are too few to establish clearly whether these fluctuations were due to changes in vulnerability of immatures to shooting or to changes in annual production. However, the available data suggest that there are annual variations in vulnerability and that annual production alone does not account for changes in the age ratio in the kill. These findings emphasize the need for adequate banding.

Differences were noted in the age composition of the kill in different areas with higher age ratios in the north than in the south. There were also monthly differences within seasons, with higher age ratios early in the season. These differences, also, appear to be due to changes in relative vulnerability of adults and immatures.

Sex ratios in trapped and shot samples and differences in mortality rates indicate that there were more males than females in black duck populations. The sex composition of trapped samples became progressively more distorted in favor of males from summer through winter and spring. Shot samples showed less distortion than trapped samples. Geographic differences were pronounced and the adult sex ratio was more distorted in the middle portions of the Atlantic and Mississippi Flyways than at the northern and southern ends. The best available estimate of the actual sex composition of the adult population is about 1.2 males per female. It would appear that regulations to direct shooting pressure

against males would have less impact on the population than regulations affecting both sexes equally.

Various ways of determining the annual status of black duck populations were considered. In the winter survey, only a fraction of the black duck population is reported each year. Despite this, the winter survey evidently correctly reflected the decline in the continental black duck population occurring between the early 1950's and early 1960's. Aerial surveys of the breeding grounds have been sporadic and are still experimental. Indirect calculations based on pre-season bandings, age ratios in the kill, and kill data yield population estimates of a reasonable magnitude. However, the banding program has been conducted on too limited a scale to annually yield indirect population estimates. The development of procedures to provide a reliable annual appraisal of the status of the black duck is an outstanding research need.

Literature Cited

- Addy, C. E.
1953. Fall migration of the black duck. U.S. Fish and Wildlife Service, Special Scientific Report - Wildlife No. 19 63(+32) pp.
- Atwood, Earl L.
1956. Validity of mail survey data on bagged waterfowl. Journal of Wildlife Management 20 (1): 1-16.
- Bellrose, Frank C. and Elizabeth Brown Chase
1950. Populations losses in the mallard, black duck, and blue-winged teal. Illinois Natural History Survey, Biological Notes no. 22, 27 pp.
- _____, Thomas G. Scott, Arthur S. Hawkins, and Jessop B. Low
1961. Sex ratios and age ratios in North American ducks. Illinois Natural History Survey Bulletin no. 27 (6): p. 391-474.
- Benson, D. A.
1963. Fishing and hunting in Canada. Canadian Wildlife Service, Ottawa, 26 pp.
- Boyd, Hugh
1957. Mortality and kill amongst British-ringed teal Anas crecca. Ibis, 99: p. 157-177.
- Chamberlain, Everett B. and Charles F. Kaczynski
1965. Problems in aerial surveys of waterfowl in eastern Canada. U.S. Fish and Wildlife Service, Special Scientific Report - Wildlife No. 93, 21 pp.
- Geis, Aelred D. and Earl L. Atwood
1961. Proportion of recovered waterfowl bands reported. Journal of Wildlife Management 25 (2): 154-159.
- _____, and Samuel M. Carney
1963. Age ratios of ducks killed during the 1962 hunting season compared to those during prior years. Migratory Bird Populations Station Administrative Report No. 27, Laurel, Maryland, 9 pp.
- Hagar, Joseph A.
1946. Black duck bandings at the Austin Ornithological Research Station on Cape Cod, Massachusetts. Bird Banding 17(3): p. 97-124.
- _____.
1954. Northeastern flyway. Massachusetts Division of Fisheries and Game, Boston, 28 pp.

Literature Cited (con.)

Hickey, Joseph J.

1952. Survival studies of banded birds. U.S. Fish and Wildlife Service, Special Scientific Report - Wildlife No. 15, 177 pp.

Hochbaum, H. Albert

1942. Sex and age determination of waterfowl by cloacal examination. Transactions of the North American Wildlife Conference, 7: p. 299-307.

Lemieux, Louis and Gaston Moisan

1959. The migration, mortality rate and recovery rate of the Quebec black duck. Transactions Northeast Wildlife Conference 10: p. 124-148.

Martinson, R. Kahler

1966. Proportion of recovered duck bands that are reported. Journal of Wildlife Management 30(2): 264-268.

_____, A. D. Geis and R. I. Smith

1968. Black duck harvest and population dynamics in eastern Canada and the Atlantic Flyway. Pp. 21-52 in The black duck, evaluation, management, and research. Wildlife Management Institute, Washington D. C. 193 pp.

Mendall, Howard L. and Howard E. Spencer

1961. Waterfowl harvest studies in Maine (1948-1957). Game Division Bulletin no. 7, Augusta, Maine, 60 pp.

Moisan, Gaston, Robert I. Smith and R. Kahler Martinson

1967. The green-winged teal, its distribution, migration and population dynamics. U.S. Fish and Wildlife Service, Special Scientific Report - Wildlife No. 100, 248 pp.

Snedecor, G. W.

1956. Statistical methods applied to experiments in agriculture and biology. 5th edition, Iowa State College Press, Ames, 534 pp.

Stewart, Robert E.

1958. Distribution of the black duck. U.S. Fish and Wildlife Service, Circular 51, 8 pp.

Stotts, Vernon D. and David E. Davis

1960. The black duck in the Chesapeake Bay of Maryland: breeding behavior and biology. Chesapeake Science 1(3-4): p. 127-154.

Literature Cited (con.)

Wight, Howard M., Robert G. Heath, and Aelred D. Geis

1965. A method for estimating fall adult sex ratios from production and survival data. *Journal of Wildlife Management* 29(1): 185-192.

Wright, Bruce S.

1954. High tide and an east wind. *The Wildlife Management Institute*, Washington, D. C. 162 pp.

TEXT TABLES AND FIGURES

Table 1.--Percent of the total duck bag consisting of black ducks by flyways and hunting seasons, 1950-62

Hunting season	Flyway		
	Atlantic	Mississippi	Central
1950-51	25.8	3.0	-- <u>1</u> /
1951-52	30.2	4.4	-- <u>1</u> /
1952-53	28.6(29.2) ^{2/}	6.0(3.7) ^{2/}	-- <u>1</u> /
1953-54	19.2	4.6	-- <u>1</u> /
1954-55	24.1	3.9	0.04
1955-56	26.3	5.3	0.08
1956-57	25.6	4.5	0.08
1957-58	22.2	3.9	0.06
1958-59	22.5	4.4	0.04
1959-60	26.0	4.5	0.09
1960-61	30.7	4.3	-- <u>1</u> /
1961-62	27.1	3.4	0.20
1962-63	28.9	3.9	0.10

^{1/} Data not available.

^{2/} During the 1950-51 and 1951-52 hunting seasons, data were obtained by contacting hunters in the field. For the 1952-53 season, the results of the field method are shown in parentheses along with the results of mail surveys which replaced the field technique in all later years.

Table 2.--Percentage of the hunting kill consisting of black ducks in each State as determined from the wing collection survey, 1960-62

	Hunting season			Mean 1960-62	Sample size		
	1960	1961	1962		1960	1961	1962
Maine	49.2	45.0	49.8	48.0	1,826	894	1,168
Vermont	40.3	45.7	35.0	40.3	600	431	671
New Hampshire	57.6	48.5	48.2	51.4	125	166	407
Massachusetts	58.1	52.8	49.4	53.4	1,138	652	1,176
Connecticut	48.3	41.4	43.8	44.5	391	302	698
Rhode Island	55.0	60.8	72.7	62.8	298	166	286
New York	26.3	23.3	26.5	25.4	1,701	1,930	2,028
Pennsylvania	22.8	25.0	20.2	22.7	535	304	1,477
West Virginia	41.3	36.1	34.9	37.4	167	73	192
New Jersey	63.2	65.4	56.6	61.7	1,886	1,137	2,126
Delaware	55.2	41.6	53.0	49.9	393	308	521
Maryland	39.7	34.9	39.0	37.9	1,014	410	1,525
Virginia	24.8	22.5	33.3	26.9	670	689	788
North Carolina	21.6	11.9	11.7	15.1	1,115	553	857
South Carolina	10.4	17.5	11.3	13.1	461	359	476
Georgia	2.7	0.0	4.7	2.5	75	56	169
Florida	3.8	3.2	1.4	2.8	714	852	1,752
Atlantic Flyway	30.7	27.1	28.9	28.9	13,109	9,282	16,317
Minnesota	2.0	0.5	0.9	1.1	2,712	1,760	4,983
Wisconsin	4.6	4.8	4.4	4.6	2,610	1,992	5,150
Michigan	14.4	14.7	14.4	14.5	1,558	1,424	2,436
Iowa	0.8	0.4	0.7	0.6	1,141	1,027	706
Illinois	1.7	3.1	4.3	3.0	1,848	1,691	1,170
Indiana	17.7	13.4	11.1	14.1	832	463	523
Ohio	21.7	10.8	8.9	13.8	980	576	1,241
Missouri	0.9	0.4	0.5	0.6	1,619	915	635
Kentucky	17.2	21.5	25.3	21.3	861	606	384
Arkansas	0.8	1.4	0.3	0.8	3,215	576	1,194
Tennessee	13.8	9.3	19.9	14.3	1,807	732	443
Louisiana	0.7	0.2	0.6	0.5	2,054	1,492	3,178
Mississippi	4.8	2.8	2.5	3.4	730	254	471
Alabama	6.5	4.6	10.4	7.2	630	262	728
Mississippi Flyway	4.3	3.4	3.9	3.9	22,597	13,770	23,242
North Dakota	--	0.0	0.2				
Oklahoma	--	0.0	0.4				
Texas	--	0.9	0.2				
Kansas	--	0.1	0.0				
Central Flyway	--	0.2	0.1				

Table 3.--Black duck bandings in States and Provinces prior to 1961,
showing individuals and agencies with 100 or more bandings

Area	Bander	Total banded
Alabama	Alabama Department of Conservation	1,844
	Wheeler NWR	473
	Miscellaneous	<u>1</u>
		2,318
Alberta	Miscellaneous	8
Arkansas	Miscellaneous	142
Connecticut	Connecticut State Board of Fisheries and Game	3,863
	Philip C. Barney	1,456
	Miscellaneous	<u>99</u>
		5,418
Delaware	Bombay Hook NWR	3,125
	Delaware Board of Game and Fish Commissioners	1,430
	Miscellaneous	<u>131</u>
		4,686
District of Columbia	Paul F. Hodge	303
Florida	Miscellaneous	95
Georgia	Miscellaneous	2
Illinois	John Jedlicka	4,870
	Chautauqua NWR	2,332
	Illinois Natural History Survey	1,938
	Crab Orchard NWR	936
	Lynn H. Hutchens	778
	Carleton A. Beckhart	754
	Christian J. Goetz	315
	G. C. Arthur	286
Miscellaneous	<u>142</u>	
		12,351
Indiana	Indiana Department of Conservation	4,921
	H. P. Cottingham	<u>121</u>
		5,042
Iowa	Miscellaneous	3

Table 3.--Black duck bandings in States and Provinces prior to 1961,
 showing individuals and agencies with 100 or more bandings
 --continued

Area	Bander	Total banded
Kansas	Miscellaneous	15
Kentucky	Kentucky Woodlands NWR	387
	Miscellaneous	<u>41</u>
		428
Labrador	Bruce S. Wright	560
	Canadian Wildlife Service	473
	Ducks Unlimited	<u>253</u>
		1,286
Louisiana	Miscellaneous	98
Mackenzie	Miscellaneous	2
Maine	Howard L. Mendall	6,274
	Maine Department of Inland Fisheries and Game	2,297
	E. J. Baker	1,136
	Moosehorn NWR	1,128
	Howard Brown	699
	O. S. Seelye	586
	Joseph Pulitzer, Jr.	422
	Miscellaneous	<u>35</u>
	12,577	
Manitoba	Arthur S. Hawkins	124
	Miscellaneous	<u>112</u>
		236
Maryland	Maryland Department of Game and Inland Fish Commission	9,634
	Blackwater NWR	1,464
	D. E. Russ	899
	Henry A. Bartholomew	531
	Charles W. Collins	225
	Oliver L. Austin, Jr.	136
	Miscellaneous	<u>200</u>
	13,089	

Table 3.--Black duck bandings in States and Provinces prior to 1961,
 showing individuals and agencies with 100 or more bandings
 --continued

Area	Bander	Total banded
Massachusetts	Austin Ornithological Research Station	10,422
	Massachusetts Department of Natural Resources	9,510
	Parker River NWR	5,933
	J. J. Storrow	4,726
	Joseph A. Hagar	4,394
	Arthur Rotch	3,676
	Raymond R. Cook	634
	Monomoy NWR	350
	Clarence L. Hawthaway	225
	Miscellaneous	<u>508</u>
	40,378	
Michigan	Michigan Department of Conservation	12,262
	Kellogg Bird Sanctuary	7,098
	Seney NWR	5,212
	Karl Christofferson	1,450
	Tom Demarest	1,163
	P. J. Olin	394
	Shiawassee NWR	326
	Joseph W. Stack	233
	Irvin Sturgis	214
	Frederick E. Ludwig	197
	Miscellaneous	<u>213</u>
	28,762	
Minnesota	Minnesota Department of Conservation	277
	Rice Lake NWR	228
	Miscellaneous	<u>172</u>
	677	
Mississippi	Miscellaneous	3
Missouri	Miscellaneous	268
Nebraska	Miscellaneous	8
New Brunswick	Bruce S. Wright-Lillian Morey	1,595
	George F. Boyer	891
	Constable Jenkins	197
	Miscellaneous	<u>241</u>
	2,924	
Newfoundland	Bruce S. Wright-Lillian Morey	904
	Stephen Hall	<u>222</u>
	1,126	

Table 3.--Black duck bandings in States and Provinces prior to 1961,
 showing individuals and agencies with 100 or more bandings
 --continued

Area	Bander	Total banded
New Hampshire	Howard Brown	672
	William D. Snow	150
	Miscellaneous	114
		<u>936</u>
New Jersey	New Jersey Division of Fish and Game	4,395
	Brigantine NWR	3,059
	H. E. Greenwald	928
	Ephraim C. Smith	712
	Miscellaneous	70
		<u>9,164</u>
New York	New York Conservation Department	36,908
	Bruce W. Large	12,334
	William Vogt	2,627
	Montezuma NWR	2,168
	Ross Federico	1,929
	Julius H. White	1,697
	D. E. Russ	1,669
	Waldemer Burding	1,055
	Charles J. Mercer	788
	Joseph Powers	603
	Lee S. Crandall	558
	Arthur A. Allen	444
	Jordan J. Frey	381
Aluah S. Allen	264	
Charles R. Wenberger	120	
Miscellaneous	304	
		<u>63,849</u>
North Carolina	Mattamuskeet NWR	1,179
	Pea Island NWR	379
	North Carolina Wildlife Resources Commission	176
	Robert O. Halstead	106
	Miscellaneous	4
		<u>1,844</u>
North Dak.	Miscellaneous	43
Nova Scotia	George Boyer	453
	Miscellaneous	315
		<u>768</u>

Table 3.--Black duck bandings in States and Provinces prior to 1961,
 showing individuals and agencies with 100 or more banded
 --continued

Area	Bander	Total banded
Ohio	Carl Warren	2,857
	Ohio Department of Natural Resources	1,408
	Miscellaneous	<u>231</u>
		4,496
Oklahoma	Miscellaneous	122
Ontario	H. S. Osler	4,260
	Edward Kroll	2,646
	Rolla Parker	1,024
	John H. Buckalew	798
	J. A. Macfie	659
	C. O. Bartlett	505
	Anton Devos	457
	E. J. Baker	440
	Thomas N. Jones	399
	H. H. Krug	166
	Marshall Field-Arthur Morley	159
	E. H. Stone	159
	R. D. Harris	120
Miscellaneous	<u>531</u>	
		12,325
Pennsylvania	Pennsylvania Game Commission	11,145
	E. H. Dustman	279
	Miscellaneous	<u>39</u>
		11,463
Prince Edward Island	Harvey Moore	2,289
	C. O. Bartlett	196
	George Boyer	169
	Miscellaneous	<u>43</u>
		2,697
Quebec	Baie Johan Beetz Banding Station	1,801
	Leo Brochet	1,435
	Canadian Wildlife Service	998
	Bruce S. Wright-Lillian D. Morey	927
	Louis J. A. Lemieux	525
	Gaston Moisan	510
	Phidelem Harvey	423
	T. S. Hennessy	272
	Howard Brown	228
	John H. Buckalew	109
Miscellaneous	<u>431</u>	
		7,660

Table 3.--Black duck bandings in States and Provinces prior to 1961,
 showing individuals and agencies with 100 or more bandings
 --continued

Area	Bander	Total banded
Rhode Island	Thomas J. Wright	2,313
	John J. Lynch	202
	Miscellaneous	62
		<u>2,577</u>
Saskatchewan	Miscellaneous	42
South Carolina	Robert G. MacFarlan	743
	Wheeler NWR	345
	South Carolina Wildlife Resources Department	106
	Santee NWR	105
	Miscellaneous	275
		<u>1,574</u>
South Dakota	Miscellaneous	120
Tennessee	Tennessee Department of Conservation	2,625
	Tennessee NWR	890
	William T. Miller	231
	Miscellaneous	1
		<u>3,747</u>
Texas	Miscellaneous	3
Vermont	Vermont Fish and Game Commission	5,222
	Missisquoi NWR	716
	Miscellaneous	1
		<u>5,939</u>
Virginia	Chincoteague NWR	1,739
	Back Bay NWR	1,039
	Virginia Commission of Game and Inland Fisheries	309
	Virginia Coop. Wildlife Research Unit	129
	John H. Buckalew	113
	Miscellaneous	25
		<u>3,354</u>
West Virginia	Department of Natural Resources	656
	Miscellaneous	4
		<u>660</u>

Table 3.--Black duck bandings in States and Provinces prior to 1961,
 showing individuals and agencies with 100 or more bandings
 --continued

Area	Bander	Total banded
Wisconsin	Wisconsin Conservation Department	768
	L. H. Barkhausen	742
	Frank Hopkins	311
	Miscellaneous	326
		<u>2,147</u>

Summary totals

Canadian Wildlife Service	6,660
United States Fish and Wildlife Service	52,498
State and Provincial Departments	140,771
Private	60,879
Not identified	4,030
	<u>264,838</u>

Table 4.--How black duck recoveries were obtained; expressed as a percent of the total recoveries in States and Provinces in all years prior to 1964

State or Province of recovery	How obtained				Total recoveries	Total percent
	Found dead	Shot	Caught in trap (not banding)	Trapped and released (other than original banding station)		
Manitoba	2.9	88.6	1.9	1.0	105	100.1
Ontario	2.0	82.8	10.5	1.8	4,098	100.0
Quebec	3.8	80.3	7.6	1.6	2,083	100.0
Labrador	1.4	73.2	0.7	8.0	138	100.0
Newfoundland	5.5	65.6	16.5	2.3	218	100.0
New Brunswick	3.6	80.7	11.3	1.2	966	99.9
Prince Edward Island	2.0	91.4	0.2	3.4	498	100.0
Nova Scotia	4.0	90.7	1.3	0.3	951	100.0
Total Canada	2.9	82.8	8.3	1.7	9,057	100.0
Maine	2.4	85.9	2.7	4.7	1,911	100.1
Vermont	1.3	94.7	0.3	1.4	714	100.1
New Hampshire	3.7	91.8	0.4	3.4	267	100.0
Massachusetts	3.2	67.1	0.2	25.8	5,237	100.0
Connecticut	2.5	86.9	1.4	7.1	945	100.0
Rhode Island	3.8	87.7	1.0	2.8	602	100.0
New York	4.3	86.9	1.4	3.4	6,119	100.0
Pennsylvania	2.9	91.4	1.1	3.0	1,093	100.0
West Virginia	3.0	88.1	1.0	7.9	101	100.0
New Jersey	3.4	90.4	1.5	2.8	3,262	100.1
Delaware	1.2	84.6	5.4	5.5	903	99.9
Maryland	1.0	89.8	0.9	5.9	2,963	99.9
Virginia	1.8	92.7	1.2	1.1	1,139	99.9
North Carolina	1.7	93.8	0.9	2.1	531	100.0
South Carolina	1.1	96.3	--	0.7	562	100.1
Georgia	4.5	90.0	0.9	--	110	99.9
Florida	--	96.9	--	--	128	100.0
Total Atlantic Flyway	2.9	84.7	1.2	8.0	26,587	99.9

Table 4.--How black duck recoveries were obtained; expressed as a percent of the total recoveries in States and Provinces in all years prior to 1964--continued

State or Province of recovery	How obtained					Total recoveries	Total percent
	Found dead	Shot	Caught in trap (not banding)	Trapped and released (other than original banding station)	Other ^{1/}		
Minnesota	0.8	93.0	1.2	2.5	2.5	244	100.0
Wisconsin	2.3	92.9	0.5	2.2	2.1	914	100.0
Michigan	5.7	85.9	2.1	2.3	4.0	3,022	100.0
Illinois	0.8	93.7	0.5	2.8	2.2	1,648	100.0
Indiana	2.7	90.4	1.1	4.3	1.6	634	100.1
Ohio	2.4	91.8	2.2	1.1	2.5	1,265	100.0
Missouri	--	94.9	1.0	2.0	2.0	98	99.9
Kentucky	1.9	92.4	1.1	1.4	3.2	370	100.0
Arkansas	0.7	95.3	0.7	0.7	2.7	298	100.1
Tennessee	1.5	94.3	0.6	1.4	2.2	716	100.0
Louisiana	--	89.7	5.4	--	4.9	185	100.0
Mississippi	0.7	96.6	1.4	--	1.4	148	100.1
Alabama	1.9	90.7	0.6	4.0	2.8	322	100.0
Total Mississippi Flyway	2.9	90.7	1.4	2.2	2.9	9,864	100.1
Central Flyway (All States combined)	1.7	87.4	--	1.7	9.2	119	100.0

^{1/}Birds that were trapped and released at original banding site are not included.

Table 5.--The percent of black duck band recovery reports that were submitted by conservation agency employees or bird banders in States and Provinces, 1950-62

State or Province	Year	Percent reported by C.A.E. ^{1/} or banders	Total recoveries received from all sources ^{2/}
Manitoba	1957-62	0	28
Ontario	1957	28.5	242
	1958	13.2	167
	1959	15.0	220
	1960	8.2	207
	1961	7.2	265
	1962	<u>10.3</u>	<u>262</u>
		13.7	1,363
Quebec	1957	12.9	93
	1958	10.3	87
	1959	5.3	57
	1960	10.2	108
	1961	7.3	96
	1962	<u>6.3</u>	<u>96</u>
		8.9	537
Labrador	1957-62	4.5	67
Newfoundland	1957-62	14.3	21
New Brunswick	1957-58	17.3	52
	1959	17.1	41
	1960-61	22.0	59
	1962	<u>7.1</u>	<u>28</u>
		17.2	180
Prince Edward Island	1957-59	38.0	71
	1960	54.3	116
	1961-62	<u>4.2</u>	<u>72</u>
		35.9	259
Nova Scotia	1957-58	4.2	48
	1959-60	3.0	67
	1961-62	<u>1.8</u>	<u>57</u>
		2.9	172
Maine	1950-53	36.6	71
	1954-55	29.7	64
	1956	49.2	67
	1957	29.0	69

Table 5.--The percent of black duck band recovery reports that were submitted by conservation agency employees or bird banders in States and Provinces, 1950-62--continued

State or Province	Year	Percent reported by C.A.E. ^{1/} or banders	Total recoveries received from all sources ^{2/}
Maine (continued)	1958	15.4	52
	1959	23.4	47
	1960	22.6	115
	1961	12.4	137
	1962	4.1	197
		<u>20.5</u>	<u>819</u>
Vermont	1950-56	41.4	70
	1957	46.3	67
	1958	50.6	81
	1959	39.4	66
	1960	26.1	65
	1961-62	21.3	80
		<u>37.5</u>	<u>429</u>
New Hampshire	1950-56	5.4	37
	1957-58	15.9	44
	1959-62	27.5	40
		<u>16.5</u>	<u>121</u>
Massachusetts	1950-51	16.1	56
	1952	6.5	46
	1953	26.0	77
	1954	20.9	43
	1955-56	10.6	47
	1957	8.2	49
	1958	6.4	94
	1959	16.7	30
	1960	15.0	60
	1961	1.8	54
	1962	0	63
		<u>11.5</u>	<u>619</u>
Connecticut	1950-57	5.3	95
	1958-59	6.4	47
	1960-62	3.8	53
		<u>5.1</u>	<u>195</u>
Rhode Island	1951-56	6.9	58
	1957	1.9	52
	1958	15.5	58
	1959-62	21.1	76
		<u>12.3</u>	<u>244</u>

Table 5.--The percent of black duck band recovery reports that were submitted by conservation agency employees or bird banders in States and Provinces, 1950-62--continued

State or Province	Year	Percent reported by C.A.E. ^{1/} or banders	Total recoveries received from all sources ^{2/}
New York	1950	5.5	90
	1951	2.6	117
	1952	11.8	51
	1953	10.2	59
	1954	15.2	105
	1955	12.2	41
	1956	4.8	83
	1957	9.7	185
	1958	8.6	257
	1959	17.7	220
	1960	13.2	332
	1961	10.7	272
	1962	<u>5.7</u>	<u>265</u>
	10.2	2,077	
Pennsylvania	1950-53	6.8	44
	1954	5.5	36
	1955	12.1	33
	1956	8.7	46
	1957	12.9	116
	1958	6.3	128
	1959	9.6	52
	1960	7.1	42
	1961-62	<u>4.8</u>	<u>63</u>
	8.4	560	
West Virginia	1953-62	11.6	43
New Jersey	1950-51	12.1	66
	1952	17.4	46
	1953-54	17.7	62
	1955	10.7	56
	1956	12.7	71
	1957	16.3	301
	1958	11.4	140
	1959	7.6	145
	1960	15.4	227
	1961	6.8	132
	1962	<u>8.1</u>	<u>148</u>
	12.5	1,394	

Table 5.--The percent of black duck band recovery reports that were submitted by conservation agency employees or bird banders in States and Provinces, 1950-62--continued

State or Province	Year	Percent reported by C.A.E. ¹ or banders	Total recoveries received from all sources ²
Delaware	1950-56	29.4	68
	1957-58	15.2	112
	1959-60	15.8	82
	1961-62	<u>14.4</u>	<u>118</u>
		17.6	380
Maryland	1950-53	18.8	48
	1954-55	14.0	57
	1956	19.1	68
	1957	18.5	308
	1958	14.8	237
	1959	12.9	171
	1960	9.0	222
	1961	7.6	144
	1962	<u>9.9</u>	<u>172</u>
	13.5	1,427	
Virginia	1950-54	3.1	65
	1955-56	14.3	42
	1957	13.2	53
	1958-59	6.1	66
	1960-61	9.8	61
	1962	<u>9.8</u>	<u>41</u>
		8.8	328
North Carolina	1951-56	11.4	44
	1957-58	7.3	55
	1959-60	19.6	46
	1961-62	<u>6.1</u>	<u>65</u>
	10.5	210	
South Carolina	1950-58	9.6	52
	1959-60	8.1	37
	1961-62	<u>9.3</u>	<u>43</u>
	9.8	132	
Georgia	1950-62	16.7	24
Florida	1950-62	19.0	21
Minnesota	1950-58	45.5	33
	1959-62	<u>20.0</u>	<u>50</u>
	30.1	83	

Table 5.--The percent of black duck band recovery reports that were submitted by conservation agency employees or bird banders in States and Provinces, 1950-62--continued

State or Province	Year	Percent reported by C.A.E. ^{1/} or banders	Total recoveries received from all sources ^{2/}
Wisconsin	1950-56	28.1	64
	1957-58	20.4	49
	1959-60	19.0	42
	1961-62	<u>3.6</u>	<u>83</u>
		16.4	238
Michigan	1950-52	23.1	65
	1953-54	11.4	44
	1955-56	12.9	62
	1957	26.7	135
	1958	19.7	66
	1959	25.4	67
	1960	27.9	61
	1961	33.3	84
	1962	<u>16.3</u>	<u>49</u>
	23.2	633	
Iowa	1951-62	6.7	15
Illinois	1950-56	13.8	80
	1957-62	<u>5.9</u>	<u>101</u>
		9.4	181
Indiana	1950-56	16.7	36
	1957-59	39.8	98
	1960-62	<u>26.9</u>	<u>67</u>
		31.3	201
Ohio	1950-52	13.0	46
	1953-54	25.6	43
	1955-56	23.5	34
	1957	13.4	67
	1958	10.7	56
	1959-60	6.7	60
	1961-62	<u>29.6</u>	<u>54</u>
	16.7	360	
Missouri	1950-62	31.3	16
Kentucky	1950-56	13.3	30
	1957-59	20.0	50
	1960-62	<u>9.1</u>	<u>44</u>
	14.5	124	

Table 5.--The percent of black duck band recovery reports that were submitted by conservation agency employees or bird banders in States and Provinces, 1950-62--continued

State or Province	Year	Percent reported by C.A.E. ^{1/} or banders	Total recoveries received from all sources ^{2/}
Arkansas	1950-62	7.8	51
Tennessee	1950-57	13.7	95
	1958-59	31.9	47
	1960-62	43.4	159
		<u>32.2</u>	<u>301</u>
Louisiana	1950-62	0	14
Mississippi	1950-62	10.0	30
Alabama	1950-56	3.2	31
	1957-58	23.1	52
	1959-62	11.8	34
		<u>14.5</u>	<u>117</u>
North Dakota	1950-62	30.8	13

^{1/} Conservation agency employees.

^{2/} Recoveries of birds shot or found dead during the hunting season.

Table 6.--Calculation of weighting factors for first hunting season recoveries from local, immature, and juvenile black ducks banded in the summer, 1946-60

Major reference area	Population estimate	Number of recoveries	Population per recovery	Recovery rate	Weight per recovery
<u>Maritimes</u>					
New Brunswick	1,575	147	10.7	.184	2.0
Newfoundland	21,250	9	2,361.1	.054	127.5
Nova Scotia	15,375	54	284.7	.216	61.5
Prince Edward Island	625	44	14.2	.169	2.4
<u>Labrador and Eastern Quebec</u>					
Labrador	51,812	16	3,238.2	.068	220.2
New Brunswick	2,850	69	589.5	.060	35.4
Quebec	37,825				
<u>Northern Quebec</u>					
Quebec	177,875	15	11,858.3	.102	1,209.5
<u>Southern Quebec</u>					
Quebec	171,875	167	1,029.2	.156	160.6
<u>St. John and St. Croix Rivers</u>					
Maine	6,250	106	59.0	.071	4.2
New Brunswick	15,000	110	136.4	.096	13.1
<u>Western Maine</u>					
Maine	16,375	889	18.4	.138	2.5
<u>Vermont and New Hampshire</u>					
New Hampshire	3,625	138	26.3	.161	4.2
Vermont	2,562	162	15.8	.131	2.1
<u>Coastal Massachusetts</u>					
Massachusetts	1,000	337	3.0	.128	0.4

Table 6.--Calculation of weighting factors for first hunting season recoveries from local, immature, and juvenile black ducks banded in the summer, 1946-60--continued

Major reference area	Population estimate	Number of recoveries	Population per recovery	Recovery rate	Weight per recovery
<u>Southern New England and Long Island</u>					
Connecticut	625	86	7.3	.139	1.0
Massachusetts	1,250	34	36.8	.125	4.6
New York	625	99	6.3	.104	0.7
Rhode Island	625	7	89.3	.096	8.6
<u>Lake Champlain</u>					
New York	1,250	52	24.0	.155	3.7
Vermont	1,250	520	2.4	.165	0.4
<u>Chesapeake and Delaware Bays</u>					
Delaware	1,500	38	39.5	.071	2.8
Maryland	4,375	274	16.0	.096	1.5
New Jersey	3,125	75	41.7	.158	6.6
North Carolina	250	3	500.0	.096	48.0
Virginia	1,250				
Pennsylvania	250	3	83.3	.115	9.6
<u>Eastern Lake Ontario</u>					
New York	7,250	569	12.7	.119	1.5
Ontario	14,625	30	487.5	.130	63.4
<u>Western Lake Ontario</u>					
New York	2,500	50	50.0	.117	5.8
Ontario	52,125	411	172.4	.143	24.7
Quebec	18,750				
<u>Western James Bay</u>					
Ontario	40,875	54	756.9	.075	56.8

Table 6.--Calculation of weighting factors for first hunting season recoveries from local, immature, and juvenile black ducks banded in the summer, 1946-60--continued

Major reference area	Population estimate	Number of recoveries	Population per recovery	Recovery rate	Weight per recovery
<u>Upper Great Lakes</u>					
Michigan	12,500	216	336.4	.088	29.6
Ontario	60,171				
<u>Western Lake Erie</u>					
Michigan	4,000	64	62.5	.133	8.3
Ohio	1,462	47	31.1	.088	2.7
Ontario	4,375	8	546.9	.133	72.7
<u>Eastern Lake Michigan</u>					
Indiana	500	18	27.8	.212	5.9
Michigan	5,250	44	119.3	.174	20.8
<u>Western Lake Michigan</u>					
Michigan	2,500	69	108.7	.202	22.0
Wisconsin	5,000				
<u>Upper Mississippi River</u>					
Minnesota	625	13	48.1	.162	7.8
Wisconsin	625	14	44.6	.182	8.1

Table 7.--Calculation of weighting factors for recoveries from black ducks banded in the summer between 1946 and 1960 and recovered as adults

Major reference area	Population estimate	Number of recoveries	Population per recovery	Recovery rate	Weight per recovery
<u>Maritimes</u>					
New Brunswick	1,260	48	26.2	.079	2.1
Newfoundland	17,000	10	1,700.0	.054	91.8
Nova Scotia	12,300	28	439.3	.130	57.1
Prince Edward Island	500	9	55.6	.088	4.9
<u>Labrador and Eastern Quebec</u>					
Labrador	41,450	64	647.7	.064	41.5
New Brunswick	2,280	113	288.0	.061	17.6
Quebec	30,260				
<u>Northern Quebec</u>					
Quebec	142,300	20	7,115.0	.102	725.7
<u>Southern Quebec</u>					
Quebec	137,500	70	1,964.3	.097	190.5
<u>St. John and St. Croix Rivers</u>					
Maine	5,000	135	37.0	.068	2.5
New Brunswick	12,000	56	214.3	.063	13.5
<u>Western Maine</u>					
Maine	13,100	531	24.7	.112	2.8
<u>Vermont and New Hampshire</u>					
New Hampshire	2,900	40	72.5	.068	4.9
Vermont	2,050	48	42.7	.089	3.8
<u>Coastal Massachusetts</u>					
Massachusetts	800	289	2.8	.086	0.2

Table 7.--Calculation of weighting factors for recoveries from black ducks banded in the summer between 1946 and 1960 and recovered as adults--continued

Major reference area	Population estimate	Number of recoveries	Population per recovery	Recovery rate	Weight per recovery
<u>Southern New England and Long Island</u>					
Connecticut	500	56	8.9	.115	1.0
Massachusetts	1,000	23	43.5	.079	3.4
New York	500	97	5.2	.076	0.4
Rhode Island	500	4	125.0	.070	8.8
<u>Lake Champlain</u>					
New York	1,000	85	11.8	.113	1.3
Vermont	1,000	208	4.8	.120	0.6
<u>Chesapeake and Delaware Bays</u>					
Delaware	1,200	64	18.8	.066	1.2
Maryland	3,500	309	11.3	.064	0.7
New Jersey	2,500	27	92.6	.082	7.6
North Carolina	200	1	1,200.0	.064	76.8
Virginia	1,000				
Pennsylvania	200	15	13.3	.076	1.0
<u>Eastern Lake Ontario</u>					
New York	5,800	487	11.9	.085	1.0
Ontario	11,700	13	900.0	.093	83.7
<u>Western Lake Ontario</u>					
New York	2,000	40	50.0	.058	2.9
Ontario	41,700	188	301.6	.075	22.6
Quebec	15,000				
<u>Western James Bay</u>					
Ontario	32,700	110	297.3	.049	14.6

Table 7.--Calculation of weighting factors for recoveries from black ducks banded in the summer between 1946 and 1960 and recovered as adults--continued

Major reference area	Population estimate	Number of recoveries	Population per recovery	Recovery rate	Weight per recovery
<u>Upper Great Lakes</u>					
Michigan	10,000	261	222.7	.059	13.1
Ontario	48,137				
<u>Western Lake Erie</u>					
Michigan	3,200	93	34.4	.132	4.5
Ohio	1,170	88	13.3	.057	0.8
Ontario	3,500	7	500.0	.132	66.0
<u>Eastern Lake Michigan</u>					
Indiana	400	7	57.1	.104	5.9
Michigan	4,200	32	131.2	.085	11.2
<u>Western Lake Michigan</u>					
Michigan	2,000	54	111.1	.105	11.7
Wisconsin	4,000				
<u>Upper Mississippi River</u>					
Minnesota	500	15	33.3	.167	5.6
Wisconsin	500	3	166.7	.095	15.8

Table 8.--Calculation of weighting factors for recoveries from black ducks banded in the winter, 1946-60

Major reference area	Population estimate	Number of recoveries	Population per recovery	Recovery rate	Weight per recovery
<u>Maritimes</u>					
New Brunswick	4,500	20	975.0	.040	39.0
Newfoundland	700				
Nova Scotia	14,300	117	38.5	.052	2.0
Prince Edward Island	4,500				
<u>Maine</u>					
Maine	11,000	111	99.1	.050	5.0
<u>New England and Eastern Long Island</u>					
Connecticut	6,900	144	47.9	.054	2.6
Massachusetts	20,600	187	116.6	.033	3.8
New Hampshire	1,200				
New York	12,200	645	18.9	.061	1.2
Rhode Island	7,400	75	98.7	.058	5.7
<u>Western Long Island and Hudson River</u>					
New York	17,400	138	129.7	.024	3.1
Ontario	200				
Vermont	100				
Quebec	200				
<u>Mid-Atlantic</u>					
Delaware	22,500	159	141.5	.046	6.5
Maryland	104,900	263	398.9	.053	21.1
New Jersey	16,900	117	144.4	.059	8.5
North Carolina	20,400	70	291.4	.055	16.0
Pennsylvania	14,500	701	20.7	.058	1.2
Virginia	18,600	14	1,328.6	.039	51.8

Table 8.--Calculation of weighting factors for recoveries from black ducks banded in the winter, 1946-60
 --continued

Major reference area	Population estimate	Number of recoveries	Population per recovery	Recovery rate	Weight per recovery
<u>Mid-Atlantic Coastal</u>					
Delaware	1,000	3	2,800.0	.040	112.0
Maryland	7,400				
New Jersey	65,200	402	162.0	.051	8.3
Virginia	14,100	55	256.4	.029	7.4
<u>Southeast</u>					
Florida	9,400	1	440.0	.044	19.4
Georgia	4,600				
South Carolina	19,000	74			
<u>Lake Ontario</u>					
New York	4,400	244	33.2	.064	2.1
Ontario	3,000				
Pennsylvania	700				
<u>Lake Erie</u>					
Michigan	14,400	558	25.8	.042	1.1
Ohio	23,000	24	958.3	.079	75.7
Ontario	4,500	5	900.0	.079	71.1
Pennsylvania	600	62	9.7	.079	0.8
<u>Upper Ohio River</u>					
Kentucky	1,400		994.7	.061	60.7
Ohio	13,200				
West Virginia	4,300				
<u>Tennessee River</u>					
Alabama	5,400	102	52.9	.065	3.4
Kentucky	500				
Tennessee	4,400	61	80.3	.066	5.3

Table 8.--Calculation of weighting factors for recoveries from black ducks banded in the winter, 1946-60
 --continued

Major reference area	Population estimate	Number of recoveries	Population per recovery	Recovery rate	Weight per recovery
<u>Lake Michigan</u>					
Indiana	6,200	3	2,500.0	.058	145.0
Michigan	2,100				
Wisconsin	4,200	2			
<u>Upper Mississippi River</u>					
Illinois	19,700	33	597.0	.083	49.6
Indiana	30,700	256	119.9	.048	5.8
Kentucky	14,400	7	2,057.1	.040	82.3
Missouri	2,000	4	500.0	.058	29.0
Tennessee	13,800	37	373.0	.062	23.1
<u>Lower Mississippi River</u>					
Arkansas	4,600	14	1,405.6	.065	91.4
Louisiana	7,090				
Mississippi	10,800	2			

Table 9.--Summary of data for minor summer reference areas of banding.

Summer reference area of banding	Population estimate	Total bandings		Major summer banding locations	Recovery distribution Tables	First-hunting-season recovery rates (summer bandings)		Mortality rates (summer bandings)	
		Summer since 1945	October all years			Immature	Adult	Immature	Adult
<u>Maritimes (1)</u>									
Newfoundland	17,000	202	911	Grand Codroy River	B1, B2	C2, C3	.063		
Nova Scotia	12,300	390	17	Chignecto Bay	B1	C4	.216	.775	
Prince Edward Island	500	268		Several locations	B1	C5	.169	.735	
New Brunswick	1,260	840		Chignecto Bay	B1	C1	.194	.757	
<u>Labrador and Eastern Quebec (2)</u>									
Labrador	41,450	583	703	Hamilton Inlet	B3, B4	C6	.081	.064	.614
				Fraser River	B3, B4	C7, C8			
Quebec	30,260	1,657	2,844	Baie Johan Beetz		C9, C10, C11	.060	.061	.572
<u>Northern Quebec (3)</u>									
Quebec	142,300	231		Charlton Island Lac Opitoon	B5	C12	.102		.560
<u>Southern Quebec (4)</u>									
Quebec	137,500	1,257	1,416	Several locations on St. Lawrence River, Lake St. John	B5, B7	C13, C14, C15	.159	.097	.461
<u>St. John and St. Croix Rivers (5)</u>									
New Brunswick	12,000	1,342	367	Several locations	B5, B8	C19, C20	.097	.063	.331
Maine	5,000	1,750	692	Moosehorn Refuge St. Croix River	B5, B8	C16, C17 C18	.071	.068	.478
<u>Western Maine (6)</u>									
Maine	13,100	7,011	255	Penobscot River Swan Island Androscoggin River	B5, B9	C21 C22, C23	.139	.112	.663

Table 9.--Summary of data for minor summer reference areas of banding.--continued

Summer reference area of banding	Population estimate	Total bandings		Major summer banding locations	Recovery distribution Tables I/ Maps	First-hunting-season recovery rates (summer bandings)		Mortality rates (summer bandings)	
		Summer since 1945	October all years			Immature	Adult	Immature	Adult
<u>Vermont & New Hampshire (7)</u> New Hampshire	2,900	936		Androscoggin River Lake Umbagog	B10, B11 C24	.161		.710	
Vermont	2,050	1,332	47	Lake Memphremagog	B10 C25	.131		.748	
<u>Coastal Massachusetts (8)</u> Massachusetts	800	3,413	5,406	Cape Cod	B10, B12 C26, C27 C28	.136	.083	.664	.424
<u>Southern New England and Long Island (9)</u> Massachusetts	1,000	284	521	Great Meadows Refuge	B13, B14 C32, C33, C34	.132		.597	
Connecticut	625	683	682	Several locations	B13, B14 C29, C30, C31	.143		.656	
New York	500	1,446	2,062	Bronx Zoological Park, Quoque	B13, B14 C35, C36, C37	.104		.582	
<u>Lake Champlain (10)</u> Vermont	1,000	3,507	812	Lake Champlain	B15, B16 C41, C42, C43	.165	.120	.716	.446
New York	1,000	1,144	2,213	Lake Champlain Tomhannock Reservoir	B15, B16 C38, C39, C40	.155	.056	.646	.421
<u>Chesapeake and Delaware Bays (11)</u> New Jersey	2,500	556	357	Brigantine Refuge	B17, B18 C50, C51, C52	.168		.812	
Delaware	1,200	806	335	Bombay Hook Refuge	B17, B18 C44, C45, C46	.071	.064	.454	.243
Maryland	3,500	3,711	1,427	Several locations in Queen Annes County	B17, B18 C47, C48, C49	.096	.064	.510	.442

Table 9.--Summary of data for minor summer reference areas of banding.--continued

Summer reference area of banding	Population estimate	Total bandings		Major summer banding locations	Recovery distribution Tables/ Maps	First-hunting-season recovery rates (summer bandings)		Mortality rates (summer bandings)	
		Summer since 1945	October all years			Immature	Adult	Immature	Adult
<u>Eastern Lake Ontario (12)</u>									
Ontario	11,700	247	8	Pembroke	B19, B20	C57	.132	.699	
New York	5,800	7,239	7,895	Perch Lake Montezuma Refuge	B19, B20	C54 C55, C56	.123 .084	.641 .457	
<u>Western Lake Ontario (13)</u>									
Ontario	41,700	3,502	5,082	Oshawa Washigami Lake	B21, B22	C61 C62, C63	.147 .074	.699 .603	
New York	2,000	775	1,275	Holiday Lake Oak Orchard Refuge	B21, B22	C58, C59 C60	.117	.694	
<u>Western James Bay (14)</u>									
Ontario	32,700	1,299	62	Piskwanish Point	B23, B24	C64	.077 .049	.594 .334	
<u>Upper Great Lakes (15)</u>									
Michigan	10,000	2,799	3,126	Seney Refuge	B25, B26	C65, C66, C67	.093 .059	.444 .416	
<u>Western Lake Erie (16)</u>									
Michigan	3,200	784	684	Shiawassee	B27, B28	C68, C69 C70	.133 .132	.624 .530	
Ohio	1,170	768	620	Resthaven Sanctuary Magee Marsh	B27, B28	C71 C72, C73	.089 .057	.542 .307	
<u>Eastern Lake Michigan (17)</u>									
Michigan	4,200	411	1,624	Kellogg Bird Sanctuary	B29, B30	C76, C77 C78	.174 .080	.762 .762	

Table 9.--Summary of data for minor summer reference areas of banding.--continued

Summer reference area of banding	Population estimate	Total bandings		Major summer banding location	Recovery distribution Tables ^{1/} Maps	First-hunting-season recovery rates (summer bandings)		Mortality rates (summer bandings)	
		Summer since 1945	October all years			Immature	Adult	Immature	Adult
Western Lake Michigan (18) Wisconsin	5,000	422	747	Horicon Marsh	B31, B32	C85, C86, C87	.241		.675
Illinois		322	2,633	Orland Park	B31, B32	C79, C80, C81	.036		.286
Indiana		164	355	Willow Slough	B31, B32	C82, C83, C84	.073		.391
Upper Mississippi River (19) Minnesota and Wisconsin	1,000	168	51	Rice Lake Refuge Necedah Refuge	B33, B34	C88			
Northwest (20) Minnesota Manitoba		298 173	35 39	Roseau Refuge Delta Waterfowl Station	B35 B35	C89 C89	.171	.156 .065	.715 .325

^{1/} Appendix tables also include small numbers of recoveries from summer and October bandings in: Rhode Island, Pennsylvania, Virginia, Ontario, Indiana, Michigan, North Dakota, South Dakota Alberta and Saskatchewan.

Table 10.--Summary of data for minor winter reference areas of banding.

Winter reference area of banding	Winter population estimate	Total bandings since 1945			Major winter banding locations	Recovery tables	Recovery distribution Maps	First-hunting-season recovery rates (winter bandings)		Mortality rates (winter bandings)								
		Nov. Dec. all years	Jan. Feb. Mar. Apr. all years	54				616	644	B36	B36	B37	Male	Female	Male	Female		
<u>Maritimes (1)</u>																		
Nova Scotia	14,300	186	54	Vicinity of Liverpool	B36	C90												
Prince Edward Island	4,500	204	616	Cardigan Bay	B36	C91, C92		.055	.050	.261	.498							
<u>Maine (2)</u>																		
Maine	11,000	254	1,614	Vicinity of Portland	B37	C93, C94		.066	.034	.635	.635							
<u>New England and Eastern Long Island (3)</u>																		
Massachusetts	20,600	13,020	2,846	Cape Cod Newburyport-Plum Island	B38	C101, C102, C103, C104, C105, C106		.027	.023	.310	.296							
Rhode Island	7,400	1,086	682	Several locations	B38	C112, C113, C114, C115, C116, C117		.060	.049	.350	.419							
Connecticut	6,900	2,084	1,117	Several locations	B38	C95, C96, C97, C98, C99, C100		.050	.064	.311	.533							
New York	12,200	3,260	5,194	Several locations	B38	C107, C108, C109, C110, C111		.062	.060	.395	.342							
<u>Western Long Island and Hudson River (4)</u>																		
New York	17,400	6,238	2,201	Several locations	B39	C118, C119, C120, C121, C122, C123		.025	.025	.376	.394							
Ontario, Quebec, and Vermont	500	278	3	Several locations	B39													

Table 10. --- Summary of data for minor winter reference areas of banding. --- continued

Winter reference area of banding	Winter population estimate	Total bandings			Major winter banding locations	Recovery distribution Tables	First-hunting-season recovery rates (winter bandings)		Mortality rates (winter bandings)		
		Nov. Dec. all years since 1945	Jan. Feb. all years	Mar. Apr. all years			Male	Female	Male	Female	
<u>Mid-Atlantic (5)</u> Pennsylvania	14,500	52	5,688	2,381	Reading Reservoir	B40	C136, C137	.064	.048	.434	.309
New Jersey	16,900	246	999	600	Several locations	B40	C131, C132	.065	.045	.474	.338
Delaware	22,500	335	1,829	1,146	New Castle County	B40	C133 C124, C125, C126	.048	.044	.378	.597
Maryland	104,900	1,158	2,962	3,366	Kent Island Eastern Bay	B40	C127, C128 C129, C130	.063	.037	.430	.501
North Carolina	20,400	364	406 ² / ₁	597	Several locations	B40	C134, C135	.067	.018	.397	
<u>Mid-Atlantic Coastal (6)</u> New Jersey	65,200	125	4,964	945	Monmouth and Ocean Counties	B41	C138, C139	.052	.050	.395	.498
Virginia	14,100	1,716	843 ² / ₁	79	Back Bay	B41	C140, C141, C142, C143, C144	.019	.040		
<u>Southeast (7)</u> South Carolina	19,000	1,039	202 ² / ₁	24	Brookgreen	B42	C145, C146				
<u>Lake Ontario (8)</u> New York	4,400	8,862	965 ² / ₁	1,399	Several locations	B43	C147, C148, C149, C150, C151, C152	.079	.034	.490	
Ontario		189		5		B43	C153				

Table 10.--Summary of data for minor winter reference areas of banding.--Continued

Winter reference area of banding	Winter population estimate	Total bandings			Major winter banding locations	Recovery distribution Tables	First-hunting-season recovery rates (winter bandings)		Mortality rates (winter bandings)		
		Nov. all years	Dec. since 1945	Jan. Feb. all years			Mar. Apr. all years	Msle	Female	Male	Female
<u>Lake Erie (9)</u> Michigan	14,400	2,819	4,715	640	Detroit River	B44	C154, C155, C156, C157	.043	.042	.317	.460
Ohio	23,000	2,237	121 ² / ₂	507		B44	C158, C159, C160, C161, C162				
Pennsylvania	600	1,569	464	530	Pymatuning Reservoir	B44	C163, C164, C165, C166, C167				
<u>Upper Ohio River (10)</u> West Virginia	4,300	368	45	233		B45	C168				
<u>Tennessee River (11)</u> Tennessee	4,400	1,943	819	16	Hiwassee Island Woods Reservoir Old Hickory Lake	B46	C172, C173, C174	.067	.066	.449	
Alabama	5,400	1,154	910	96	Wheeler Refuge	B46	C169, C170, C171				
<u>Lake Michigan (12)</u> Michigan	2,100	3,479	25	344		B47	C177, C178, C179, C180				
Wisconsin	4,200	175		20		B47	C181				
Indiana	6,200	460		88		B47	C175, C176				
<u>Upper Mississippi Ri. (13)</u> Illinois	19,700	7,866	166 ² / ₂	181	Chautauqua Refuge	B48	C182, C183, C184, C185, C186, C187, C188, C189, C190, C191, C192, C193, C194, C195, C196				
Indiana	30,700	1,086	1,715	769	Hovey Lake	B48					
Tennessee	13,500	705	226	8	Vicinity of Reeffoot Lake	B48					

1/ Appendix tables also include small numbers of recoveries from winter bandings in: New Hampshire, Virginia, Ontario, Ohio, Kentucky, Missouri, Arkansas, Louisiana, South Dakota, and Oklahoma.

2/ Additional bandings in December and/or winter bandings during years prior to 1946 were used to represent the recovery distribution of the winter population.

Table 11.--Summary of hunting regulations in important black duck harvest areas

Year	Flyway	Season length in days			Daily bag limit (black duck)	Opening and closing dates of the season in selected Provinces and States									
		Eastern Canada		United States		Southern Ontario		Quebec	Nova Scotia		Maine	Massachusetts	Maryland	Michigan	Tennessee
	Atlantic Miss.	Southern Ontario	Central Quebec	Southern Nova Scotia	United States	Eastern Canada	Southern Ontario	Quebec	Nova Scotia	Maine	Massachusetts	Maryland	Michigan	Tennessee	
1927	107	106	106	108	25	25	9/1-12/15	9/1-12/15	9/15-12/31	9/16-12/31	9/16-12/31	11/1-1/31	9/16-12/31	11/1-1/31	
1928	107	92	106	108	25	25	9/15-12/15	9/1-12/15	9/15-12/31	9/16-12/31	9/16-12/31	11/1-1/31	9/16-12/31	11/1-1/31	
1929	107	92	106	107	25	25	9/15-12/15	9/1-12/15	10/1-1/15	9/16-12/31	9/16-12/31	11/1-1/31	9/16-12/31	11/1-1/31	
1930	107	92	106	107	15	25	9/15-12/15	9/1-12/15	10/1-1/15	9/16-12/31	10/1-1/15	11/1-1/31	9/16-12/31	11/1-1/31	
1931	30	92	106	107	15	15	9/15-12/15	9/1-12/15	10/1-1/15	10/1-10/31	11/1-11/30	11/16-12/15	10/1-10/31	11/16-12/15	
1932	61	92	106	107	15	15	9/15-12/15	9/1-12/15	10/1-1/15	10/16-12/15	10/16-12/15	11/16-12/15	10/1-11/30	11/16-1/15	
1933	61	92	106	107	12	10-25	9/15-12/15	9/1-12/15	10/1-1/15	10/1-11/30	10/16-12/15	11/16-12/15	10/1-11/30	11/16-1/15	
1934	30	92	106	107	12	10-25	9/15-12/15	9/1-12/15	10/1-1/15	Thurs.-Sat. 10/4-12/8	Thurs.-Sat. 10/19-12-22	Thurs.-Sat. 11/8-1/12	Thurs.-Sat. 10/3-11/11	Thurs.-Sat. 11/8-1/12	
1935	30	61	106	107	10	10-25	10/1-11/30	9/1-12/15	10/1-1/15	10/21-11/19	10/21-11/19	11/20-12/19	10/21-11/19	11/20-12/19	
1936	30	61	61	61	10	12	10/1-11/30	9/1-10/31	10/1-11/30	10/10-11/8	11/1-11/30	11/26-12/25	10/10-11/8	11/26-12/25	
1937	30	61	61	61	10	12	10/1-11/30	9/15-11/14	11/1-12/31	10/9-11/7	10/9-11/7	11/27-12/26	10/9-11/7	11/27-12/26	
1938	45	61	61	61	10	12	10/1-11/30	9/15-11/14	10/1-11/30	10/1-11/14	10/15-11/28	11/15-12/29	10/1-11/14	11/15-12/29	
1939	45	61	61	76	10	12	10/1-11/30	9/15-11/14	11/1-1/15	10/1-11/14	10/22-12/5	11/15-12/29	10/1-11/14	11/15-12/29	
1940	60	61	61	76	10	12	10/1-11/30	9/15-11/14	11/1-1/15	10/1-11/29	10/16-12/14	11/2-12/31	10/1-11/29	11/2-12/31	
1941	60	76	70	76	10	12	10/1-12/15	9/12-12/20	11/1-1/15	10/1-11/29	10/16-12/14	11/2-12/31	10/1-11/29	11/2-12/31	
1942	70	76	70	92	10	12	10/1-12/15	9/12-11/20	10/16-1/15	9/26-12/4	10/15-12/23	11/2-1/10	9/26-12/4	11/2-1/10	
1943	70	77	70	92	10	12	9/25-12/10	9/11-11/19	10/16-1/15	9/25-12/3	10/15-12/23	11/2-1/10	9/25-12/3	11/2-1/10	
1944	80	82	80	92	10	12	9/25-12/15	9/9-11/27	10/16-1/15	9/20-12/8	10/14-1/1	11/2-1/20	9/20-12/8	11/2-1/20	
1945	80	82	80	92	10	15	9/25-12/15	9/8-11/26	10/16-1/15	9/20-12/8	10/13-12/31	11/2-1/20	9/20-12/8	11/2-1/30	
						(12 in S. Nova Scotia)									
1946	45	76	75	77	7	12	9/25-12/9	9/14-11/27	10/16-12/31	10/5-11/18	10/26-12/9	11/23-1/6	10/5-11/18	11/23-1/6	

Table 11.--Summary of hunting regulations in important black duck harvest areas.--continued

Year	Flyway Atlantic Mide.	Eastern Canada				Opening and closing dates of the season in selected Provinces and States										
		Southern Ontario		Central Quebec		Southern Ontario		Central Quebec		Nova Scotia						
		Southern Ontario	Central Quebec	Southern Ontario	Central Quebec	Southern Ontario	Central Quebec	Nova Scotia	Nova Scotia	Nova Scotia	Nova Scotia					
1947 ^{1/}	30	45	45	45	45	7	10/4-11/17	9/27-11/10	11/1-12/15	10/7-10/18	11/4-11/15	11/18-12/17	11/4-11/15	12/23-1/3	10/7-11/5	12/8-1/6
1948	30	45	45	45	45	7	10/2-11/15	9/25-11/8	11/15-12/29	10/8-10/19	10/29-11/9	11/26-12/7	12/28-1/8	11/12-11/23	10/15-11/13	12/10-1/8
1949	40	55	55	55	55	7	10/15-12/8	9/24-11/17	11/15-1/8	10/7-10/22	10/21-11/5	11/23-12/8	12/9-12/24	11/18-12/27	10/7-11/15	11/18-12/27
1950	40	35	55	55	55	7	10/7-11/30	9/16-11/9	11/15-1/8	10/6-10/21	10/20-11/4	11/24-12/9	12/15-12/30	11/27-1/5	10/13-11/16	12/2-1/5
1951	45	57	57	57	57	7	10/6-12/1	9/20-11/15	11/15-1/10	10/5-10/22	11/23-12/10	10/26-12/9	11/22-1/5	10/12-11/25	11/22-1/5	11/22-1/5
1952	55	57	57	57	57	7	10/4-11/29	9/20-11/15	11/15-1/10	10/1-10/22	11/19-12/10	11/17-12/31	11/17-1/10	10/1-11/24	11/17-1/10	11/17-1/10
1953	60	55	60	60	60	8	10/3-12/1	9/19-11/17	11/21-1/19	10/9-12/7	10/28-12/26	11/11-1/9	10/1-11/24	10/1-11/24	11/7-1/15	11/7-1/15
1954	60	55	75	65	60	8	10/2-12/15	9/18-11/21	11/15-1/13	10/4-10/30	11/19-12/15	10/27-12/25	11/12-1/10	10/1-11/24	11/17-1/10	11/17-1/10
1955	70	76	70	70	70	8	10/1-12/15	9/17-11/25	11/23-1/31	10/7-12/15	10/21-12/29	11/7-1/15	10/1-12/9	10/1-12/9	11/7-1/15	11/7-1/15
1956	70	78	70	70	70	8	10/6-12/15	9/15-11/23	11/23-1/31	10/5-12/13	10/20-12/28	11/7-1/15	10/1-12/9	10/1-12/9	11/7-1/15	11/7-1/15
1957	70	70	70	70	70	8	10/5-12/14	9/14-11/22	11/23-1/31	10/4-12/12	10/26-1/3	11/7-1/15	10/1-12/9	10/1-12/9	11/7-1/15	11/7-1/15
1958	60	70	72	70	70	8	10/4-12/15	9/13-11/21	11/23-1/31	10/10-12/8	12/8-1/10	10/20-11/8	11/17-1/15	10/1-12/9	11/7-1/15	11/7-1/15
1959	40-50	35-45	88	72	70	6	10/3-12/15	9/19-11/29	11/23-1/31	10/9-11/7	10/20-11/11	11/21-12/5	12/14-1/4	11/20-1/8	10/1-12/9	11/30-1/8
1960	40-50	40-50	83	72	70	6	10/1-12/15	9/17-11/27	11/23-1/31	10/7-10/29	10/29-11/26	11/19-12/10	12/16-12/31	11/19-1/7	10/7-11/15	11/30-1/8
1961	40-50	30	69	85	70	6	10/7-12/15	9/16-12/9	11/23-1/31	10/13-10/21	10/18-11/11	11/4-12/9	12/11-12/30	11/11-12/30	10/13-11/11	12/1-12/30
1962	40-50	25	70	93	70	1-2	6	10/6-12/15	9/15-12/16	11/23-1/31	10/12-11/3	10/12-10/27	11/17-12/8	12/1-12/29	11/9-12/28	12/6-12/30
1963	40-50	35	70	86	70	2	6	10/5-12/14	9/21-12/15	11/23-1/31	11/22-12/14	11/29-12/27	11/13-1/1	10/5-11/8	12/2-1/5	12/2-1/5

^{1/} Starting in 1947 a few States each year selected a split season with a 10 percent reduction in the number of days.

Table 12.--Numbers of migratory bird hunting stamps sold in States of the Atlantic and Mississippi Flyways, 1934-62

	1934	1935	1936	1937	1938	1939	1940	1941	1942	1943	1944	1945	1946	1947	1948	1949
*Maine	6,539	3,214	4,527	5,546	7,812	8,349	10,017	10,350	10,770	9,162	12,407	14,731	15,016	10,905	12,142	10,187
*Vermont	1,754	1,116	1,256	1,810	2,263	2,851	3,153	3,395	3,642	2,836	3,965	4,303	4,593	3,161	3,865	3,360
*New Hampshire	1,641	829	1,166	1,688	1,864	2,777	3,226	3,545	4,074	3,432	4,231	4,708	5,750	3,428	3,656	3,014
*Massachusetts	14,124	6,033	7,380	12,161	12,087	15,048	19,464	22,230	20,135	18,677	21,616	25,165	28,142	15,780	19,370	17,408
*Connecticut	4,372	2,116	2,381	3,249	4,318	4,904	6,733	8,434	8,501	6,172	9,506	10,683	11,224	6,692	7,699	5,534
*Rhode Island	1,794	1,074	1,177	1,477	1,824	2,641	3,329	3,997	3,353	2,764	3,535	4,220	4,864	2,595	2,564	2,092
*New York	21,502	11,917	15,470	23,286	29,825	32,304	42,934	50,824	46,344	38,730	46,475	56,354	62,680	48,029	66,809	50,727
*Pennsylvania	8,751	5,088	5,458	5,613	13,353	16,008	22,044	30,317	34,604	25,027	34,322	41,185	48,308	32,841	47,389	31,920
*West Virginia	566	396	419	446	789	1,037	1,521	1,769	1,528	1,481	1,873	2,014	2,092	2,243	1,859	2,662
*New Jersey	12,739	6,040	6,517	9,921	14,486	16,936	20,525	23,388	24,991	19,519	24,609	29,356	39,454	16,948	17,649	15,847
*Delaware	3,600	1,259	1,115	2,001	2,576	3,164	3,646	3,752	3,232	2,906	3,916	4,648	5,130	3,284	4,823	4,709
*Maryland	6,575	2,831	3,358	4,360	6,861	8,993	11,011	11,184	12,356	10,182	14,039	16,738	14,182	12,195	15,418	17,031
D.C.	1,204	958	1,017	1,105	1,378	3,421	1,312	1,348	1,212	1,349	1,694	1,757	1,499	1,153	1,361	1,492
*Virginia	4,628	1,792	2,251	3,052	4,538	6,767	10,076	10,965	11,469	10,713	13,169	15,641	13,179	11,418	13,293	13,643
North Carolina	4,964	1,995	2,865	4,344	6,362	8,564	9,965	11,086	7,828	8,291	12,002	11,666	13,002	12,741	15,749	17,359
South Carolina	1,800	1,944	1,680	2,353	3,653	3,634	5,554	4,180	5,503	4,893	6,237	6,996	7,153	6,959	9,797	9,628
Georgia	1,540	730	816	938	1,387	2,569	3,992	3,737	2,874	2,511	3,928	3,866	4,396	4,143	5,018	4,289
Florida	6,704	4,431	5,774	7,175	10,424	13,009	14,717	14,268	12,886	11,675	18,828	21,788	21,250	19,369	22,916	20,412
Atlantic Flyway	104,797	53,763	64,627	90,525	125,800	152,926	193,129	218,767	215,302	180,320	236,352	275,819	301,914	213,884	271,377	231,314
Minnesota	51,536	44,062	72,460	97,609	116,461	120,034	118,931	121,032	110,986	95,446	115,415	130,757	175,151	145,926	162,300	143,496
*Wisconsin	40,769	35,154	48,999	61,783	79,688	84,075	89,317	89,195	83,527	66,328	75,208	83,681	102,971	91,326	101,842	103,826
*Michigan	25,348	14,796	31,482	56,888	80,458	86,064	94,180	103,798	108,663	83,554	90,265	100,382	117,294	91,334	83,582	98,285
Iowa	16,129	18,910	27,294	25,427	36,267	39,143	40,670	51,268	41,739	36,749	44,339	43,529	54,925	52,719	63,805	56,477
Illinois	42,687	36,337	53,251	51,333	57,538	66,434	64,212	84,997	83,391	66,587	69,891	77,452	93,387	81,753	110,980	106,767
Indiana	8,250	5,379	7,648	12,311	14,724	18,686	18,882	22,071	24,157	22,740	24,462	28,159	35,409	17,038	35,574	31,183
*Ohio	10,407	7,001	10,493	14,662	19,076	20,680	23,558	25,855	27,631	21,334	22,987	27,777	37,105	27,087	39,176	33,249
Missouri	23,001	14,080	17,149	16,469	20,034	26,961	26,723	36,828	40,834	34,193	41,354	44,962	52,563	50,733	69,269	62,901
*Kentucky	2,314	1,291	1,136	2,676	3,465	4,564	4,611	4,553	5,065	4,227	5,772	6,390	6,178	5,502	7,717	7,977
Arkansas	11,973	9,134	10,268	11,799	15,342	14,401	16,330	18,526	24,266	19,725	26,451	45,538	48,874	44,788	60,758	54,214
Tennessee	6,918	5,024	4,754	5,366	7,813	8,615	10,600	12,326	12,160	10,929	13,941	20,393	20,224	19,830	25,746	25,577
Louisiana	20,081	10,242	13,721	19,366	31,190	33,870	43,079	45,102	44,252	35,199	45,455	56,876	53,490	62,998	80,701	71,923
Mississippi	4,703	3,154	3,168	4,855	6,306	7,591	9,211	9,707	8,902	7,487	10,313	15,211	16,861	17,322	20,507	17,825
Alabama	2,533	1,403	1,914	2,889	4,940	5,833	6,590	6,969	6,924	5,841	7,226	9,466	10,319	11,210	12,595	10,993
Miss. Flyway	266,649	205,967	303,737	383,433	493,302	536,951	566,894	632,227	622,497	510,339	593,079	692,573	824,751	719,566	874,552	824,693
Total	371,446	259,730	368,364	473,958	619,102	689,877	760,023	850,994	837,799	725,641	829,431	968,392	1,126,665	933,450	1,145,929	1,056,007
Total for 17																
Important States	168,627	102,905	145,602	211,724	286,661	320,533	370,567	408,897	411,097	328,393	389,589	451,733	519,661	385,921	450,484	422,963

Table 12.--Numbers of migratory bird hunting stamps sold in States of the Atlantic and Mississippi Flyways, 1934-62--continued

	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962
*Maine	10,024	10,606	12,703	13,262	12,266	13,586	12,861	12,700	12,032	9,704	10,730	7,213	8,020
*Vermont	3,467	3,453	4,017	4,341	4,208	4,713	4,684	4,468	4,139	3,471	3,803	3,616	3,637
*New Hampshire	3,224	3,349	3,467	5,107	4,667	5,088	4,910	4,910	4,692	3,742	4,433	4,220	4,333
*Massachusetts	17,253	18,803	16,645	19,506	18,952	20,770	22,197	20,543	21,182	17,022	17,736	17,411	17,162
*Connecticut	6,012	5,972	7,327	7,776	8,095	9,214	8,725	8,818	9,095	6,970	8,485	6,204	7,497
*Rhode Island	2,387	2,338	2,927	3,098	3,185	3,260	3,350	3,059	2,943	2,372	2,130	2,057	1,625
*New York	52,222	55,627	59,455	73,112	74,741	85,814	73,697	68,559	66,700	52,390	64,045	53,731	50,014
*Pennsylvania	38,496	40,636	43,931	46,006	48,646	53,064	51,860	47,707	40,604	27,525	30,747	25,684	27,621
*West Virginia	2,167	3,788	2,612	2,335	2,480	2,454	2,942	2,776	2,278	654	1,743	1,218	1,454
*New Jersey	17,780	20,499	28,364	23,937	26,341	29,558	26,600	29,777	22,500	16,925	17,890	15,226	18,734
*Delaware	4,564	5,122	6,351	6,737	7,018	7,905	7,905	8,081	7,983	6,683	6,229	6,336	5,664
*Maryland	17,309	19,986	23,082	25,184	25,256	26,732	28,326	27,264	22,373	15,103	17,707	17,077	18,063
D.C.	1,333	1,650	1,923	2,079	2,060	2,358	2,483	2,197	2,247	1,518	1,378	1,322	1,434
*Virginia	13,314	15,370	20,549	24,269	23,210	26,279	26,633	25,576	20,765	12,577	15,139	12,365	13,580
North Carolina	17,567	18,041	28,063	28,941	27,547	30,963	30,318	29,502	25,468	19,685	21,972	17,888	20,394
South Carolina	8,974	8,943	14,295	14,139	13,794	16,498	17,613	15,018	14,488	8,506	10,647	10,657	10,541
Georgia	3,987	5,126	8,320	8,599	8,515	9,841	12,405	11,516	10,081	4,926	6,368	6,651	5,882
Florida	19,652	20,007	26,517	30,378	32,496	38,753	40,862	34,117	35,934	23,254	23,664	23,702	20,656
Atlantic Flyway	239,732	259,316	311,526	340,806	343,477	386,866	378,549	356,588	325,504	233,027	264,846	232,578	236,311
Minnesota	145,708	162,486	163,109	154,004	143,886	131,985	150,550	151,156	147,895	118,624	139,065	85,251	78,071
*Wisconsin	103,981	108,429	134,351	131,029	127,358	131,101	130,306	115,248	109,856	100,658	109,875	89,848	73,141
*Michigan	88,425	111,651	136,306	137,225	129,937	146,240	140,648	128,131	110,260	77,553	84,284	64,628	49,610
Iowa	49,518	62,169	54,396	70,510	56,991	52,196	57,505	58,994	54,816	51,040	49,657	41,147	30,602
Illinois	94,062	114,836	119,873	114,914	110,507	125,815	117,650	119,010	108,456	85,902	78,722	63,435	42,256
Indiana	29,386	36,983	43,137	41,751	39,716	48,756	47,659	50,565	41,450	31,111	29,935	20,862	15,965
*Ohio	33,435	37,561	42,625	43,081	38,730	47,076	46,738	45,107	43,003	27,961	39,057	24,857	20,057
Missouri	51,811	69,342	61,668	50,626	58,606	75,772	72,873	76,774	73,150	53,851	49,103	39,118	27,016
*Kentucky	8,102	13,328	17,366	14,936	14,969	17,887	18,622	19,527	17,174	9,588	9,500	6,337	4,488
Arkansas	55,706	64,892	61,091	25,466	46,219	58,122	55,136	59,064	59,218	38,910	43,642	19,037	9,549
Tennessee	25,752	31,137	35,060	33,200	33,783	39,210	41,431	42,203	38,730	21,184	25,375	15,472	8,066
Louisiana	71,834	74,339	83,072	92,478	88,237	106,316	102,734	102,224	91,803	66,734	63,741	45,644	39,766
Mississippi	18,537	19,250	19,043	18,938	17,264	20,646	20,598	19,379	19,442	13,837	13,808	7,128	7,102
Alabama	10,290	12,836	17,962	17,699	15,879	18,653	20,245	17,173	16,291	10,696	10,879	5,782	6,292
Miss. Flyway	786,547	919,239	989,059	945,857	922,082	1,019,145	1,022,695	1,004,555	931,544	707,649	746,643	528,542	411,981
Total	1,026,279	1,178,555	1,300,585	1,286,663	1,265,559	1,405,694	1,401,244	1,361,143	1,257,048	940,676	1,011,489	761,120	648,292
Total for 17 important States	423,495	478,168	564,979	585,020	572,119	633,115	613,665	574,448	519,826	392,416	444,911	359,346	326,134

*Important black duck States where either more than 5 percent of the black duck kill in the United States occurs or where the black duck makes up more than 20 percent of the total duck kill in the State.

Table 13.--Duck stamp purchasers in selected States classified by hunting activity and seasonal success, based on the mail survey of waterfowl hunters in 1960 and 1961.

State	Hunting activity classification	Percent of total stamp purchasers		Percent of total kill	
		1960	1961	1960	1961
Maine	Non hunter ^{1/}	1.3	0.9		
	Inactive hunter ^{2/}	15.1	24.5		
	Active hunter:				
	seasonal bag 0	22.0	14.7		
	1-5	32.9	30.4	18.5	14.2
	6-10	15.3	13.2	25.3	17.0
	11-20	9.3	10.8	28.0	27.1
	21-+	4.2	5.5	28.2	41.7
	Total	100.1	100.0	100.0	100.0
	Sample size ^{3/}	1,533	1,543	4,344	5,100
Massachusetts	Non hunter	1.0	1.1		
	Inactive hunter	17.9	26.1		
	Active hunter:				
	seasonal bag 0	31.0	20.6		
	1-5	29.7	31.7	21.6	21.1
	6-10	11.4	9.5	23.3	17.8
	11-20	5.6	8.0	22.3	29.3
	21-+	3.3	3.1	33.0	31.9
	Total	99.9	100.1	100.2	100.1
	Sample Size	1,767	1,616	4,292	3,955
Rhode Island	Non hunter	2.3	0.6		
	Inactive hunter	10.6	14.1		
	Active hunter:				
	seasonal bag 0	15.8	14.1		
	1-5	44.8	36.6	22.6	14.9
	6-10	9.7	18.8	12.6	23.5
	11-20	11.4	10.3	30.2	23.6
	21-+	5.3	5.7	34.6	37.9
	Total	99.9	100.2	100.0	99.9
	Sample size	176	173	665	643

Table 13.--Duck stamp purchasers in selected States classified by hunting activity and seasonal success, based on the mail survey of waterfowl hunters in 1960 and 1961--continued.

State	Hunting activity classification	Percent of total stamp purchasers		Percent of total kill	
		1960	1961	1960	1961
New York	Non hunter	1.7	2.3		
	Inactive hunter	19.3	27.6		
	Active hunter:				
	seasonal bag 0	30.0	22.6		
	1-5	31.3	28.3	26.1	21.7
	6-10	10.4	9.7	25.4	21.5
	11-20	4.4	6.4	20.5	27.2
	21-+	2.9	3.1	28.0	29.6
	Total	100.0	100.0	100.0	100.0
	Sample size	1,786	2,683	3,679	5,970
New Jersey	Non hunter	2.5	3.2		
	Inactive hunter	22.2	28.6		
	Active hunter:				
	seasonal bag 0	34.6	22.8		
	1-5	26.2	28.4	22.6	25.9
	6-10	7.5	7.6	21.6	18.4
	11-20	4.2	6.5	23.8	30.2
	21-+	2.7	2.8	32.0	25.5
	Total	99.9	99.9	100.0	100.0
	Sample size	642	741	444	1,439
Maryland	Non hunter	0.6	0.6		
	Inactive hunter	17.1	19.0		
	Active hunter:				
	seasonal bag 0	38.2	34.0		
	1-5	26.1	27.1	23.4	20.3
	6-10	8.9	10.1	23.2	22.3
	11-20	6.9	5.4	32.6	23.6
	21-+	2.2	3.8	20.8	33.8
	Total	100.0	100.0	100.0	100.0
	Sample size	827	718	1,646	1,376

Table 13.--Duck stamp purchasers in selected States classified by hunting activity and seasonal success, based on the mail survey of waterfowl hunters in 1960 and 1961--continued.

State	Hunting activity classification	Percent of total stamp purchasers		Percent of total kill	
		1960	1961	1960	1961
Wisconsin	Non hunter	0.9	0.7		
	Inactive hunter	12.9	18.4		
	Active hunter:				
	seasonal bag 0	34.5	23.0		
	1-5	29.0	29.2	19.0	15.8
	6-10	10.7	14.7	21.0	23.6
	11-20	8.5	8.6	31.0	25.9
	21-+	3.6	5.4	29.0	34.7
	Total	100.1	100.0	100.0	100.0
	Sample size	4,587	2,358	12,569	6,950
Michigan	Non hunter	1.6	1.1		
	Inactive hunter	18.1	21.9		
	Active hunter:				
	seasonal bag 0	29.9	25.9		
	1-5	30.3	31.2	22.0	22.6
	6-10	10.8	10.3	23.0	21.4
	11-20	6.2	6.4	26.0	26.9
	21-+	3.1	3.3	29.0	29.1
	Total	100.0	100.0	100.0	100.0
	Sample size	3,541	3,211	1,777	6,491
Ohio	Non hunter	1.0	2.7		
	Inactive hunter	13.6	18.2		
	Active hunter:				
	seasonal bag 0	26.7	27.0		
	1-5	33.8	30.6	20.0	19.5
	6-10	11.0	11.0	18.0	21.3
	11-20	9.8	6.5	30.0	23.9
	21-+	4.2	4.2	32.0	35.3
	Total	100.1	100.2	100.0	100.0
	Sample size	1,494	1,928	3,882	4,158

Table 13.--Duck stamp purchasers in selected States classified by hunting activity and seasonal success, based on the mail survey of waterfowl hunters in 1960 and 1961--continued.

State	Hunting activity classification	Percent of total stamp purchasers		Percent of total kill	
		1960	1961	1960	1961
Kentucky	Non hunter	0.0	1.1		
	Inactive hunter	21.2	17.3		
	Active hunter:				
	seasonal bag 0	27.7	30.6		
	1-5	29.9	30.2	20.0	24.0
	6-10	10.9	11.3	23.0	27.8
	11-20	6.6	7.6	23.0	31.0
	21-+	3.6	2.0	34.0	17.1
	Total	99.9	100.1	100.0	99.9
	Sample size	228	360	552	783

^{1/} Non-hunters are primarily stamp collectors.

^{2/} Persons who purchased a duck stamp with the intention of going hunting but did not hunt.

^{3/} Number of respondents to the mail questionnaire survey of waterfowl hunters.

Table 14.--First-and-second-hunting season recoveries and recovery rates for black ducks banded in summer areas of reference, 1946-60

Area of reference	Age	Summer bandings*						October bandings**					
		First hunting season			Second hunting season***			First hunting season			Second hunting season		
		Number banded	Number recovered	Recovery rate	Number banded	Number recovered	Recovery rate	Number banded	Number recovered	Recovery rate	Number banded	Number recovered	Recovery rate
<u>Maritimes</u>													
<u>New Brunswick</u>													
	Loc.	309	64	.207	309	9	.029	--	--	--	--	--	
	Juv.	51	5	.098	51	1	.020	--	--	--	--	--	
	Imm.	402	78	.194	402	10	.025	--	--	--	--	--	
	Ad.	76	6	.079	76	1	.013	--	--	--	--	--	
	Unk.	2	0	.000	2	0	.000	--	--	--	--	--	
<u>Newfoundland</u>													
	Loc.	15	0	.000	15	2	.133	1	0	.000	1	0	
	Juv.	24	0	.000	24	0	.000	--	--	--	--	--	
	Imm.	142	9	.063	142	3	.021	811	49	.060	811	15	
	Ad.	21	2	.095	21	0	.000	99	3	.030	99	5	
<u>Nova Scotia</u>													
	Loc.	170	19	.112	170	4	.024	--	--	--	--	--	
	Imm.	162	35	.216	162	4	.025	12	2	.167	12	0	
	Ad.	54	7	.130	54	4	.074	5	2	.400	5	0	
	Unk.	4	2	.500	4	0	.000	--	--	--	--	--	
<u>Prince Edward Island</u>													
	Loc.	260	44	.169	149	7	.047	--	--	--	--	--	
	Ad.	8	1	.125	7	0	.000	--	--	--	--	--	
<u>Labrador and E. Quebec</u>													
<u>Labrador</u>													
	Loc.	7	0	.000	7	0	.000	--	--	--	--	--	
	Juv.	21	0	.000	21	3	.143	--	--	--	--	--	
	Imm.	198	16	.081	198	1	.005	446	25	.056	446	9	
	Ad.	357	23	.064	357	11	.031	256	10	.039	256	8	
	Unk.	--	--	--	--	--	--	1	0	.000	1	0	
<u>Quebec</u>													
	Loc.	21	2	.095	21	1	.048	--	--	--	--	--	
	Juv.	130	7	.054	130	2	.015	--	--	--	--	--	
	Imm.	996	60	.060	964	21	.022	2,091	138	.066	1,879	35	
	Ad.	507	31	.061	505	10	.020	752	44	.059	676	15	
	Unk.	3	1	.333	3	0	.000	1	1	1.000	1	0	

Table 14.--First-and-second-hunting season recoveries and recovery rates for black ducks banded in summer areas of reference, 1946-60--continued

Area of reference	Age	Summer bandings*						October bandings**					
		First hunting season			Second hunting season***			First hunting season			Second hunting season		
		Number banded	Number recovered	Recovery rate	Number banded	Number recovered	Recovery rate	Number banded	Number recovered	Recovery rate	Number banded	Number recovered	Recovery rate
<u>N. Quebec</u>													
Quebec	Loc.	4	0	.000	4	0	.000	--	--	--	--	--	
	Imm.	137	14	.102	137	3	.022	--	--	--	--	--	
	Ad.	90	7	.078	90	2	.022	--	--	--	--	--	
<u>S. Quebec</u>													
Quebec	Loc.	13	2	.154	12	0	.000	1	0	.000	1	0	
	Juv.	4	0	.000	4	0	.000	--	--	--	--	--	
	Imm.	1,073	171	.159	870	22	.025	738	72	.098	738	26	
	Ad.	165	16	.097	118	4	.034	585	37	.063	585	26	
	Unk.	2	1	.500	1	0	.000	92	0	.000	92	0	
<u>St. John and St. Croix Rivers</u>													
Maine	Loc.	90	6	.067	90	4	.044	--	--	--	--	--	
	Imm.	1,405	100	.071	1,405	53	.038	234	16	.068	234	3	
	Ad.	237	16	.068	227	5	.022	101	3	.030	93	4	
	Unk.	18	0	.000	18	1	.056	--	--	--	--	--	
<u>New Brunswick</u>													
	Loc.	72	9	.125	72	1	.014	--	--	--	--	--	
	Juv.	4	0	.000	4	1	.250	--	--	--	--	--	
	Imm.	1,056	102	.097	693	21	.030	121	12	.099	121	3	
	Ad.	207	13	.063	188	5	.027	245	26	.106	245	6	
	Unk.	3	1	.333	3	0	.000	--	--	--	--	--	
<u>N. Maine</u>													
Maine	Loc.	401	61	.152	401	11	.027	--	--	--	--	--	
	Juv.	9	0	.000	9	0	.000	--	--	--	--	--	
	Imm.	5,901	822	.139	5,900	189	.032	110	9	.082	110	5	
	Ad.	517	58	.112	516	13	.025	16	1	.062	16	1	
	Unk.	183	14	.076	183	11	.060	44	4	.091	44	1	

Table 14.--First-and-second-hunting season recoveries and recovery rates for black ducks banded in summer areas of reference, 1946-60--continued

Area of reference	Age	Summer bandings*						October bandings**					
		First hunting season			Second hunting season***			First hunting season			Second hunting season		
		Number banded	Number recovered	Recovery rate	Number banded	Number recovered	Recovery rate	Number banded	Number recovered	Recovery rate	Number banded	Number recovered	Recovery rate
<u>Vermont and New Hampshire</u>													
<u>New Hampshire</u>													
	Loc.	5	2	.400	5	0	.000	--	--	--	--	--	
	Imm.	843	136	.161	706	20	.028	--	--	--	--	--	
	Ad.	88	6	.068	75	1	.013	--	--	--	--	--	
<u>Vermont</u>													
	Loc.	9	1	.111	8	0	.000	--	--	--	--	--	
	Imm.	1,231	161	.131	954	20	.021	45	15	.333	45	2	
	Ad.	90	8	.089	70	2	.029	2	0	.000	2	0	
	Unk.	2	0	.000	2	0	.000	--	--	--	--	--	
<u>Coastal Massachusetts</u>													
<u>Massachusetts</u>													
	Loc.	45	4	.089	42	0	.000	--	--	--	--	--	
	Juv.	292	17	.058	292	10	.034	376	27	.072	376	9	
	Imm.	2,293	313	.136	2,293	74	.032	1,262	193	.153	1,262	36	
	Ad.	709	59	.083	653	22	.034	1,435	89	.060	1,435	34	
	Unk.	74	4	.054	74	1	.014	80	5	.062	80	1	
<u>S. New England and Long Island</u>													
<u>Connecticut</u>													
	Loc.	21	2	.095	21	0	.000	--	--	--	--	--	
	Juv.	74	8	.108	74	2	.027	34	2	.059	34	1	
	Imm.	530	76	.143	530	20	.038	221	17	.077	221	7	
	Ad.	52	6	.115	52	2	.038	54	6	.111	54	0	
	Unk.	6	1	.167	6	0	.000	1	1	1.000	1	0	
<u>Massachusetts</u>													
	Loc.	7	0	.000	7	0	.000	--	--	--	--	--	
	Juv.	14	0	.000	14	1	.071	--	--	--	--	--	
	Imm.	226	30	.132	197	9	.046	88	12	.136	88	2	
	Ad.	35	2	.057	18	0	.000	17	4	.235	17	0	
	Unk.	2	0	.500	2	1	.500	--	--	--	--	--	
<u>New York</u>													
	Loc.	7	0	.000	7	0	.000	--	--	--	--	--	
	Juv.	944	98	.104	944	36	.038	206	20	.097	206	5	
	Imm.	4	1	.250	3	1	.333	110	12	.109	110	4	
	Ad.	35	1	.029	35	1	.029	161	16	.099	161	5	
	Unk.	456	32	.070	456	12	.026	473	24	.051	473	11	

Table 14.--First-and-second-hunting season recoveries and recovery rates for black ducks banded in summer areas of reference, 1946-60--continued

Area of reference	Age	Summer bandings*				October bandings**							
		First hunting season		Second hunting season***		First hunting season		Second hunting season					
		Number banded	Number recovered	Number banded	Number recovered	Number banded	Number recovered	Number banded	Number recovered				
<u>Lake Champlain</u>													
<u>New York</u>													
	Juv.	539	29	.054	539	11	.020	649	32	.049	649	19	.029
	Imm.	148	23	.155	138	4	.029	329	23	.070	327	7	.021
	Ad.	324	18	.056	312	17	.054	675	41	.061	675	23	.034
	Unk.	133	6	.045	133	4	.030	560	29	.052	560	15	.027
<u>Vermont</u>													
	Loc.	20	1	.050	20	1	.050	--	--	--	--	--	--
	Juv.	12	1	.083	12	0	.000	--	--	--	--	--	--
	Imm.	3,128	517	.165	2,920	82	.028	302	36	.119	302	7	.023
	Ad.	341	41	.120	317	11	.035	292	27	.092	292	6	.021
	Unk.	6	1	.167	6	0	.000	2	2	1.000	2	0	.000
<u>Chesapeake and Delaware Bays</u>													
<u>Delaware</u>													
	Loc.	5	1	.200	5	0	.000	--	--	--	--	--	--
	Juv.	10	2	.200	10	0	.000	--	--	--	--	--	--
	Imm.	524	37	.071	399	14	.035	157	11	.070	152	8	.053
	Ad.	235	15	.064	216	10	.046	169	15	.089	169	9	.053
	Unk.	32	3	.094	32	2	.062	9	0	.000	9	0	.000
<u>Maryland</u>													
	Loc.	422	44	.104	422	8	.019	2	1	.500	2	0	.000
	Imm.	2,407	230	.096	2,407	106	.044	686	56	.082	686	21	.031
	Ad.	880	56	.064	880	22	.025	506	28	.055	506	17	.034
	Unk.	2	1	.500	2	0	.000	8	0	.000	8	0	.000
<u>New Jersey</u>													
	Loc.	29	0	.000	29	2	.069	--	--	--	--	--	--
	Juv.	28	0	.000	28	0	.000	31	0	.000	31	0	.000
	Imm.	446	75	.168	445	11	.025	217	30	.138	217	7	.032
	Ad.	51	3	.059	51	2	.039	56	4	.071	56	1	.018
	Unk.	2	0	.000	2	0	.000	53	7	.132	52	0	.000

Table 14.--First-and-second-hunting season recoveries and recovery rates for black ducks banded in summer areas of reference, 1946-60--continued

Area of reference	Age	Summer bandings*						October bandings**					
		First hunting season			Second hunting season***			First hunting season			Second hunting season		
		Number banded	Number recovered	Recovery rate	Number banded	Number recovered	Recovery rate	Number banded	Number recovered	Recovery rate	Number banded	Number recovered	Recovery rate
<u>E. Lake Ontario</u>													
New York													
	Loc.	36	0	.000	7	0	.000	--	--	--	--	--	
	Juv.	1,524	165	.108	1,524	52	.034	451	31	.069	451	16	
	Imm.	3,275	404	.123	2,331	81	.035	1,060	106	.100	924	29	
	Ad.	1,808	152	.084	1,373	62	.045	1,015	71	.070	935	44	
	Unk.	596	47	.079	596	24	.040	1,273	88	.069	1,273	48	
Ontario													
	Loc.	28	4	.143	1	0	.000	--	--	--	--	--	
	Juv.	3	0	.000	3	0	.000	--	--	--	--	--	
	Imm.	197	26	.132	197	5	.025	2	0	.000	2	0	
	Ad.	19	4	.211	19	2	.105	--	--	--	--	--	
	Unk.	--	--	--	--	--	--	6	0	.000	6	1	
<u>W. Lake Ontario</u>													
New York													
	Loc.	66	4	.061	66	0	.000	--	--	--	--	--	
	Imm.	394	46	.117	394	8	.020	216	30	.139	216	6	
	Ad.	52	3	.058	52	3	.058	102	8	.078	102	3	
	Unk.	263	23	.087	263	11	.042	779	60	.077	779	24	
Ontario													
	Loc.	17	2	.118	17	1	.059	--	--	--	--	--	
	Juv.	43	4	.093	43	2	.047	--	--	--	--	--	
	Imm.	2,818	413	.147	2,557	78	.031	1,211	134	.111	1,106	42	
	Ad.	378	28	.074	327	10	.031	395	40	.101	351	17	
	Unk.	246	11	.045	246	5	.020	2	1	.500	--	--	
<u>W. James Bay</u>													
Ontario													
	Loc.	12	2	.167	12	0	.000	--	--	--	--	--	
	Imm.	697	54	.077	697	21	.030	56	8	.143	56	1	
	Ad.	590	29	.049	590	18	.031	6	0	.000	6	0	

Table 14.--First-and-second-hunting season recoveries and recovery rates for black ducks banded in summer areas of reference, 1946-60--continued

Area of reference	Age	Summer bandings*						October bandings**					
		First hunting season			Second hunting season***			First hunting season			Second hunting season		
		Number banded	Number recovered	Recovery rate	Number banded	Number recovered	Recovery rate	Number banded	Number recovered	Recovery rate	Number banded	Number recovered	Recovery rate
<u>Upper Great Lakes</u>													
<u>Michigan</u>													
	Loc.	86	11	.128	86	8	.093	--	--	--	--	--	
	Juv.	706	56	.079	706	24	.034	152	11	.072	152	7	
	Imm.	1,556	144	.093	1,341	56	.042	600	48	.080	594	30	
	Ad.	393	23	.059	360	18	.050	344	19	.055	344	13	
	Unk.	58	11	.190	51	0	.000	4	0	.000	4	0	
<u>W. Lake Erie</u>													
<u>Michigan</u>													
	Loc.	18	1	.056	13	0	.000	--	--	--	--	--	
	Imm.	472	63	.133	378	14	.037	--	--	--	--	--	
	Ad.	288	38	.132	273	13	.048	--	--	--	--	--	
	Unk.	6	1	.167	6	0	.000	6	0	.000	6	0	
<u>Ohio</u>													
	Loc.	4	0	.000	4	0	.000	--	--	--	--	--	
	Imm.	531	47	.089	526	18	.034	199	31	.156	193	6	
	Ad.	228	13	.057	219	14	.064	175	15	.086	171	1	
	Unk.	23	0	.000	23	0	.000	3	0	.000	1	0	
<u>E. Lake Michigan</u>													
<u>Michigan</u>													
	Juv.	4	0	.000	4	0	.000	3	1	.333	3	1	
	Imm.	253	44	.174	233	10	.043	177	10	.056	169	9	
	Ad.	125	10	.080	123	7	.057	195	13	.067	187	7	
	Unk.	29	3	.103	29	0	.000	123	11	.089	123	5	
<u>W. Lake Michigan</u>													
<u>Illinois</u>													
	Juv.	252	9	.036	252	9	.036	194	15	.077	194	6	
	Imm.	5	1	.200	5	0	.000	44	4	.091	44	2	
	Ad.	33	2	.061	33	0	.000	126	4	.032	126	4	
	Unk.	32	5	.156	32	1	.031	199	13	.065	199	2	
<u>Indiana</u>													
	Imm.	109	8	.073	109	6	.055	123	6	.049	123	5	
	Ad.	55	2	.036	55	4	.073	232	15	.065	232	17	

Table 14. --First-and-second-hunting season recoveries and recovery rates for black ducks banded in summer areas of reference, 1946-60--continued

Area of reference	Age	Summer bandings*						October bandings**					
		First hunting season			Second hunting season***			First hunting season			Second hunting season		
		Number banded	Number recovered	Recovery rate	Number banded	Number recovered	Recovery rate	Number banded	Number recovered	Recovery rate	Number banded	Number recovered	Recovery rate
<u>W. Lake Michigan</u>													
Wisconsin													
Juv.		95	9	.095	95	2	.021	95	9	.095	95	4	.042
Imm.		249	60	.241	249	13	.052	49	5	.102	46	2	.043
Ad.		76	8	.105	76	10	.132	42	4	.095	39	2	.051
Unk.		2	0	.000	2	0	.000	12	1	.083	10	0	.000
<u>Northwest</u>													
Manitoba													
Juv.		1	0	.000	1	0	.000	3	0	.000	3	0	.000
Imm.		19	1	.053	19	0	.000	8	0	.000	8	0	.000
Ad.		153	10	.065	128	11	.086	27	3	.111	21	0	.000
Unk.		--	--	--	--	--	--	1	0	.000	1	0	.000
<u>Minnesota</u>													
Juv.		7	0	.000	7	0	.000	2	1	.500	2	0	.000
Imm.		105	18	.171	101	3	.030	10	1	.100	10	0	.000
Ad.		186	29	.156	184	10	.054	23	0	.000	20	1	.050
<u>Other Canadian Areas</u>													
Loc.		36	5	.139	32	2	.062	--	--	--	--	--	--
Juv.		13	4	.308	13	0	.000	1	0	.000	1	0	.000
Imm.		64	3	.047	45	0	.000	5	0	.000	5	0	.000
Ad.		67	4	.060	64	6	.094	6	1	.167	6	0	.000
Unk.		7	2	.286	7	0	.000	115	5	.043	86	3	.035
<u>Other Atlantic Flyway Areas</u>													
Loc.		46	2	.043	46	0	.000	--	--	--	--	--	--
Juv.		4	0	.000	4	0	.000	1	0	.000	1	0	.000
Imm.		119	10	.084	94	0	.000	113	6	.053	111	3	.027
Ad.		39	3	.077	35	3	.086	122	9	.082	122	4	.033
Unk.		114	9	.079	113	4	.036	78	4	.051	78	2	.026

Table 15.--Recovery rates from black ducks banded in summer areas of reference prior to 1946 and recovered through 1960

Area of reference	Summer bandings*						October bandings**					
	First hunting season		Second hunting season		All hunting seasons		First hunting season		Second hunting season		All hunting seasons	
	Number banded	Rec. rate	Number rec.	Rec. rate	Number rec.	Rec. rate	Number banded	Rec. rate	Number rec.	Rec. rate	Number rec.	Rec. rate
<u>Maritimes</u>												
New Brunswick	219	.132	3	.014	33	.151	--	--	--	--	--	--
Nova Scotia	100	.160	3	.030	19	.190	--	--	--	--	--	--
<u>St. John and St. Croix Rivers</u>												
Maine	49	.163	1	.020	11	.224	337	.160	6	.018	63	.187
New Brunswick	104	.087	1	.010	11	.106	1	.000	0	.000	0	.000
<u>Western Maine</u>												
Maine	328	.076	11	.033	47	.143	85	.071	1	.012	10	.118
<u>Coastal Massachusetts</u>												
Massachusetts	1,958	.088	43	.022	276	.141	2,253	.081	55	.024	295	.131
<u>S. New England and Long Island</u>												
Connecticut	19	.053	0	.000	1	.053	372	.188	5	.013	84	.226
Massachusetts	186	.113	5	.027	29	.156	416	.072	14	.034	53	.127
New York	2,112	.066	44	.021	220	.104	1,112	.106	28	.025	172	.155
<u>Lake Champlain</u>												
Vermont	10	.100	0	.000	1	.100	216	.069	12	.056	34	.157
<u>Chesapeake and Delaware Bays</u>												
Maryland	19	.053	0	.000	1	.053	225	.076	8	.036	39	.173
<u>E. Lake Ontario</u>												
New York	1,301	.080	21	.016	150	.115	4,096	.053	93	.023	396	.097
<u>W. Lake Ontario</u>												
New York	--	--	--	--	--	--	178	.191	5	.028	41	.230
Ontario	688	.147	18	.026	133	.193	3,474	.157	127	.037	784	.226

Table 15.--Recovery rates from black ducks banded in summer areas of reference prior to 1946 and recovered through 1960--continued

Area of reference	Summer bandings*						October bandings**									
	First hunting season			Second hunting season			First hunting season			Second hunting season			All hunting seasons			
	Number banded	Rec. rate	Rec. rate	Number rec.	Rec. rate	Rec. rate	Number banded	Rec. rate	Rec. rate	Number rec.	Rec. rate	Rec. rate	Number rec.	Rec. rate	Rec. rate	
<u>Upper Great Lakes</u>																
Michigan	5,191	.626	.121	176	.034	.189	2,026	.188	.093	65	.032	331	.163			
<u>W. Lake Erie</u>																
Michigan	87	6	.069	1	.011	.126	678	.42	.062	25	.037	96	.142			
Ohio	4	0	.000	0	.000	.000	243	11	.045	4	.016	25	.103			
Ontario	146	3	.021	2	.014	.055	11	0	.000	0	.000	0	.000			
<u>E. Lake Michigan</u>																
Indiana	23	2	.087	0	.000	.087	187	10	.053	2	.011	17	.091			
Michigan	1,539	147	.096	44	.029	.152	1,126	68	.060	43	.038	160	.142			
<u>W. Lake Michigan</u>																
Illinois	877	88	.100	31	.035	.166	2,070	183	.088	83	.040	370	.179			
Wisconsin	443	88	.199	11	.025	.242	549	62	.113	14	.026	90	.164			
<u>Southeast</u>																
South Carolina	--	--	--	--	--	--	153	4	.026	8	.052	20	.131			
<u>Upper Mississippi River</u>																
	116	7	.060	6	.052	.138	51	6	.118	1	.020	9	.176			
<u>Northwest</u>																
	64	7	.109	4	.062	.219	15	2	.133	1	.067	4	.267			
<u>Other Canadian Areas</u>																
	68	8	.118	3	.044	.162	87	11	.126	0	.000	11	.126			
<u>Other Atlantic Flyway Areas</u>																
	77	1	.013	0	.000	.052	16	0	.000	0	.000	0	.000			
<u>Other Mississippi and Central Flyway Areas</u>																
	23	2	.087	0	.000	.087	22	1	.045	1	.045	2	.091			

*May through September or to the beginning of the hunting season.

**From the beginning of the hunting season through October.

Table 16.--First- and second-hunting-season recovery rates of black ducks banded in winter areas of reference from 1946-60.

Area of reference	Banding period	Sex ^{1/}	First season			Second season ^{2/}			
			Number banded	Number recovered	Recovery rate	Number banded	Number recovered	Recovery rate	
<u>Maritimes</u>									
Nova Scotia	Jan. 1-15	Combined	11	0	.000	11	1	.091	
	Jan. 16-Feb.	Combined	175	5	.029	175	2	.011	
	Mar.-April	Combined	54	4	.074	54	3	.056	
Prince Edward Island	December	Male	100	0	.000	100	1	.010	
	December	Female	104	0	.000	104	1	.010	
	December	Combined	204	0	.000	204	1	.005	
	Jan. 1-15	Male	110	0	.000	110	5	.045	
	Jan. 1-15	Female	81	0	.000	81	0	.000	
	Jan. 1-15	Combined	191	0	.000	191	5	.026	
	Jan. 16-Feb.	Male	724	40	.055	347	5	.014	
	Jan. 16-Feb.	Female	684	34	.050	362	9	.025	
	Jan. 16-Feb.	Unknown	2	0	.000				
	Jan. 16-Feb.	Combined	1,410	74	.052	709	14	.020	
	Mar.-April	Male	350	6	.017	321	6	.019	
	Mar.-April	Female	266	9	.034	251	4	.016	
Mar.-April	Combined	616	15	.024	572	10	.017		
<u>Maine</u>									
Maine	November	Combined	100	10	.100	100	5	.050	
	Jan. 1-15	Male	445	0	.000	445	37	.083	
	Jan. 1-15	Female	273	0	.000	273	17	.062	
	Jan. 1-15	Unknown	174	0	.000	174	4	.023	
	Jan. 1-15	Combined	892	0	.000	892	58	.065	
	Jan. 16-Feb.	Male	379	25	.066	166	1	.006	
	Jan. 16-Feb.	Female	177	6	.034	81	3	.037	
	Jan. 16-Feb.	Unknown	166	5	.030	166	1	.006	
	Jan. 16-Feb.	Combined	722	36	.050	413	5	.012	
	Mar.-April	Male	294	11	.037	240	10	.042	
	Mar.-April	Female	111	6	.054	103	2	.019	
	Mar.-April	Unknown	197	10	.051	197	7	.036	
	Mar.-April	Combined	602	27	.045	540	19	.035	
	<u>New Eng. & E. Long Is.</u>								
	Connecticut	November	Male	438	36	.082	438	24	.055
November		Female	374	31	.083	374	21	.056	
November		Unknown	3	0	.000	3	0	.000	
November		Combined	815	67	.082	815	45	.055	
December		Male	252	8	.032	252	19	.075	
December		Female	211	8	.038	211	7	.033	
December		Unknown	3	0	.000	3	0	.000	
December		Combined	466	16	.034	466	26	.056	
Jan. 1-15		Combined	79	0	.000	79	5	.063	
Jan. 16-Feb.		Male	725	36	.050	725	29	.040	
Jan. 16-Feb.		Female	312	20	.064	312	5	.016	
Jan. 16-Feb.		Unknown	1	0	.000	1	0	.000	
Jan. 16-Feb.		Combined	1,038	56	.054	1,038	34	.033	
Mar.-April		Male	284	15	.053	284	17	.060	
Mar.-April		Female	89	3	.034	89	0	.000	
Mar.-April		Unknown	10	1	.100	10	0	.000	
Mar.-April		Combined	383	19	.050	383	17	.044	

Table 16.--First- and second-hunting-season recovery rates of black ducks banded in winter areas of reference from 1946-60.--continued

Area of reference	Banding period	Sex ^{1/}	First season			Second season ^{2/}			
			Number banded	Number recovered	Recovery rate	Number banded	Number recovered	Recovery rate	
Massachusetts	November	Male	539	15	.028	539	16	.030	
	November	Female	442	14	.032	442	10	.023	
	November	Unknown	8	2	.250	8	1	.125	
	November	Combined	989	31	.031	989	27	.027	
	December	Male	910	22	.024	910	41	.045	
	December	Female	650	18	.028	650	19	.029	
	December	Unknown	2	0	.000	2	0	.000	
	December	Combined	1,562	40	.026	1,562	60	.038	
	Jan. 1-15	Male	273	0	.000	273	8	.029	
	Jan. 1-15	Female	139	0	.000	139	3	.022	
	Jan. 1-15	Unknown	2	0	.000	2	0	.000	
	Jan. 1-15	Combined	414	0	.000	414	11	.027	
	Jan. 16-Feb.	Male	1,781	48	.027	1,725	37	.021	
	Jan. 16-Feb.	Female	650	15	.023	647	4	.006	
	Jan. 16-Feb.	Unknown	1	0	.000	1	1	1.000	
	Jan. 16-Feb.	Combined	2,432	63	.026	2,373	42	.018	
	Mar.-April	Male	437	22	.050	437	10	.023	
	Mar.-April	Female	87	3	.034	87	1	.011	
	Mar.-April	Combined	524	25	.048	524	11	.021	
	New York	November	Male	450	30	.067	450	20	.044
		November	Female	326	25	.077	326	10	.031
		November	Unknown	1	0	.000	1	0	.000
		November	Combined	777	55	.071	777	30	.039
December		Male	967	9	.009	967	58	.060	
December		Female	793	7	.009	793	34	.043	
December		Combined	1,760	16	.009	1,760	92	.052	
Jan. 1-15		Male	680	0	.000	680	45	.066	
Jan. 1-15		Female	471	0	.000	471	31	.066	
Jan. 1-15		Combined	1,151	0	.000	1,151	76	.066	
Jan. 16-Feb.		Male	2,325	144	.062	2,043	78	.038	
Jan. 16-Feb.		Female	1,716	103	.060	1,447	44	.030	
Jan. 16-Feb.		Unknown	2	0	.000	2	0	.000	
Jan. 16-Feb.		Combined	4,043	247	.061	3,492	122	.035	
Mar.-April		Male	1,116	94	.084	1,074	26	.024	
Mar.-April		Female	621	28	.045	602	12	.020	
Mar.-April		Unknown	1	0	.000	1	0	.000	
Mar.-April		Combined	1,738	122	.070	1,617	38	.023	
Rhode Island		November	Male	260	17	.065	258	19	.074
		November	Female	172	10	.058	171	7	.041
	November	Unknown	4	0	.000	4	1	.250	
	November	Combined	436	27	.062	433	27	.062	
	December	Male	369	14	.038	369	24	.065	
	December	Female	278	21	.076	278	13	.047	
	December	Unknown	3	0	.000	3	0	.000	
	December	Combined	650	35	.054	650	37	.057	
	Jan. 1-15	Combined	144	0	.000	144	7	.049	
	Jan. 16-Feb.	Male	317	19	.060	190	3	.016	
	Jan. 16-Feb.	Female	204	10	.049	141	4	.028	
	Jan. 16-Feb.	Unknown	17	2	.118	15	0	.000	
	Jan. 16-Feb.	Combined	538	31	.058	346	7	.020	
	Mar.-April	Male	339	16	.047	296	11	.037	
	Mar.-April	Female	163	6	.037	144	5	.035	
	Mar.-April	Unknown	2	0	.000	2	0	.000	
	Mar.-April	Combined	504	22	.044	442	16	.036	

Table 16.--First- and second-hunting-season recovery rates of black ducks banded in winter areas of reference from 1946-60.--continued

Area of reference	Banding Period	Sex ^{1/}	First season			Second season ^{2/}			
			Number banded	Number recovered	Recovery rate	Number banded	Number recovered	Recovery rate	
<u>W. Long Is. & Hudson River</u>									
New York	November	Male	1,668	81	.049	1,627	67	.041	
	November	Female	1,532	72	.047	1,481	54	.036	
	November	Unknown	72	5	.069	72	5	.069	
	November	Combined	3,272	158	.048	3,180	126	.040	
	December	Male	466	10	.021	454	18	.040	
	December	Female	347	3	.009	334	14	.042	
	December	Unknown	18	0	.000	18	0	.000	
	December	Combined	831	13	.016	806	32	.040	
	Jan. 1-15	Male	249	0	.000	249	5	.020	
	Jan. 1-15	Female	133	0	.000	133	8	.060	
	Jan. 1-15	Unknown	1	0	.000	1	0	.000	
	Jan. 1-15	Combined	383	0	.000	383	13	.034	
	Jan. 16-Feb.	Male	1,337	33	.025	1,273	25	.020	
	Jan. 16-Feb.	Female	476	12	.025	435	5	.011	
	Jan. 16-Feb.	Unknown	5	0	.000	3	0	.000	
	Jan. 16-Feb.	Combined	1,818	45	.025	1,711	30	.018	
	Mar.-April	Male	851	26	.031	818	13	.016	
	Mar.-April	Female	301	11	.037	289	3	.010	
	Mar.-April	Unknown	17	1	.059	16	0	.000	
	Mar.-April	Combined	1,169	38	.032	1,123	16	.014	
Quebec	November	Combined	132	5	.038	132	6	.045	
Vermont	November	Combined	146	4	.027	146	6	.041	
	Mar.-April	Combined	3	0	.000	3	0	.000	
<u>Mid-Atlantic</u>									
Delaware	November	Combined	36	2	.056	36	0	.000	
	December	Male	103	2	.019	103	6	.058	
	December	Female	96	0	.000	96	1	.010	
	December	Unknown	11	0	.000	11	2	.182	
	December	Combined	210	2	.010	210	9	.043	
	Jan. 1-15	Male	119	0	.000	119	5	.042	
	Jan. 1-15	Female	90	0	.000	90	5	.056	
	Jan. 1-15	Unknown	1	0	.000	1	0	.000	
	Jan. 1-15	Combined	210	0	.000	210	10	.048	
	Jan. 16-Feb.	Male	937	45	.048	645	20	.031	
	Jan. 16-Feb.	Female	675	30	.044	484	20	.041	
	Jan. 16-Feb.	Unknown	7	0	.000	6	0	.000	
	Jan. 16-Feb.	Combined	1,619	75	.046	1,135	40	.035	
	Mar.-April	Male	587	23	.039	453	14	.031	
	Mar.-April	Female	394	12	.030	317	5	.016	
	Mar.-April	Unknown	6	0	.000	5	0	.000	
	Mar.-April	Combined	987	35	.035	775	19	.025	
	Maryland	November	Combined	195	8	.041	179	3	.017
		December	Combined	382	6	.016	318	13	.041
		Jan. 1-15	Combined	172	0	.000	172	7	.041
Jan. 16-Feb.		Male	1,652	104	.063	1,420	35	.025	
Jan. 16-Feb.		Female	1,011	37	.037	845	21	.025	
Jan. 16-Feb.		Unknown	127	7	.055	127	1	.008	
Jan. 16-Feb.		Combined	2,790	148	.053	2,392	57	.024	
Mar.-April		Male	2,030	115	.057	1,527	56	.037	
Mar.-April		Female	1,269	64	.050	920	25	.027	
Mar.-April		Unknown	64	0	.000	64	1	.016	
Mar.-April		Combined	3,363	179	.053	2,511	82	.033	

Table 16.--First- and second-hunting-season recovery rates of black ducks banded in winter areas of reference from 1946-60.--continued

Area of reference	Banding period	Sex ^{1/}	First season			Second season ^{2/}			
			Number banded	Number recovered	Recovery rate	Number banded	Number recovered	Recovery rate	
New Jersey	Jan. 1-15	Combined	28	0	.000	28	2	.071	
	Jan. 16-Feb.	Male	657	43	.065	657	21	.032	
	Jan. 16-Feb.	Female	314	14	.045	314	4	.013	
	Jan. 16-Feb.	Combined	971	57	.059	971	25	.026	
	Mar.-April	Male	321	20	.062	321	8	.025	
	Mar.-April	Female	149	4	.027	149	4	.027	
	Mar.-April	Combined	470	24	.051	470	12	.026	
North Carolina	November	Combined	93	2	.022	93	2	.022	
	December	Combined	169	1	.006	169	2	.012	
	Jan. 1-15	Combined	113	0	.000	113	7	.062	
	Jan. 16-Feb.	Male	120	8	.067	71	0	.000	
	Jan. 16-Feb.	Female	113	2	.018	75	1	.013	
	Jan. 16-Feb.	Unknown	60	6	.100	50	2	.040	
	Jan. 16-Feb.	Combined	293	16	.055	196	3	.015	
	Mar.-April	Combined	31	3	.097	20	1	.050	
Pennsylvania	November	Combined	52	1	.019	52	6	.115	
	Jan. 1-15	Male	1,318	1	.001	1,318	75	.057	
	Jan. 1-15	Female	963	0	.000	963	59	.061	
	Jan. 1-15	Combined	2,281	1	.000	2,281	134	.059	
	Jan. 16-Feb.	Male	2,128	136	.064	2,128	74	.035	
	Jan. 16-Feb.	Female	1,279	61	.048	1,279	35	.027	
	Jan. 16-Feb.	Combined	3,407	197	.058	3,407	109	.032	
	Mar.-April	Male	1,724	87	.050	1,724	45	.026	
	Mar.-April	Female	1,107	54	.049	1,107	19	.017	
	Mar.-April	Combined	2,831	141	.050	2,831	64	.023	
Virginia	November	Combined	8	0	.000	8	0	.000	
	December	Combined	88	4	.045	88	2	.023	
	Jan. 1-15	Combined	32	0	.000	32	0	.000	
	Jan. 16-Feb.	Combined	154	6	.039	154	3	.019	
	Mar.-April	Combined	1	0	.000	1	0	.000	
<u>Mid-Atlantic Coastal</u>									
New Jersey	November	Combined	48	9	.188	48	1	.021	
	December	Combined	77	4	.052	77	4	.052	
	Jan. 1-15	Male	432	0	.000	432	25	.058	
	Jan. 1-15	Female	284	0	.000	284	6	.021	
	Jan. 1-15	Combined	716	0	.000	716	31	.043	
	Jan. 16-Feb.	Male	2,631	138	.052	2,399	55	.023	
	Jan. 16-Feb.	Female	1,556	78	.050	870	15	.017	
	Jan. 16-Feb.	Unknown	61	2	.033	52	2	.038	
	Jan. 16-Feb.	Combined	4,248	218	.051	3,321	72	.022	
	Mar.-April	Male	655	42	.064	592	18	.030	
	Mar.-April	Female	278	9	.032	223	4	.018	
	Mar.-April	Unknown	12	0	.000	2	0	.000	
	Mar.-April	Combined	945	51	.054	817	32	.039	
	Virginia	November	Male	228	5	.022	228	2	.009
		November	Female	243	10	.041	241	4	.017
November		Unknown	28	1	.036	28	0	.000	
November		Combined	499	16	.032	497	6	.012	
December		Male	293	11	.038	269	6	.022	
December		Female	279	14	.050	264	9	.034	
December		Unknown	12	0	.000	12	0	.000	
December		Combined	584	25	.043	545	15	.028	
Jan. 1-15		Male	153	0	.000	153	6	.039	
Jan. 1-15		Female	91	0	.000	91	1	.011	
Jan. 1-15		Unknown	21	0	.000	21	0	.000	
Jan. 1-15		Combined	265	0	.000	265	7	.026	
Jan. 16-Feb.		Male	370	7	.019	349	2	.006	
Jan. 16-Feb.		Female	200	8	.040	192	2	.010	
Jan. 16-Feb.		Unknown	8	0	.000	8	0	.000	
Jan. 16-Feb.		Combined	578	15	.026	549	4	.007	
Mar.-April		Combined	76	3	.039	76	0	.000	

Table 16.--First- and second-hunting season recovery rates of black ducks banded in winter areas of reference from 1946-60.--continued

Area of reference	Banding period	Sex ^{1/}	First season			Second season ^{2/}			
			Number banded	Number recovered	Recovery rate	Number banded	Number recovered	Recovery rate	
<u>Southeast</u>									
South Carolina	November	Combined	21	2	.095	20	0	.000	
	December	Combined	124	1	.008	94	6	.064	
	Jan. 1-15	Combined	88	0	.000	88	1	.011	
	Jan. 16-Feb.	Combined	114	5	.044	72	3	.042	
	Mar.-April	Combined	5	0	.000	5	0	.000	
<u>Lake Ontario</u>									
New York	November	Male	1,178	67	.057	1,178	53	.045	
	November	Female	968	46	.048	968	32	.033	
	November	Unknown	24	0	.000	24	1	.042	
	November	Combined	2,170	113	.052	2,170	86	.040	
	December	Male	308	10	.032	200	11	.055	
	December	Female	229	4	.017	185	5	.027	
	December	Unknown	6	0	.000	6	0	.000	
	December	Combined	543	14	.026	391	16	.041	
	Jan. 1-15	Male	251	0	.000	251	24	.096	
	Jan. 1-15	Female	105	0	.000	105	11	.105	
	Jan. 1-15	Combined	356	0	.000	356	35	.098	
	Jan. 16-Feb.	Male	405	32	.079	352	18	.051	
	Jan. 16-Feb.	Female	204	7	.034	178	5	.028	
	Jan. 16-Feb.	Combined	609	39	.064	530	23	.043	
	Mar.-April	Male	208	15	.072	170	7	.041	
	Mar.-April	Female	91	2	.022	70	1	.014	
	Mar.-April	Unknown	3	0	.000	3	0	.000	
	Mar.-April	Combined	302	17	.056	243	8	.033	
	Ontario	November	Combined	107	7	.065	107	5	.047
		Jan. 1-15	Combined	2	0	.000	2	0	.000
Jan. 16-Feb.		Combined	6	0	.000	6	0	.000	
Mar.-April		Combined	1	0	.000	1	0	.000	
<u>Lake Erie</u>									
Michigan	November	Combined	1	0	.000	1	0	.000	
	December	Male	1,867	5	.003	1,867	81	.043	
	December	Female	667	3	.004	667	17	.025	
	December	Unknown	16	0	.000	16	1	.063	
	December	Combined	2,550	8	.003	2,550	99	.039	
	Jan. 1-15	Male	828	0	.000	828	35	.042	
	Jan. 1-15	Female	242	0	.000	242	11	.045	
	Jan. 1-15	Combined	1,070	0	.000	1,070	46	.043	
	Jan. 16-Feb.	Male	2,680	114	.043	2,680	90	.034	
	Jan. 16-Feb.	Female	965	41	.042	965	31	.032	
	Jan. 16-Feb.	Combined	3,645	155	.043	3,645	121	.033	
	Mar.-April	Male	180	12	.067	180	6	.033	
	Mar.-April	Female	79	3	.038	79	1	.013	
	Mar.-April	Unknown	4	0	.000	4	0	.000	
	Mar.-April	Combined	263	15	.057	263	7	.027	

Table 16.--First- and second-hunting season recovery rates of black ducks banded in winter areas of reference from 1946-60.--continued

Area of reference	Banding period	Sex ^{1/}	First season			Second season ^{2/}			
			Number banded	Number recovered	Recovery rate	Number banded	Number recovered	Recovery rate	
Ohio	November	Male	134	4	.030	111	4	.036	
	November	Female	137	5	.037	121	3	.025	
	November	Combined	271	9	.033	232	7	.030	
	December	Male	143	2	.014	143	4	.028	
	December	Female	115	1	.009	115	5	.043	
	December	Unknown	18	0	.000	18	1	.056	
	December	Combined	276	3	.011	276	10	.036	
	Jan. 1-15	Combined	50	0	.000	50	2	.040	
	Jan. 16-Feb.	Combined	71	7	.099	71	1	.014	
	Mar.-April	Male	119	9	.076	117	3	.026	
	Mar.-April	Female	65	5	.078	64	0	.000	
	Mar.-April	Unknown	2	0	.000	2	0	.000	
	Mar.-April	Combined	186	14	.075	183	3	.016	
	Ontario	November	Male	146	4	.027	138	5	.036
		November	Female	87	4	.046	82	0	.000
November		Unknown	131	1	.008	131	5	.038	
November		Combined	364	9	.025	351	10	.028	
December		Combined	177	3	.017	110	2	.018	
Jan. 1-15		Combined	45	0	.000	45	2	.044	
Mar.-April		Combined	41	0	.000	41	0	.000	
Pennsylvania	November	Male	610	17	.028	610	22	.036	
	November	Female	372	10	.027	372	13	.035	
	November	Unknown	38	2	.053	38	3	.079	
	November	Combined	1,020	29	.028	1,020	38	.037	
	December	Male	387	3	.008	387	15	.039	
	December	Female	161	3	.019	161	6	.037	
	December	Unknown	1	0	.000	1	0	.000	
	December	Combined	549	6	.011	549	21	.038	
	Jan. 1-15	Male	214	0	.000	214	2	.056	
	Jan. 1-15	Female	124	0	.000	124	1	.008	
	Jan. 1-15	Combined	338	0	.000	338	3	.038	
	Jan. 16-Feb.	Combined	126	4	.032	126	3	.024	
	Mar.-April	Male	188	7	.037	188	11	.059	
	Mar.-April	Female	68	2	.029	68	3	.044	
	Mar.-April	Combined	256	9	.035	256	14	.055	
<u>Upper Ohio River</u>									
West Virginia	November	Combined	132	12	.091	132	7	.053	
	December	Male	146	7	.048	83	11	.133	
	December	Female	90	5	.056	64	2	.031	
	December	Combined	236	12	.051	147	13	.088	
	Jan. 1-15	Combined	27	0	.000	27	1	.037	
	Jan. 16-Feb.	Combined	18	3	.167	18	0	.000	
	Mar.-April	Male	166	5	.030	162	3	.019	
	Mar.-April	Female	67	2	.030	62	1	.016	
	Mar.-April	Combined	233	7	.030	224	4	.018	
<u>Tenn. River</u>									
Alabama	November	Combined	95	2	.021	75	1	.013	
	December	Combined	1,032	28	.027	667	29	.043	
	Jan. 1-15	Combined	415	0	.000	415	29	.070	
	Jan. 16-Feb.	Combined	495	31	.063	470	15	.032	
	Mar.-April	Combined	93	7	.075	93	2	.022	

Table 16.--First- and second-hunting-season recovery rates of black ducks banded in winter areas of reference from 1946-60.--continued

Area of reference	Banding period	Sex ^{1/}	First season			Second season ^{2/}			
			Number banded	Number recovered	Recovery rate	Number banded	Number recovered	Recovery rate	
Tennessee	November	Male	146	9	.062	120	4	.033	
	November	Female	165	9	.055	131	5	.038	
	November	Unknown	1	0	.000				
	November	Combined	312	18	.058	251	9	.036	
	December	Male	848	21	.025	573	30	.052	
	December	Female	725	17	.023	440	14	.032	
	December	Unknown	58	0	.000	1	0	.000	
	December	Combined	1,631	38	.023	1,014	44	.043	
	Jan. 1-15	Male	232	0	.000	232	14	.060	
	Jan. 1-15	Female	119	0	.000	119	4	.034	
	Jan. 1-15	Unknown	1	0	.000	1	0	.000	
	Jan. 1-15	Combined	352	0	.000	352	18	.051	
	Jan. 16-Feb.	Male	269	18	.067	121	2	.017	
	Jan. 16-Feb.	Female	198	13	.066	62	2	.032	
	Jan. 16-Feb.	Combined	467	31	.066	183	4	.022	
	Mar.-April	Combined	16	3	.188	16	0	.000	
	Lake Michigan Michigan	November	Male	805	31	.039	790	38	.048
November		Female	559	20	.036	538	28	.052	
November		Unknown	4	0	.000	3	0	.000	
November		Combined	1,368	51	.037	1,331	66	.050	
December		Male	148	0	.000	148	8	.054	
December		Female	73	0	.000	73	5	.068	
December		Combined	221	0	.000	221	13	.059	
Jan. 1-15		Combined	1	0	.000				
Jan. 16-Feb.		Combined	24	1	.042	24	0	.000	
Mar.-April		Combined	15	2	.133	15	1	.067	
Upper Miss. River Illinois		November	Male	1,812	70	.039	1,812	69	.038
		November	Female	973	48	.049	973	44	.045
	November	Unknown	8	1	.125	8	1	.125	
	November	Combined	2,793	119	.043	2,793	114	.041	
	December	Male	480	12	.025	475	26	.055	
	December	Female	271	8	.030	268	13	.049	
	December	Unknown	1	0	.000	1	0	.000	
	December	Combined	752	20	.027	744	39	.052	
	Jan. 1-15	Combined	44	0	.000	43	0	.000	
	Jan. 16-Feb.	Combined	122	10	.082	52	1	.019	
	Mar.-April	Combined	15	1	.067				
	Indiana	November	Male	306	27	.088	306	17	.056
November		Female	298	13	.044	298	15	.050	
November		Combined	604	40	.066	604	32	.053	
December		Male	335	11	.033	322	25	.078	
December		Female	147	4	.027	143	4	.028	
December		Combined	482	15	.031	465	29	.062	
Jan. 1-15		Male	981	0	.000	981	47	.048	
Jan. 1-15		Female	525	0	.000	525	27	.051	
Jan. 1-15		Combined	1,506	0	.000	1,506	74	.049	
Jan. 16-Feb.		Male	151	8	.053	144	6	.042	
Jan. 16-Feb.		Female	58	2	.034	50	0	.000	
Jan. 16-Feb.		Combined	209	10	.048	194	6	.031	
Mar.-April		Male	479	31	.065	468	25	.053	
Mar.-April		Female	290	11	.038	274	13	.047	
Mar.-April		Combined	769	42	.055	742	38	.051	

Table 16.--First- and second-hunting-season recovery rates of black ducks banded in winter areas of reference from 1946-60.--continued

Area of reference	Banding period	Sex ^{1/}	First season			Second season ^{2/}		
			Number banded	Number recovered	Recovery rate	Number banded	Number recovered	Recovery rate
Kentucky	November	Combined	151	4	.026	151	6	.040
	December	Combined	100	0	.000	97	2	.021
	Jan. 1-15	Combined	27	0	.000	27	0	.000
	Jan. 16-Feb.	Combined	99	4	.040	53	1	.019
	Mar.-April	Combined	46	1	.022	23	1	.043
Tennessee	November	Male	197	11	.056	197	9	.046
	November	Female	170	12	.071	170	5	.029
	November	Unknown	44	8	.182	44	0	.000
	November	Combined	411	31	.075	411	14	.034
	December	Male	168	6	.036	168	9	.054
	December	Female	122	7	.057	122	4	.033
	December	Unknown	4	0	.000	4	0	.000
	December	Combined	294	13	.044	294	13	.044
	Jan. 1-15	Combined	162	0	.000	162	9	.056
	Jan. 16-Feb.	Combined	64	4	.063	64	3	.047
	Mar.-April	Combined	8	0	.000	8	2	.250
	<u>Other Northeast Areas</u>							
	November	Combined	64	4	.062	64	1	.016
	Mar.-April	Combined	96	8	.083	96	4	.042
<u>Other Atlantic Flyway Areas</u>								
	November	Combined	18	1	.056	18	1	.056
	December	Combined	34	0	.000	34	0	.000
	Jan. 1-15	Combined	33	0	.000	33	0	.000
	Jan. 16-Feb.	Combined	27	1	.037	27	1	.037
	Mar.-April	Combined	11	1	.091	11	0	.000
<u>Other Northern Miss. & Central Flyway Areas</u>								
	November	Combined	76	5	.066	69	4	.058
	December	Combined	65	1	.015	64	1	.016
	Jan. 1-15	Combined	7	0	.000	7	0	.000
	Jan. 16-Feb.	Combined	42	0	.000	42	1	.024
	Mar.-April	Combined	83	2	.024	83	1	.012
<u>Other Southern Miss. & Central Flyway Areas</u>								
	November	Combined	62	5	.081	44	1	.023
	December	Combined	87	2	.023	86	6	.070
	Jan. 1-15	Combined	43	0	.000	42	5	.119
	Jan. 16-Feb.	Combined	60	6	.100	55	4	.073
	Mar.-April	Combined	41	5	.122	32	2	.062

^{1/} Data for males and females are separated when there are at least 100 bandings for one or the other.

^{2/} The number of banded birds is sometimes less for second than for first hunting season recovery rates because at the time this table was compiled birds banded in 1960 had not yet been exposed to a second hunting season.

Table 17.--Recovery rates of black ducks banded in winter areas of reference prior to 1946 and recovered through 1960

Area of reference	Banding period	Number banded	First season		Second season		All seasons	
			Number rec.	Rec. rate	Number rec.	Rec. rate	Number rec.	Rec. rate
<u>Maine</u>								
Maine	Nov.	154	5	.032	2	.013	8	.052
	Mar.-Apr.	42	1	.024	0	.000	2	.048
<u>New Eng. & E. Long Is.</u>								
Connecticut	Nov.	411	53	.129	11	.027	81	.197
	Dec.	392	7	.018	11	.028	31	.079
	Jan.16-Feb.	33	1	.030	0	.000	4	.121
	Mar.-Apr.	417	29	.070	9	.022	56	.134
Massachusetts	Nov.	4,636	226	.049	127	.027	523	.113
	Dec.	5,833	72	.012	212	.036	531	.091
	Jan.1-15	3,452	2	.001	166	.048	329	.095
	Jan.16-Feb.	6,081	200	.033	115	.019	512	.084
	Mar.-Apr.	2,732	111	.041	60	.022	273	.100
New York	Nov.	332	14	.042	3	.009	23	.069
	Dec.	391	3	.008	23	.059	34	.087
	Jan.1-15	157	0	.000	4	.025	9	.057
	Jan.16-Feb.	813	49	.060	37	.046	106	.130
	Mar.-Apr.	384	28	.073	17	.044	57	.148
<u>W. Long Is. & Hudson River</u>								
New York	Nov.	1,603	138	.086	29	.018	202	.126
	Dec.	532	17	.032	19	.036	50	.094
	Jan.1-15	269	0	.000	10	.037	13	.048
	Jan.16-Feb.	210	1	.005	1	.005	4	.019
	Mar.-Apr.	511	23	.045	15	.029	59	.115
<u>Mid-Atlantic</u>								
Delaware	Nov.	51	3	.059	0	.000	3	.059
	Dec.	38	0	.000	1	.026	1	.026
	Jan.1-15	103	0	.000	4	.039	5	.049
	Jan.16-Feb.	33	1	.030	1	.030	3	.091
	Mar.-Apr.	159	10	.063	1	.006	15	.094
Maryland	Nov.	169	7	.041	3	.018	16	.095
	Dec.	412	32	.078	5	.012	44	.107
	Jan.1-15	142	0	.000	3	.021	4	.028
	Jan.16-Feb.	225	6	.027	1	.004	8	.036
	Mar.-Apr.	3	0	.000	0	.000	0	.000
New Jersey	Nov.	94	6	.064	2	.021	11	.117
	Dec.	152	5	.033	19	.125	39	.257
	Jan.1-15	17	0	.000	3	.176	3	.176
	Jan.16-Feb.	319	11	.034	4	.013	19	.060
	Mar.-Apr.	130	8	.062	4	.031	17	.131
North Carolina	Dec.	102	0	.000	3	.029	5	.049
	Jan.1-15	15	0	.000	0	.000	0	.000
	Jan.16-Feb.	462	16	.035	10	.022	37	.080
	Mar.-Apr.	566	19	.034	8	.014	38	.067
<u>Mid-Atlantic Coastal</u>								
Virginia	Nov.	258	15	.058	6	.023	26	.101
	Dec.	375	9	.024	10	.027	35	.093
	Jan.1-15	32	0	.000	0	.000	2	.062
	Jan.16-Feb.	79	1	.013	0	.000	3	.038
	Mar.-Apr.	2	0	.000	0	.000	0	.000
<u>Southeast</u>								
South Carolina	Nov.	495	13	.026	25	.050	68	.137
	Dec.	399	4	.010	16	.040	40	.100
	Jan.1-15	35	0	.000	0	.000	3	.086
	Jan.16-Feb.	116	5	.043	2	.017	10	.086
	Mar.-Apr.	19	1	.053	1	.053	2	.105
<u>Lake Ontario</u>								
New York	Nov.	4,825	148	.031	127	.026	376	.078
	Dec.	2,316	19	.008	79	.034	149	.064
	Jan.1-15	745	0	.000	18	.024	31	.042
	Jan.16-Feb.	1,284	36	.028	24	.019	74	.058
	Mar.-Apr.	1,097	43	.039	19	.017	82	.075
Ontario	Nov.	189	25	.132	5	.026	32	.169
	Mar.-Apr.	5	0	.000	0	.000	0	.000
<u>Lake Erie</u>								
Michigan	Nov.	265	11	.042	15	.057	35	.132
	Dec.	3	0	.000	0	.000	0	.000

Table 17.--Recovery rates of black ducks banded in winter areas of reference prior to 1946 and recovered through 1960--continued

Area of reference	Banding period	Number banded	First season		Second season		All seasons	
			Number rec.	Rec. rate	Number rec.	Rec. rate	Number rec.	Rec. rate
<u>Lake Erie (Con.)</u>								
Michigan	Jan.16-Feb.	354	15	.042	13	.037	49	.138
	Mar.-Apr.	377	19	.050	7	.019	41	.109
Ohio	Nov.	1,086	49	.045	45	.041	147	.135
	Dec.	604	1	.002	44	.073	77	.127
	Jan.1-15	49	0	.000	5	.102	7	.143
	Jan.16-Feb.	60	3	.050	2	.033	6	.100
	Mar.-Apr.	321	5	.016	7	.022	28	.087
Pennsylvania	Mar.-Apr.	274	9	.033	5	.018	28	.102
<u>Tennessee River</u>								
Alabama	Nov.	17	1	.059	1	.059	4	.235
	Dec.	10	0	.000	0	.000	0	.000
	Jan.1-15	11	0	.000	0	.000	1	.091
	Jan.16-Feb.	104	4	.038	3	.029	10	.096
	Mar.-Apr.	3	0	.000	0	.000	0	.000
<u>Lake Michigan</u>								
Indiana	Nov.	319	8	.025	17	.053	41	.129
	Dec.	141	3	.021	8	.057	18	.128
	Jan.16-Feb.	2	0	.000	0	.000	0	.000
	Mar.-Apr.	88	12	.136	4	.045	17	.193
Michigan	Nov.	1,357	23	.017	76	.056	188	.139
	Dec.	533	1	.002	35	.066	67	.126
	Jan.1-15	59	0	.000	3	.051	8	.136
	Jan.16-Feb.	51	3	.059	0	.000	4	.078
	Mar.-Apr.	329	17	.052	10	.030	46	.140
Wisconsin	Nov.	156	4	.026	6	.038	20	.128
	Dec.	19	0	.000	1	.052	2	.105
	Jan.1-15	9	0	.000	0	.000	0	.000
	Jan.16-Feb.	19	0	.000	1	.052	2	.105
	Mar.-Apr.	20	2	.100	0	.000	3	.150
<u>Upper Mississippi River</u>								
Illinois	Nov.	3,296	220	.067	166	.050	568	.172
	Dec.	1,025	24	.023	67	.065	162	.158
	Jan.1-15	97	0	.000	1	.010	4	.041
	Jan.16-Feb.	128	10	.078	0	.000	11	.086
	Mar.-Apr.	166	12	.072	6	.036	28	.169
<u>Other New Eng. & Nova Scotia</u>								
Nov. Scotia	Nov.	83	5	.060	3	.036	10	.120
	Dec.	46	0	.000	2	.043	5	.109
	Jan.1-15	14	0	.000	1	.071	3	.214
	Jan.16-Feb.	94	4	.043	2	.021	7	.074
Mar.-Apr.	70	6	.086	1	.014	7	.100	
<u>Other Atlantic Flyway</u>								
Flyway	Nov.	158	0	.000	1	.006	3	.019
	Dec.	133	1	.008	1	.008	6	.045
	Jan.1-15	51	0	.000	1	.020	3	.059
	Jan.16-Feb.	21	2	.095	0	.000	2	.095
	Mar.-Apr.	90	0	.000	0	.000	2	.022
<u>Other Northern Miss. & Northern Central Flyway</u>								
Flyway	Nov.	72	0	.000	3	.042	5	.069
	Dec.	8	0	.000	1	.125	4	.500
	Jan.16-Feb.	5	0	.000	0	.000	0	.000
	Mar.-Apr.	34	1	.029	1	.029	2	.059
<u>Other Southern Miss. & Southern Central Flyway</u>								
Flyway	Nov.	50	2	.040	1	.020	4	.080
	Dec.	77	3	.039	5	.065	12	.156
	Jan.1-15	35	0	.000	1	.029	1	.029
	Jan.16-Feb.	105	7	.067	4	.038	14	.133
	Mar.-Apr.	73	3	.041	2	.027	5	.068

Table 18.--First-hunting-season recovery rates of immature and adult black ducks of both sexes banded in the summer, 1946-60

Reference area of banding	First-hunting-season recovery rate					
	Immature			Adult		
	Male	Female	Total	Male	Female	Total
<u>Maritimes</u>						
New Brunswick	-	-	.184	-	-	-
Nova Scotia	-	-	.216	-	-	-
<u>Labrador & E. Quebec</u>						
Labrador	-	-	-	-	-	.064
Quebec	.068	.053	.060	.055	-	.061
<u>Southern Quebec</u>						
Quebec	.150	.157	.152	-	-	.091
<u>St. John & St. Croix Rivers</u>						
Maine	.080	.063	.071	-	-	.068
New Brunswick	-	-	.097	-	-	.063
<u>W. Maine</u>						
Maine	.135	.141	.138	.112	.111	.111
<u>Vermont & New Hampshire</u>						
New Hampshire	.152	.172	.161	-	-	-
Vermont	.123	.142	.131	-	-	-
<u>Coastal Massachusetts</u>						
Massachusetts	.144	.133	.128	.097	.091	.086
<u>S. New England & Long Island</u>						
Connecticut	.113	.173	.139	-	-	-
Massachusetts	-	-	.133	-	-	-
New York	.122	.104	.104	-	-	-
<u>Lake Champlain</u>						
New York	-	-	.076	-	-	.056
Vermont	.164	.167	.165	.099	.145	.120
<u>Chesapeake & Delaware Bays</u>						
Delaware	-	-	.071	-	-	.066
Maryland	.099	.090	.096	.081	.046	.064
New Jersey	.158	.188	.166	-	-	-
<u>E. Lake Ontario</u>						
New York	.134	.112	.119	.081	.090	.085
Ontario	-	-	.132	-	-	-
<u>W. Lake Ontario</u>						
New York	.111	.127	.117	-	-	-
Ontario	.137	.154	.144	-	.099	.075

Table 18.--First-hunting-season recovery rates of immature and adult black ducks of both sexes banded in the summer, 1946-60--continued

Reference area of banding	First-hunting-season recovery rate					
	Immature			Adult		
	Male	Female	Total	Male	Female	Total
<u>W. James Bay</u>						
Ontario	.077	.071	.075	.061	.029	.049
<u>Upper Great Lakes</u>						
Michigan	.091	.085	.088	-	-	.058
<u>W. Lake Erie</u>						
Michigan	.128	.144	.134	.104	.198	.132
Ohio	.088	.089	.089	.039	.080	.057
<u>E. Lake Michigan</u>						
Michigan	-	-	.174	-	-	-
<u>W. Lake Michigan</u>						
Wisconsin	.257	.231	.241	-	-	.107
Weighted averages	-	-	.122	-	-	.080
Weighted average using only those areas where data for both males and females were available	.117	.115	-	.080	.076	-
Weighted average based on recoveries in the United States only, using reference areas with both adult and immature rates	-	-	.068	-	-	.056

Table 19.--First-hunting-season recovery rates of male and female black ducks banded in the winter period (Jan. 16 through Feb.), 1946-60^{1/}

Area of reference	First-hunting-season recovery rate	
	Male	Female
<u>Maritimes</u>		
Prince Edward Island	.055	.050
<u>New England & E. Long Island</u>		
Connecticut	.050	.064
Massachusetts	.027	.023
New York	.062	.060
Rhode Island	.060	.049
<u>W. Long Island & Hudson River</u>		
New York	.025	.025
<u>Mid-Atlantic</u>		
Delaware	.048	.044
Maryland	.063	.037
New Jersey	.065	.045
Pennsylvania	.064	.048
<u>Mid-Atlantic Coastal</u>		
New Jersey	.052	.050
Virginia	.023 ^{2/}	.037 ^{2/}
<u>Lake Erie</u>		
Michigan	.043	.042
<u>Upper Mississippi River</u>		
Illinois	.058 ^{2/}	.052 ^{2/}
Indiana	.048 ^{2/}	.051 ^{2/}
Weighted average	.052	.043

^{1/} Rates based on more than 200 birds banded in each reference area.

^{2/} Indiana rates are from January 1-15 bandings while Virginia and Illinois rates are first-full-hunting-season rates based on December bandings. An adjustment was made for recoveries in the hunting season of banding as follows:

Recoveries in first season times 2.5 = x
 Total banded (-) x = y
 Recoveries in first full hunting season ÷ y = rate

Table 20.--Comparison of hunting regulations and first-hunting-season recovery rates of adult and immature black ducks banded in the summer

Reference area of banding	Age	Years	Number banded	Recovery Rate	Regulations	
					Season length	Bag limit
<u>St. John & St. Croix Rivers</u>						
Maine	Immature	1949-51	286	.063	32s-36s	1/
		1952-54	607	.087	44s-60	
		1955-57	400	.050	70	
W. Maine	Immature	1946	228	.044	45	7
		1947-50	567	.125	24s-32s	4
		1952-54	1,697	.140	44s-60	4
		1955-57	2,945	.152	70	4
<u>Vermont & N. H.</u>						
New Hampshire	Immature	1955-57	367	.155	70	4
		1958	257	.179	60	4
		1959-60	219	.151	45s-50	3
Vermont	Immature	1955-57	757	.136	70	4
		1959-60	420	.119	50	3
<u>S. New Eng. & Long Is.</u>						
Connecticut	Immature	1948-51	246	.089	30-45	4
		1952-53	348	.175	55-60	4
Long Island	Immature	1949-51	471	.091	32s-36s	4
		1952	473	.116	55	4
<u>Lake Champlain</u>						
Vermont	Immature	1948-50	391	.169	30-40	4
		1952-54	753	.179	55-60	4
		1955-57	691	.181	70	4
		1958	601	.183	60	4
		1959-60	655	.111	50	3

Table 20.--Comparison of hunting regulations and first-hunting-season recovery rates of adult and immature black ducks banded in the summer-continued

Reference area of banding	Age	Years	Number banded	Recovery rate	Regulations	
					Season Length	Bag Limit
<u>Chesapeake & Del. Bays</u>						
Delaware	Immature	1952-54	365	.085	55-60	4
		1959-60	524	.071	40-50	4
Maryland	Adult	1953-54	372	.067	60	4
		1955-57	406	.066	70	4
	Immature	1953-54	719	.086	60	4
		1956-57	1,061	.108	70	4
		1958	548	.084	60	4
<u>E. Lake Ontario</u>						
New York	Adult	1950-51	465	.067	32s-36s	4
		1952-54	526	.078	55-60	4
	Immature	1950-51	437	.103	32s-36s	4
		1952-54	2,031	.113	55-60	4
		1955-57	289	.124	70	4
		1959-60	1,931	.127	50	3
<u>Upper Great Lakes</u>						
Michigan	Adult	1928-33	248	.149	30-107	12-25
		1934-37	355	.045	30	10
		1938-39	382	.105	45	10
		1940-41	282	.092	60	10
		1942-43	286	.080	70	10

Table 20.--Comparison of hunting regulations and first-hunting-season recovery rates of adult and immature black ducks banded in the summer--continued

Reference area of banding	Age	Years	Number banded	Recovery rate	Regulations	
					Season length	Bag limit
Michigan	Immature	1928-30	529	.229	107	15-25
		1931-33	427	.201	30-61	12-15
		1934-37	582	.053	30	10
		1938-39	450	.113	45	10
		1940-43	587	.138	60	10
		1946-51	886	.085	30-45	4-7
		1952-54	604	.071	55	4
		1955-58	403	.104	70	4
		1959-60	369	.108	35-40	4
<u>W. Lake Erie</u> Ohio	Immature	1950-51	222	.072	35-45	4
		1952-54	295	.095	55	4
<u>E. Lake Michigan</u> Michigan	Immature	1932-33	251	.131	61	12-15
		1934-39	343	.111	30-45	10-12
<u>W. Lake Michigan</u> Illinois	Immature	1941-43	378	.085	60-70	10
		1944-45	241	.133	80	10
		1946-47	252	.036	30-45	4-7

1/ s = split season

Table 21.--Percent distribution of weighted band recoveries by States and Provinces. Based on summer (pre-hunting season) and winter (January 16 through February) bandings, 1946-60

State or Province of kill	Summer			Winter
	Adult	Immature	Ages combined	Adult
Alberta	T ^{1/}	--	T	--
Saskatchewan	T	--	T	0.3
Manitoba	T	--	T	0.4
Ontario	6.0	11.8	9.6	8.8
Quebec	11.3	18.0	15.5	3.9
Labrador	0.4	--	0.1	0.1
Newfoundland	0.3	0.3	0.3	0.1
New Brunswick	1.3	2.0	1.8	1.1
P. E. I.	0.4	1.0	0.8	1.1
Nova Scotia	6.6	4.6	5.3	2.8
CANADA	26.3	37.7	33.4	18.6
Maine	3.7	2.5	2.9	2.5
Vermont	0.9	0.7	0.8	0.7
New Hampshire	0.2	0.4	0.3	0.3
Massachusetts	5.2	2.5	3.5	2.2
Connecticut	2.1	3.3	2.9	1.3
Rhode Island	1.0	0.9	0.9	1.3
New York	9.1	7.4	8.0	5.8
Pennsylvania	1.1	3.4	2.6	2.8
West Virginia	0.2	0.1	0.1	0.2
New Jersey	15.2	9.9	11.8	13.7
Delaware	4.0	2.9	3.3	2.6
Maryland	12.0	5.0	7.6	12.8
Virginia	5.1	3.2	3.9	2.6
North Carolina	1.4	1.8	1.7	1.4
South Carolina	1.3	1.4	1.3	1.3
Georgia	0.1	T	0.1	T
Florida	0.2	0.4	0.3	0.3
ATLANTIC FLYWAY	62.8	45.8	52.0	51.8

Table 21.--Percent distribution of weighted band recoveries by States and Provinces. Based on summer (pre-hunting season) and winter (January 16 through February) bandings, 1946-60

State or Province of kill	Summer			Winter
	Adult	Immature	Ages combined	Adult
Minnesota	0.2	0.2	0.2	0.9
Wisconsin	0.9	2.4	1.9	4.0
Michigan	3.7	5.5	4.8	4.4
Iowa	0.1	0.1	0.1	0.3
Illinois	0.6	1.1	0.9	3.9
Indiana	1.0	0.8	0.9	1.1
Ohio	1.8	4.0	3.2	7.1
Missouri	T	0.1	0.1	T
Kentucky	0.6	0.3	0.4	1.6
Arkansas	0.2	0.6	0.5	2.1
Tennessee	0.9	0.7	0.8	2.1
Louisiana	0.1	0.2	0.1	0.3
Mississippi	0.3	0.3	0.3	0.1
Alabama	0.6	0.2	0.4	0.8
MISSISSIPPI FLYWAY	11.0	16.5	14.6	28.7
Montana	T	--	T	--
North Dakota	T	T	T	0.4
South Dakota	T	--	T	0.3
Kansas	--	--	--	T
CENTRAL FLYWAY	T	--	--	0.8
Utah	T	--	T	--
U. S. and Canada	100.1	100.0	100.0	99.9

1/ Trace = less than 0.1

Table 22.-Percent distribution of the black duck kill in the United States as measured by the mail questionnaire and wing collection surveys, 1954-62^{1/}

State	1954	1955	1956	1957	1958	1959	1960	1961	1962	Mean
										1954-1960
Maine	4.8	5.1	4.7	4.6	5.7	5.7	6.2	6.0	6.2	5.3
Vermont	0.7	0.6	1.1	0.9	0.7	0.9	0.9	2.4	2.6	0.8
New Hampshire	2.3	0.6	1.2	0.9	0.7	0.6	1.7	2.3	1.6	1.1
Massachusetts	4.6	7.5	6.6	5.2	7.3	8.1	8.7	11.1	7.9	6.9
Connecticut	3.0	2.1	1.4	1.7	2.6	2.6	3.0	2.2	4.9	2.3
Rhode Island	1.7	1.9	1.8	2.5	2.1	2.1	1.5	1.7	1.7	1.9
New York	19.0	14.8	14.1	11.3	12.0	13.0	12.4	14.7	12.7	13.8
Pennsylvania	3.0	3.5	3.4	5.0	3.0	3.6	2.8	4.5	4.3	3.5
West Virginia	0.0 ^{2/}	0.1	0.4	0.1	0.1	0.1	0.3	0.3	0.5	0.2
New Jersey	8.1	7.6	9.0	11.5	5.5	6.2	7.2	9.3	16.5	7.9
Delaware	2.4	3.2	3.1	4.7	3.1	3.4	3.8	4.1	3.9	3.4
Maryland	5.8	4.9	3.9	4.9	3.3	4.4	5.8	6.2	8.5	4.7
Virginia	3.3	4.2	4.0	4.4	2.9	2.8	3.6	2.9	5.5	3.6
North Carolina	3.0	1.9	1.8	2.4	2.1	2.2	3.7	2.1	2.1	2.4
South Carolina	1.2	0.7	0.6	0.4	1.8	0.9	1.1	2.5	2.2	1.0
Georgia	0.1	0.1	0.5	0.0	0.2	0.1	0.1	0.0	0.4	0.2
Florida	2.5	2.7	3.5	1.1	1.9	1.6	1.0	1.4	0.5	2.0
ATLANTIC FLYWAY	66.0	61.7	61.2	61.7	55.1	58.4	63.5	73.5	82.0	61.1
Minnesota	3.0	2.5	4.9	4.1	4.4	2.0	4.4	0.8	0.9	3.6
Wisconsin	6.9	6.4	6.0	4.8	6.7	5.2	5.7	6.0	3.0	6.0
Michigan	11.1	12.5	12.3	11.8	8.3	11.3	9.3	7.6	6.0	10.9
Iowa	0.2	0.2	0.4	0.2	0.5	0.6	0.4	0.2	0.2	0.4
Illinois	1.2	1.5	1.8	1.9	2.5	3.5	1.1	2.6	1.4	1.9
Indiana	0.7	2.0	0.9	2.0	2.2	1.0	2.0	1.3	0.7	1.5
Ohio	2.2	3.2	3.2	4.6	4.8	5.6	6.4	2.3	1.5	4.3
Missouri	0.5	1.0	0.5	0.4	0.4	0.6	0.4	0.2	0.1	0.5
Kentucky	0.3	0.4	1.5	0.6	2.0	0.6	1.1	1.5	0.8	0.9
Arkansas	0.3	0.5	1.1	1.6	2.5	0.7	0.7	0.4	0.1	1.1
Tennessee	0.7	1.4	1.0	2.0	1.8	1.4	2.8	1.9	1.4	1.6
Louisiana	5.4	5.2	4.5	1.8	7.1	7.5	0.7	0.2	0.4	4.6
Mississippi	0.2	0.3	0.1	0.3	0.6	0.9	0.7	0.2	0.4	0.4
Alabama	1.0	0.9	0.6	1.8	0.9	0.3	0.6	0.3	1.0	0.9
MISS. FLYWAY	33.9	38.1	38.8	38.1	44.7	41.2	36.5	25.6	17.8	38.8

Table 22.--Percent distribution of the black duck kill in the United States as measured by the mail questionnaire and wing collection surveys, 1954-62^{1/} --continued

State	1954	1955	1956	1957	1958	1959	1960	1961	1962	Mean
										1954-1960
Colorado	--	--	--	--	T ^{1/}	T	T	--	--	T
North Dakota	--	--	T	T	--	--	T	--	0.1	T
South Dakota	--	--	--	0.2	0.2	--	--	--	--	T
Nebraska	--	--	T	--	--	--	--	--	--	T
Kansas	0.1	--	--	--	--	T	T	0.1	--	T
Oklahoma	T	0.1	T	--	T	--	T	--	T	T
Texas	--	--	--	--	--	0.4	T	0.8	0.1	T
New Mexico	--	--	--	--	--	--	T	--	--	--
CENTRAL FLYWAY	0.1	0.1	0.1	0.3	0.2	0.4	? ^{3/}	0.9	0.2	0.2
UNITED STATES	100.0	99.9	100.1	100.1	100.0	100.0	100+	100.0	100.0	100.1

^{1/} Only mail questionnaire data available from 1954 to 1959.

^{2/} Insufficient data (1 respondent for State).

^{3/} 1960 Central Flyway data not usable because of type of questionnaire used.

Table 23.--Comparison of the percent distribution of black duck hunting kill in the United States based on data from banding and questionnaire surveys.

State of kill	SOURCE OF INFORMATION			
	Weighted band recoveries			Mail
	Summer bandings		Winter bandings	Questionnaire Survey
	Adult	Ages combined	Adult	Mean - 1954-60
Maine	5.0	4.4	3.1	5.3
Vermont	1.2	1.2	0.9	0.8
New Hampshire	0.3	0.5	0.3	1.1
Massachusetts	7.1	5.2	2.8	6.9
Connecticut	2.9	4.3	1.6	2.3
Rhode Island	1.3	1.4	1.6	1.9
New York	12.3	12.1	7.3	13.8
Pennsylvania	1.5	3.8	3.4	3.5
West Virginia	0.2	0.2	0.3	0.2
New Jersey	20.6	17.8	17.0	7.9
Delaware	5.4	4.9	3.2	3.4
Maryland	16.3	11.4	15.9	4.7
Virginia	7.0	5.9	3.3	3.6
North Carolina	1.9	2.5	1.7	2.4
South Carolina	1.7	2.0	1.6	1.0
Georgia	0.2	0.1	T	0.2
Florida	0.3	0.5	0.3	2.0
ATLANTIC FLYWAY	85.2	78.2	64.3	61.1
Minnesota	0.2	0.3	1.2	3.6
Wisconsin	1.3	2.8	5.0	6.0
Michigan	5.0	7.3	5.5	10.9
Iowa	0.1	0.1	0.4	0.4
Illinois	0.8	1.4	4.8	1.9
Indiana	1.4	1.3	1.4	1.5
Ohio	2.4	4.8	8.8	4.3
Missouri	T	0.1	T	0.5
Kentucky	0.9	0.7	2.0	0.9
Arkansas	0.3	0.7	2.6	1.1
Tennessee	1.2	1.2	2.6	1.6
Louisiana	0.1	0.2	0.4	4.6
Mississippi	0.4	0.4	0.1	0.4
Alabama	0.8	0.6	1.0	0.9
MISSISSIPPI FLYWAY	14.9	21.9	35.8	38.8

Table 23.--Comparison of the percent distribution of black duck hunting kill in the United States based on data from banding and questionnaire surveys.--continued

State of kill	SOURCE OF INFORMATION			
	Weighted band recoveries			Mail
	Summer bandings		Winter bandings	Questionnaire Survey
	Adult	Ages combined	Adult	Mean - 1954-60
Montana	T ^{1/}	T	--	--
North Dakota	T	T	T	T
South Dakota	T	T	T	T
Nebraska	--	--	--	T
Kansas	--	--	T	T
Oklahoma	--	--	--	T
Texas	--	--	--	T
CENTRAL FLYWAY	--	--	--	0.2
Utah	T	T	--	--
U.S.	100.1	100.1	100.1	100.1

^{1/} Trace = less than 0.1

Table 24.--Direct and indirect recoveries of black ducks banded in summer reference areas and recovered in three latitudinal zones, 1946-1960. (shown in percentages)

Banding area	Recovery zone	Adult Male When Recovered Banded as			Adult Female When Recovered Banded as			Immature When Recovered		
		Adult		Immature	Adult		Immature	Male	Female	Combined
		Direct recovery	Indirect recovery		Direct recovery	Indirect recovery				
Lab. & E. Quebec										
Lebrador										
	North of 43°	16	39	29	50	0	0	43	43	43
	43° - 41°	47	25	29	0	100	100	14	29	21
	South of 41°	37	36	43	50	0	0	43	29	36
	Total	100	100	101	100	100	100	100	101	100
	Number of recoveries	19	27	7	4	3	1	7	7	14
Quebec										
	North of 43°	15	48	30	36	17	33	37	47	42
	43° - 41°	35	28	33	27	50	33	29	18	23
	South of 41°	50	24	37	36	33	33	34	35	35
	Total	100	100	100	99	100	99	100	100	100
	Number of recoveries	20	29	27	11	6	18	35	34	69
W. Maine										
Maine										
	North of 43°	30	14	22	43	23	38	40	42	41
	43° - 41°	22	43	35	24	43	27	28	21	24
	South of 41°	48	43	44	32	35	35	32	37	34
	Total	100	100	101	99	101	100	100	100	99
	Number of recoveries	23	14	234	37	23	176	465	422	887
Coastal Mass.										
Massachusetts										
	North of 43°	0	16	11	3	23	22	3	1	2
	43° - 41°	84	65	71	84	68	63	89	89	89
	South of 41°	16	19	18	13	9	15	9	10	9
	Total	100	100	100	100	100	100	101	100	100
	Number of recoveries	31	31	101	31	22	68	176	157	333
Chesapeake & Del. Bays										
Maryland										
	North of 39°	3	11	11	5	13	3	2	1	1
	39° - 37°	94	89	88	95	83	92	98	99	98
	South of 37°	3	0	1	0	4	5	1	0	Trace
	Total	100	100	100	100	100	100	101	100	99
	Number of recoveries	36	36	135	20	23	59	171	103	274
E. Lake Ontario										
New York										
	North of 43°	21	20	20	32	25	30	52	46	49
	43° - 41°	28	24	15	31	27	28	24	24	24
	South of 41°	51	56	65	37	47	43	24	31	27
	Total	100	100	100	100	99	101	100	101	100
	Number of recoveries	80	59	119	71	51	94	303	249	552
W. James Bay										
Ontario										
	North of 42°	22	24	0	17	28	18	24	33	28
	42° - 40°	39	24	47	17	22	18	15	24	19
	South of 40°	39	53	53	67	50	64	61	43	54
	Total	100	101	100	101	100	100	100	100	101
	Number of recoveries	23	34	17	6	18	11	33	21	54
W. Lake Erie										
Michigan										
	North of 42°	38	30	37	47	40	12	54	62	57
	42° - 40°	29	39	26	47	60	75	33	33	33
	South of 40°	33	30	37	6	0	12	13	8	11
	Total	100	99	100	100	100	99	100	103	101
	Number of recoveries	21	23	19	17	5	8	39	24	63

Table 25.--Direct and indirect recoveries of black ducks banded in selected summer reference areas as locals, juveniles, or immatures, and recovered in three latitudinal zones, 1946-60.

Banding area	Recovery zone	Percent in each recovery area			
		Male		Female	
		Direct recovery	Indirect recovery	Direct recovery	Indirect recovery
<u>St. John & St. Croix Rivers</u> Maine	North of 43°	54	63	38	40
	43° - 41°	19	15	28	29
	South of 41°	27	22	34	31
	Total	100	100	100	100
	No. of recoveries	59	60	47	42
<u>S. New Eng. & Long Island</u> New York	North of 43°	2	11	--	15
	43° - 41°	5	20	8	31
	South of 41°	94	69	92	54
	Total	101	100	100	100
	No. of recoveries	63	45	36	26
<u>Lake Champlain</u> Vermont	North of 43°	64	29	66	38
	43° - 41°	11	16	13	17
	South of 41°	25	55	21	45
	Total	100	100	100	100
	No. of recoveries	280	87	229	60

Table 25.--Direct and indirect recoveries of black ducks banded in selected summer reference areas as locals, juveniles, or immatures, and recovered in three latitudinal zones, 1946-60.--continued

Banding area	Recovery zone	Percent in each recovery area			
		Male		Female	
		Direct recovery	Indirect recovery	Direct recovery	Indirect recovery
<u>W. Lake Ontario</u>					
Ontario	North of 42°	63	30	60	40
	42° - 40°	14	28	18	12
	South of 40°	23	42	22	48
	Total	100	100	100	100
	No. of recoveries	230	89	178	48
<u>Upper Great Lakes</u>					
Michigan	North of 42°	33	27	47	32
	42° - 40°	32	40	26	29
	South of 40°	35	33	27	39
	Total	100	100	100	100
	No. of recoveries	125	138	77	59
<u>W. Lake Michigan</u>					
Illinois	North of 42°	2	15	--	24
	42° - 40°	80	76	92	57
	South of 40°	18	10	8	19
	Total	100	101	100	100
	No. of recoveries	50	41	24	21

Table 26.--Immature^{1/} black ducks banded in United States summer reference areas, and recovered more than 140 miles north of the reference areas of banding, 1946-1960.

Reference area of banding	Male				Female				
	Total recoveries		Percent taken north		Total recoveries		Percent taken north		
	Direct	Indirect	Direct	Indirect	Direct	Indirect	Direct	Indirect	
<u>St. John & St. Croix Rivers</u>									
Maine	59	60	0.0	3.3	47	42	0.0	2.4	
<u>W. Maine</u>									
Maine	465	234	0.4	0.4	422	176	0.0	2.3	
<u>Vermont & N.H.</u>									
New Hampshire	71	15	1.4	0.0	67	16	1.5	0.0	
Vermont	86	21	0.0	4.8	76	16	0.0	0.0	
<u>Coastal Mass.</u>									
Massachusetts	176	101	0.0	5.9	157	68	1.3	14.7	
<u>S. New Eng. & Long Is.</u>									
Connecticut	33	30	0.0	10.0	53	16	0.0	18.7	
Massachusetts	23	8	0.0	0.0	7	11	0.0	18.2	
New York	63	45	1.6	11.1	36	26	0.0	15.4	
<u>Lake Champlain</u>									
New York	27	9	0.0	11.1	25	17	0.0	0.0	
Vermont	280	87	0.0	3.4	239	60	0.4	0.0	
<u>Chesapeake & Del. Bays</u>									
Delaware	17	24	0.0	12.5	20	9	0.0	11.1	
Maryland	171	135	0.0	8.1	103	59	0.0	1.7	
New Jersey	43	16	0.0	12.5	32	6	0.0	0.0	

Table 26.--Immature^{1/} black ducks banded in United States summer reference areas, and recovered more than 140 miles north of the reference areas of banding, 1946-1960.--continued

Reference area of banding	Male				Female			
	Total recoveries		Percent taken north		Total recoveries		Percent taken north	
	Direct	Indirect	Direct	Indirect	Direct	Indirect	Direct	Indirect
<u>E. Lake Ontario</u> New York	303	119	0.0	1.7	249	94	0.4	2.1
<u>W. Lake Ontario</u> New York	30	15	0.0	6.7	20	7	0.0	14.3
<u>Upper Great Lakes</u> Michigan	125	138	0.0	0.0	77	59	0.0	0.0
<u>W. Lake Erie</u> Michigan	39	19	5.1	0.0	25	8	0.0	0.0
Ohio	26	19	0.0	5.3	21	19	0.0	10.5
<u>E. Lake Michigan</u> Michigan	25	7	0.0	0.0	19	5	0.0	0.0
<u>W. Lake Michigan</u> Illinois	50	41	0.0	7.3	24	21	0.0	14.3
Wisconsin	47	22	0.0	4.5	22	11	0.0	0.0

^{1/}These are birds classified as immatures at time of banding.

Table 27.--Recoveries of adult male and female black ducks taken more than 300 miles north of the center of the summer reference areas of banding, 1946-60.

Banding Area	Total Recoveries		Percent taken North	
	Male	Female	Male	Female
<u>St. John & St. Croix Rivers</u>				
Maine	73	57	4.1	0
<u>W. Maine</u>				
Maine	271	236	2.2	2.5
<u>Coastal Massachusetts</u>				
Massachusetts	163	121	6.8	10.7
<u>Lake Champlain</u>				
Vermont	122	86	2.5	1.2
<u>Chesapeake & Del. Bays</u>				
Maryland	207	102	6.3	4.0
<u>E. Lake Ontario</u>				
New York	257	216	3.9	2.8
<u>W. Lake Ontario</u>				
Ontario	106	73	2.8	1.4
<u>Upper Great Lakes</u>				
Michigan	173	77	3.5	0

Table 28.--Distribution of male and female black duck recoveries in relation to winter reference areas of banding, 1946-60. Shown as percent of total recoveries for each reference area.

Winter reference area of banding	Sex	Location of recoveries				Total	Total recoveries
		Within state	North	South	East or West ^{1/}		
<u>Eastern Areas</u>							
Maritimes (Provinces combined)	Male	96.2	2.5	1.2	--	99.9	80
	Female	91.1	5.4	3.6	--	100.1	56
Maine	Male	80.0	1.5	12.3	6.2	100.0	65
	Female	81.5	3.7	--	14.8	100.0	27
New England & E. Long Is.	Male	72.1	20.8	2.6	4.6	100.1	716
	Female	60.8	31.6	3.0	4.5	99.9	332
W. Long Is. & Hudson River	Male	41.7	51.0	5.2	2.1	100.0	96
	Female	30.0	60.0	5.0	5.0	100.0	40
Mid-Atlantic	Male	47.4	21.8	17.6	13.2	100.0	831
	Female	36.4	38.3	14.1	11.2	100.0	418
Mid-Atlantic Coastal	Male	66.6	20.9	3.5	9.0	100.0	287
	Female	52.1	31.4	5.7	10.7	99.9	140
Lake Erie	Male	79.0	5.3	12.3	3.4	100.0	505
	Female	69.8	11.6	10.1	8.5	100.0	129
<u>Western Areas</u>							
Tennessee Riv.	Male	35.0	57.5	5.0	2.5	100.0	40
	Female	19.0	76.0	--	4.8	99.8	21
Upper Miss. River	Male	28.9	45.1	8.5	17.5	100.0	246
	Female	24.4	53.3	10.0	12.2	99.9	90

^{1/} East or west at the same latitude as State of banding.

Table 29.--First-and-later-hunting season recoveries of black ducks in three zones of latitude, based on birds banded during winter in Massachusetts, 1946-60. (Shown as percent of total recoveries.)

Harvest area	Males		Females	
	First season	Later seasons	First season	Later seasons
North of 43°	21	23	49	49
43° - 41°	75	72	50	49
South of 41°	4	4	1	2
Total	100	99	100	100
No. of recoveries	112	442	76	160

Table 30.--Monthly distribution of the hunting kill of adult black ducks, based on recoveries of birds banded in winter, 1946-1957.

Major winter banding area	Sex	Percent of total recoveries				Total percent recoveries	Total recoveries
		Sept.	Oct.	Nov.	Dec.			Jan.
Maritimes	Unknown	0.0	50.0	50.0	0.0	0.0	2
	Male	3.6	25.0	42.8	17.8	10.7	28
	Female	20.0	20.0	46.7	6.7	6.7	15
	Combined	8.9	24.4	44.4	13.3	8.9	45
Maine	Unknown	0.0	30.8	38.5	23.0	7.7	13
	Male	9.0	27.3	27.3	36.4	0.0	11
	Female	0.0	80.0	20.0	0.0	0.0	5
	Combined	3.4	37.9	31.0	24.1	3.4	29
New Eng. & E. Long Is.	Unknown	20.0	0.0	40.0	20.0	20.0	5
	Male	2.3	17.6	32.8	40.5	6.8	561
	Female	4.5	23.9	36.0	32.0	3.6	222
	Combined	3.0	19.3	33.8	37.9	6.0	788
W. Long Is. & Hudson Riv.	Male	14.8	37.0	24.1	24.1	0.0	54
	Female	8.7	39.1	30.4	21.7	0.0	23
	Combined	13.0	37.7	26.0	23.4	0.0	77
Mid-Atlantic	Unknown	--	20.0	40.0	30.0	10.0	30
	Male	3.4	20.4	34.8	28.7	12.7	466
	Female	9.0	28.7	24.0	29.9	8.3	254
	Combined	5.2	23.2	31.3	29.2	11.1	750

Table 30.--Monthly distribution of the hunting kill of adult black ducks, based on recoveries of birds banded in winter, 1946-1957.--continued

Major winter banding area	Sex	Percent of total recoveries				Total percent recoveries	Total recoveries	
		Sept.	Oct.	Nov.	Dec.			
Mid-Atlantic Coastal	Unknown	--	--	33.3	66.6	0.0	99.9	6
	Male	4.1	12.9	35.4	36.0	11.6	100.0	147
	Female	5.8	13.9	38.3	31.4	10.5	99.9	86
	Combined	4.6	13.0	36.4	35.1	10.9	100.0	239
Lake Ontario	Unknown	--	--	--	100.0	--	100.0	1
	Male	4.6	16.1	27.6	43.6	8.0	99.9	87
	Female	4.3	34.8	30.4	30.4	0.0	99.9	23
	Combined	4.5	19.8	27.9	41.4	6.3	99.9	111
Lake Erie	Unknown	--	20.0	--	80.0	--	100.0	5
	Male	0.9	29.7	44.0	22.9	2.5	100.0	323
	Female	2.2	35.2	40.7	19.8	2.2	100.1	91
	Combined	1.2	30.8	42.7	23.0	2.4	100.1	419
Tennessee River	Unknown	0.0	20.4	36.4	31.8	11.4	100.0	44
	Male	0.0	11.1	11.1	55.5	22.2	99.9	9
	Female	0.0	16.7	16.7	16.7	50.0	100.1	6
	Combined	0.0	18.6	30.5	34.0	16.9	100.0	59

Table 30.--Monthly distribution of the hunting kill of adult black ducks, based on recoveries of birds banded in winter, 1946-1957.--continued

Major winter banding area	Sex	Percent of total recoveries				Total percent recoveries	Total recoveries
		Sept.	Oct.	Nov.	Dec.			Jan.
Upper Miss. River	Unknown	--	100.0	--	--	100.0	1
	Male	0.5	27.7	35.1	30.4	6.3	191
	Female	1.4	31.9	33.3	26.4	6.9	72
	Combined	0.8	29.2	34.5	29.2	6.4	264
Combined weighted average	Male	3.2	21.4	34.8	31.1	9.5	1877
	Female	6.4	27.7	31.4	26.8	7.7	797

Table 31.--Recovery rates (relative likelihood of being shot) by months for adult male and female black ducks.

Month of recovery ^{1/}	Recovery rate ^{2/}		Relative recovery rate (males ÷ females)
	Male	Female	
September	.002	.005	0.4
October	.017	.021	0.8
November	.028	.024	1.2
December	.025	.020	1.3
January	.008	.006	1.3
Total	.080	.076	1.05

^{1/}Combined weighted average from table 30.

^{2/}Obtained by multiplying percent recoveries by weighted average first season recovery rates for males and females from table 18.

Table 32.--Age ratios and adult sex ratios of black ducks shot monthly during the hunting season in selected States, 1960-63 based on weighted wing survey data. (Wing sample sizes in parentheses. Samples of less than 50 wings not included.)

State	Age ratios (immatures/adult)			Sex ratios of adults (males/female)		
	October	November	December	October	November	December
	January	January	January	January	January	January
Maine	2.8 (1783)	1.5 (471)	0.9 (304)	1.0 (444)	1.8 (187)	1.9 (161)
Massachusetts	2.7 (750)	1.6 (761)	1.5 (1168)	0.9 (195)	1.3* (146)	1.2 (394)
New York	3.1 (731)	2.3 (630)	1.2 (582)	1.8* (184)	1.2 (183)	2.1 (265)
New Jersey	0.9* (128)	1.6 (1668)	1.2 (1969)	1.1* (69)	1.5 (633)	1.5 (894)
Maryland		1.4 (630)	1.1 (650)		1.9 (270)	1.6 (314)
Virginia		1.7 (283)	1.0 (476)		0.8 (112)	1.3 (241)
Michigan	1.8 (790)	1.7 (208)		1.2 (273)	1.5 (92)	
Ohio	2.3 (159)	1.1 (213)	0.7* (186)	2.1 (59)	1.2 (102)	3.2* (110)
Tennessee			1.0 (454)		0.8* (79)	2.3 (220)

*All years not represented due to changes in hunting season dates.

Table 33.--Percent distribution of direct recoveries of black ducks banded during summer in Coastal Massachusetts. (Shown for different recovery periods.)

Recovery location	Period of recovery (hunting season)					
	1932-39	1940-44	1945-49	1950-51	1952	1953
Ontario	1.4	--	--	--	--	--
Quebec	4.2	--	--	--	1.3	--
New Brunswick	4.2	1.0	--	--	--	1.7
Nova Scotia	--	--	--	--	1.3	--
Canada	9.9	1.0	--	--	2.5	1.7
Maine	4.2	2.0	2.2	0.7	2.5	9.1
New Hampshire	1.4	2.0	2.2	0.7	3.8	5.8
Massachusetts	71.8	90.8	80.4	84.9	83.8	60.3
Connecticut	1.4	--	2.2	1.4	1.3	4.1
Rhode Island	1.4	2.0	4.3	1.4	--	4.1
New York	4.2	1.0	4.3	1.4	1.3	5.8
Pennsylvania	--	--	--	--	--	0.8
New Jersey	2.8	1.0	4.3	3.4	3.8	4.1
Delaware	--	--	--	2.1	--	1.7
Maryland	1.4	--	--	2.7	--	1.7
Virginia	1.4	--	--	1.4	1.3	--
North Carolina	--	--	--	--	--	0.8
Atlantic Flyway	90.1	99.0	99.9	100.0	97.5	98.3
U. S. and Canada	99.8	99.8	99.9	100.1	100.4	100.0
Total recoveries	71	98	46	146	80	121

Table 33.1.1.--Chi-square test of homogeneity for data in table 33^{1/}

Recovery area	Period of recovery (hunting season)				Total recoveries
	1932-39	1940-44	1945-49	1950-51	
Maine & New Hampshire	4	4	2	2 ^{2/}	18 ^{2/} 35
Massachusetts	51	89 ^{2/}	37	124	73 ^{2/} 441
Remaining Atlantic Flyway	9	2 ^{2/} 4 ^{2/}	7	20	28 ^{2/} 74
Total recoveries	64	97	46	146	78 119 550 ^{3/}

^{1/} Data from Canada omitted from statistical test.

^{2/} Significant at the 99 percent level of probability.

^{3/} Highly significant variation overall. (99 percent level of probability)

Table 34.--Percent distribution of indirect recoveries of black ducks banded during summer in Coastal Massachusetts. (Shown for different recovery periods.)

Recovery location	Period of recovery (Hunting season)						
	1932-39	1940-44	1945-49	1950-53	1954	1955	1956-60
Ontario	--	--	--	1.9	--	--	--
Quebec	6.1	--	4.4	3.7	7.1	--	1.5
Labrador	2.0	--	--	--	--	--	--
Newfoundland	2.0	--	--	--	--	--	--
New Brunswick	4.1	8.3	6.7	5.6	1.4	--	2.4
P.E.I.	2.0	2.8	--	--	2.9	--	--
Nova Scotia	10.2	--	13.3	3.7	--	2.9	2.4
Canada	26.5	11.1	24.4	14.8	11.4	2.9	14.3
Maine	6.1	2.8	13.3	3.7	11.4	11.4	2.4
Vermont	--	2.8	2.2	--	2.9	--	--
New Hampshire	--	2.8	--	9.3	5.7	2.9	2.4
Massachusetts	49.0	58.3	48.9	55.6	45.7	31.4	54.8
Connecticut	--	--	4.4	--	--	5.7	--
Rhode Island	2.0	5.6	4.4	--	2.9	20.0	7.1
New York	12.0	2.8	--	3.7	5.7	11.4	7.1
New Jersey	2.0	5.6	--	7.4	8.6	2.9	4.8
Delaware	--	--	--	--	--	2.9	2.4
Maryland	2.0	5.6	--	1.9	2.9	5.7	2.4
Virginia	--	2.8	--	3.7	--	--	2.4
North Carolina	--	--	--	--	2.9	2.9	--
Georgia	--	--	2.2	--	--	--	--
Atlantic Flyway	73.5	88.9	75.6	88.5	88.6	97.1	85.7
U.S. and Canada	99.7	100.2	99.8	100.2	100.1	100.1	100.1
Total recoveries	49	36	45	54	70	35	42

Table 34.1.1.--Chi-square test of homogeneity for data in table 34.1/

Recovery area	Period of recovery (hunting season)						Total recoveries
	1932-39	1940-44	1945-49	1950-53	1954	1956-60	
Canada	13 ^{1/}	4	11	8	8	1 ^{1/}	51
Maine, Vermont & New Hampshire	3	3	7	7	14 ^{1/}	5	41
Massachusetts	24	21	22	30	32	11 ^{1/}	163
Remaining Atlantic Flyway	9	8	5 ^{1/}	9	16	18 ^{2/}	76
Total recoveries	49	36	45	54	70	35	331 ^{3/}

^{1/} Significant at the 95 percent level of probability

^{2/} Significant at the 99 percent level of probability

^{3/} Highly significant variation overall (99 percent level of probability)

Table 35.--Percent distribution of direct recoveries for immature and juvenile black ducks banded during summer in the Lake Ontario Region of New York. (Shown for different recovery periods.)

Recovery location	Period of recovery(hunting seasons)				
	1950-52	1953	1954	1955-59	1960
Ontario	14.9	18.4	30.3	20.9	24.7
Quebec	4.1	2.3	9.1	6.0	10.5
Canada	18.9	20.7	39.4	26.9	35.5
Vermont	1.4	1.1	6.1	--	1.1
Massachusetts	--	1.1	3.0	--	1.1
Connecticut	--	2.3	--	--	--
New York	50.0	44.8	18.1	43.3	43.0
Pennsylvania	5.4	3.4	6.1	3.0	--
New Jersey	2.7	3.4	6.1	7.5	4.3
Delaware	1.4	2.3	--	4.5	--
Maryland	1.4	6.9	12.1	1.5	4.3
Virginia	6.8	8.0	6.1	1.5	4.3
North Carolina	2.7	--	--	--	3.2
South Carolina	1.4	3.4	--	1.5	--
Georgia	--	--	--	1.5	1.1
Florida	1.4	--	--	--	1.1
Atlantic Flyway	74.3	77.0	57.6	65.7	63.4
Michigan	1.4	--	3.0	1.5	1.1
Indiana	--	--	--	3.0	--
Ohio	1.4	--	--	--	--
Arkansas	1.4	--	--	--	--
Tennessee	2.7	--	--	1.5	--
Mississippi	--	--	--	1.5	--
Alabama	--	2.3	--	--	--
Mississippi Flyway	6.8	2.3	3.0	7.5	1.1
U. S. and Canada	100.5	99.7	100.0	100.2	99.8
Total recoveries	74	87	33	67	93

Table 35.1.--Chi-square test of homogeneity for data in table 35^{1/}

Recovery area	Period of recoveries (hunting season)				Total recoveries
	1950-52	1953	1954	1955-59	
Canada	14	18	13	18	63
New York	37	39	$\frac{1}{6}$	29	151
Remaining Atlantic Flyway	18	28	13	15	93
Total recoveries	69	85	32	62	340 ^{2/}

^{1/} Significant at the 95 percent level of probability

^{2/} Significant variation overall (95 percent level of probability)

Table 36.--Percent distribution of direct recoveries of adult black ducks banded during summer in the Lake Ontario Region of New York. (Shown for different recovery periods)

Recovery location	Period of recovery (hunting season)					
	1950-52	1953	1954	1955	1956-59	1960
Ontario	20.0	6.3	14.0	8.9	6.4	11.1
Quebec	--	9.4	4.7	2.2	2.1	11.1
New Brunswick	4.0	--	--	--	--	--
Nova Scotia	--	--	--	--	4.3	--
Canada	24.0	15.6	18.6	11.1	12.8	22.2
Maine	--	--	2.3	--	--	--
New Hampshire	--	--	--	2.2	--	--
Massachusetts	4.0	--	--	--	--	--
Connecticut	--	--	--	--	2.1	1.9
New York	28.0	34.4	23.3	15.6	12.8	31.5
Pennsylvania	--	3.1	4.7	8.9	8.5	--
West Virginia	--	--	--	--	--	1.9
New Jersey	8.0	12.5	18.6	22.2	27.7	9.3
Delaware	--	--	2.3	--	2.1	3.7
Maryland	16.0	9.4	16.3	17.8	17.0	11.1
Virginia	12.0	--	7.0	4.4	4.3	5.6
North Carolina	--	3.1	2.3	6.7	4.3	1.9
South Carolina	--	6.3	--	2.2	--	3.7
Georgia	--	3.1	--	--	--	1.9
Florida	--	3.1	--	--	--	--
Atlantic Flyway	68.0	75.0	76.7	80.0	78.7	72.2
Minnesota	--	3.1	--	--	--	--
Wisconsin	4.0	--	--	--	--	1.9
Michigan	--	--	--	4.4	--	--
Indiana	--	--	2.3	--	--	--
Ohio	--	3.1	--	--	2.1	1.9
Kentucky	--	--	2.3	2.2	--	1.9
Arkansas	--	--	--	--	4.3	--
Tennessee	--	--	--	2.2	--	--
Alabama	4.0	3.1	--	--	--	--
Mississippi Flyway	8.0	9.4	4.7	8.9	6.4	5.6
North Dakota	--	--	--	--	2.1	--
Central Flyway	--	--	--	--	2.1	--
U.S. and Canada	100.0	100.0	100.1	99.9	100.1	100.4
Total recoveries	25	32	43	45	47	54

Table 36.1.1.--Chi-square test of homogeneity for data in table 36^{1/}

Recovery area	Period of recovery (hunting season)					Total recoveries
	1950-52	1953	1954	1955	1956-59	
Canada	6	5	8	5	6	42
New York	7	11	10	7	6	58
Remaining Atlantic Flyway	10	13	23	29 ^{1/}	31 ^{1/}	128
Total recoveries	23	29	41	41	43	228 ^{2/}

^{1/} Significant at the 95 percent level of probability.

^{2/} No significant variation overall.

Table 37.--Percent distribution of direct recoveries for immature and juvenile black ducks banded during summer in northern Michigan.
(Shown for different recovery periods.)

Recovery Location	Period of recovery (hunting season)										
	1927-29	1930-32	1933	1934-38	1939-40	1941-45	1946-48	1949-51	1952-54	1955	1956-60
Ontario	14.8	6.3	7.6	12.7	5.2	--	2.8	--	3.9	5.3	4.3
Canada	14.8	6.3	7.6	12.7	5.2	--	2.8	--	3.9	5.3	4.3
New York	--	1.6	--	--	--	--	--	2.6	2.0	2.6	--
Pennsylvania	--	--	--	--	--	2.0	--	--	2.0	--	--
West Virginia	--	--	1.5	--	1.7	--	--	--	2.0	--	2.1
New Jersey	1.1	--	--	1.8	--	--	--	--	--	--	--
Delaware	--	1.6	--	--	--	--	--	--	--	--	--
Maryland	--	1.6	--	--	--	--	2.8	--	--	--	--
Virginia	1.1	1.6	6.1	--	--	--	--	--	2.0	--	--
North Carolina	--	1.6	--	--	--	2.0	--	2.6	2.0	2.6	--
South Carolina	3.4	3.1	3.0	5.5	1.7	--	2.8	--	3.9	--	--
Georgia	1.1	--	1.5	--	1.7	--	--	--	--	--	--
Florida	--	--	1.5	--	1.7	--	2.8	--	2.0	--	--
Atlantic Flyway	6.8	10.9	13.6	7.3	6.9	4.0	11.1	5.1	15.7	5.3	2.1
Minnesota	1.1	--	--	--	1.7	--	--	--	2.0	--	2.1
Wisconsin	10.2	3.1	--	1.8	12.1	18.4	8.3	12.8	13.7	7.9	19.1
Michigan	43.2	43.8	28.8	54.5	39.7	36.7	22.0	30.8	27.5	50.0	29.8
Iowa	3.4	--	--	--	--	4.0	--	2.6	2.0	--	--
Illinois	2.3	20.3	7.6	7.3	13.8	12.2	11.1	20.5	5.9	5.3	8.5
Indiana	1.1	--	3.0	--	--	4.0	11.1	2.6	--	7.9	12.8
Ohio	5.7	3.1	15.2	9.1	6.9	6.1	11.1	15.4	3.9	10.5	6.4
Missouri	--	--	--	--	1.7	2.0	--	--	2.1	--	2.1
Kentucky	1.1	1.6	4.5	--	--	--	--	--	2.0	--	6.4
Arkansas	2.3	3.1	7.6	3.6	--	4.0	2.8	5.1	5.9	5.3	--
Tennessee	3.4	1.6	1.5	1.8	--	--	5.6	--	9.8	--	4.3
Louisiana	2.3	3.1	4.5	1.8	5.2	2.0	--	2.6	--	2.6	--
Mississippi	1.1	--	3.0	--	1.7	--	8.3	--	3.9	--	2.1
Alabama	1.1	3.1	1.5	--	1.7	6.1	5.6	2.6	3.9	--	--
Mississippi Flyway	78.4	82.8	77.3	80.0	84.5	95.9	86.1	94.9	80.4	89.5	93.6
Oklahoma	--	--	1.5	--	--	--	--	--	--	--	--
Texas	--	--	--	--	3.4	--	--	--	--	--	--
Central Flyway	--	--	1.5	--	3.4	--	--	--	--	--	--
U.S. and Canada	99.8	100.2	99.9	99.9	99.9	99.5	99.9	100.2	100.3	100.0	100.0
Total recoveries	88	64	66	55	58	49	36	39	51	38	47

Table 37.1.--Chi-square test of homogeneity for data in table 37^{1/2}/

Recovery area	Period of recovery (hunting season)											Total recoveries
	1927-29	1930-32	1933	1934-38	1939-40	1941-45	1946-48	1949-51	1952-54	1955	1956-60	
Canada & Atlantic Flyway	19	11	14	11	7	2 ^{1/2}	5	2	10	4	3	88
Michigan	38	28	19	30 ^{2/2}	23	18	8 ^{1/8}	12	14	19	14	223
Remaining Miss. Flyway	31 ^{1/2}	25	32	14 ^{2/2}	26	29	23 ^{1/2}	25 ^{1/2}	27	15	30 ^{1/2}	277
Total recoveries	88	64	65	55	56	49	36	39	51	38	47	588 ^{3/2}

^{1/2} Significant at the 95 percent level of probability

^{2/2} Significant at the 99 percent level of probability

^{3/2} Highly significant variation overall (99 percent level of probability)

Table 38.--Percent distribution of direct recoveries of black ducks banded during summer in northern Michigan. (Shown for different recovery periods)

Recovery location	Period of recovery (hunting season)															
	1928-31	1932-33	1934-36	1937-38	1939	1940	1941	1942	1943	1944-45	1946-48	1949-50	1951-53	1954	1955-56	1957-60
Manitoba	--	--	--	1.9	--	--	--	--	--	--	--	--	2.5	4.3	--	--
Ontario	2.0	16.7	8.5	13.0	7.8	6.1	3.8	5.3	2.0	11.6	5.7	20.5	5.0	--	6.5	7.3
Quebec	--	--	--	--	2.0	--	--	--	--	--	--	--	--	--	--	--
Nova Scotia	--	--	--	--	--	--	--	1.8	--	--	--	--	--	--	--	--
Canada	2.0	16.7	8.5	14.8	7.8	8.2	3.8	7.0	2.0	11.6	5.7	20.5	7.5	4.3	6.5	7.3
Connecticut	--	--	--	--	--	--	--	--	2.0	--	--	--	--	--	--	--
New York	--	--	--	--	2.0	--	--	--	2.0	--	--	--	--	2.2	--	--
Pennsylvania	--	--	--	1.9	--	--	--	1.8	--	--	--	2.6	2.5	2.2	--	1.8
West Virginia	--	--	--	--	--	--	--	--	--	2.3	--	--	--	--	1.6	1.8
New Jersey	2.0	1.9	2.1	3.7	2.0	--	--	--	2.0	--	--	--	--	--	--	--
Delaware	--	--	--	3.7	--	--	--	1.8	--	--	--	--	--	--	--	1.8
Maryland	3.9	1.9	2.1	1.9	--	--	3.8	1.8	--	--	--	--	--	--	3.2	3.6
Virginia	3.9	--	--	--	--	--	--	7.0	4.1	9.3	--	--	--	--	3.2	--
North Carolina	2.0	2.1	2.1	--	3.9	--	--	--	--	--	--	--	--	--	--	3.6
South Carolina	5.9	--	6.4	3.7	3.9	6.1	--	3.5	6.1	--	--	--	2.5	--	3.2	--
Georgia	3.9	--	--	--	2.0	3.8	--	--	--	--	--	2.6	--	2.2	1.6	--
Florida	2.0	--	--	--	2.0	3.8	--	--	--	2.3	2.9	--	2.5	--	--	--
Atlantic Flyway	23.5	3.7	12.8	14.8	13.7	8.2	11.5	15.8	16.3	14.0	2.9	5.1	7.5	6.5	12.9	12.7
Minnesota	2.0	--	--	1.9	2.0	2.0	3.8	1.8	2.0	2.3	--	2.6	--	--	--	3.6
Wisconsin	--	1.9	4.3	9.3	11.8	8.2	--	8.8	4.1	4.7	5.7	10.3	2.5	8.7	4.8	--
Michigan	39.2	33.3	46.8	31.5	33.3	24.5	42.3	28.1	28.6	25.6	14.3	33.3	20.0	30.4	40.3	27.3
Iowa	--	--	--	--	--	--	--	--	2.0	--	--	2.6	2.5	--	--	1.8
Illinois	2.0	13.0	--	5.6	5.9	8.2	11.5	17.5	10.2	18.6	20.0	5.1	7.5	6.5	1.6	1.8
Indiana	2.0	1.9	--	1.9	3.9	8.2	11.5	7.0	12.2	--	5.7	7.7	12.5	6.5	6.5	12.7
Ohio	9.8	5.6	8.5	7.4	9.8	10.2	3.8	5.3	10.2	11.6	11.4	2.6	17.5	19.6	12.9	14.5
Missouri	--	--	--	--	2.0	4.1	--	--	--	--	--	--	--	--	--	--
Kentucky	3.9	3.7	2.1	1.9	--	--	3.8	3.5	--	2.3	2.9	5.1	2.5	4.3	4.8	9.1
Arkansas	--	7.4	2.1	1.9	--	--	--	1.8	--	--	--	2.6	--	--	1.6	--
Tennessee	--	1.9	10.7	--	2.0	2.0	3.8	1.8	2.0	--	14.3	--	10.0	4.3	6.5	7.3
Louisiana	5.9	5.6	2.1	3.7	--	6.1	3.8	--	4.1	--	2.9	--	2.5	--	--	--
Mississippi	2.0	1.9	--	--	2.0	2.0	--	1.8	2.0	9.3	2.9	--	2.5	2.2	--	--
Alabama	7.8	1.9	2.1	3.7	7.8	8.2	--	--	4.1	--	8.6	--	2.5	6.5	1.6	1.8
Mississippi Flyway	74.5	77.8	78.7	68.5	78.4	83.7	84.6	77.2	81.6	74.4	88.6	71.8	82.5	89.1	80.6	80.0
North Dakota	--	--	--	--	--	--	--	--	--	--	--	2.6	--	--	--	--
South Dakota	--	--	--	--	--	--	--	--	--	--	2.9	--	--	--	--	--
Texas	--	1.9	--	1.9	--	--	--	--	--	--	--	--	2.5	--	--	--
Central Flyway	--	1.9	--	1.9	--	--	--	--	--	--	2.9	2.6	2.5	--	--	--
Total U. S. & Canada	100.2	100.5	99.9	100.5	100.1	99.9	99.5	100.4	99.7	99.9	100.2	100.2	100.0	99.9	99.9	99.8
Total recoveries	51	54	47	54	51	49	25	57	49	43	35	39	40	46	62	55

Table 38.1.--Chi-square test of homogeneity for data in table 38^{1/}

Recovery area	Period of recovery (hunting season)															Total recoveries	
	1928-31	1932-33	1934-36	1937-38	1939	1940	1941	1942	1943	1944-45	1946-48	1949-50	1951-53	1954	1955-56		1957-60
Canada & Atlantic Flyway	13	11	10	16	11	8	4	13	9	11	3	10	6	5	12	11	153
Michigan	20	18	22 ^{1/}	17	17	12	11	16	14	11	5 ^{1/}	13	8	14	25	15	238
Remaining Miss. Flyway	18	24	15 ^{1/}	20	23	29	11	28	26	21	26 ^{2/}	15	25 ^{1/}	27	25	29	362
Total recoveries	51	53	47	53	51	49	26	57	49	43	34	38	39	46	62	55	753 ^{3/}

^{1/} Significant at the 95 percent level of probability.

^{2/} Significant at the 99 percent level of probability.

^{3/} No significant variation overall.

Table 39.--Percent distribution of direct recoveries of black ducks banded during winter in Massachusetts.
(Shown for different recovery periods.)

Recovery location	Period of recovery (hunting season)									
	1939-40	1941-42	1943-45	1946-49	1950-52	1953-54	1955-57	1958-60		
Saskatchewan	--	--	--	--	2.2	--	--	--		
Ontario	--	--	--	--	--	--	2.8	--		
Quebec	6.5	7.6	8.8	6.7	6.5	4.2	8.3	8.5		
Newfoundland	--	1.3	--	4.4	--	--	--	--		
New Brunswick	2.2	8.9	3.5	8.9	8.7	5.6	4.2	1.7		
P.E.I.	1.1	1.3	--	4.4	--	1.4	2.8	1.7		
Nova Scotia	3.3	6.3	5.3	8.9	8.7	5.6	2.8	1.7		
Canada	13.0	25.3	17.5	33.3	26.1	16.7	20.8	13.6		
Maine	10.9	12.7	14.0	8.9	6.5	18.1	5.6	5.1		
Vermont	1.1	1.3	--	--	--	--	--	--		
New Hampshire	6.5	2.5	10.5	--	4.3	2.8	1.4	3.4		
Massachusetts	64.1	53.2	54.4	53.3	60.9	59.7	41.7	44.1		
Connecticut	--	1.3	1.8	--	--	--	--	--		
Rhode Island	1.1	--	--	--	--	1.4	--	--		
New York	2.2	--	1.8	--	2.2	--	23.6	28.8		
Pennsylvania	--	--	--	--	--	--	--	1.7		
New Jersey	1.1	1.3	--	2.2	--	1.4	5.6	1.7		
Maryland	--	1.3	--	--	--	--	--	--		
Virginia	--	--	--	2.2	--	--	--	1.7		
North Carolina	--	1.3	--	--	--	--	--	--		
Atlantic Flyway	87.0	74.7	82.4	66.7	74.0	83.3	77.8	86.4		
North Dakota	--	--	--	--	--	--	1.4	--		
Central Flyway	--	--	--	--	--	--	1.4	--		
U.S. and Canada	100.1	100.3	100.1	99.9	100.0	100.2	100.2	100.1		
Total recoveries	92	79	57	45	46	72	72	59		

Table 39.1.1.--Chi-square test of homogeneity for data in table 39^{1/}

Recovery area	Period of recovery (hunting season)										Total recoveries
	1939-40	1941-42	1943-45	1946-49	1950-52	1953-54	1955-57	1958-60			
Canada	12	20	10	15 ^{1/}	12	12	15	8			104
Maine, Vermont & New Hampshire	17	13	14 ^{1/}	4	5	15	5 ^{1/}	5			78
Massachusetts	59 ^{1/}	42	31	24	28	43	30 ^{1/}	26			283
Remaining Atlantic Flyway	1 ^{1/}	4	2	2	1	2 ^{1/}	21 ^{2/}	20 ^{2/}			56
Total recoveries	92	79	57	45	46	72	71	59			521 ^{3/}

^{1/} Significant at the 95 percent level of probability.
^{2/} Significant at the 99 percent level of probability.
^{3/} No significant variation overall.

Table 40.--Percent distribution of direct recoveries of black ducks banded during winter in eastern Pennsylvania, (Shown for different recovery periods.)

Recovery location	Period of recovery (hunting season)					
	1953-54	1955	1956	1957	1958	1959
Manitoba	--	--	--	1.4	0.6	--
Ontario	6.1	13.2	5.7	10.8	5.4	5.4
Quebec	16.3	4.4	6.8	11.5	8.4	7.1
New Brunswick	--	--	0.6	0.7	--	--
P.E.I.	--	--	0.6	0.7	--	--
Nova Scotia	--	--	1.7	0.7	1.2	--
Canada	22.4	17.6	15.3	25.7	15.7	12.5
Maine	--	--	0.6	1.4	--	1.8
Vermont	--	--	--	2.0	1.2	--
New Hampshire	--	--	0.6	--	0.6	--
Massachusetts	2.0	1.5	1.7	0.7	1.8	--
Connecticut	--	--	1.1	0.7	--	--
Rhode Island	--	1.5	--	--	--	--
New York	4.1	4.4	8.0	2.7	4.2	14.3
Pennsylvania	44.9	54.4	50.6	40.5	44.0	35.7
New Jersey	14.3	7.4	13.6	12.8	16.9	23.2
Delaware	2.0	1.5	2.8	4.7	3.6	1.8
Maryland	8.2	8.8	2.3	6.1	9.6	7.1
Virginia	--	1.5	1.1	1.4	0.6	1.8
North Carolina	2.0	1.5	--	1.4	0.6	--
South Carolina	--	--	0.6	--	0.6	1.8
Atlantic Flyway	77.6	82.4	83.0	74.3	83.7	87.5
Ohio	--	--	0.6	--	0.6	--
Mississippi Flyway	--	--	0.6	--	0.6	--
North Dakota	--	--	1.1	--	--	--
Central Flyway	--	--	1.1	--	--	--
U.S. and Canada	99.9	100.1	100.1	100.2	99.9	100.0
Total recoveries	49	68	176	148	166	56
						41
						100.0

Table 40.1.1.--Chi-square test of homogeneity for data in table 40^{1/}

Recovery area	Period of recovery (hunting season)						Total recoveries
	1953-54	1955	1956	1957	1958	1959	
Canada	11	12	27	38 ^{2/}	26	7	127
North of Pennsylvania	3	5	21	11	13	9	67
Pennsylvania	22	37	89	60	73	20	323
South of Pennsylvania	13	14	36	39	53 ^{1/}	20	183
Total recoveries	49	68	173	148	165	56	700 ^{3/}

^{1/} Significant at the 95 percent level of probability.

^{2/} Significant at the 99 percent level of probability.

^{3/} No significant variation overall.

Table 41.--Percent distribution of direct recoveries for black ducks banded during winter in the Chesapeake Bay area of Maryland. (Shown for different recovery periods.)

Recovery location	Period of recovery (hunting season)				
	1951-55	1956-57	1958	1959	1960
Ontario	--	4.2	12.0	8.3	--
Quebec	5.5	7.0	8.0	8.3	3.9
New Brunswick	--	--	--	--	2.0
Canada	5.5	11.3	20.0	16.7	5.9
Maine	5.5	--	2.0	--	--
New Hampshire	--	--	--	2.8	--
Massachusetts	--	--	4.0	--	--
Rhode Island	--	--	--	--	2.0
New York	5.5	2.8	4.0	2.8	7.8
Pennsylvania	--	1.4	--	--	2.0
New Jersey	11.1	7.0	16.0	11.1	9.8
Delaware	--	7.0	6.0	--	2.0
Maryland	72.2	69.0	44.0	58.3	66.7
Virginia	--	1.4	2.0	5.5	2.0
Atlantic Flyway	94.4	88.7	78.0	80.6	92.1
Minnesota	--	--	--	2.8	2.0
Michigan	--	--	2.0	--	--
Mississippi Flyway	--	--	2.0	2.8	2.0
U.S. and Canada	99.8	99.8	100.0	99.9	100.2
Total recoveries	18	71	50	36	51

Table 41.1--Chi-square test of homogeneity for data in table 41^{1/}

Recovery area	Period of recovery (hunting season)					Total recoveries
	1951-55	1956-57	1958	1959	1960	
Canada	1	8	10	6	3	28
N. of Maryland & Virginia	4	13	16	6	12	51
Maryland & Virginia	13	50	23 ^{1/}	23	35	144
Total recoveries	18	71	49	35	50	223 ^{2/}

^{1/} Significant at the 99 percent level of probability.

^{2/} No significant variation overall.

Table 42.--Percent distribution of direct recoveries of black ducks banded during winter in southeastern Michigan.
(Shown for different recovery periods.)

Recovery location	Period of recovery (hunting season)									
	1942-49	1950	1951	1952-53	1954-55	1956	1957	1958	1959-60	
Manitoba	--	2.2	--	--	--	1.2	--	3.8	2.0	
Ontario	23.7	11.1	28.2	31.5	32.8	32.5	31.1	22.6	28.6	
Quebec	--	--	--	--	1.7	--	2.2	--	--	
New Brunswick	--	--	--	--	--	--	--	--	2.0	
Canada	23.7	13.3	28.2	31.5	34.5	33.7	33.3	26.4	32.6	
Vermont	2.6	--	--	--	--	--	--	--	--	
New York	--	--	1.2	1.9	--	--	--	1.9	--	
Pennsylvania	--	--	1.2	--	--	--	--	--	--	
West Virginia	--	--	--	--	1.7	--	--	3.8	--	
New Jersey	--	--	--	--	--	1.2	--	--	--	
Maryland	--	--	1.2	--	--	--	1.1	--	--	
North Carolina	2.6	--	--	1.9	--	1.2	--	--	--	
South Carolina	--	--	1.2	--	--	--	--	--	2.0	
Georgia	2.6	--	--	--	--	--	--	1.9	--	
Florida	--	--	--	--	--	--	--	1.9	--	
Atlantic Flyway	7.9	--	4.7	3.7	1.7	2.5	1.1	9.5	2.0	
Minnesota	2.6	2.2	1.2	--	1.7	1.2	1.1	--	2.0	
Wisconsin	2.6	2.2	1.2	--	1.7	--	--	1.9	--	
Michigan	57.9	66.7	54.1	51.9	37.9	47.5	35.6	34.0	42.9	
Illinois	--	--	--	--	--	1.2	--	--	2.0	
Indiana	--	--	2.4	--	--	1.2	--	1.9	--	
Ohio	5.3	8.9	7.1	1.9	20.7	11.2	18.9	24.5	14.3	
Kentucky	--	4.4	1.2	1.9	1.7	1.2	6.7	1.9	2.0	
Arkansas	--	--	--	1.9	--	--	--	--	--	
Tennessee	--	--	--	3.7	--	--	2.2	--	--	
Alabama	--	--	--	3.7	--	--	1.1	--	2.0	
Mississippi Flyway	68.4	84.4	67.2	64.8	63.8	63.7	65.6	64.2	65.2	
South Dakota	--	2.2	--	--	--	--	--	--	--	
Central Flyway	--	2.2	--	--	--	--	--	--	--	
U.S. and Canada	99.9	99.9	100.2	100.3	99.9	99.9	100.0	100.1	99.8	
Total recoveries	38	45	85	54	58	80	90	53	49	

Table 42.1--Chi-square test of homogeneity for data in table 42^{1/}.

Recovery area	Period of recovery (hunting season)										Total recoveries
	1942-49	1950	1951	1952-53	1954-55	1956	1957	1958	1959-60		
Canada & Atlantic Flyway	12	6 ^{1/}	28	19	21	29	31	19	17	182	
Michigan	22	30 ^{1/}	46	28	22	38	32 ^{2/}	18	21	257	
Remaining Miss. Flyway	4	8	11	7	15	13	27 ^{2/}	16	11	112	
Total recoveries	38	44	85	54	58	80	90	53	49	551 ^{3/}	

^{1/} Significant at the 99 percent level of probability.

^{2/} Significant at the 95 percent level of probability.

^{3/} Significant variation overall.

Table 43.--Retrieved hunting kill of black ducks in the United States, based on data from the Mail Questionnaire Survey - 1952-62.

Hunting season	Flyway			Total
	Atlantic	Mississippi	Central	
1952	276,309	316,122	<u>1/</u>	592,431
1953	191,264	204,860	<u>1/</u>	396,124
1954	304,512	164,798	1,433	470,743
1955	407,264	252,250	2,539	662,053
1956	344,725	218,510	2,462	563,235
1957	288,311	177,943	2,324	468,578
1958	268,081	217,372	901	486,354
1959	177,488	125,141	1,320	303,949
1960	250,500	133,300	<u>1/</u>	383,800
1961	201,100	62,100	2,000	265,200
1962	223,100	43,200	500	266,800
Average ^{2/} 1952-60 ^{2/}	278,717	201,144	1,830 ^{3/}	480,807

^{1/}Data not available.

^{2/}Data for 1961 and 1962 omitted from average to facilitate comparisons with recovery data, little of which is derived from birds banded in these years.

^{3/}Central Flyway average for 1954-59 only.

Table 44.--Percent of ducks of all species shot down by hunters but not retrieved as reported in the Mail Questionnaire Survey

Hunting season	Flyway		
	Atlantic	Mississippi	Central
1955	19.2	18.4	15.1
1956	23.4	18.7	14.0
1957	18.2	19.7	15.0
1958	19.8	18.4	15.3
1959	19.0	20.4	12.6
1960	25.8	26.2	25.1
1961	23.5	24.6	22.9
1962	20.0	23.9	23.1

Table 45.--Annual kill and rate of kill of black ducks in the United States compared with hunter numbers, season length, and black duck population levels.

Year	Season length	Number of hunters ^{1/} (in thousands)	Estimate ^{2/} annual kill ^{2/} (in thousands)	Post-season season population ^{3/} (in thousands)	Preseason population index ^{4/} (in thousands)	Kill rate index ^{5/}
1952	55	565	592	753	1345	.44
1953	55	585	396	654	1050	.38
1954	55	572	471	805	1276	.37
Average 1952-54	55	574	486	737	1311	.37
1955	70	633	662	672	1334	.50
1956	70	614	563	668	1231	.46
1957	70	574	469	552	1021	.46
1958	60-70	520	486	513	999	.49
Average 1955-58	70	585	545	601	1146	.48
1959	40-50	392	304	557	861	.35
1960	40-50	445	384	498	882	.44
1961	20-50	359	265	458	723	.37
1962	25-50	326	267	483	750	.36
Average 1959-62	20-50	380	305	499	804	.38

^{1/}Based on duck stamp sales in important States as shown in table 12.

^{2/}From Mail Questionnaire Survey (see table 43)

^{3/}As revealed by the mid-winter survey.

^{4/}Estimated kill plus post-hunting population.

^{5/}Estimated kill divided by preseason population index.

Table 46.--First-hunting-season band recovery rates for immature black ducks, and population index values during the three different periods.

Banding location	Periods					
	1952-1954		1955-1958		1959-1963	
	Bandings	Recovery rates	Bandings	Recovery rates	Bandings	Recovery rates
Quebec	371	.148	833	.119	568	.123
Maine	2440	.125	3401	.139	3715	.093
Vermont	753	.179	2103	.165	2026	.112
New York	1189	.115	393	.125	5554	.110
Chesapeake Bay	1084	.085	1609	.100	104	.096
Ontario	456	.074	2560	.146	2207	.122
Michigan	692	.080	537	.123	1386	.095
Average recovery rate		.115		.131		.107
Average retrieved kill in United States	486,000		545,000		305,000	
Pre-season population index value	4226		4160		2850	

Table 47.--Monthly and seasonal percentages of adult black duck kill derived from populations wintering in the State or Province of harvest. Based on recoveries from winter bandings, 1946-1960^{1/}

State or Province of harvest	Percent of monthly adult kill					Percent of seasonal kill
	Sept.	Oct.	Nov.	Dec.	Jan.	
<u>Canada</u>						
P.E.I.	62.5	45.1	46.5	44.4	--	51.1
Nova Scotia	--	53.6	66.0	78.4	71.4	68.7
<u>Atlantic Flyway</u>						
Maine	--	34.6	71.6	73.2	--	55.8
Massachusetts	--	53.6	55.7	61.6	86.0	60.8
Connecticut	--	27.3	52.3	68.0	92.9	61.6
Rhode Island	--	--	85.2	67.0	76.4	73.5
New York	--	24.4	54.1	63.7	78.9	53.8
Pennsylvania	--	55.4	34.0	44.7	--	45.8
New Jersey	--	--	63.0	74.4	75.0	66.6
Delaware	--	--	34.0	54.6	34.2	43.0
Maryland	--	--	84.2	87.4	82.6	86.5
Virginia	--	--	41.3	48.8	65.4	53.2
North Carolina	--	--	41.3	85.5	72.4	66.0
South Carolina	--	--	58.0	81.4	94.8	70.2
<u>Mississippi Flyway</u>						
Michigan	--	13.1	26.3	67.4	--	28.5
Illinois	--	89.5	50.0	48.5	--	43.6
Indiana	--	--	97.7	42.5	--	55.0
Ohio	--	77.5	70.4	50.6	--	69.0
Tennessee	--	--	94.8	85.8	49.4	76.5
Alabama	--	--	100.0	22.0	71.1	27.5

^{1/} Seasonal percentages based on less than 20 recoveries and monthly percentages based on less than 10 recoveries are omitted.

Table 48.--Summer reference area sources of the black duck kill for States and Provinces in major harvest areas.
(Shown as percentages of weighted band recoveries in harvest areas, from bandings in summer reference areas for the period 1946-1960.)

Harvest area	Summer Reference Area						
	Maritimes	Lab. & E. Quebec	N. Quebec	S. Quebec	St. John & St. Croix Riv.	W. Maine	Vermont & N.H.
Maritimes							
Newfoundland	89.4	10.6	--	--	--	--	--
Nova Scotia	60.4	26.0	9.5	2.5	0.8	0.5	--
P.E.I.	29.6	67.7	--	--	0.2	2.3	--
New Brunswick	18.2	37.4	--	6.3	33.4	4.0	0.2
Harvest area percentage	49.3	31.8	6.3	3.0	7.9	1.4	0.1
Reference area percentage	(76.1) ^{1/}	(34.8)	(2.2)	(0.9)	(30.7)	(4.5)	(0.5)
Coastal New England							
Maine	1.8	30.0	--	21.5	8.6	32.8	3.8
New Hampshire	--	4.1	--	37.9	2.2	11.9	35.4
Massachusetts	13.8	23.6	14.6	28.2	6.7	6.0	1.0
Rhode Island	12.3	13.9	--	37.6	8.8	10.2	2.5
Harvest area percentage	8.5	24.2	6.7	27.1	7.5	17.0	3.6
Reference area percentage	(12.3)	(24.7)	(2.2)	(7.2)	(27.4)	(49.9)	(29.9)
Mid-Atlantic							
Connecticut	--	7.1	75.7	8.5	1.3	1.3	1.0
Long Island	1.8	9.8	51.6	23.0	3.0	4.5	1.1
New Jersey	2.2	9.4	31.6	35.0	3.1	3.4	1.4
Pennsylvania	--	--	66.2	14.0	0.2	0.9	0.4
Delaware	2.0	3.1	57.3	21.4	0.9	2.0	0.6
Maryland	0.6	2.2	44.5	28.3	1.4	1.3	1.0
Virginia	--	11.1	47.6	16.0	1.4	1.8	0.5
Harvest area percentage	1.2	6.8	46.8	25.3	2.0	2.5	1.0
Reference area percentage	(8.7)	(34.1)	(76.3)	(32.8)	(36.2)	(36.3)	(41.5)
Carolinas							
North Carolina	3.8	11.4	--	42.5	2.4	2.8	0.8
South Carolina	--	13.3	--	35.0	0.7	1.4	0.2
Harvest area percentage	2.1	12.2	--	39.2	1.7	2.2	0.6
Reference area percentage	(1.2)	(5.0)	(0.0)	(4.1)	(3.4)	(2.5)	(1.8)
Labrador-Quebec							
Labrador	--	--	--	94.1	1.2	2.8	1.9
Quebec	T	0.7	12.0	83.2	0.1	0.6	0.5
Harvest area percentage	T	0.7	11.9	83.3	0.2	0.6	0.5
Reference area percentage	(0.1)	(1.5)	(8.1)	(45.5)	(1.2)	(3.8)	(8.2)
Vermont-New York							
Vermont	--	--	--	64.2	--	2.1	16.1
New York (except L.I.)	1.5	--	--	43.3	1.5	0.8	1.2
Harvest area percentage	1.2	--	--	47.8	1.2	1.1	4.4
Reference area percentage	(0.8)	(0.0)	(0.0)	(5.9)	(2.0)	(1.5)	(17.1)
Ontario							
Ontario	T	--	--	6.1	T	0.2	0.1
Harvest area percentage	T	--	--	6.1	T	0.2	0.1
Reference area percentage	(T)	(0.0)	(0.0)	(2.0)	(0.1)	(0.6)	(0.6)
Interior							
Michigan	--	--	17.5	--	--	--	--
Illinois	--	--	--	12.3	--	0.2	--
Indiana	--	--	--	12.6	--	0.2	--
Ohio	--	--	53.2	--	--	0.1	--
Missouri	--	--	--	--	--	--	4.4
Kentucky	--	--	--	--	--	--	--
West Virginia	--	--	--	--	--	--	--
Arkansas	--	--	--	24.0	--	--	--
Tennessee	--	--	--	--	--	--	--
Louisiana	--	--	--	--	--	--	--
Mississippi	--	--	--	--	--	--	--
Alabama	--	--	--	--	--	--	--
Georgia	--	--	--	--	2.8	3.2	--
Florida	12.0	--	--	3.6	--	2.8	--
Harvest area percentage	0.3	--	19.8	3.5	T	0.1	T
Reference area percentage	(0.8)	(0.0)	(11.1)	(1.6)	(0.1)	(0.7)	(0.3)
Wisconsin							
Wisconsin	--	--	--	--	--	--	--
Harvest area percentage	--	--	--	--	--	--	--
Reference area percentage	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)
Minnesota-Iowa							
Minnesota	--	--	--	--	--	1.1	--
Iowa	--	--	--	--	--	--	--
Harvest area percentage	--	--	--	--	--	0.8	--
Reference area percentage	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.1)	(0.0)
Reference area totals	(100.0)	(100.1)	(99.9)	(100.0)	(100.1)	(99.9)	(99.9)

Table 48.--Summer reference area sources of the black duck kill for States and Provinces in major harvest areas.
(Shown as percentages of weighted band recoveries in harvest areas, from bandings in summer reference
areas for the period 1946-1960.)--continued

Harvest area	Summer Reference Area						
	Coastal Mass.	S. New Eng. & L. I.	Lake Champlain	Chesapeake & Delaware Bays	E. Lake Ontario	W. Lake Ontario	W. James Bay
<u>Maritimes</u>							
Newfoundland	--	--	--	--	--	--	--
Nova Scotia	T	T	T	T	T	--	0.2
P.E.I.	T	T	--	0.1	--	--	--
New Brunswick	0.1	0.2	T	T	T	--	--
Harvest area percentage	T	0.1	T	T	T	--	0.1
Reference area percentage	(1.8)	(0.9)	(0.3)	(0.2)	(0.1)	(0.0)	(0.3)
<u>Coastal New England</u>							
Maine	0.2	0.6	0.1	0.2	T	--	0.4
New Hampshire	1.6	0.5	0.5	--	0.6	5.3	--
Massachusetts	2.7	1.9	0.2	0.5	0.1	--	0.6
Rhode Island	0.5	6.7	0.1	--	0.1	7.2	--
Harvest area percentage	1.5	1.9	0.2	0.3	0.1	1.1	0.4
Reference area percentage	(82.5)	(32.5)	(2.8)	(1.9)	(0.3)	(0.8)	(0.9)
<u>Mid-Atlantic</u>							
Connecticut	0.1	3.5	0.2	T	0.1	1.1	--
Long Island	0.1	1.6	0.4	T	0.1	1.3	1.7
New Jersey	T	0.3	0.5	4.4	0.7	3.1	4.8
Pennsylvania	T	0.1	0.3	0.9	1.2	8.1	4.0
Delaware	T	0.3	0.6	2.7	0.6	3.8	4.3
Maryland	T	0.3	0.2	6.4	2.5	6.5	4.1
Virginia	T	0.5	0.4	1.7	2.8	8.6	5.1
Harvest area percentage	T	0.7	0.4	3.2	1.2	4.5	3.8
Reference area percentage	(12.8)	(60.9)	(31.6)	(95.9)	(14.7)	(15.8)	(43.5)
<u>Carolinas</u>							
North Carolina	T	0.5	0.2	T	1.4	20.4	7.7
South Carolina	--	--	0.4	0.2	5.6	20.1	10.5
Harvest area percentage	T	0.3	0.3	0.1	3.2	20.2	8.9
Reference area percentage	(0.5)	(1.8)	(2.2)	(0.3)	(3.2)	(5.9)	(8.3)
<u>Labrador-Quebec</u>							
Labrador	--	--	--	--	--	--	--
Quebec	T	0.1	0.3	T	1.0	0.8	0.6
Harvest area percentage	T	0.1	0.3	T	0.9	0.8	0.6
Reference area percentage	(1.6)	(2.5)	(10.6)	(0.3)	(4.9)	(1.3)	(2.8)
<u>Vermont-New York</u>							
Vermont	T	T	16.7	0.1	0.7	--	--
New Ynrk (except L.I.)	T	0.1	3.3	0.1	19.8	17.0	8.3
Harvest area percentage	T	0.1	6.2	0.1	15.7	13.4	6.5
Reference area percentage	(0.6)	(0.8)	(49.3)	(0.2)	(18.4)	(4.6)	(7.1)
<u>Ontario</u>							
Ontario	T	T	0.1	0.1	17.3	60.2	7.8
Harvest area percentage	T	T	0.1	0.1	17.3	60.2	7.8
Reference area percentage	(0.1)	(0.5)	(2.0)	(0.9)	(55.2)	(56.0)	(23.1)
<u>Interior</u>							
Michigan	--	--	T	--	0.1	6.7	0.6
Illinois	--	--	--	0.1	--	5.5	--
Indiana	--	--	T	--	0.3	13.0	2.3
Ohio	--	--	--	T	0.2	11.2	5.7
Missouri	--	--	--	--	--	28.8	--
Kentucky	--	--	--	--	11.1	20.7	4.7
West Virginia	--	--	0.2	--	1.2	40.9	--
Arkansas	--	--	0.1	--	0.2	24.9	--
Tennessee	--	--	--	--	1.1	22.8	15.7
Louisiana	--	--	--	--	0.6	43.4	--
Mississippi	--	--	--	--	0.4	31.4	7.8
Alabama	--	--	--	--	1.3	13.9	2.8
Georgia	--	--	--	0.1	10.8	53.6	--
Florida	T	0.1	0.9	--	2.1	15.5	14.9
Harvest area percentage	T	T	T	T	0.7	12.3	3.5
Reference area percentage	(0.1)	(0.1)	(1.0)	(0.2)	(3.1)	(15.1)	(13.9)
<u>Wisconsin</u>							
Wisconsin	--	--	--	T	0.1	2.9	--
Harvest area percentage	--	--	--	T	0.1	2.9	--
Reference area percentage	(0.0)	(0.0)	(0.0)	(T)	(T)	(0.5)	(0.0)
<u>Minnesota-Iowa</u>							
Minnesota	--	--	--	--	0.4	2.3	--
Iowa	--	--	--	--	--	--	--
Harvest area percentage	--	--	--	--	0.3	1.6	--
Reference area percentage	(0.0)	(0.0)	(0.0)	(0.0)	(T)	(T)	(0.0)
Reference area totals	(100.0)	(100.0)	(99.8)	(99.9)	(99.9)	(100.0)	(99.9)

Table 48.--Summer reference area sources of the black duck kill for States and Provinces in major harvest areas.
(Shown as percentages of weighted band recoveries in harvest areas, from bandings in summer reference areas for the period 1946-1960.)--continued

Harvest area	Summer Reference Area					State & Harvest area totals	Percent of continental kill occurring in harvest area
	Upper Great Lakes	W. Lake Erie	E. Lake Michigan	W. Lake Michigan	Upper Miss. River		
Maritimes							
Newfoundland	--	--	--	--	--	100.0	
Nova Scotia	--	--	--	--	--	99.9	
P.E.I.	--	--	--	--	--	99.9	
New Brunswick	--	--	--	--	--	99.8	
Harvest area percentage	--	--	--	--	--	100.0	8.1
Reference area percentage	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)		
Coastal New England							
Maine	--	--	--	--	--	100.0	
New Hampshire	--	--	--	--	--	100.0	
Massachusetts	--	--	--	--	--	99.9	
Rhode Island	--	--	--	--	--	99.9	
Harvest area percentage	--	T	--	--	--	100.1	7.6
Reference area percentage	(0.0)	(T)	(0.0)	(0.0)	(0.0)		
Mid-Atlantic							
Connecticut	--	T	--	--	--	99.9	
Long Island	--	--	--	--	--	100.0	
New Jersey	--	--	--	--	--	99.9	
Pennsylvania	1.9	1.8	--	--	--	100.0	
Delaware	0.3	0.1	--	--	--	100.0	
Maryland	0.5	0.1	--	--	--	99.9	
Virginia	1.0	1.5	--	--	--	100.0	
Harvest area percentage	0.4	0.3	--	--	--	100.1	37.4
Reference area percentage	(1.9)	(7.7)	(0.0)	(0.0)	(0.0)		
Carolinas							
North Carolina	6.0	0.1	--	--	--	100.0	
South Carolina	6.7	5.0	0.3	0.6	--	100.0	
Harvest area percentage	6.3	2.2	0.1	0.3	--	99.9	3.0
Reference area percentage	(2.8)	(4.4)	(0.4)	(0.6)	(0.0)		
Labrador-Quebec							
Labrador	--	--	--	--	--	100.0	
Quebec	--	--	--	--	--	99.9	
Harvest area percentage	--	--	--	--	--	99.9	15.7
Reference area percentage	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)		
Vermont-New York							
Vermont	--	--	--	--	--	100.0	
New York (except L.I.)	2.9	0.2	--	--	--	100.0	
Harvest area percentage	2.3	0.2	--	--	--	100.2	3.6
Reference area percentage	(1.2)	(0.4)	(0.0)	(0.0)	(0.0)		
Ontario							
Ontario	3.6	4.0	0.2	0.2	--	99.9	
Harvest area percentage	3.6	4.0	0.2	0.2	T	99.9	9.7
Reference area percentage	(5.1)	(25.3)	(1.6)	(1.6)	(1.6)		
Interior							
Michigan	43.6	11.5	17.6	2.3	--	99.9	
Illinois	63.5	0.1	0.9	12.8	4.7	100.1	
Indiana	58.4	2.3	7.0	2.8	1.1	100.0	
Ohio	22.8	4.9	1.4	0.3	0.2	100.0	
Missouri	34.5	--	--	25.7	6.5	99.9	
Kentucky	46.0	5.6	--	9.3	2.5	99.9	
West Virginia	49.9	0.9	--	6.8	--	99.9	
Arkansas	41.7	--	--	8.3	0.8	100.0	
Tennessee	47.2	8.4	--	4.0	0.7	99.9	
Louisiana	48.1	4.7	3.3	--	--	100.1	
Mississippi	58.1	2.2	--	--	--	99.9	
Alabama	51.2	28.5	--	2.3	--	100.1	
Georgia	29.7	--	--	--	--	100.1	
Florida	17.9	0.2	--	--	--	100.0	
Harvest area percentage	41.0	7.3	7.6	3.2	0.6	99.9	12.8
Reference area percentage	(76.8)	(61.3)	(97.2)	(27.2)	(34.1)		
Wisconsin							
Wisconsin	37.6	0.1	0.4	56.3	2.6	100.0	
Harvest area percentage	37.6	0.1	0.4	56.3	2.6	100.0	1.9
Reference area percentage	(10.3)	(0.1)	(0.8)	(70.7)	(20.3)		
Minnesota-Iowa							
Minnesota	39.9	6.7	--	--	49.5	99.9	
Iowa	74.3	--	--	--	25.7	100.0	
Harvest area percentage	50.8	4.6	--	--	42.0	100.1	0.3
Reference area percentage	(1.9)	(0.8)	(0.0)	(0.0)	(43.9)		
Reference area totals	(100.0)	(100.0)	(100.0)	(100.1)	(99.9)		100.1

1/ Numbers in parentheses show the percent distribution among harvest areas of total recoveries from each summer reference area.

Table 51.--Summer reference area sources of the black duck kill by month in Coastal and Interior New England harvest zones, based on weighted band recoveries. (Shown as percent of weighted recoveries in each harvest zone.)

Summer banding area source	Month of Kill							
	October		November		December		January	
	Coastal	Interior	Coastal	Interior	Coastal	Interior	Coastal	Interior
Maritimes	7.6	2.7	2.3	0.2	10.6	0.4	11.9	--
Labrador & E. Quebec	17.8	10.3	8.3	40.4	14.6	58.3	26.2	49.7
N. Quebec	--	--	26.2	--	53.2	--	--	--
S. Quebec	33.5	29.1	43.9	17.9	8.2	--	36.8	--
St. John & St. Croix Rivers	12.9	3.8	3.7	7.8	4.4	21.1	9.7	11.9
W. Maine	18.2	38.4	7.3	18.5	4.0	11.4	6.8	23.7
Vermont and New Hampshire	1.3	13.1	1.2	7.2	0.7	3.6	5.1	--
Coastal Massachusetts	5.1	0.2	2.2	0.6	0.4	0.5	0.7	1.1
S. New England & Long Island	0.6	1.6	3.2	5.5	1.1	3.8	2.7	13.6
Lake Champlian	0.1	0.3	0.1	0.3	0.1	0.2	0.1	--
Chesapeake & Delaware Bays	0.1	0.3	0.5	--	0.1	0.4	--	--
E. Lake Ontario	0.5	0.1	0.2	--	0.1	0.2	--	--
W. Lake Ontario	2.4	--	0.9	--	1.9	--	--	--
W. James Bay	--	--	--	1.6	0.5	--	--	--
Total	100.0	99.9	100.0	100.0	99.9	99.9	100.0	100.0
Percent monthly New England kill in each zone	27.6	72.4	75.5	24.5	92.2	7.8	93.6	6.4

Table 52.--Average annual mortality rates, calculated by two different methods, for black ducks banded in summer areas of reference.--continued

Minor reference area of banding	Span of years	Sex and age	Band period	Mortality rate				Number of recoveries used for mortality estimate							
				Relative recovery		Composite dynamic method		Relative recovery		Composite dynamic method					
				1st year	2nd year	1st year	2nd year	1st year	2nd year	1st year	2nd year				
Vermont and New Hampshire	1955-60	Su	Imm	.775	.525	.710	.429	.386	.571	179	32	136	20	30	166
	1955-60	Su	Imm	.764	.417	.748	.477	.515	.675	174	37	161	20	37	198
Coastal Mass., Massachusetts	1946-53	Su	Imm	.728	.548	.664	.499	.462	.580	571	207	333	84	168	501
	1944-53	Su	Ad	.528	--	.513	.424	.359	.424	148	--	62	23	53	115
	1945-54	Oct	Imm	--	--	.668	.424	.318	.489	--	--	209	44	98	307
	1945-54	Oct	Ad	--	--	.483	.343	.326	.387	--	--	98	36	102	200
	1931-42	Su	Ad	.643	--	.699	.452	.397	.569	126	--	72	14	31	103
1931-42	Oct	Ad	--	--	.673	--	.472	.591	--	--	35	--	17	52	
S. New England & Long Island Connecticut	1949-53	Su	Imm	.654	.490	.636	.500	.500	.593	158	62	84	22	44	128
	1945-53	Oct	Imm	--	--	.541	--	.362	.440	--	--	20	--	17	37
	1933 only	Oct	Ad	--	--	.843	--	.345	.698	--	--	59	--	11	70
	1950-53	Su	Imm	.677	--	.597	--	.354	.468	52	--	30	--	17	47
Massachusetts	1950-53	Oct	Imm	--	--	.600	--	.333	.463	--	--	12	--	8	20
	1949-52	Su	Imm	.639	.544	.582	.521	.473	.532	200	104	99	37	71	170
	1949-52	Oct	Imm	--	--	.604	--	.358	.481	--	--	32	--	21	53
	1926-27	Su	Imm	--	--	.800	--	.375	.679	--	--	16	--	4	20
Lake Champlain New York	1926-38	Su	Ad	--	--	.533	--	.591	.538	--	--	16	--	14	30
	1949-60	Su	Imm	.640	.517	.646	.532	.451	.560	99	37	52	15	27	73
Vermont	1949-60	Su	Ad	.335	--	.355	.540	.569	.421	79	--	18	17	31	49
	1947-60	Oct	Imm	--	--	.471	.465	.343	.393	--	--	55	26	57	112
	1948-60	Oct	Ad	--	--	.411	.365	.366	.384	--	--	42	22	58	100
	1948-60	Su	Imm	.764	.475	.716	.427	.346	.549	799	206	519	82	146	665
	1946-60	Su	Ad	.642	--	.603	.439	.310	.446	78	--	41	11	20	61
1946-56	Oct	Imm	--	--	.622	--	.329	.466	--	--	36	--	21	57	
1946-54	Oct	Ad	--	--	.529	--	.315	.401	--	--	27	--	24	51	
1942-44	Oct	Ad	--	--	.424	.632	.432	.429	--	--	14	12	19	33	

Table 52.--Average annual mortality rates, calculated by two different methods, for black ducks banded in summer areas of reference.--Continued

Minor reference areas of banding	Span of years	Sex and age	Mortality rate						Number of recoveries used for mortality estimate								
			Relative recovery rate method			Composite dynamic method			Relative recovery rate method			Composite dynamic method					
			1st year	2nd year	All years	1st year	2nd year	All years	1st year	2nd year	All years	1st year	2nd year	All years			
<u>W. Lake Erie Michigan</u>																	
	1949-60	Su	.619	.424	.624	.460	.548	.448	.548	.448	.548	.448	40	63	14	27	90
	1949-60	Su	.571	--	.586	.471	.530	.463	.530	.463	.530	.463	--	38	12	25	63
	1936-38	Oct	--	--	.348	--	.307	.289	.307	.289	.307	.289	--	8	--	15	23
<u>Ohio</u>																	
	1950-60	Su	.551	.447	.542	.457	.446	.370	.446	.370	.446	.370	54	47	18	38	85
	1950-60	Su	.224	--	.250	.373	.332	.332	.332	.332	.332	.332	--	31	14	37	50
	1950-60	Oct	--	--	.750	--	.634	.434	.634	.434	.634	.434	--	31	--	10	41
	1950-60	Oct	--	--	.554	--	.407	.306	.407	.306	.407	.306	--	14	--	11	25
<u>E. Lake Michigan Indiana</u>																	
	1950-59	Su	--	--	.739	--	.682	.539	.682	.539	.682	.539	--	18	--	6	24
<u>Michigan</u>																	
	1949-60	Su	.764	--	.762	--	.758	.741	.758	.741	.758	.741	--	44	--	12	56
	1948-60	Oct	--	--	.361	--	.356	.354	.356	.354	.356	.354	--	11	--	17	28
	1948-60	Oct	--	--	.362	--	.355	.351	.355	.351	.355	.351	--	13	--	20	33
<u>W. Lake Michigan Illinois</u>																	
	1930-43	Su	.723	.689	.730	.676	.653	.507	.653	.507	.653	.507	43	92	23	34	126
	1931-42	Su	.541	--	.439	.391	.410	.389	.410	.389	.410	.389	--	36	18	46	82
	1931-43	Oct	--	--	.469	.471	.474	.479	.474	.479	.474	.479	--	30	16	34	64
	1931-43	Oct	--	--	.333	.324	.367	.386	.367	.386	.367	.386	--	17	11	34	51
<u>W. Lake Michigan Indiana</u>																	
	1946-47	Su	.196	--	.286	--	.261	.253	.261	.253	.261	.253	--	10	--	25	35
	1946-53	Oct	--	--	.443	--	.386	.350	.386	.350	.386	.350	--	20	--	25	45
	1946-52	Oct	--	--	.160	--	.223	.244	.223	.244	.223	.244	--	4	--	21	25
	1941-45	Su	.644	.559	.634	.486	.483	.333	.483	.333	.483	.333	56	64	18	37	101
	1940-47	Su	--	--	.486	--	.500	.514	.500	.514	.500	.514	--	17	--	17	34
<u>Indiana</u>																	
	1938-45	Oct	--	--	.496	.400	.451	.414	.451	.414	.451	.414	--	69	28	70	139
	1938-45	Oct	--	--	.427	.400	.385	.359	.385	.359	.385	.359	--	56	30	75	131
<u>Wisconsin</u>																	
	1954-49	Su	--	--	.391	--	.425	.481	.425	.481	.425	.481	--	8	--	12	20
	1952-59	Oct	--	--	.317	.527	.426	.507	.426	.507	.426	.507	--	15	17	26	41
	1947-51	Su	.561	.123	.675	.452	.568	.424	.568	.424	.568	.424	44	69	15	33	102
	1948-51	Su	.275	--	.381	--	.749	.749	.540	.749	.540	.749	--	8	--	13	21
	1946-51	Oct	--	--	.560	--	.511	.455	.511	.455	.511	.455	--	14	--	11	25
<u>Northwest Minnesota</u>																	
	1930-39	Oct	--	--	.692	--	.578	.421	.578	.421	.578	.421	--	18	--	8	26
<u>Minnesota</u>																	
	1949-60	Su	.130	--	.214	.357	.325	.382	.325	.382	.325	.382	--	10	11	28	38
	1949-60	Su	--	--	.715	--	.591	.411	.591	.411	.591	.411	--	18	--	5	23
	1949-60	Su	.638	--	.632	--	.578	.491	.578	.491	.578	.491	--	29	--	15	44

1/ May through September or to the beginning of the hunting season if earlier than Oct. 1.

2/ The month of October or from the beginning of the hunting season through Oct. 31.

Table 53.--Average annual mortality rates, calculated by two different methods, for black ducks banded in winter areas of reference.

Minor reference areas of banding	Span of Years	Banding period	Sex	Relative recovery rate method			Mortality rate			Relative recovery rate method			Number of recoveries used for mortality estimate				
				1st year		2nd year	1st year		2nd year	1st year		2nd year	1st year		2nd year	Composite dynamic method	
				rate	method	rate	method	rate	method	rate	method	rate	method	rate	method	rate	method
Maritimes Prince Edward Island	1953-60	Jan. 16-Feb.	Male	.369	.364	--	.184	.261	69	40	--	--	17	57			
	1953-60	Jan. 16-Feb.	Female	.381	.544	--	.453	.498	51	34	--	--	13	47			
	1953-60	Mar.-April	Male	--	.240	--	.349	.308	--	6	--	--	15	21			
	1949-60	Jan. 16-Feb.	Male	--	.825	--	.304	.635	--	25	--	--	2	27			
	1945-60	Mar.-April	Male	--	.334	--	.424	.389	--	12	--	--	15	27			
	1949-53	Nov.	Male	--	.428	--	.417	--	--	35	--	--	22	46			
	1949-53	Nov.	Female	--	.470	--	.600	--	--	31	--	--	21	35			
	1949-53	Dec.	Male	--	.182	--	.528	--	--	8	--	--	19	36			
	1948-53	Dec.	Female	--	.308	--	.400	--	--	8	--	--	18	18			
	1949-58	Jan. 16-Feb.	Male	.274	.329	.396	.303	.311	133	36	29	61	97				
1949-58	Jan. 16-Feb.	Female	.613	.630	--	.423	.533	38	20	--	--	11	31				
1949-57	Mar.-April	Male	--	.310	.509	.322	.318	--	15	17	29	44					
1933-48	Nov.	Male	--	.673	--	.400	--	--	37	--	--	18	--				
1933-48	Dec.	Male	--	.300	--	.400	--	--	14	--	--	14	--				
1934-38	Mar.-April	Male	--	.500	--	.306	.378	--	16	--	--	16	32				
Massachusetts	1949-53	Nov.	Male	--	.308	--	.428	--	--	8	--	--	18	--			
	1949-53	Dec.	Male	--	.209	.422	.308	--	15	24	56	35	--				
	1949-52	Dec.	Female	--	.385	--	.600	--	--	10	--	--	16	--			
	1946-60	Jan. 16-Feb.	Male	.380	.280	.309	.324	.310	261	48	37	116	164				
	1946-60	Jan. 16-Feb.	Female	.387	.359	--	.268	.296	52	15	--	24	39				
	1952-53	Mar.-April	Male	--	.422	--	.345	.374	--	22	--	--	30	52			
	1928-48	Nov.	Male	--	.323	.289	.298	--	--	76	46	159	--				
	1928-49	Nov.	Female	--	.394	.523	.439	--	--	86	69	132	--				
	1928-48	Dec.	Male	--	.120	.323	.295	--	--	42	99	304	--				
	1928-48	Dec.	Female	--	.175	.494	.463	--	--	33	77	156	--				
	1929-48	Jan. 1-15	Male	--	.390	.217	.180	.228	--	91	31	110	201				
	1930-45	Jan. 1-15	Female	--	.560	.375	.367	.455	--	51	15	40	91				
	1929-45	Jan. 16-Feb.	Male	.324	.334	.349	.325	.328	538	108	75	215	323				
1929-45	Jan. 16-Feb.	Female	.548	.545	.384	.457	.384	195	73	41	134	61					
1932-46	Mar.-April	Male	--	.398	.347	.336	.358	--	78	28	118	196					
1932-46	Mar.-April	Female	--	.371	.487	.434	.407	--	23	19	39	62					
New York	1947-51	Nov.	Male	--	.385	.417	.405	--	30	20	48	--					
	1947-51	Nov.	Female	--	.581	--	.424	--	25	--	18	--					
	1947-52	Dec.	Male	--	.062	.426	.425	--	9	58	136	--					
	1947-52	Dec.	Female	--	.082	.436	.429	--	7	34	78	--					
	1948-59	Jan. 1-15	Male	--	.503	.338	.380	.435	--	45	15	35	80				
	1948-59	Jan. 1-15	Female	--	.533	.443	.473	.503	--	31	12	21	52				
	1948-60	Jan. 16-Feb.	Male	.357	.381	.381	.404	.395	513	144	78	186	330				
	1948-60	Jan. 16-Feb.	Female	.461	.439	.396	.291	.342	275	103	44	86	189				
	1948-60	Mar.-April	Male	--	.472	.257	.352	.400	--	94	26	77	171				
	1948-60	Mar.-April	Female	--	.507	.453	.484	.495	--	28	12	23	51				
1927-40	Jan. 16-Feb.	Male	.279	.364	.714	.588	.478	49	12	15	21	33					
1928-40	Jan. 16-Feb.	Female	.265	.360	--	.727	.532	38	9	--	14	23					

Table 53.--Average annual mortality rates, calculated by two different methods, for black ducks banded in winter areas of reference.--continued

Minor reference areas of banding	Span of year	Banding period	Sex	Mortality rate				Number of recoveries used for mortality estimate					
				Relative recovery rate method		Composite dynamic method		Relative recovery rate method		Composite dynamic method			
				1st year	2nd year	1st year	All years	1st year	2nd year	1st year	2nd year	All years	
<u>New England & E. Long Is. (con)</u>													
Rhode Island													
	1954-60	Nov.	Male	.330	.554	.476	--	--	--	17	19	32	--
	1954-60	Nov.	Female	.461	.533	.478	--	--	--	21	13	22	--
	1954-58	Dec.	Male	.193	.382	.411	--	--	--	14	24	52	--
	1954-58	Dec.	Female	.481	.632	.569	--	--	--	25	17	26	--
	1952-60	Jan. 16-Feb.	Male	.380	.335	.350	.066	.42	.350	19	--	17	36
	1952-60	Jan. 16-Feb.	Female	.406	.432	.419	--	--	.419	10	--	10	20
	1952-60	Mar.-April	Male	.328	.384	.249	--	--	.276	16	11	19	35
<u>W. Long Is. & Hudson River</u>													
New York													
	1948-60	Nov.	Male	.333	.484	.415	--	--	--	67	63	127	--
	1948-60	Nov.	Female	.365	.460	.465	--	--	--	61	47	100	--
	1947-60	Dec.	Male	.180	.404	.409	--	--	--	10	18	43	--
	1947-60	Dec.	Female	.087	.467	.454	--	--	--	3	14	29	--
	1948-60	Jan. 1-15	Male	.196	--	.479	.373	--	--	5	--	18	23
	1948-60	Jan. 16-Feb.	Male	.311	.459	.388	.376	.97	.376	32	25	42	74
	1948-60	Jan. 16-Feb.	Female	.351	.389	.398	.394	.34	.394	12	--	14	26
	1948-60	Mar.-April	Male	.400	.346	.352	.373	--	--	26	13	28	54
	1945-47	Nov.	Male	.402	.239	.267	--	--	--	31	11	46	--
	1945-47	Nov.	Female	.436	--	.379	--	--	--	17	--	22	--
	1927 & 44	Mar.-April	Male	.481	--	.361	.413	--	--	13	--	14	27
<u>Mid-Atlantic</u>													
Delaware													
	1951-60	Jan. 16-Feb.	Male	.372	.383	.382	.378	.134	.378	45	20	45	90
	1951-60	Jan. 16-Feb.	Female	.478	.853	.773	.597	.76	.597	30	20	23	53
	1952-60	Mar.-April	Male	.244	.256	.312	.291	--	.291	23	14	45	68
	1952-60	Mar.-April	Female	.490	--	.374	.423	--	.423	12	--	8	20
	1951-60	Jan. 16-Feb.	Male	.488	.372	.380	.430	.237	.430	104	35	67	171
	1951-60	Jan. 16-Feb.	Female	.436	.523	.580	.501	107	.501	37	21	35	72
	1952-60	Mar.-April	Male	.422	.474	.459	.443	--	.443	115	56	89	204
	1950-60	Mar.-April	Female	.475	.481	.543	.508	--	.508	65	25	43	108
	1953-58	Jan. 16-Feb.	Male	.490	.456	.466	.474	117	.474	43	21	41	84
	1953-58	Jan. 16-Feb.	Female	.501	--	.272	.338	34	.338	14	--	13	27
	1953-58	Mar.-April	Male	.407	--	.325	.354	--	.354	20	--	19	39
	1931 only	Dec.	Male	.136	.579	.600	--	--	--	3	11	19	--
	1937-43	Jan. 16-Feb.	Male	.414	--	.386	.397	--	.397	12	--	17	29
<u>North Carolina</u>													
Pennsylvania													
	1953-58	Jan. 1-15	Male	.415	.477	.483	.451	--	.451	76	51	97	173
	1953-58	Jan. 1-15	Female	.541	.629	.661	.589	--	.589	60	32	50	110
	1953-58	Jan. 16-Feb.	Male	.439	.417	.430	.434	.398	.434	137	73	147	284
	1953-58	Jan. 16-Feb.	Female	.291	.301	.290	.309	182	.309	61	34	72	133
	1949-58	Mar.-April	Male	.348	.276	.316	.326	--	.326	87	45	123	210
	1949-58	Mar.-April	Female	.461	.302	.342	.391	--	.391	54	19	51	105

Table 53.--Average annual mortality rates, calculated by two different methods, for black ducks banded in winter areas of reference.--continued

Minor reference areas of banding	Span of banding year	Banding period	Sex	Relative recovery rate method				Mortality rate				Number of recoveries used for mortality estimate			
				Relative recovery rate method		Composite dynamic method		Composite dynamic method		Relative recovery rate method		Composite dynamic method		Composite dynamic method	
				1st year	All years	1st year	2 and later years	1st year	2 and later years	1st year	2 and later years	1st year	2 and later years	1st year	2 and later years
<u>Mid-Atlantic Coastal</u>															
<u>New Jersey</u>															
	1949-60	Jan. 1-15	Male	--	.456	--	.308	.362	--	--	25	6	31		
	1950-60	Jan. 16-Feb.	Male	.246	.391	.434	.397	.395	333	53	136	102	238		
	1950-60	Jan. 16-Feb.	Female	.364	.516	.372	.481	.498	137	15	78	37	115		
	1950-60	Mar. - April	Male	--	.401	.319	.309	.349	--	42	18	37	79		
<u>Virginia</u>															
	1945-59	Nov.	Male	--	.575	--	.339	--	--	13	--	9	--		
	1945-60	Nov.	Female	--	.493	--	.526	--	--	13	--	13	--		
	1945-60	Dec.	Male	--	.235	--	.264	--	--	12	--	32	--		
	1945-60	Dec.	Female	--	.409	.538	.488	--	--	20	15	27	--		
<u>Lake Ontario</u>															
<u>New York</u>															
	1947-55	Nov.	Male	--	.335	.399	.356	--	--	67	53	126	--		
	1947-55	Nov.	Female	--	.385	.448	.448	--	--	46	32	73	--		
	1948-55	Dec.	Male	--	.292	.455	.367	--	--	10	11	24	--		
	1956-58	Jan 1-15	Male	--	.464	.434	.388	--	--	24	12	21	45		
	1955-60	Jan. 16-Feb.	Male	.351	.461	.532	.520	.490	64	32	18	27	59		
	1934-60	Mar. - April	Male	--	.497	--	.634	.534	--	15	--	12	27		
	1927-44	Nov.	Male	--	.394	.750	.625	--	--	13	15	20	--		
	1927-44	Nov.	Female	--	.500	.500	.426	--	--	20	10	20	--		
<u>Lake Erie</u>															
<u>Michigan</u>															
	1948-55	Dec.	Male	--	.020	.331	.304	--	--	5	81	244	--		
	1948-55	Dec.	Female	--	.055	.333	.367	--	--	3	17	51	--		
	1950-56	Jan. 1-15	Male	--	.308	.280	.273	.283	--	35	22	74	109		
	1950-56	Jan. 1-15	Female	--	.433	--	.509	.471	--	11	--	14	25		
	1948-59	Jan. 16-Feb.	Male	.342	.307	.307	.322	.317	542	114	90	220	334		
	1948-58	Jan. 16-Feb.	Female	.431	.443	.600	.474	.460	133	41	31	48	89		
	1949-59	Mar. - April	Male	--	.413	--	.288	.330	--	12	--	13	25		
	1941-42	Jan. 16-Feb.	Male	--	.300	.392	.291	.294	--	12	11	28	40		
	1929-41	Mar. - April	Male	--	.542	--	.250	.353	--	13	--	11	24		
<u>Ohio</u>															
	1939-46	Nov.	Male	--	.337	.364	.280	--	--	28	20	55	--		
	1939-46	Nov.	Female	--	.397	.500	.529	--	--	25	19	38	--		
	1939-46	Dec.	Male	--	.045	.444	.422	--	--	3	28	63	--		
	1939-46	Dec.	Female	--	.537	--	.466	--	--	--	22	41	--		
	1941 only	Mar. - April	Male	--	.087	--	.412	.311	--	2	--	20	22		
<u>Pennsylvania</u>															
	1948-52	Nov.	Male	--	.190	.303	.286	--	--	17	22	71	--		
	1948-52	Nov.	Female	--	.303	.565	.404	--	--	10	13	23	--		
	1948-54	Dec.	Male	--	.056	.297	.297	--	--	3	15	48	--		
	1954 only	Jan. 1-15	Male	--	.308	--	.357	.339	--	12	--	27	39		
	1953 only	Mar. - April	Male	--	.233	.478	.444	.360	--	7	11	23	30		
	1938-39	Mar. - April	Male	--	.286	--	.417	.368	--	6	--	15	21		
<u>Upper Ohio River</u>															
<u>West Virginia</u>															
	1954-60	Dec.	Male	--	.123	.386	.354	--	--	7	11	22	--		

Table 53.--Average annual mortality rates, calculated by two different methods, for black ducks banded in winter areas of reference.--Continued

Minor reference areas of banding	Span of years	Banding period	Sex	Mortality rate				Number of recoveries used for mortality estimate				
				Relative recovery rate method		Composite dynamic method		Relative recovery rate method		Composite dynamic method		
				1st year	2nd year	1st year	2nd year	1st year	2nd year	1st year	2nd year	
<u>Tennessee River</u>												
Tennessee	1952-60	Dec.	Male	.203	.539	.523	--	--	21	30	41	--
	1952-60	Dec.	Female	.297	.574	.394	--	--	17	14	18	--
	1953-60	Jan. 16-Feb.	Male	.630	--	--	.449	--	18	--	--	21
<u>Lake Michigan</u>												
Indiana	1936-45	Nov.	Male	.125	--	.568	--	--	3	--	21	--
<u>Michigan</u>												
	1948-60	Nov.	Male	.209	.329	.421	--	--	31	38	110	--
	1948-60	Nov.	Female	.213	.394	.420	--	--	20	28	64	--
	1951-55	Dec.	Male	--	--	.450	--	--	--	--	28	--
<u>Tennessee River</u>												
	1928-41	Nov.	Male	.136	.389	.368	--	--	15	37	95	--
	1930-41	Nov.	Female	.095	.567	.515	--	--	7	38	67	--
	1931-39	Dec.	Male	.083	.512	.473	--	--	1	22	43	--
	1931-39	Dec.	Female	--	.591	.618	--	--	--	13	22	--
	1930-42	Mar. - April	Male	.387	--	.253	.292	--	12	--	19	31
<u>Upper Miss. River</u>												
Illinois	1945-59	Nov.	Male	.256	.302	.337	--	--	82	72	232	--
	1945-59	Nov.	Female	.358	.503	.473	--	--	50	45	88	--
	1945-60	Dec.	Male	.144	.364	.355	--	--	13	29	76	--
	1945-60	Dec.	Female	.226	.485	.482	--	--	12	20	40	--
	1945-60	Jan. 16-Feb.	Male	.684	--	--	.497	--	15	--	--	20
<u>Indiana</u>												
	1922-44	Nov.	Male	.345	.471	.410	--	--	122	109	231	--
	1922-44	Nov.	Female	.455	.536	.425	--	--	81	52	97	--
	1938-44	Dec.	Male	.157	.480	.389	--	--	14	36	75	--
	1938-44	Dec.	Female	.118	.600	.492	--	--	4	18	30	--
<u>Tennessee</u>												
	1949-58	Nov.	Male	.402	.424	.364	--	--	27	17	40	--
	1949 & 51	Nov.	Female	.265	.417	.472	--	--	13	15	36	--
	1949 & 51	Dec.	Male	.175	.481	.383	--	--	11	25	52	--
	1949-58	Dec.	Female	.177	--	.346	--	--	4	--	18	--
	1950-59	Jan. 1-15	Male	.266	.277	.383	.342	--	47	36	129	176
	1950-59	Jan. 1-15	Female	.498	.483	.483	.478	--	27	15	30	57
	1953-60	Mar. - April	Male	.321	.389	.387	.362	--	31	25	54	85
	1953-60	Mar. - April	Female	.318	.584	.434	.384	--	11	13	19	30
<u>Tennessee</u>												
	1949-58	Nov.	Male	.315	--	.419	--	--	11	--	23	--
	1949-54	Nov.	Female	.444	--	.483	--	--	12	--	15	--
	1949-58	Dec.	Male	.187	--	.459	--	--	6	--	25	--

Table 54.--Average annual mortality rates, calculated by the composite dynamic method, and direct recovery rates of immature and adult black ducks banded in summer, 1946 - 1960.^{1/}

Reference area of banding	Mortality rate			Direct recovery rate	
	Immature		Adult	Immature	Adult
	1st year	Later years	All years		
<u>Maritimes</u>					
New Brunswick	.757	.341	--	.184	--
Nova Scotia	.775	--	--	.216	--
<u>Labrador & E. Quebec</u>					
Labrador	--	--	.363	--	.064
Quebec	.572	.381	.335	.060	.061
<u>Southern Quebec</u>					
Quebec	.572	.417	.461	.152	.091
<u>St. John & St. Croix Rivers</u>					
Maine	.478	.419	.266	.071	.068
New Brunswick	.543	.411	.331	.097	.063
<u>W. Maine</u>					
Maine	.663	.420	.504	.138	.111
<u>Vermont & N. Hampshire</u>					
New Hampshire	.710	.386	--	.161	--
Vermont	.748	.515	--	.131	--
<u>Coastal Massachusetts</u>					
Massachusetts	.664	.462	.424	.128	.086
<u>S. New England & Long Is.</u>					
Connecticut	.656	.500	--	.139	--
Massachusetts	.597	--	--	.133	--
New York	.582	.473	--	.104	--
<u>Lake Champlain</u>					
New York	.646	.451	.421	.076	.056
Vermont	.716	.346	.446	.165	.120
<u>Chesapeake & Delaware Bays</u>					
Delaware	.454	.480	.243	.071	.066
Maryland	.510	.400	.442	.096	.064
New Jersey	.812	.539	--	.166	--
<u>E. Lake Ontario</u>					
New York	.641	.494	.457	.119	.085
Ontario	.699	--	--	.132	--
<u>W. Lake Ontario</u>					
New York	.694	.482	--	.117	--
Ontario	.699	.505	.603	.144	.075
<u>W. James Bay</u>					
Ontario	.594	.312	.334	.075	.049
<u>Upper Great Lakes</u>					
Michigan	.444	.327	.416	.088	.058
<u>W. Lake Erie</u>					
Michigan	.624	.448	.530	.134	.132
Ohio	.542	.370	.307	.089	.057
<u>E. Lake Michigan</u>					
Michigan	.762	.741	--	.174	--
<u>W. Lake Michigan</u>					
Wisconsin	.675	.424	.540	.202	.107
Weighted Averages	.649	.404	.443	.122	.080

^{1/} Compiled from table 52

Table 55.--Average annual mortality rates^{1/} and first-hunting-season recovery rates for different sex and age groups of black ducks banded in summer, 1946-60.

Summer banding area	Mortality rate						Direct recovery rate				
	First year		Immature		Adult		Immature		Adult		
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	
<u>Labrador & E. Quebec</u>											
Quebec	.560	.563	.422	--	.359	--	.068	.053	.055	--	
<u>Southern Quebec</u>											
Quebec	.718	.778	.357	--	--	--	.150	.157	--	--	
<u>St. John & St. Croix Rivers</u>											
Maine	.493	.459	.564	.310	--	--	.080	.063	--	--	
<u>W. Maine</u>											
Maine	.650	.690	.383	.476	.477	.529	.135	.141	.112	.111	
<u>Vermont & New Hampshire</u>											
New Hampshire	.696	.741	--	--	--	--	.152	.172	--	--	
Vermont	.737	.765	.440	.647	--	--	.123	.142	--	--	
<u>Coastal Massachusetts</u>											
Massachusetts	.672	.700	.431	.573	.394	.552	.144	.133	.097	.091	
<u>S. New England & Long Is.</u>											
Connecticut	.509	.797	.482	--	--	--	.113	.173	--	--	
New York	.594	.574	.466	.462	--	--	.122	.104	--	--	
<u>Lake Champlain</u>											
Vermont	.696	.753	.371	.404	.338	.879	.164	.167	.099	.145	
<u>Chesapeake & Delaware Bays</u>											
New Jersey	.741	.863	--	--	--	--	.158	.188	--	--	
Maryland	.482	.563	.398	.440	.432	.429	.099	.090	.081	.046	
<u>E. Lake Ontario</u>											
New York	.660	.662	.483	.540	.437	.496	.134	.112	.081	.090	
<u>W. Lake Ontario</u>											
Ontario	.669	.743	.491	.558	--	.669	.137	.154	--	.099	
New York	.656	.758	--	--	--	--	.111	.127	--	--	
<u>W. James Bay</u>											
Ontario	.677	.645	--	--	.352	.281	.077	.071	.061	.029	
<u>Upper Great Lakes</u>											
Michigan	.428	.507	.319	.390	--	--	.091	.085	--	--	
<u>W. Lake Erie</u>											
Michigan	.607	.669	--	--	.438	.762	.128	.144	.104	.198	
Ohio	.557	.522	--	--	.290	.334	.088	.089	.039	.080	
<u>W. Lake Michigan</u>											
Wisconsin	.709	.700	--	--	--	--	.257	.231	--	--	
Weighted average using only those areas where data for both males and females were available.	.619	.663	.428	.470	.403	.433	.117	.115	.080	.076	

^{1/} Calculated by the composite dynamic method.

Table 56.--Average annual mortality rates^{1/} and first-hunting-season recovery rates of male and female black ducks banded January 16 through February, 1946-60

Area of reference	Annual mortality rate		First hunting season recovery rate	
	Male	Female	Male	Female
<u>Maritimes</u>				
Prince Edward Island	.261	.498	.055	.050
<u>New Eng. & E. Long Is.</u>				
Connecticut	.311	.533	.050	.064
Massachusetts	.310	.296	.027	.023
New York	.395	.342	.062	.060
Rhode Island	.350	.419	.060	.049
<u>W. Long Is. & Hudson R.</u>				
New York	.376	.394	.025	.025
<u>Mid-Atlantic</u>				
Delaware	.378	.597	.048	.044
Maryland	.430	.501	.063	.037
New Jersey	.474	.338	.065	.045
Pennsylvania	.434	.309	.064	.048
<u>Mid-Atlantic Coastal</u>				
New Jersey	.395	.498	.052	.050
Virginia	.264	.488	.023 ^{2/}	.037 ^{2/}
<u>Lake Erie</u>				
Michigan	.317	.460	.043	.042
<u>Upper Miss. River</u>				
Illinois	.355	.482	.058 ^{2/}	.052 ^{2/}
Indiana	.342	.478	.048	.051
Weighted average	.375	.469	.052	.043

^{1/} Calculated by the composite dynamic method.

^{2/} Virginia and Illinois rates are first full hunting season recovery rates based upon December bandings. An adjustment was made for recoveries occurring in the hunting season of banding as follows:

$$\begin{aligned}
 &\text{Recoveries in first season} \times 2.5 = x \\
 &\text{Total banded} - x = y \\
 &\underline{\text{Recovery in first full hunting season}} = \frac{\text{rate}}{y}
 \end{aligned}$$

Table 57.--Estimates of the proportion of total black duck deaths due to hunting

	Banded in summer				Banded in winter ^{1/}	
	Immature		Adult		Adult	
	Male	Female	Male	Female	Male	Female
Average annual mortality rate ^{2/}	.619	.663	.403	.433	.375	.469
Average annual recovery rate ^{2/}	.117	.115	.080	.076	.052	.043
Average total kill rate ^{3/}	.329	.324	.225	.214	.146	.121
Average non-hunting mortality rate	.290	.339	.178	.219	.229	.348
Proportion of total deaths due to hunting	.532	.488	.558	.494	.389	.258

1. January 16 through February.

2. From tables 55 and 56.

3. Assumes 49 percent of banded birds taken are reported and 27.5 percent of birds killed by shooting are not retrieved (see text pages 45 and 68)

Table 58.--Regression equations, correlation coefficients and statistical significance for relationships between band recovery rates and annual mortality rates shown in figures 10-17.

<u>Summer bandings</u>	<u>Regression equation</u>	<u>Correlation coefficient r</u>	<u>Probability of relationship due to chance</u>	<u>Number of comparisons</u>
Immature male	$y = 1.350 x + .455$	.611	<.01	20
Immature female	$y = 1.867 x + .430$	.789	<.001	20
Total immature	$y = 1.931 x + .398$	.796	<.0001	28
Adult male	$y = 1.770 x + .247$	.729	<.04	9
Adult female	$y = 3.239 x + .228$	.857	<.01	9
Total adult	$y = 2.497 x + .216$	.623	<.01	18
<u>Winter bandings</u>				
Adult male	$y = 2.491 x + .236$	.582	<.03	15
Adult female	$y = 2.215 x + .342$	.281	>.20	15

Table 59. --Mortality rates of summer-banded black ducks and corresponding hunting regulations^{1/}

Summer banding area	Age	Years	Number of Recoveries	Mortality Rate ^{2/}	Regulations	
					Season Length	Bag Limit
<u>St. John & St. Croix Rivers</u>						
Maine	Immature	1952-54	101	.412	44s-60 ^{3/}	4
		1955-57	41	.406	70	4
<u>W. Maine</u>	Adult	1946-51	31	.617	24s-45	4-7
		1952-54	44	.658	44s-60	4
<u>Coastal Massachusetts</u>	Immature	1947-51	191	.648	24s-36s	4
		1952-54	373	.604	44s-60	4
		1955-57	607	.697	70	4
		1940-45	88	.423	60-80	10
<u>Lake Champlain</u>	Adult	1946-51	204	.653	24s-45	4-7
		1952-53	293	.725	55-60	4
<u>New York</u>	Immature	1949-51	21	.366	32s-36s	4
		1952-54	25	.452	45-60	4
<u>Chesapeake & Del. Bays</u>	Immature	1948-51	107	.686	30-45	4
		1952-54	180	.736	55-60	4
		1955-57	165	.717	70	4
<u>Maryland</u>	Immature	1953-54	122	.421	60	4
		1956-57	190	.485	70	4
<u>E. Lake Ontario</u>	Adult	1946-51	78	.388	24s-45	4-7
		1952-54	87	.595	45-60	4
		1955-58	34	.537	60s-70	4
		1959-60	68	.585	40-50	3-4

Table 59.--Mortality rates of summer-banded black ducks and corresponding hunting regulations^{1/} ---continued

Summer banding area	Age	Years	Number of Recoveries	Mortality Rate ^{2/}	Regulations	
					Season Length	Bag Limit
New York (cont.)	Immature	1949-51	60	.406	24s-36s	4
		1952-54	358	.642	55-60	4
		1955-57	59	.427	70	4
		1959-60	66	.771	50	3
<u>Upper Great Lakes Michigan</u>	Adult	1928-33	58	.621	30-107	12-25
		1934-39	111	.553	30-45	10-12
		1940-45	96	.458	60-80	10
		1952-54	19	.241	55	4
		1927-30, 32, 33	240	.840	61-107	12-25
<u>E. Lake Michigan Michigan</u>	Immature	1934-39	139	.632	30-45	10-12
		1940-43	130	.648	60-70	10
		1946-51	159	.320	30-45	4-7
		1952-54	114	.299	55	4
		1926-33	43	.459	30-107	12-25
<u>W. Lake Michigan Illinois</u>	Adult	1934-39	36	.331	30-45	10-12
		1941-45	101	.642	60-80	10
	Immature	1946-47	34	.200	30-45	4-7

1/ Sexes combined

2/ Mortality index for immatures

3/ s = Split season

Table 60.--Mortality rates of adult black ducks banded in winter^{1/} and spring^{2/} and corresponding hunting regulations

Area of reference	Sex	Season banded	Years	Number of recoveries	Mortality rate	Regulations	
						Season length	Bag limit
<u>New Eng. & E. Long Is.</u> Massachusetts	Males	Winter	1934-39	80	.590	30-45	10-12
			1940-45	219	.234	60-80	10
			1952-53	97	.125	55-60	4
		Spring	1934-39	75	.330	30-45	10-12
			1940-45	95	.378	60-80	10
			1952-53	52	.371	55-60	4
Connecticut	Males	Winter	1949-51	39	.390	40	4
			1955-58	25	.422	55s-70 ^{3/}	4
Eastern Long Island	Males	Winter	1948-51	53	.441	24s-36s	4
			1952-54	235	.387	55-60s ^{4/}	4
		Spring	1948-51	75	.591	24s-36s	4
			1956-58	93	.642	60s-70	4
<u>W. Long Is. & Hudson River</u> New York	Males	Winter	1948-51	37	.351	24s-36s	4
			1956-58	22	.214	60s-70	4
<u>Mid-Atlantic</u> Pennsylvania	Males	Spring	1953-54	60	.169	59-60	4
			1955-58	129	.244	60-70	4
Delaware	Males	Winter	1952-54	46	.360	55-60	4
			1955-58	19	.370	60-70	4
		Spring	1952-54	35	.547	55-60	4
			1955-58	24	.151	60-70	4

Table 60.--Mortality rates of adult black ducks banded in winter^{1/} and spring^{2/} and corresponding hunting regulations (continued)

Areas of reference	Sex	Season banded	Years	Number of recoveries	Mortality rate	Regulations	
						Season length	Bag limit
Maryland	Males	Winter	1955-58	118	.374	60-70	4
			1959-60	41	.602	50	3
<u>Mid-Atlantic Coastal</u> New Jersey	Males	Winter	1952-54	120	.232	55-60	4
			1955-58	41	.450	60-70	4
	Females	Winter	1952-54	52	.261	55-60	4
			1955-58	33	.483	60-70	4
<u>Lake Eries</u> Michigan	Males	Winter	1948-51	151	.398	30-45	4
			1955-58	165	.342	70	4
	Females	Winter	1948-51	32	.407	30-45	4
			1955-58	53	.343	70	4

1/ January 16 through February.

2/ March and April.

3/ s = Split season.

4/ Hunting seasons were later on Long Island than for inland New York starting in 1953-54.

Table 61.--Average recovery rates for black ducks banded during different periods within the year. (Data from table 16 except as noted)

Age when banded	Banding period	Hunting season of recovery	Recovery rate	
			Male	Female
All ages	Jan 16-Feb	Second	.028	.022
All ages	March - April	Second	.031	.023
Immature	Summer ^{1/}	Second ^{2/}	.026	.022
Immature	October	Second ^{2/}	.031	.026
All ages	November	Second	.042	.035
All ages	December	Second	.049	.034
All ages	January 1-15	Second	.053	.049
All ages	Jan 16-Feb	First	.053	.044
All ages	March - April	First	.053	.040

^{1/} Defined in text, page 25.

^{2/} Basic data contained in unpublished work tables used to obtain mortality rate estimates.

Table 62.--Black duck age ratios (immatures per adult) in the hunting kill, based on wing collection and weighted band recovery data.

	Wing collection survey				Weighted band recoveries 1946-60	Wing collection sample size		
	1960	1961	1962	Ave. 1960-62		1960	1961	1962
Maine	3.0	1.8	1.7	2.2	1.2	878	379	564
Vermont	5.5	3.8	3.5	4.3	1.4	233	186	232
New Hampshire	4.9	3.5	2.8	3.7	3.3	71	72	193
Massachusetts	2.2	1.8	1.6	1.9	0.8	636	329	566
Connecticut	2.4	2.1	1.6	2.0	2.6	183	122	294
Rhode Island	1.9	1.0	1.1	1.3	1.6	159	93	204
New York	2.7	2.3	1.6	2.2	1.4	435	418	524
Pennsylvania	3.0	0.6	1.2	1.6	5.4	163	73	277
West Virginia	0.6	0.9	0.4	0.6	1.0	66	26	65
New Jersey	1.9	1.6	1.0	1.5	1.1	1,132	712	1,152
Delaware	1.2	2.0	1.6	1.6	1.2	200	122	259
Maryland	1.4	2.2	1.0	1.5	0.7	378	131	557
Virginia	1.6	1.1	1.0	1.2	1.1	161	148	247
North Carolina	1.5	1.7	1.0	1.4	2.2	228	59	93
South Carolina	1.6 _{1/}	1.0	1.1	1.2	1.9	46	53	54
Georgia	--	--	--	--	5.0	2	--	8
Florida	4.0	3.0	2.1	3.0	3.2	25	24	25
Atlantic Flyway	2.11	1.75	1.32	1.73				
Minnesota	2.3	--	3.0	2.7	1.7	50	8	44
Wisconsin	3.4	3.5	1.7	2.9	4.5	114	89	220
Michigan	2.0	2.5	1.6	2.0	2.6	216	200	338
Iowa	--	--	--	--	2.6	8	3	5
Illinois	2.0	1.4	1.5	1.6	3.1	30	52	48
Indiana	1.2	1.1	1.7	1.3	1.4	141	55	57
Ohio	1.2	1.5	1.3	1.3	3.8	207	62	110
Missouri	--	--	--	--	--	14	4	3
Kentucky	1.1	1.0	1.1	1.1	0.9	141	126	96
Arkansas	2.0	--	--	2.0	5.8	27	8	3
Tennessee	1.3	1.0	1.2	1.2	1.3	241	67	85
Louisiana	--	--	--	--	4.9	13	3	19
Mississippi	2.6	--	--	2.6	1.7	32	7	11
Alabama	1.9	--	0.7	1.3	0.7	41	9	75
Mississippi Flyway	1.83	2.04	1.49	1.79				
Continental U.S. weighted ratio ^{2/}	2.00	1.82	1.35	1.72				

^{1/} Ratio not shown if based on less than 20 wings.

^{2/} In estimating Flyway and U.S. ratios, the ratio for each State was weighted in proportion to the estimated size of the kill in that State.

Table 63.--Number of males per female among black ducks trapped in winter areas of reference^{1/}

Banding area	Banding period			Sample size		
	Nov.- Jan. 15	Jan. 16 - Feb.	Mar. - Apr.	Nov. - Jan. 15	Jan. 16 - Feb.	Mar. - Apr.
<u>Maritimes</u>						
Prince Edward Island	1.1	1.1	1.3	395	1,408	616
<u>Maine</u>						
Maine	1.4	2.1	2.7	852	556	431
New England & Eastern						
<u>Long Island</u>						
Connecticut	1.4	2.3	--	1,972	1,044	--
Massachusetts	1.3	2.2	3.4	14,680	7,883	3,013
New York	1.3	1.4	1.9	4,001	4,636	1,857
Rhode Island	1.4	1.6	2.1	1,251	576	551
W. Long Island & Hudson						
<u>River</u>						
New York	1.2	2.8	2.3	5,410	1,817	1,514
<u>Mid-Atlantic</u>						
Delaware	1.2	1.4	1.5	477	1,612	981
Maryland	1.4	1.6	1.6	359	2,664	3,070
New Jersey	1.0	1.9	2.2	325	1,289	600
North Carolina	1.2	1.1	1.6	453	695	333
Pennsylvania	1.3	1.7	1.6	2,331	3,407	2,831
<u>Mid-Atlantic Coastal</u>						
New Jersey	1.5	1.7	2.9	839	4,187	884
Virginia	1.1	1.9	--	1,862	644	--
<u>Lake Ontario</u>						
New York	1.2	1.9	2.1	4,012	722	485
<u>Lake Erie</u>						
Michigan	2.8	2.9	2.7	3,827	3,997	568
Ohio	1.3	--	2.1	2,194	--	467
<u>Tennessee River</u>						
Tennessee	1.2	1.4	--	2,235	467	--
<u>Upper Mississippi River</u>						
Indiana	1.7	--	1.7	2,592	--	769
All Areas ^{2/}	1.43	1.83	2.06	65,863	39,197	21,257

^{1/} Only samples containing 100 or more of each sex are included.

^{2/} Unweighted averages based on combination of all areas regardless of sample size.

Table 64.--Sex ratios of adult black ducks shot in Atlantic and Mississippi Flyway States during the 1960-1962 hunting seasons.^{1/}

	Males per female	Number of wings
Maine	1.41	554
Vermont	0.54	126
New Hampshire	0.68	77
Massachusetts	1.08	524
Connecticut	1.28	192
Rhode Island	1.26	187
New York	1.92	359
Pennsylvania	1.48	211
West Virginia	1.47	89
New Jersey	1.96	1023
Delaware	1.17	452
Maryland	1.63	226
Virginia	1.02	251
North Carolina	1.37	154
South Carolina	1.03	71
Georgia	0.60	8
Florida	0.90	19
Atlantic Flyway	1.36	4523
Minnesota	0.92	25
Wisconsin	1.12	125
Michigan	1.35	259
Iowa	1.50	5
Illinois	1.45	49
Indiana	2.33	110
Ohio	1.88	164
Missouri	--	--
Kentucky	2.08	185
Arkansas	10.00	11
Tennessee	1.93	167
Louisiana	1.50	10
Mississippi	1.10	21
Alabama	1.52	63
Mississippi Flyway	1.53	1194

Weighted ratio for United States 1.43

^{1/}Based on wing collection survey data.

Table 65.--Winter survey counts of black ducks, 1948-1963.

State or Province	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963
Manitoba	4,000	2	6,713	5,973	5,161	11,581	15,476	13,006	9,891	3,382	11,096	5,492	7,098	2,001	2,001	6,970
Ontario	1,300	1,300	113	126	23	695	228	1,067	89	190	187	325	86	127	127	324
Quebec	61,600	55,300	20,920	376	431	1,034	1,342	1,025	1,067	870	1,346	186	512	1,570	943	918
Newfoundland	--	--	20,920	6,900	3,200	3,525	1,342	2,445	1,067	1,533	1,251	1,422	1,271	9,582	6,309	8,788
New Brunswick	--	--	2,320	3,740	3,000	3,787	--	7,076	5,869	5,548	3,733	4,763	4,641	--	--	1,274
P. E. I.	--	--	28,650	25,900	14,706	16,358	--	19,890	14,056	5,772	2,687	8,731	6,100	--	--	6,186
Nova Scotia	65,600	63,702	59,724	43,015	26,521	36,980	38,497	43,548	33,507	17,295	9,017	26,385	18,341	18,336	9,380	16,550
Canada	31,350	30,850	52,638	8,534	9,641	12,083	10,552	11,293	7,893	8,426	6,249	10,836	20,921	20,791	23,000	19,900
Maine	175	116	370	81	--	--	--	--	--	--	--	--	--	--	--	--
Vermont	150	2,679	1,805	1,217	801	1,026	1,093	1,387	523	1,148	1,754	329	1,385	2,000	2,000	2,000
New Hampshire	21,992	25,779	18,731	19,336	21,936	23,823	22,463	18,754	19,064	25,514	19,412	14,466	23,042	23,272	29,800	25,100
Massachusetts	2,931	11,724	13,386	6,974	7,727	5,907	6,077	3,762	4,797	4,001	4,780	2,888	10,288	7,217	8,500	8,300
Connecticut	2,750	4,523	2,193	6,786	8,115	8,575	6,275	5,908	5,496	10,129	9,137	5,991	7,530	3,889	10,200	10,800
Rhode Island	16,500	21,545	23,875	31,673	27,063	34,463	32,637	32,017	33,920	31,075	39,601	28,928	49,945	36,730	45,800	29,350
New York	13,900	24,551	28,044	25,572	13,200	21,263	12,947	29,426	15,809	8,062	8,508	5,280	14,243	3,715	5,200	6,700
Pennsylvania	--	100	57	4,890	1,851	3,296	9,318	776	8,800	2,419	3,260	6,675	1,093	1,239	1,500	5,200
West Virginia	51,500	121,500	116,800	110,100	78,200	102,300	85,160	97,010	64,654	95,617	59,041	47,821	76,204	45,635	41,100	44,600
New Jersey	3,443	9,351	9,000	22,547	29,640	60,325	38,681	25,364	27,591	18,818	11,849	12,612	23,775	31,015	25,700	10,100
Delaware	41,075	62,651	73,517	71,505	54,191	133,610	84,687	223,729	149,070	133,300	49,515	58,000	62,800	63,000	67,300	46,000
Maryland	14,000	20,075	20,900	28,000	35,000	55,000	72,100	58,300	41,965	47,600	19,838	20,600	33,400	28,100	26,600	21,690
Virginia	17,000	19,000	20,300	29,200	29,800	21,900	24,900	40,585	21,994	13,800	26,406	21,800	16,000	13,300	13,300	16,080
North Carolina	5,000	11,000	16,100	30,400	16,400	16,600	17,700	17,500	18,290	11,100	10,500	64,100	27,800	32,800	30,600	75,100
South Carolina	8,000	12,000	8,600	7,000	10,100	4,700	6,300	1,030	1,113	1,500	2,895	4,000	1,100	3,800	1,700	2,600
Georgia	75,000	25,000	26,900	30,400	13,800	33,500	13,700	15,612	8,784	7,400	5,122	5,500	4,500	4,900	3,500	1,500
Florida	304,766	402,444	433,216	434,170	357,465	538,371	438,590	582,453	424,843	419,909	277,867	309,745	374,046	320,852	337,500	325,200
Atlantic Flyway	1,165	32	122	6	125	437	567	396	302	295	212	107	103	69	111	225
Minnesota	1,221	3,720	3,705	2,182	2,182	4,251	8,967	3,703	3,155	4,816	2,319	4,464	3,837	5,775	2,430	3,016
Wisconsin	2,730	6,400	9,141	10,220	3,139	10,055	13,015	23,240	34,600	30,300	17,999	12,778	15,606	12,177	2,486	4,014
Michigan	100	--	200	100	80	17	6	--	--	52	2	6	50	18	--	2
Iowa	16,500	17,220	10,800	17,003	9,283	15,208	26,530	26,690	32,000	44,531	14,008	5,979	15,607	15,803	2,830	17,972
Illinois	2,753	7,891	9,299	6,371	8,369	41,552	20,823	22,678	29,475	33,809	143,431	28,593	24,063	5,006	5,476	9,408
Indiana	23,610	31,300	28,003	8,443	8,145	33,575	28,942	48,524	63,749	62,835	22,894	24,662	31,546	52,221	26,521	37,465
Ohio	275	460	1,278	5,140	2,323	5,761	98	1,744	1,500	2,09	6,403	965	636	685	329	2,314
Missouri	5,000	5,600	12,300	22,900	24,800	25,000	25,000	6,000	21,000	12,287	9,241	14,500	11,700	5,100	15,500	14,970
Kentucky	4,500	5,000	27,600	4,400	1,300	4,400	1,700	690	1,000	1,000	970	11,200	8,300	2,200	2,900	3,950
Arkansas	13,100	16,900	19,800	29,200	45,000	19,300	25,700	11,212	9,300	19,970	18,878	32,700	15,300	32,200	16,900	20,030
Tennessee	25,000	15,000	17,300	19,100	23,500	7,700	15,900	15,000	6,695	17,000	22,310	36,700	32,300	14,300	14,800	13,850
Louisiana	8,500	21,750	22,700	65,700	5,200	200	4,500	4,004	4,185	1,333	2,611	200	1,000	2,600	4,900	4,900
Mississippi	4,000	12,000	7,800	5,300	10,500	10,500	5,300	4,619	6,218	3,200	3,565	3,700	5,000	10,500	15,600	9,000
Alabama	107,233	140,774	145,463	219,188	136,846	177,765	177,048	178,480	213,185	231,657	264,843	176,554	165,048	158,654	110,783	141,116
Mississippi Flyway	--	--	--	--	--	--	--	--	--	--	1	--	--	--	--	5
North Dakota	--	--	--	7	11	1	2	85	--	--	47	--	10	--	--	--
South Dakota	--	--	--	10	--	--	--	--	--	--	--	--	--	--	--	--
Nebraska	--	--	--	--	--	--	--	--	--	3	--	--	--	--	--	--
Kansas	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	9
Central Flyway	--	--	--	17	11	1	2	85	--	3	48	--	10	--	--	14
U.S. and Canada	477,599	606,920	638,403	696,390	520,843	753,117	654,137	804,566	671,535	668,864	551,775	512,464	557,445	497,842	457,663	482,880

1/ In 1948, 49, 61 and 62 counts for the Maritime Provinces were lumped.

2/ After 1952 Vermont was counted with New York.

Table 66.--Estimated average size of the continental black duck population prior to the hunting season

Statistic	Ages combined	Immature	Adult
Average annual harvest in U.S. 1952-1960	480,807	304,039	176,768
Average age ratio in the kill (Immature/adult - from table 62)			1.72
Average direct recovery rate in the U.S.		.068	.056
Average harvest rate in the U.S. (assumes 49 percent bands reported)		.139	.114
Estimated population	3,737,927	2,187,331	1,550,596

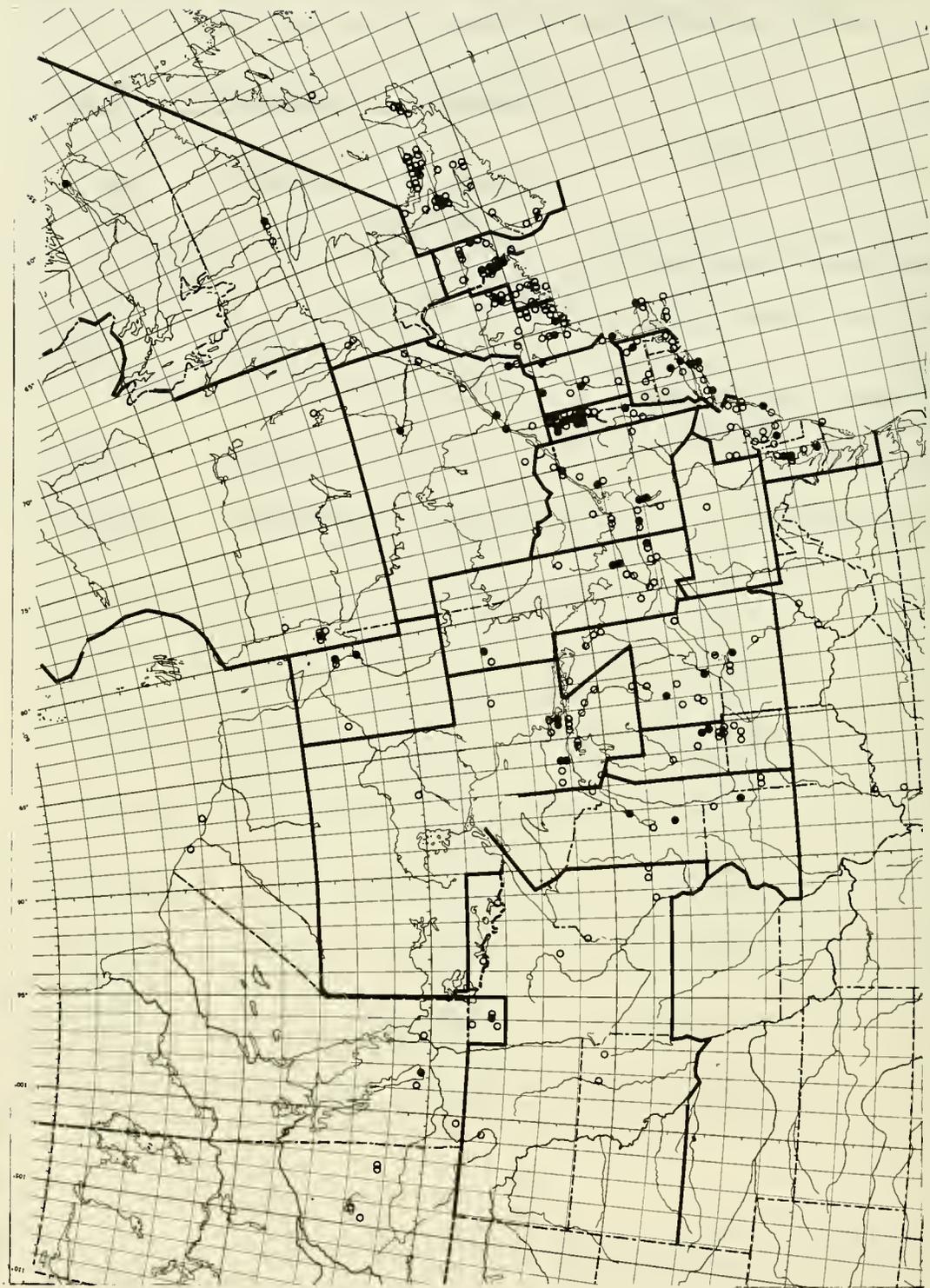


Figure 1.--Locations where black ducks were banded in summer, 1946-60. Banding stations producing fewer than 30 recoveries indicated by circles; 30 or more recoveries by dots. Heavy lines delineate major summer reference areas of banding.

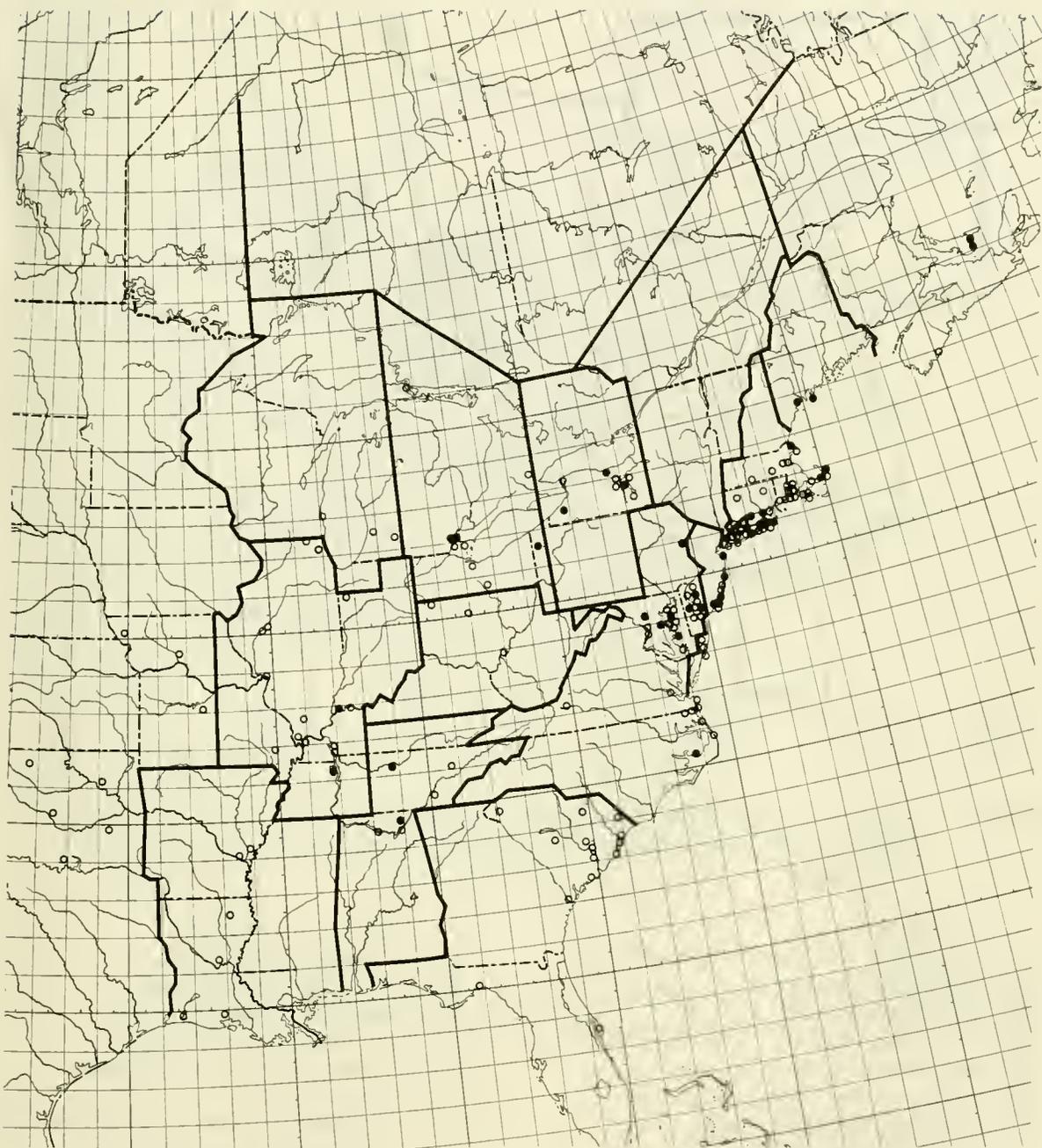


Figure 2.--Locations where black ducks were banded in winter, 1946-60. Banding stations producing fewer than 30 recoveries indicated by circles; 30 or more recoveries by dots. Heavy lines delineate major summer reference areas of banding.

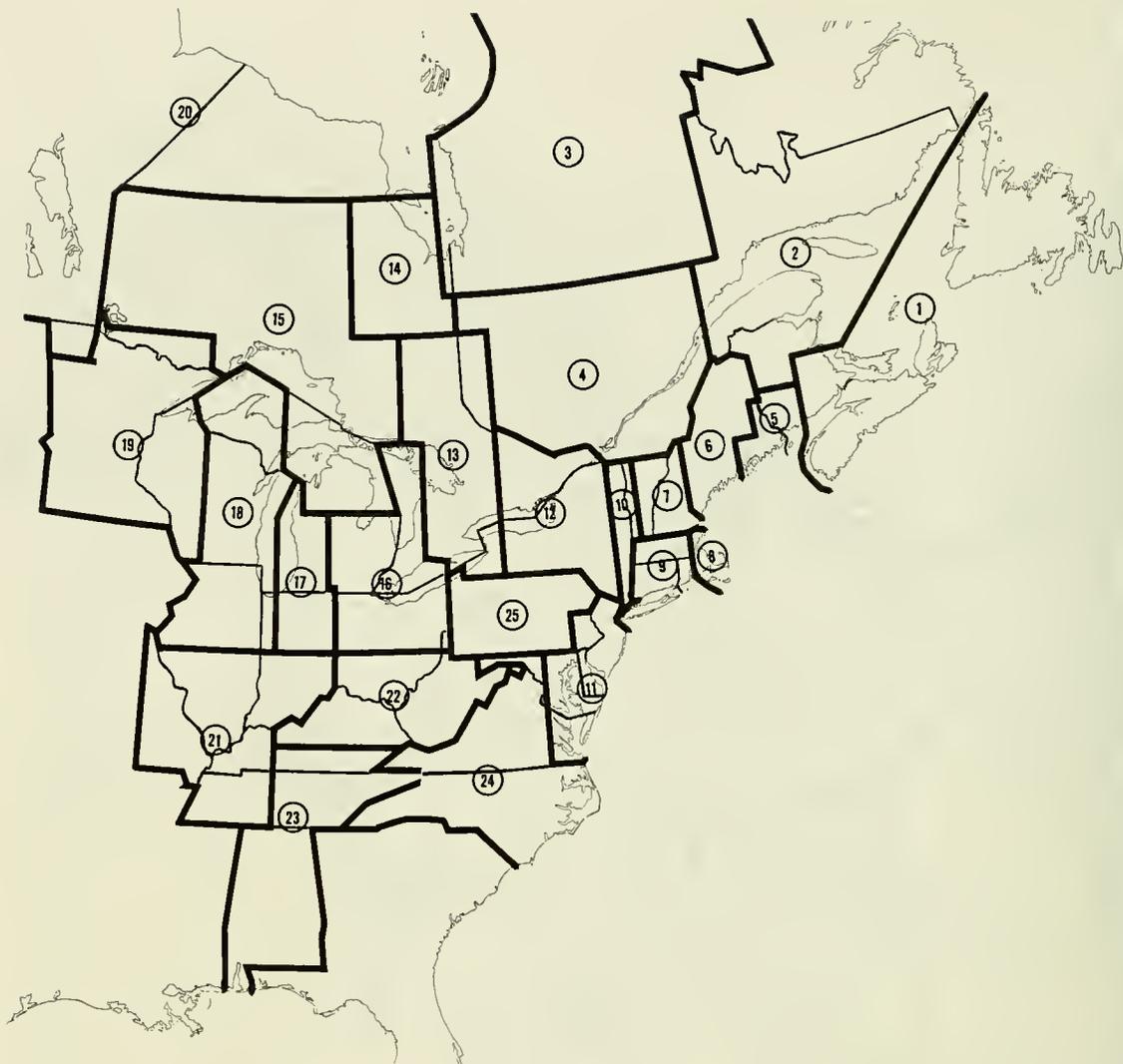


Figure 3.--Major summer reference areas delineated to combine banding data from locations which had similar recovery distribution patterns.

- | | |
|---|---|
| 1. Maritimes | 14. Western James Bay |
| 2. Labrador and Eastern Quebec | 15. Upper Great Lakes |
| 3. Northern Quebec | 16. Western Lake Erie |
| 4. Southern Quebec | 17. Eastern Lake Michigan |
| 5. St. John and St. Croix Rivers | 18. Western Lake Michigan |
| 6. Western Maine | 19. Upper Mississippi River |
| 7. Vermont and New Hampshire | 20. Northwest |
| 8. Coastal Massachusetts | 21. Southern Illinois and Eastern Tennessee |
| 9. Southern New England and Long Island | 22. Northeastern Kentucky and Southern Ohio |
| 10. Lake Champlain | 23. Eastern Tennessee and Alabama |
| 11. Chesapeake and Delaware Bays | 24. North Carolina and Virginia |
| 12. Eastern Lake Ontario | 25. Pennsylvania |
| 13. Western Lake Ontario | |

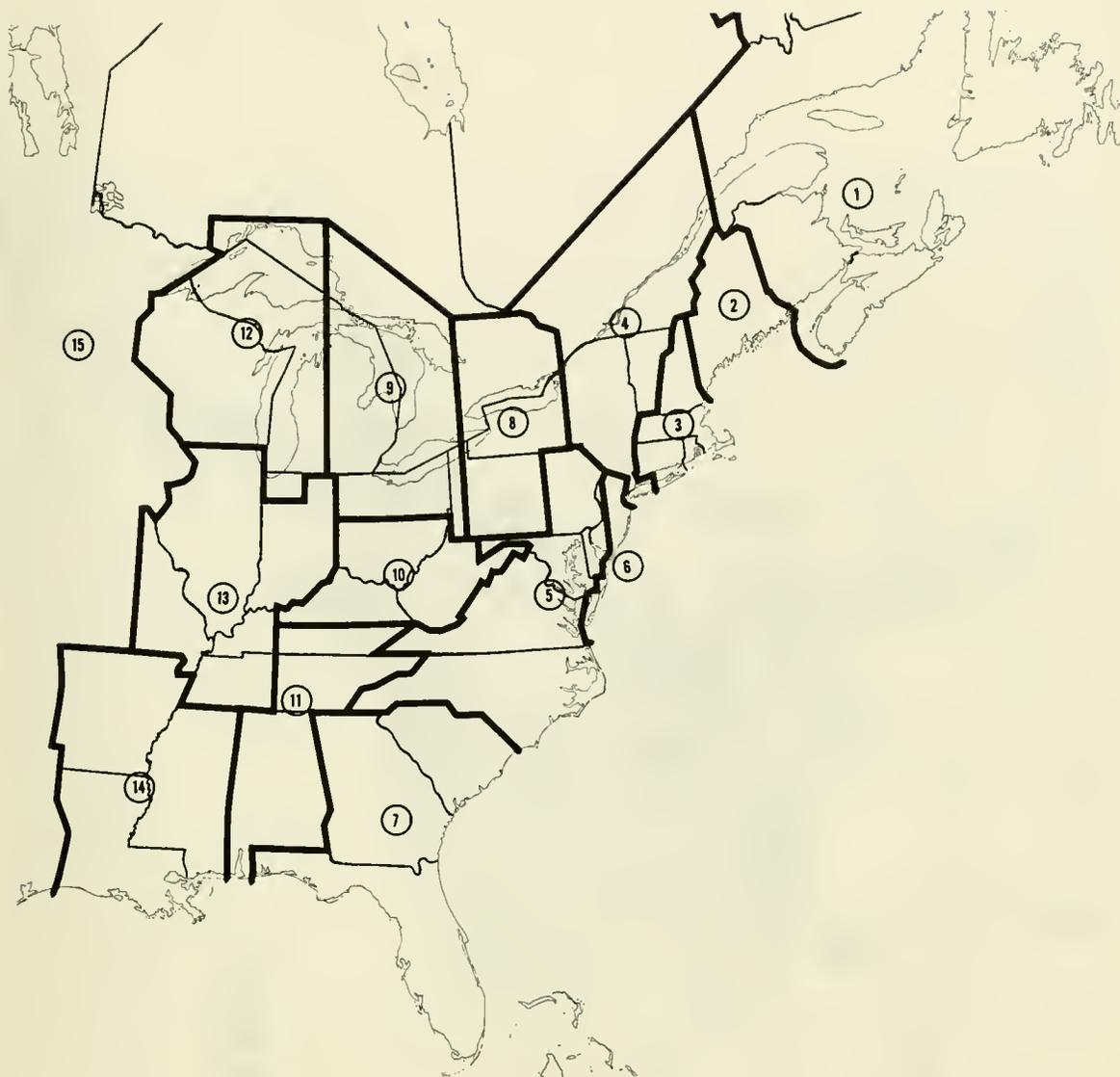


Figure 4.--Major winter reference areas delineated to combine banding data from locations which had similar recovery distribution patterns.

- | | |
|--|-----------------------------|
| 1. Maritimes | 8. Lake Ontario |
| 2. Maine | 9. Lake Erie |
| 3. New England and Eastern
Long Island | 10. Upper Ohio River |
| 4. Western Long Island and
Hudson River | 11. Tennessee River |
| 5. Mid-Atlantic | 12. Lake Michigan |
| 6. Mid-Atlantic Coastal | 13. Upper Mississippi River |
| 7. Southeast | 14. Lower Mississippi River |
| | 15. Western States |

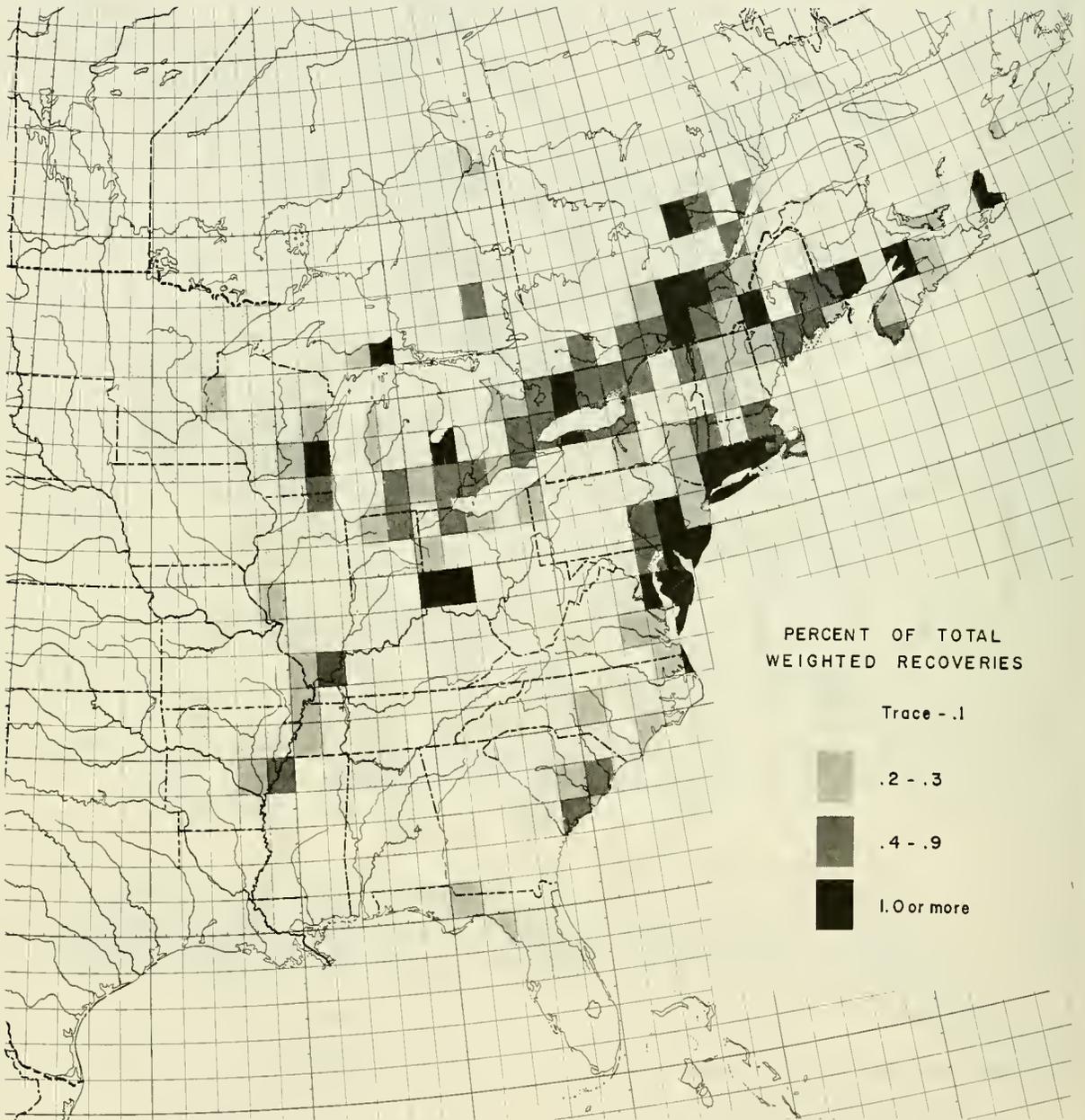


Figure 5.--Distribution of weighted band recoveries from black ducks banded in the summer as immatures and recovered in the first hunting season following banding, 1946-60.

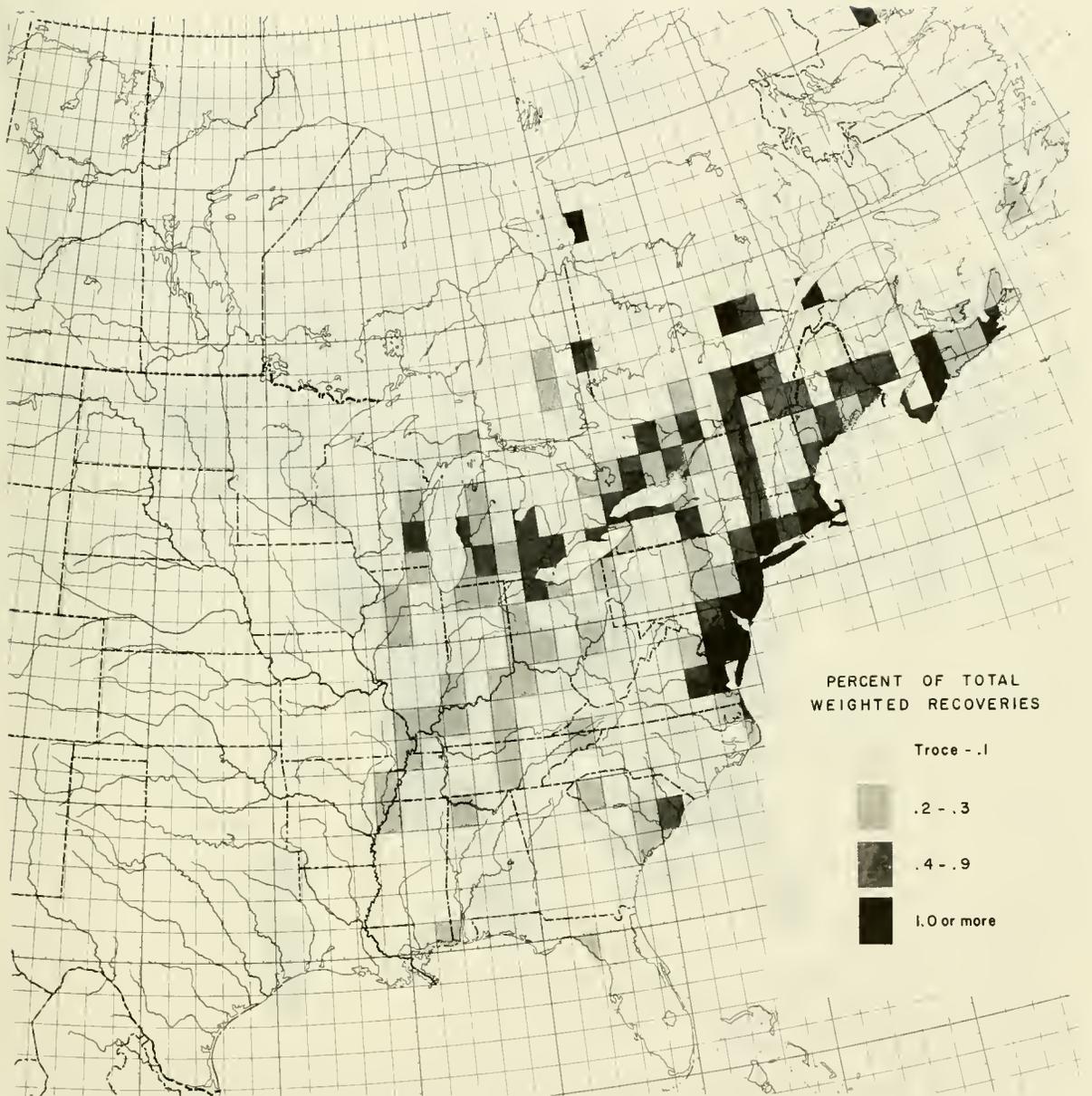


Figure 6.--Distribution of weighted band recoveries from black ducks banded in the summer as immatures and adults and recovered as adults, 1946-60.

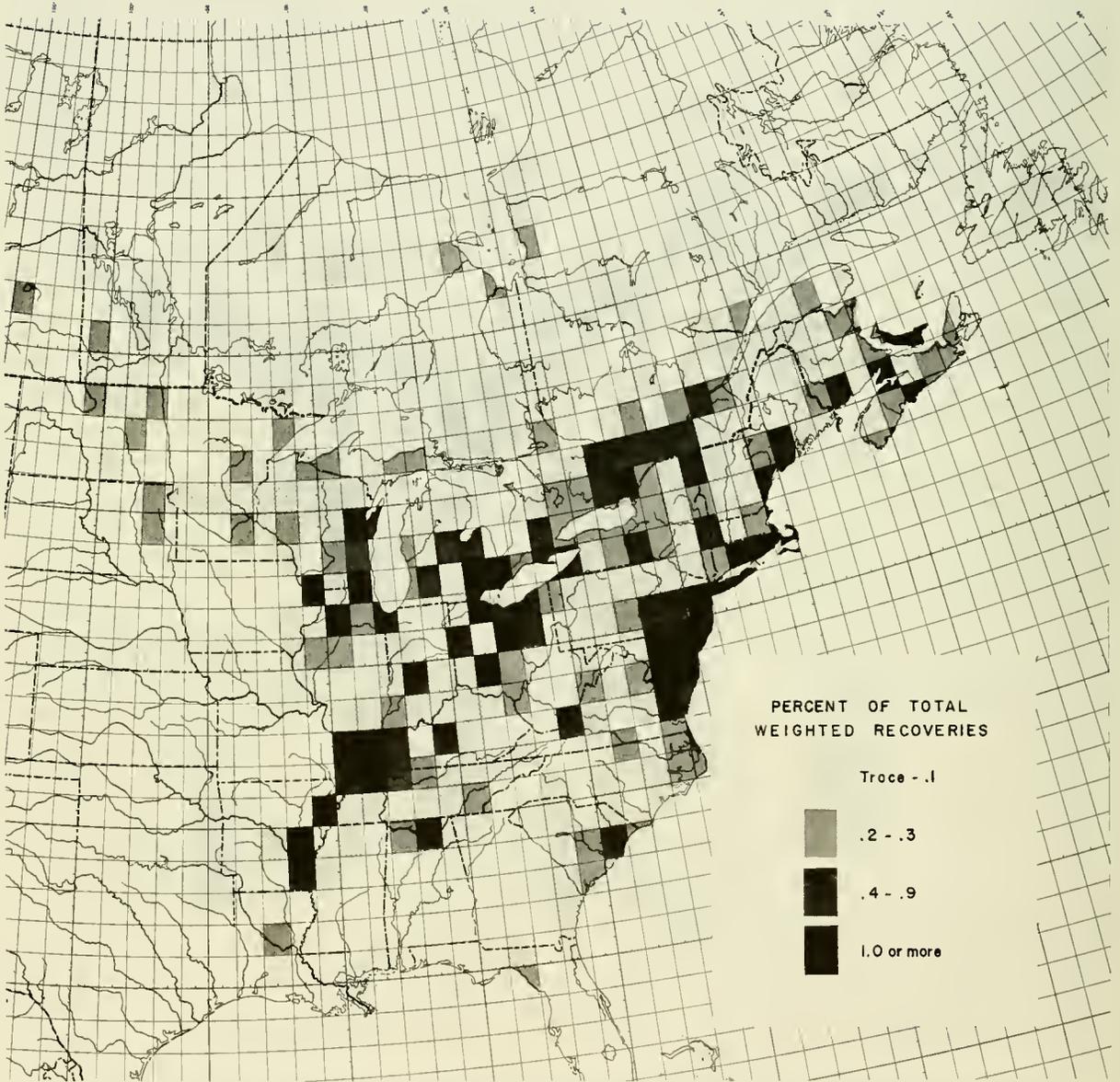


Figure 7.--Distribution of weighted band recoveries from black ducks banded in the winter, 1946-60.

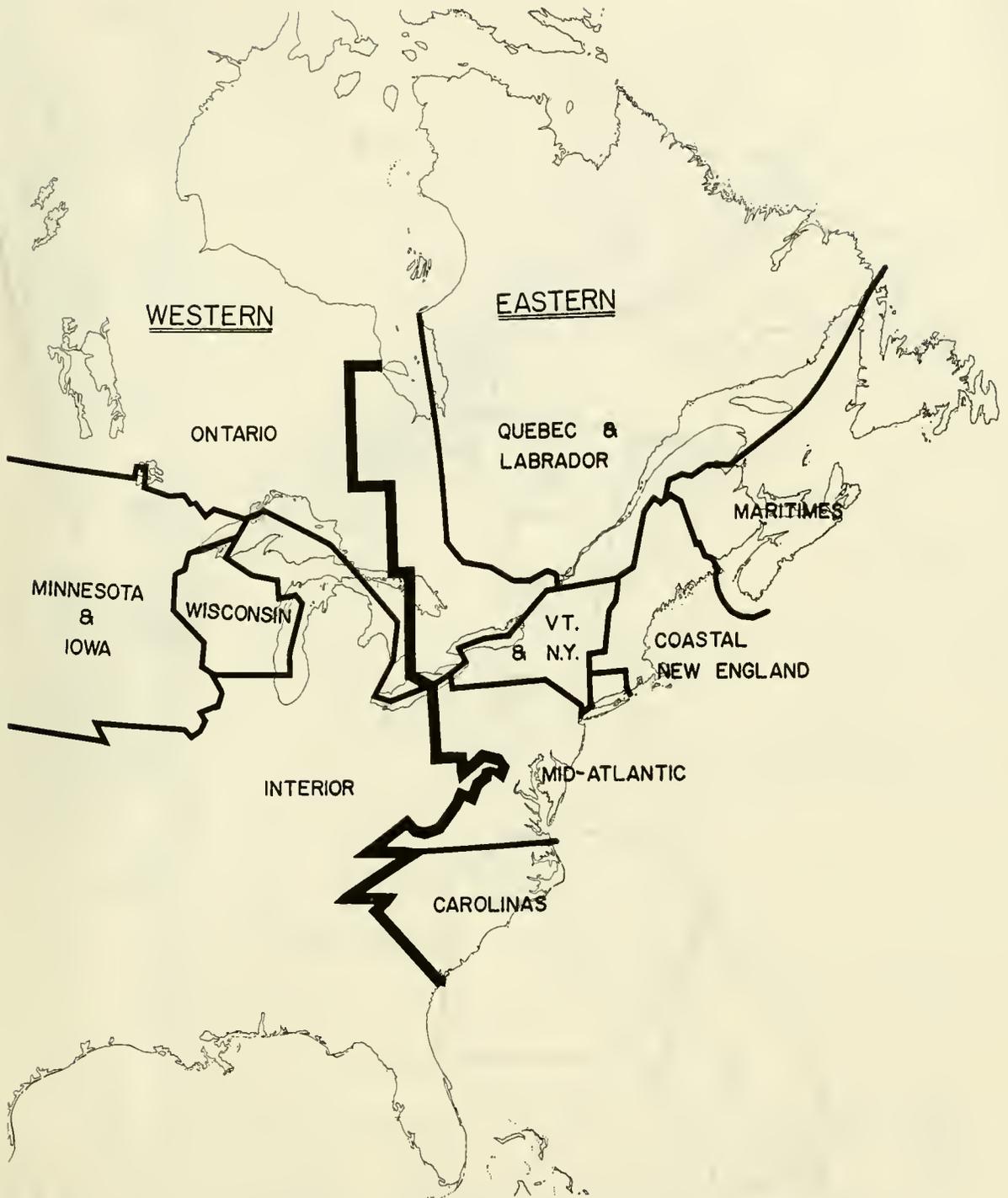


Figure 8.--Eastern and western units of production and harvest of black ducks in North America (heavy line) showing major harvest areas in each unit.

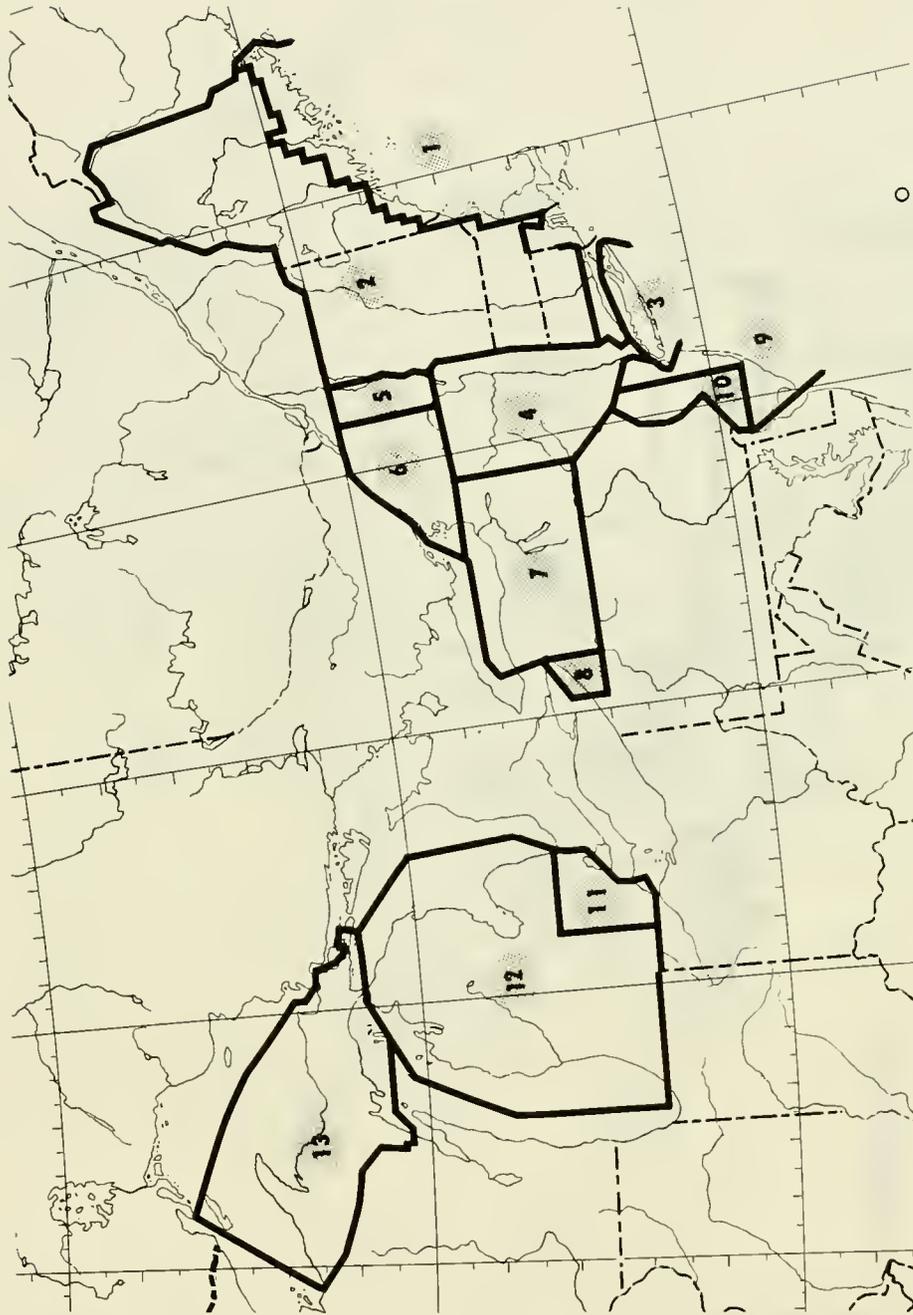


Figure 9.--Harvest zones delineated to examine differences in reference area sources of the black duck kill within New England, New York, New Jersey and Michigan.

- | | | |
|-------------------------|---|---------------------------------|
| 1. Coastal New England | 6. St. Lawrence River portion of New York | 9. Coastal New Jersey |
| 2. Interior New England | 7. Lake Ontario portion of New York | 10. Interior New Jersey |
| 3. Long Island | 8. Lake Erie portion of New York | 11. Southeastern Michigan |
| 4. Hudson River | | 12. Lower Peninsula of Michigan |
| 5. Lake Champlain | | 13. Upper Peninsula of Michigan |

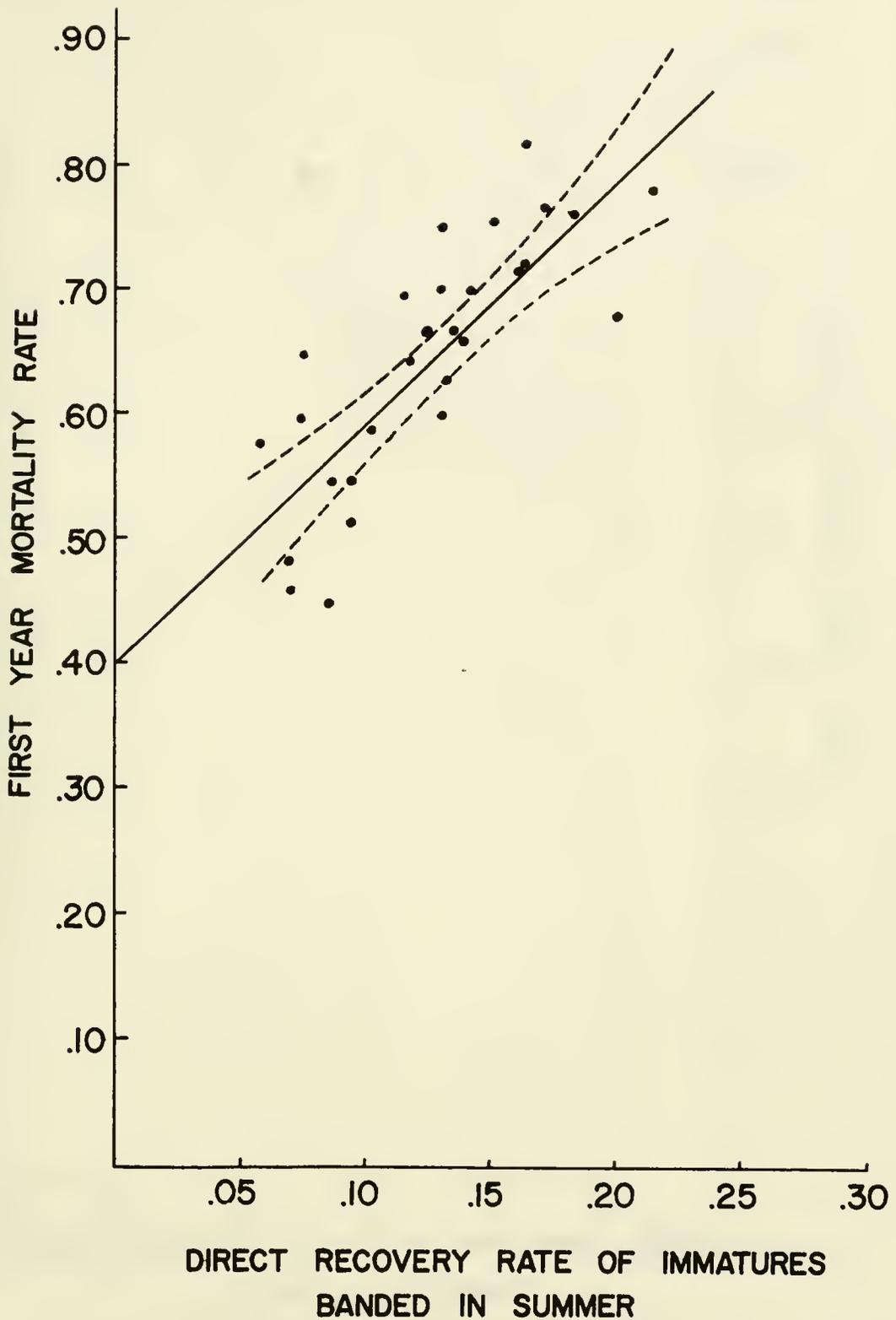


Figure 10.--Relation between direct recovery rates and mortality rates of immature black ducks banded in the summer, 1946-60 (data from table 54).

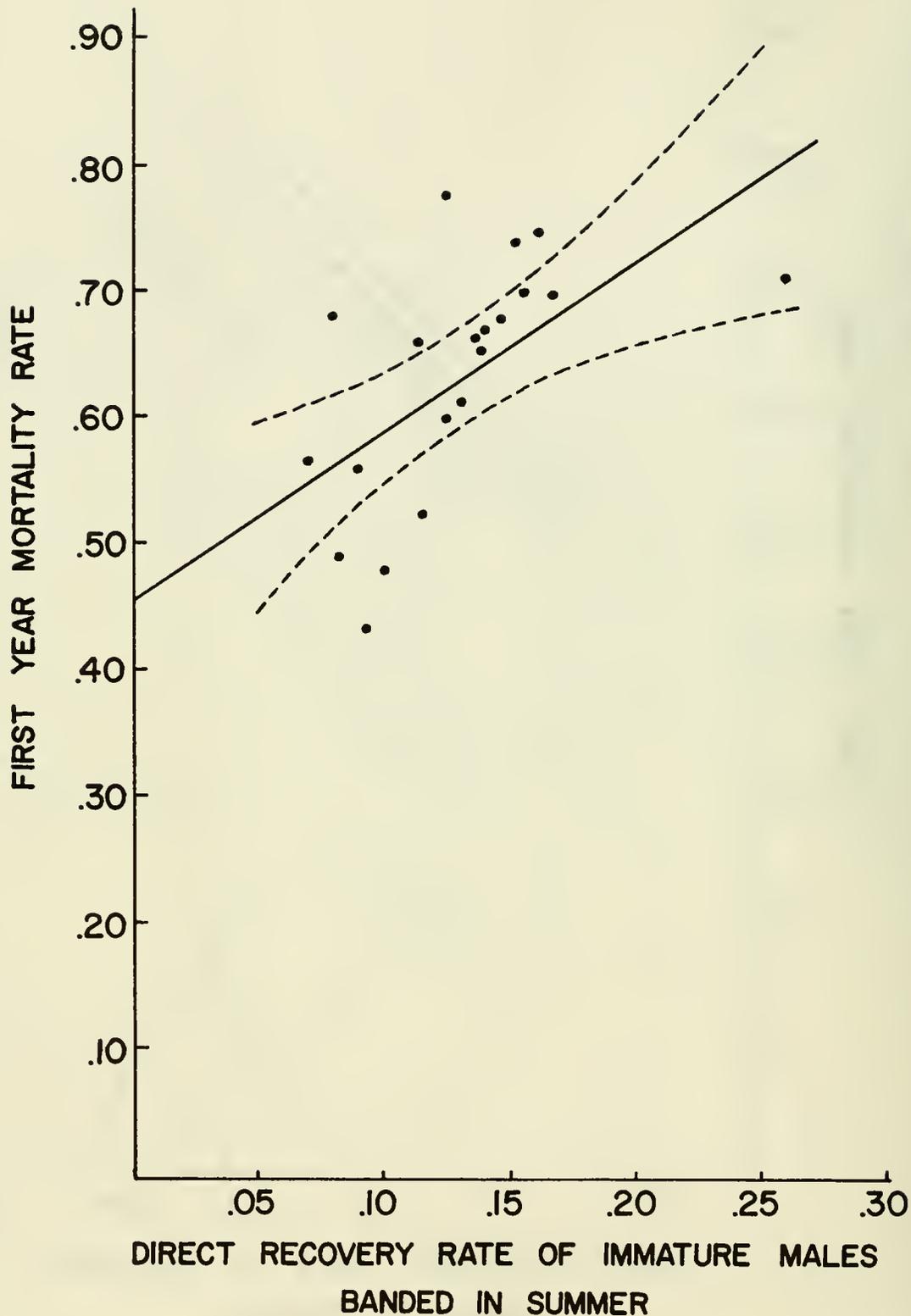


Figure 11.--Relation between direct recovery rates and mortality rates of immature male black ducks banded in the summer, 1946-60 (data from table 55).

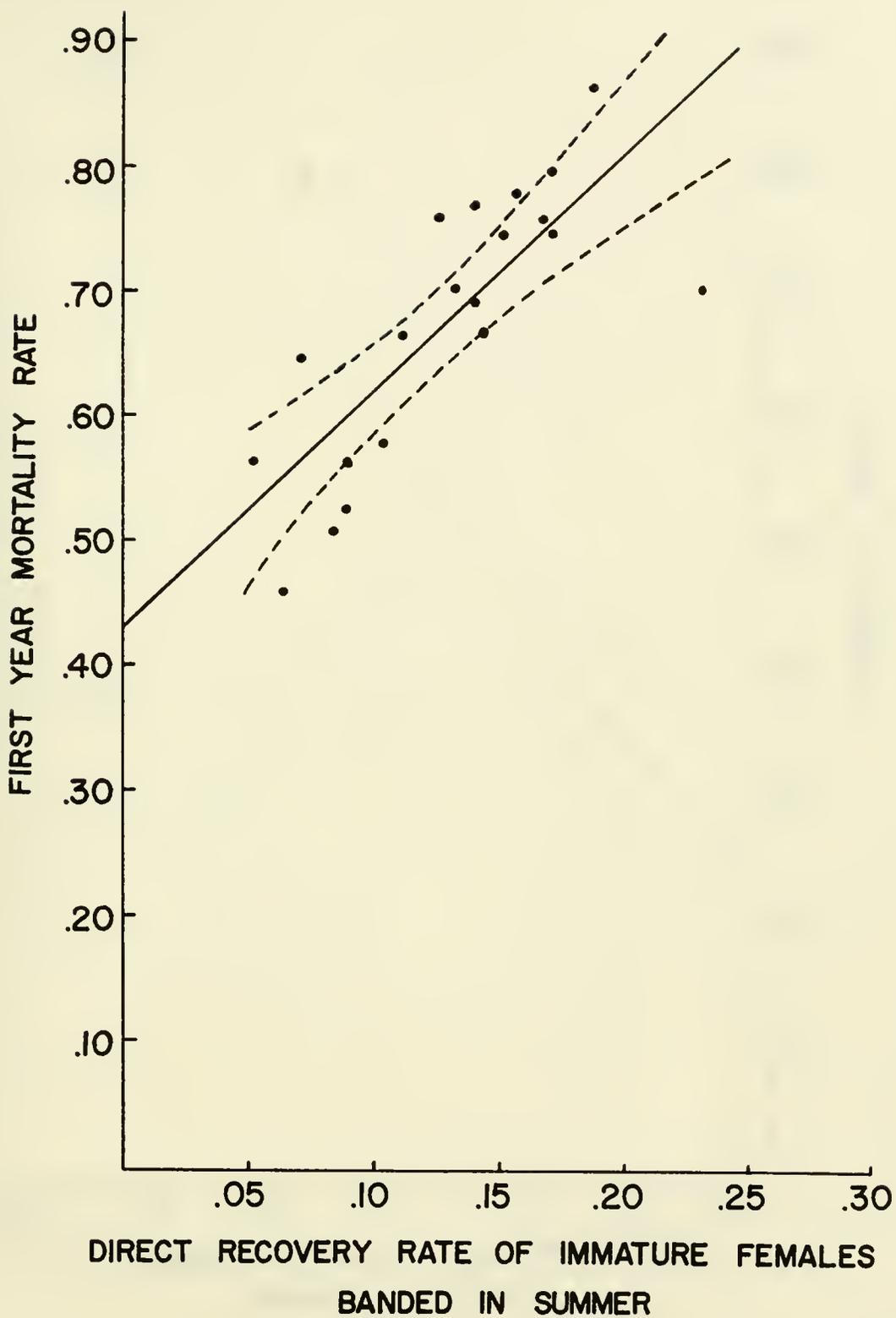


Figure 12.--Relation between direct recovery rates and mortality rates of immature female black ducks banded in the summer, 1946-60 (data from table 55).

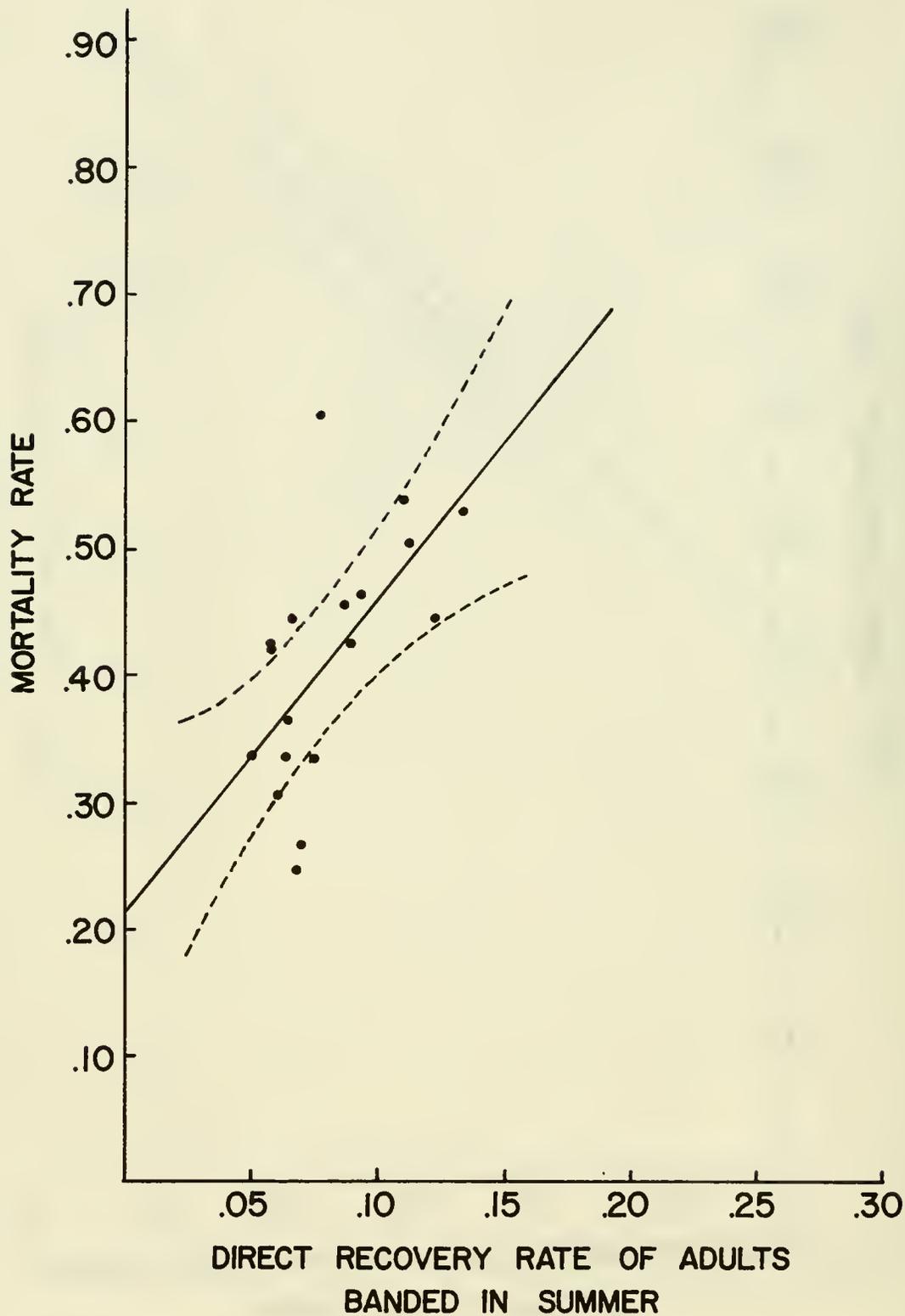


Figure 13.--Relation between direct recovery rates and mortality rates of adult black ducks banded in the summer, 1946-60 (data from table 54).

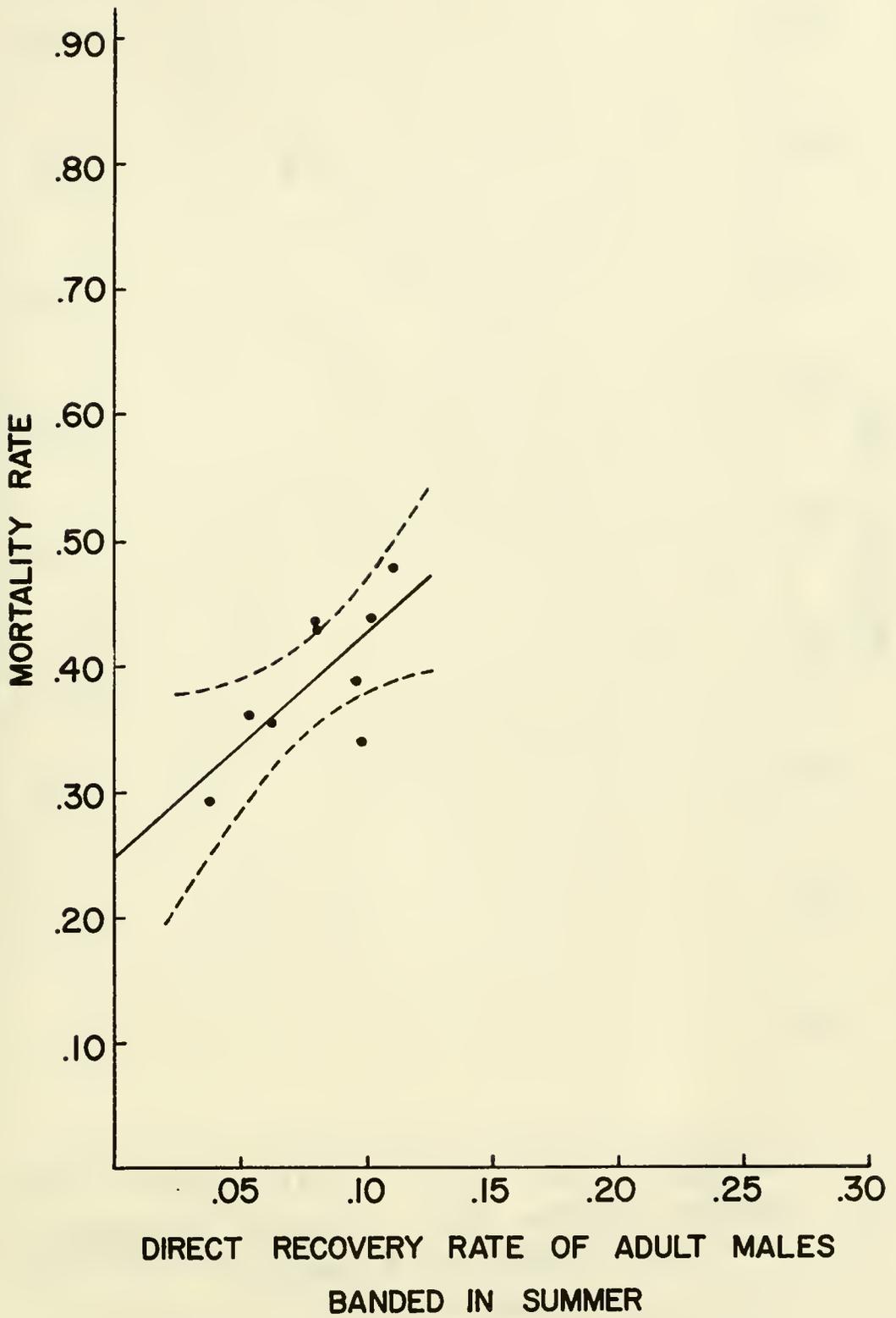


Figure 14.--Relation between direct recovery rates and mortality rates of adult male black ducks banded in the summer, 1946-60 (data from table 55).

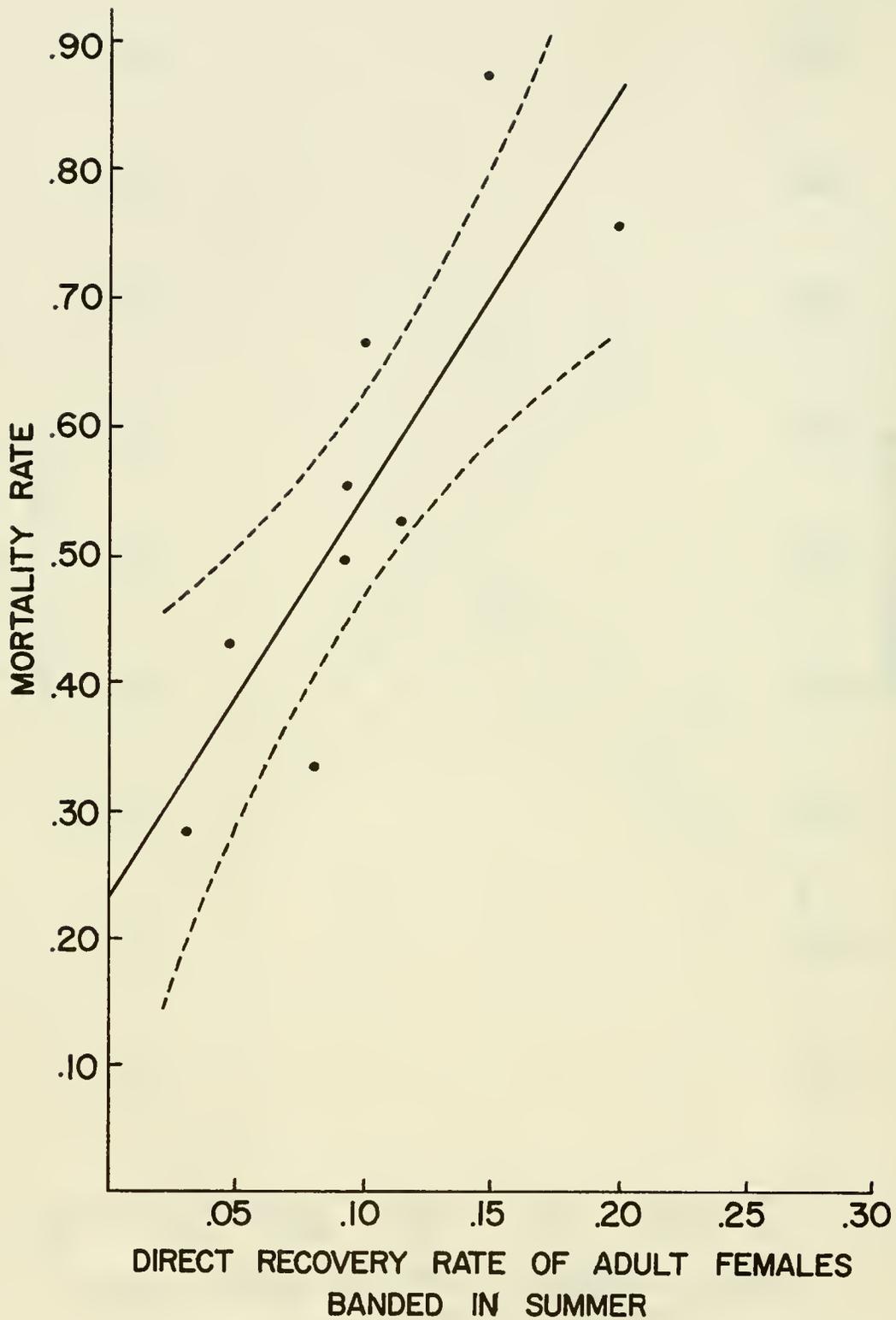


Figure 15.--Relation between direct recovery rates and mortality rates of adult female black ducks banded in the summer, 1946-60 (data from table 55).

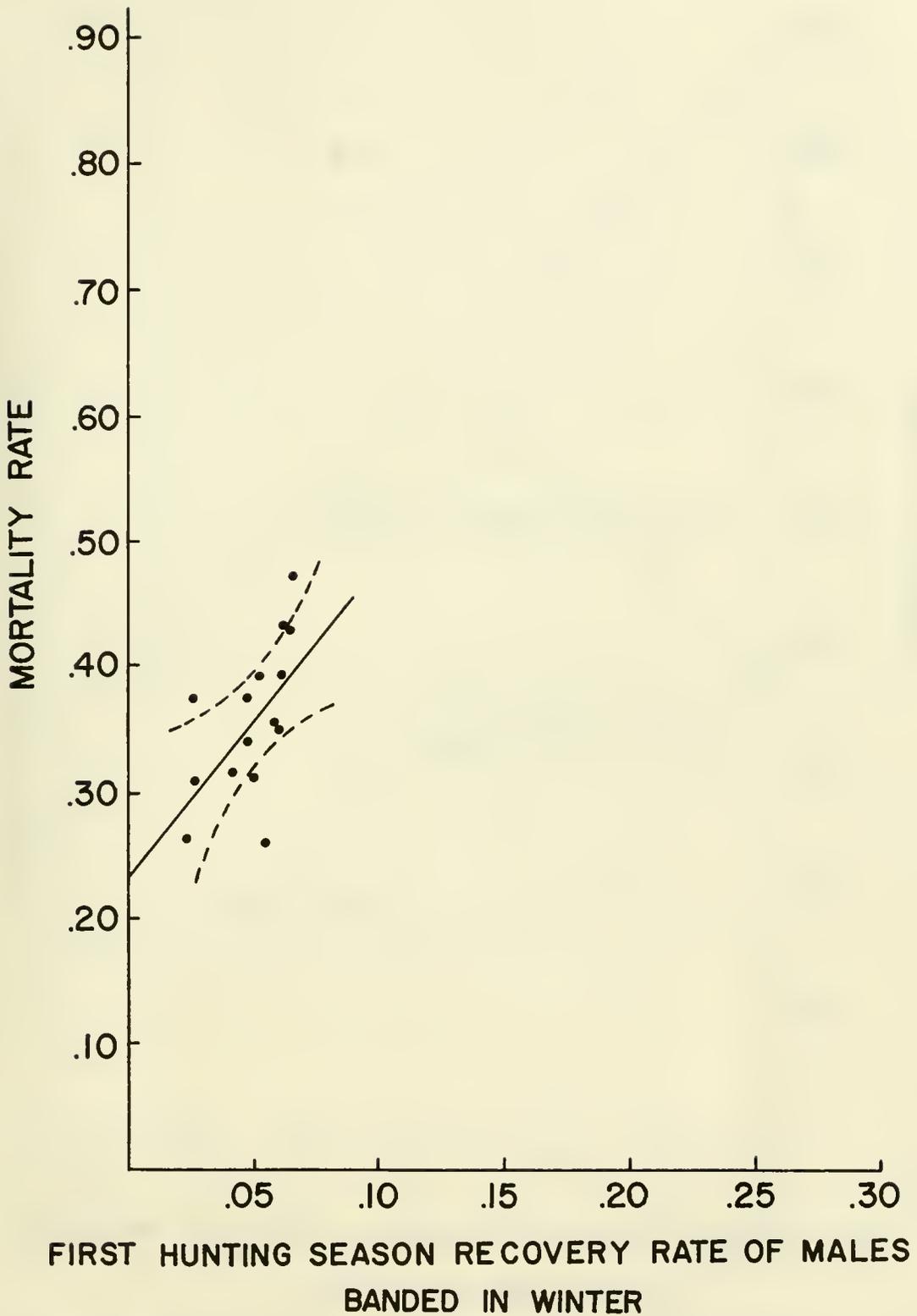


Figure 16.--Relation between first hunting season recovery rates and mortality rates of male black ducks banded in the winter, 1946-60 (data from table 56).

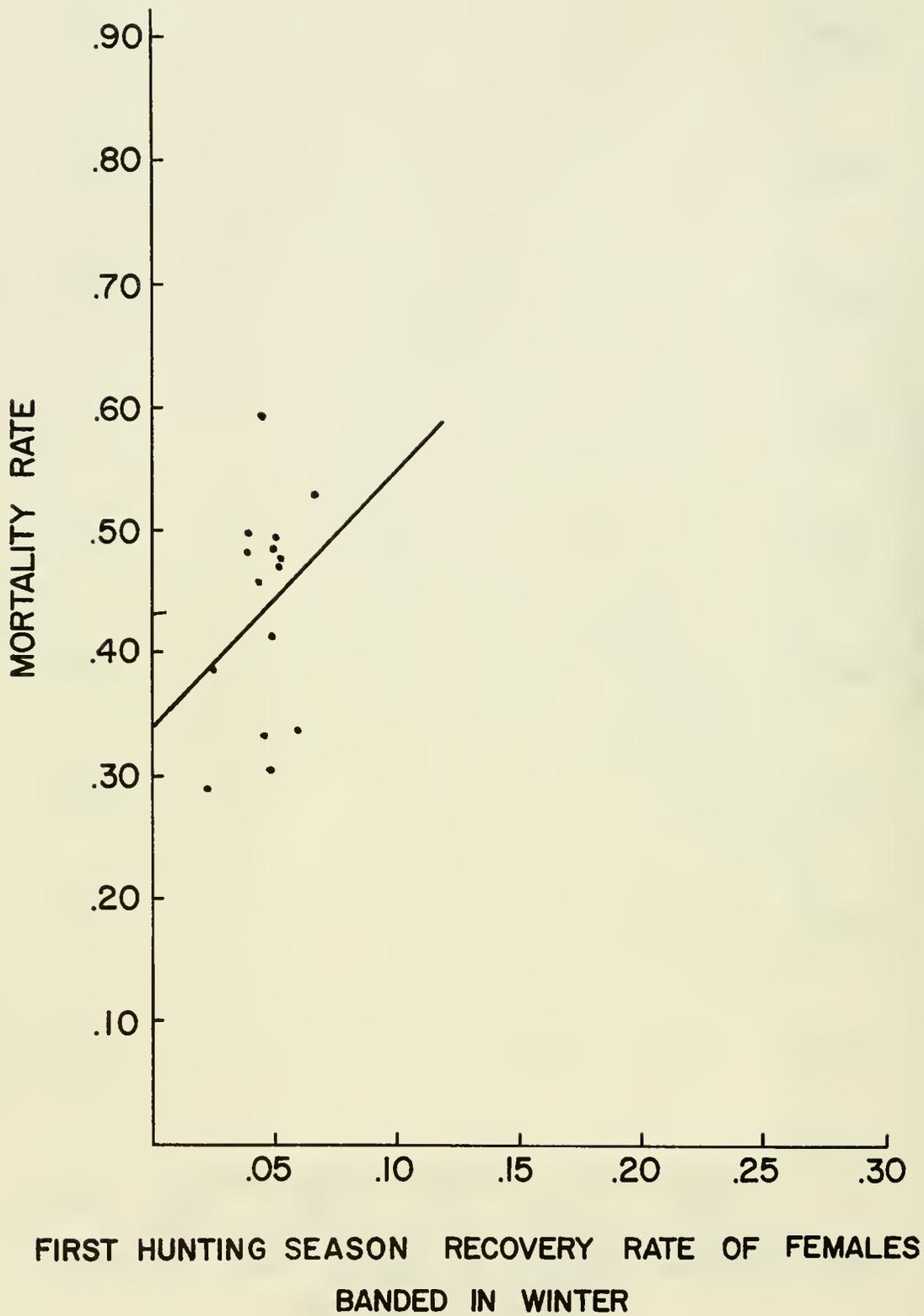


Figure 17.--Relation between first hunting season recovery rates and mortality rates of female black ducks banded in the winter, 1946-60 (data from table 56).

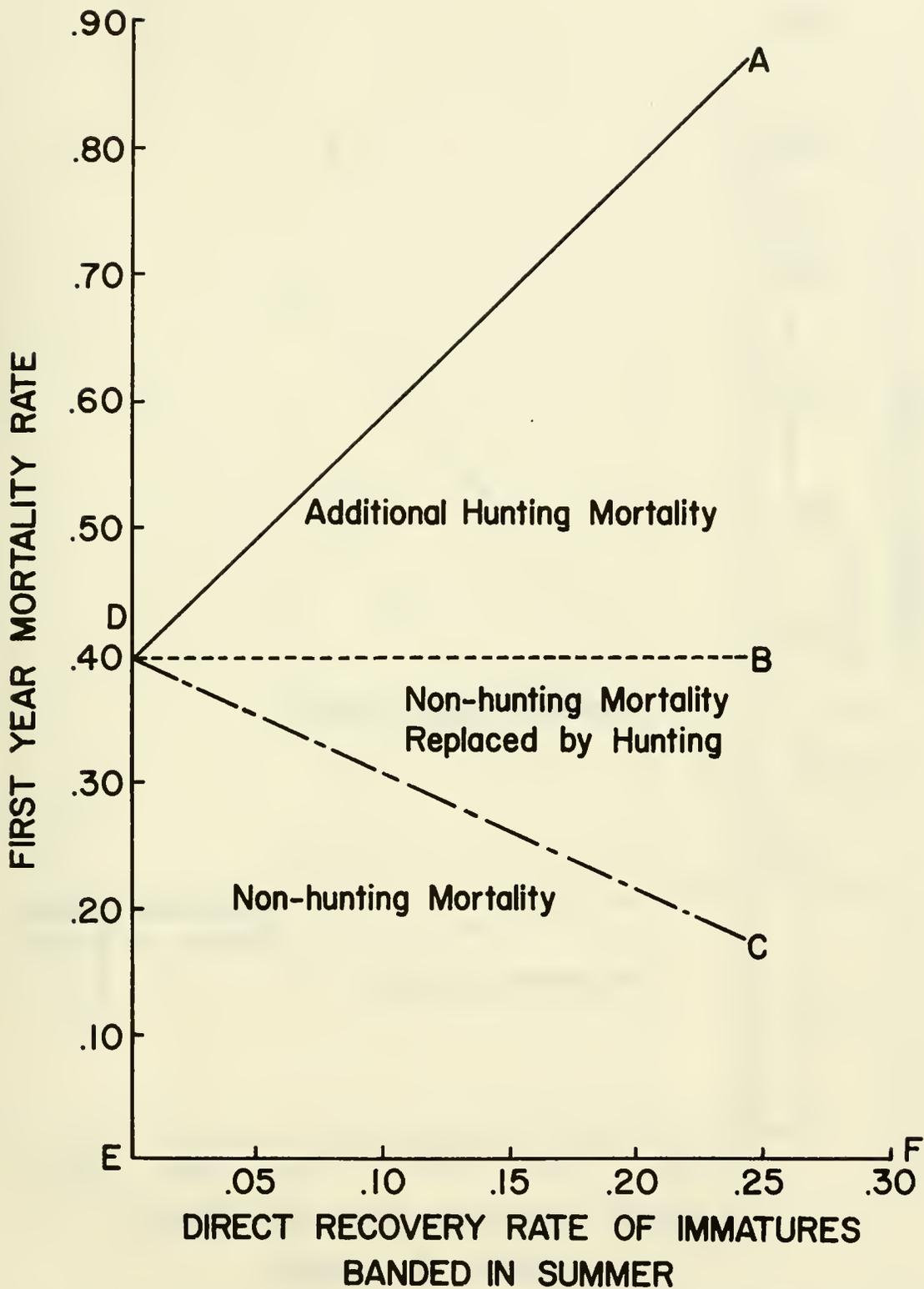


Figure 18.--Relation between hunting and non-hunting mortality among immature black ducks, using the regression of mortality rates on direct recovery rates (figure 10).

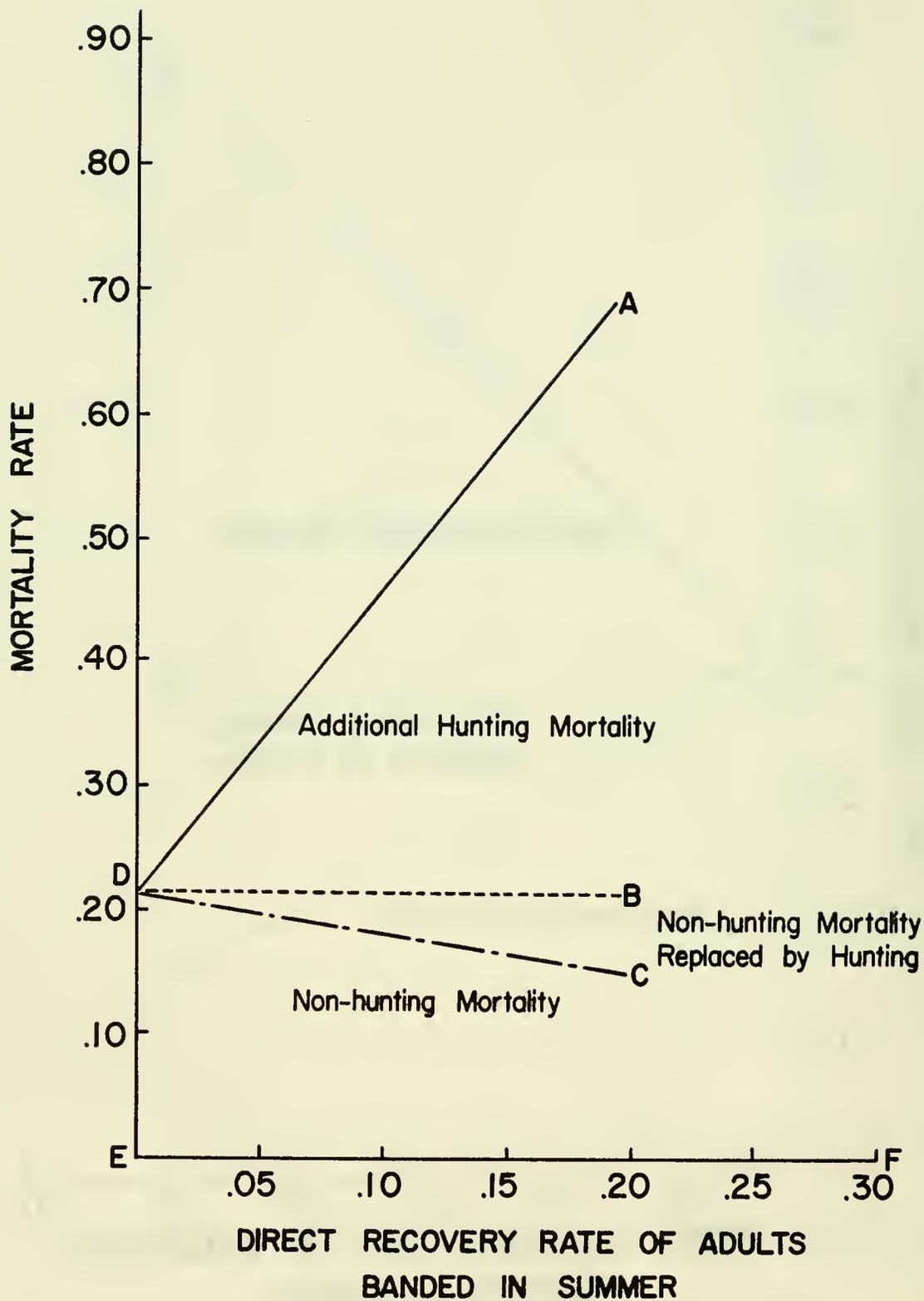
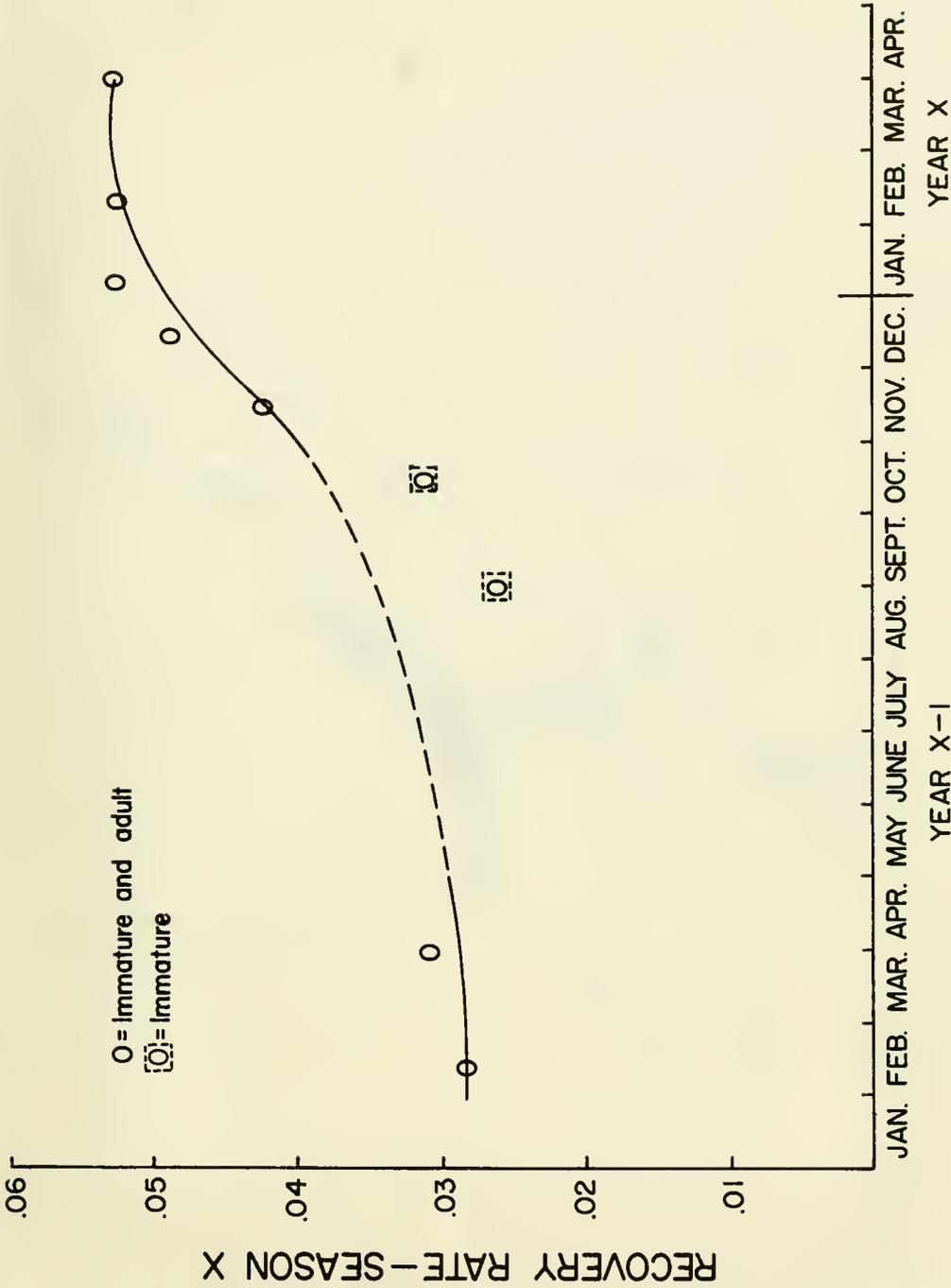


Figure 19.--Relation between hunting and non-hunting mortality among adult black ducks, using the regression of mortality rates on direct recovery rates (figure 13).



DATE OF BANDING

Figure 20.---The cumulative occurrence of deaths during the year among male black ducks, estimated from differences in recovery rates from bandings at various times of the year. The recovery rates plotted are averages from bandings, 1946-60.

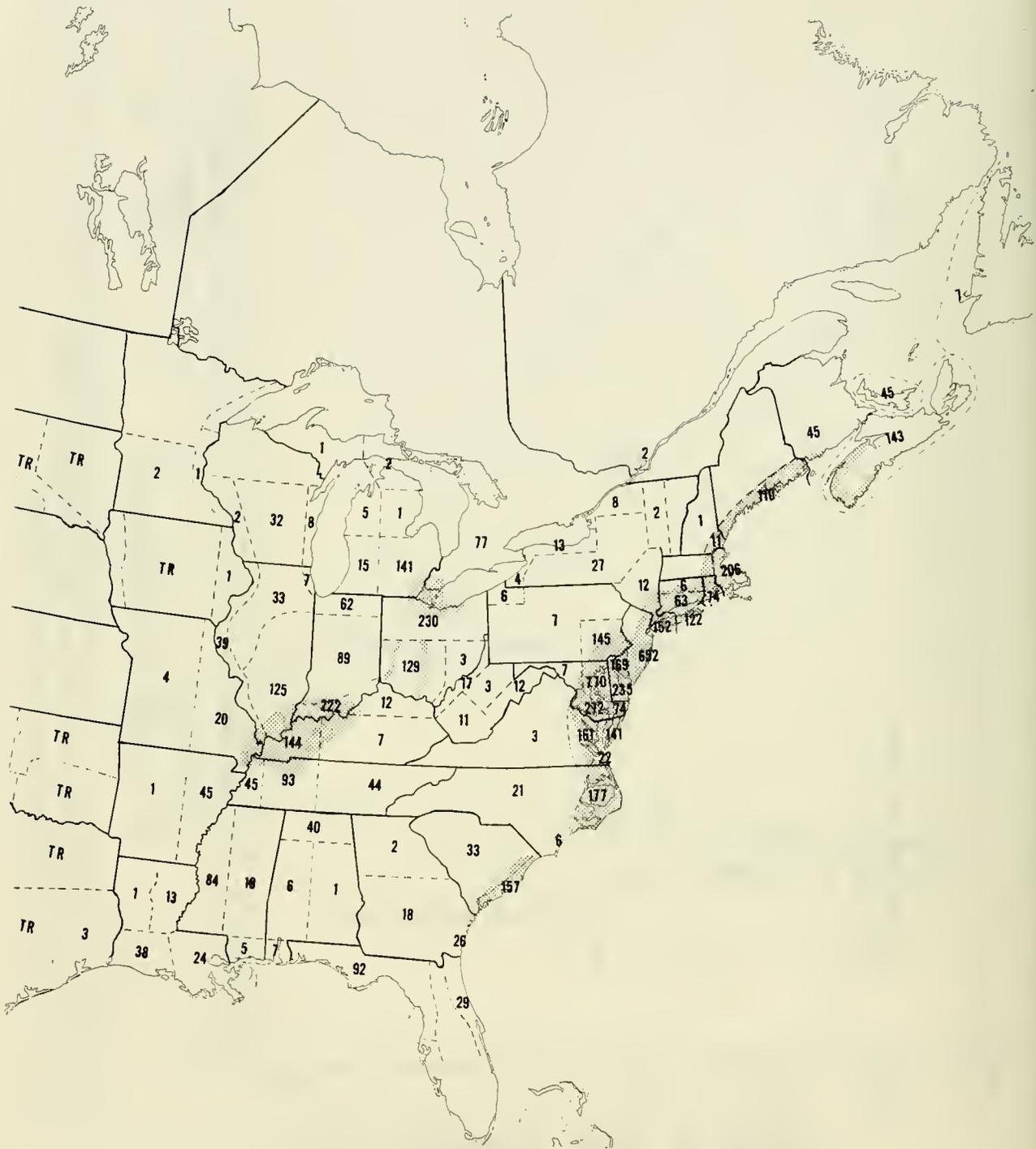


Figure 21.--Average numbers of black ducks observed annually on winter surveys, 1950-60 (in hundreds). Major concentrations are shaded and broken lines show winter survey units within States.

APPENDIX

Appendix A

Calculating annual mortality rates

The procedures followed in calculating mortality rates are illustrated using data from the New York portion of the Eastern Lake Ontario summer reference area of banding. Table A-1 shows data for adults banded from 1949 through 1960 and the steps used in determining mortality by the composite dynamic method.

This method utilizes a composite of several years of banding data. When bandings in recent years are used, as in this example, the number of birds banded long enough to yield recoveries during the first and second hunting seasons after banding is much greater than the number banded long enough to be recovered in the eighth and ninth seasons after banding. In table A-1, for example, 1,787 birds were available to yield recoveries during the first season, but only 737 had been banded long enough to be available for recovery during the ninth season.

Since the composite dynamic method assumes that the number of recoveries in each season reflects the relative number of deaths that occurred, an adjustment must be made for yearly differences in the numbers of birds available for recovery. This is done by presenting recoveries in terms of the number per 1,000 birds banded long enough to be available for recovery in each season (shown as recoveries per 1,000 banded in table A-1). The sum of these values represents the total birds dying from years 1 through 9 (175.8 in table A-1). For the purpose of calculating mortality rate, this also represents the number alive at the beginning of the first hunting season (see Alive beginning each period). Subtracting the number dying during the first season (175.8 - 85.0) gives the number alive at the beginning of the second hunting season (90.8). This process is continued until, during the last season, all the remaining birds die.

Because of the method used, mortality in the last year is always 100 percent and this biases the overall mortality estimate toward the high side. Therefore, mortality estimates for all years combined, and all years except the first are based on totals excluding the last year. Thus, in table A-1 the number dying in year 9 (1.4) was subtracted from the total alive for all periods, and the total dying in all periods, to obtain the adjusted totals shown in parenthesis. When sample sizes are large, this adjustment, which eliminates the last year of a series, has very little effect on the estimate.

In instances when a season prior to the last had no recoveries, the last year was used in mortality calculations for this study. This

was done so that the 100 percent survival rate implied by the year or years with no recoveries would be counterbalanced by the last year having 100 percent mortality. Actually, both the 100 percent mortality in the last year and the 100 percent survival occurring during years with no recoveries are "sampling errors."

By the above approach, it is possible to make annual mortality estimates for each year of life (beginning with the first hunting season after banding), or for any combination of years. In table A-1, the mortality rate during the first year is 85.0 divided by 175.8 or .48. For the remaining years the mortality is 89.4 divided by 205.9 or .43. During the entire span, the average annual mortality rate is 174.4 divided by 381.7) or .46. The calculation based on all years combined is believed to reflect the average annual mortality rate for birds banded as adults more accurately than any estimate based on less than the entire time span, because it is based on more data.

Table A-2 shows an estimate of mortality rates of birds banded as immatures using the composite dynamic method. Banding and recovery periods are the same as in table A-1. Data for individual years of banding were omitted. The estimate indicates that during the first year (between the beginning of the first and second hunting seasons after banding) immatures had a mortality rate of .64. For later years the rate was .49, and it averaged .58 for all years. For birds banded as locals (flightless young of the year) or immatures (flying young of the year), the first year mortality rate is usually much higher than during later years. Mortality of locals and immatures prior to the first hunting season after banding is not measured by the procedures in tables A-1 and A-2: only birds known to be alive at the beginning of the hunting season (because they were recovered) enter into the calculations.

Data from bandings of locals and immatures yield useful adult mortality rates when first hunting season recoveries are omitted from the calculations. An average mortality rate calculated from bandings of immatures, based on all recovery years combined, does not accurately represent mortality during any particular annual period since it is lower than the first year mortality rate and higher than the rate for later years. Nevertheless, it has value in indicating the average annual increment of young birds required to maintain a stable population.

When banding was done during the hunting season, first year and average annual mortality rate estimates were biased because deaths early in the hunting season of banding (before banding was accomplished) were not represented in the data. However, first year mortality estimates from in-season bandings, when compared to estimates from pre-hunting season bandings, were useful for obtaining an index to shooting mortality between the beginning of the hunting season and the time of banding.

The mortality estimates illustrated thus far are called composite because recoveries occurring at specified intervals after a number of different calendar years of banding are combined: recoveries for any particular interval after banding actually occurred in a number of different hunting seasons. Neither shooting pressure (which affects the proportion of banded birds present that are recovered) nor mortality rates are the same each year. By using a composite of data from several years instead of data from a single year a more reliable estimate of average annual mortality rate is obtained because the influence of annual variations in these factors is minimized.

If shooting pressures and annual mortality rates fluctuate from year to year at random, composite dynamic mortality estimates should not be biased, since a "heavy kill year" would be as likely to affect the number of recoveries in the first hunting season after banding as in some later season. Since these variables probably do not average out in all cases another method of estimating mortality rates - the relative recovery rate method - was also used in this study.

With this method the mortality rate estimate is based on a comparison of recovery rates during the same hunting period from samples of a population banded in different time periods. This approach assumes that birds banded during one period would have the same recovery rate as birds banded during a later period, if they suffered no losses in the interval. Thus, the difference in recovery rates from birds banded at different times (usually a year apart) reflects the mortality that occurred between the two banding periods. Since the recovery rates relate to the same hunting season there should be no difference in shooting pressure or other seasonal variables, and they should be directly comparable. Thus, a potential bias associated with the composite dynamic method is eliminated.

A condition for using the relative recovery rate method is that the samples banded each year are drawn from the same population of birds. This condition is most likely to be met when dealing with relatively stable, well defined populations. In practice, this means that the samples should be from summer or winter bandings, when migration is not likely to be a complicating factor. The relative recovery rate method usually was not used for birds banded during migration.

With the above explanation in mind we may now turn to a specific example using black duck bandings from New York. In table A-3, banding data from table A-1 are arranged for calculating an annual mortality rate by the relative recovery rate method. Here, recoveries from 12 successive hunting seasons are used to obtain a summary measure of the mortality that occurred between 12 successive annual banding periods. The comparisons are made as follows: birds banded in 1949 and recovered during the 2nd through 12th hunting seasons

after banding are compared with birds banded in 1950 and recovered during the 1st through 11th seasons after banding; 1950 birds recovered in seasons 2-11 after banding are compared with 1951 birds recovered in seasons 1-10; . . . etc., until in the last comparison, 1959 birds recovered in season 2 after banding are compared with 1960 birds recovered in season 1. In table A-3 the brackets enclosing lines of recovery figures, and the slanted lines connecting figures in the columns of recoveries from each year of banding, show the recovery data being compared.

Table A-3 shows how data from several years can be pooled when bandings and recoveries from individual years are relatively few in number. A measure of the average rate of survival between banding periods (0.56) is obtained by dividing the recovery rate under Column 1 in table A-3 by that under Column 2. Subtracting this from 1.00 gives the average annual mortality rate during the years 1949-60 (0.44). This compares with the average annual mortality rate of 0.46 as determined by the composite dynamic method.

Typically, immatures have a higher first hunting season recovery rate than adults. This is because immatures are more vulnerable to shooting than adults. The dynamic method of estimating mortality rates assumes that the number of recoveries occurring each year reflects the number of deaths that year. Since hunting removes a larger fraction of immatures than of adults from the population, this assumption is met only if nonhunting mortality factors, also, remove a larger fraction of immatures. Examination of this point in the section dealing with mortality rates suggests that nonhunting mortality factors do take a larger fraction of immatures than adults. If this were not so, immature mortality estimates would be biased on the high side when the dynamic method is used.

To determine a mortality rate for immatures with the relative recovery rate method, first hunting season recovery rates for adults should be compared with second hunting season recovery rates of birds banded as immatures from the same population. In this study, however, so few adults were banded in most summer populations that first and second hunting season recovery rates of birds banded as immatures were compared even though the resulting mortality estimates were biased on the high side because of the greater vulnerability of immatures to shooting. These biased estimates should be viewed only as an index to mortality rates of immatures. Because of this problem, the relative recovery rate method applied to data from immatures was not as satisfactory as when applied to data from adults.

We did not thoroughly study the complex subject of sampling error in mortality estimates. However, estimates were presented only when they met the following conditions: composite dynamic mortality estimates were made for samples with 20 or more recoveries, and estimates for the first year, the second through all later years,

and for the entire span of time were included. Second year mortality estimates were included when there were 11 or more recoveries during the second year; relative recovery rate mortality estimates were presented when the two recovery rates used in the comparison had a total of more than 25 recoveries and neither of the rates were based on less than 8 recoveries.

Table A-1.--Procedure for estimating annual mortality rate by the composite dynamic method. Data from adult black ducks banded during summer banding periods in New York portion of Eastern Lake Ontario reference area.

Year banded	Number banded	Recoveries in each hunting season after banding								
		1	2	3	4	5	6	7	8	9
1949	7	1	0	0	0	0	0	0	0	0
1950	315	21	14	7	2	1	3	0	1	1
1951	150	10	5	1	3	1	2	0	1	0
1952	265	18	6	5	4	1	1	1	0	0
1953	165	21	8	4	1	1	2	0	0	
1954	96	2	6	2	1	3	0	0		
1955	19	2	3	0	0	0	0			
1956	91	10	6	3	0	0				
1957	37	3	1	0	0					
1958	25	4	2	0						
1959	182	14	8							
1960	435	46								
Total recoveries		152	59	22	11	7	8	1	2	1
Banded birds "available"		1787	1352	1170	1145	1108	1017	998	902	737
Recoveries per 1000 banded (Dying in each period)		85.0	<u>43.6</u>	<u>18.8</u>	<u>9.6</u>	<u>6.3</u>	<u>7.9</u>	<u>1.0</u>	<u>2.2</u>	1.4=175.8 (174.4) <u>1/</u>
Alive beginning each period		175.8	<u>90.8</u>	<u>47.2</u>	<u>28.4</u>	<u>18.8</u>	<u>12.5</u>	<u>4.6</u>	<u>3.6</u>	1.4=383.1 (381.7) <u>1/</u>
Annual mortality rate		.48				.43				.46

1/ Total minus the last year.

Table A-2.--Procedure for estimating annual mortality rate by the composite dynamic method. Data from immature black ducks banded during summer banding periods in New York portion of Eastern Lake Ontario reference area.

	Hunting seasons after banding							
	1	2	3	4	5	6	7	8
Total recoveries	569	132	45	19	10	8	6	1
Banded birds "available"	4,792	3,848	2,861	2,757	2,723	2,593	2,468	1,952
Recoveries per 1,000 banded (Dying in each period)	118.7	34.3	15.7	6.9	3.7	3.0	2.4	0.5 = 185.2 (184.7) $\frac{1}{1}$
					66.0			
Alive beginning each period	185.2	66.5	32.2	16.5	9.6	5.9	2.9	0.5 = 319.3 (318.8) $\frac{1}{1}$
				133.6				
Annual mortality rate	.64				.49			.58

$\frac{1}{1}$ Total minus the last year.

Table A-3.--Procedure for estimating annual mortality rate by the relative recovery rate method, using data from table A-1.

Year banded	Number banded	Year recovered												Recoveries from each year of banding			
		1949	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1	2		
														Total minus first year after banding	Total		
1949	7	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1/
1950	315	21	14	7	2	1	3	0	1	1	0	0	0	29	50		
1951	150	10	10	5	1	3	1	2	0	1	0	0	0	13	23		
1952	265	18	18	6	5	4	1	1	1	1	0	0	0	18	36		
1953	165	21	21	8	4	1	1	1	1	2	0	0	0	16	37		
1954	96	2	2	6	2	2	1	1	1	3	0	0	0	12	14		
1955	19	2	2	2	3	2	0	0	0	0	0	0	0	3	5		
1956	91	10	10	6	3	10	6	3	0	3	0	0	0	9	19		
1957	37	3	3	3	1	3	1	1	0	1	0	0	0	1	4		
1958	25	4	4	4	4	4	2	0	0	0	0	0	0	2	6		
1959	182	14	14	14	14	14	14	8	8	8	8	8	8	8	22		
1960	435	46	46	46	46	46	46	46	46	46	46	46	46	46	46	1/	
Pooled recoveries														111	262		
Total bandings related to recoveries in each column														1,352	1,780		
Recovery rates														.0821	.1472		
Annual mortality rate																	.44

1/ Not involved in comparisons



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