

WATERFOWL
BROOD SURVEY
MANUAL



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Revised 1970 June

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WATERFOWL PRODUCTION SURVEYS

I. INTRODUCTION.

This manual describes procedures for conducting standard brood surveys. It also outlines a method for using brood data to provide an index which can be combined with breeding population data to give an estimate of productivity rate. The techniques can be used for individual water bodies, large marshes, or blocks of wetland habitat.

Intensive brood counts, such as the beat-out, are desirable for special studies and have been described by Blankenship, et. al. (1953. Techniques for brood production studies. Duplicated pamphlet. Edited by W. H. Marshall, University of Minnesota).

We have modified an extensive chronology survey (Murphy, Ray and Maurice Anderson. 1955. Duck Production Surveys in Eastern South Dakota, 1953 and 1954. S.D. Dept. of Game, Fish and Parks. Mimeo., Federal Aid Report, Proj. W 17-R-10. September 30, 1955.) to yield the desired brood index which is representative of the habitat and which spans the entire brood season.

The latter section of this manual contains a waterfowl production inventory plan for Bureau of Sport Fisheries and Wildlife, Refuge Division, Waterfowl Production Areas in the Dakotas, Minnesota and Nebraska.

The term productivity rate is defined as the percent of pairs producing a brood.

1. The average productivity rate required to maintain a stable population in mallards is estimated to be 42-50 percent (5 to 6 young per pair). This is equivalent to 1.25 young per adult in the fall (Crissey, W. F., 1964. Comments on the collections of waterfowl data for discussion with waterfowl techniques. Feb. 13, 1964. 11 pp.).
2. For our purpose, this productivity rate need not be exact. It will be used as an average for comparative purposes on all habitat blocks sampled. Future studies may indicate what true average productivity rates are for various habitat strata or individual wetlands.
3. In many years productivity rates appear to be relatively similar over large geographic areas, suggesting that weather and/or weather-dependent factors are important widespread regulators of productivity rate.

4. Productivity rates vary greatly from year to year with the actual rate ranging approximately between 20 and 80 percent. This simplifies the problem of detecting major changes (between 20-40-60-80 percent), despite variables inherent with brood survey work.

Some variables which influence the efficiency of brood counting are known; however, adequate correction factors are not presently available. Future studies may identify these more precisely. Therefore, it is important that variables be measured, described and recorded in present survey work. Factors required are: emergent vegetation, open water interspersed estimates, water depth, wetland type and wetland size.

Many of the variables can be reduced when selecting the exact time of survey (e.g., wind, rain, time of day, survey technique, etc.). Variations in seasonal phenology, annual changes in vegetative height and density, and water levels are some problems which must be solved.

II. SAMPLES.

The sample unit will be a single early morning or evening count designed for about $2\frac{1}{2}$ hours of effective counting on the sample areas. With 1 to 2 hours allowed for travel time, 4 hours will normally be required to complete a sample unit.

The unit may include a walk/wade (see methods) portion which would be completed following the early morning sample or prior to an evening run.

Size of the unit will be selected so that brood surveys can be completed under optimum water conditions, in years with high production, and when the maximum number of broods will be present (late July and early August).

The sample unit should be designed so that a maximum amount of potential brood habitat can be scanned during an observation period.

The number of sample units and counting frequency will usually be determined by survey objectives, but may need to be modified to fit manpower availability.

Sample selection. The goal of sample unit selection should be such that the number of broods observed is directly proportional to the number produced. To accomplish this the same water areas must be inspected each year in a standardized pattern. Unmeasurable biases will be introduced as emergent vegetation pattern varies and water levels change between years (discussed further on page 11 and Instr., Form 5.2).

Waterfowl Production Areas (WPA). The WPA survey unit will usually consist of an auto transect combined with use of observation points to scan portions of the larger water bodies.

It will be desirable to design some sample units to include those WPA blocks counted annually in breeding population surveys. In addition, one or more of the brood index transects established in 1964 or earlier should be included annually. Assistance may be available from wetlands offices, Refuges and other Bureau Divisions. The 1964 brood transects were selected to be representative of the major types of waterfowl habitat within the WPA Districts.

When a WPA block is included it may be desirable to use field trails if a better index will be obtained. If soil will not permit auto travel after rain, this modification will not be possible.

The Wetland Manager's brood survey will combine two objectives: 1) to obtain a representative District brood index, and 2) to provide a record of minimum brood use of a few selected Waterfowl Production Areas. Additional information in the latter category may be obtained for other WPAs, if time permits.

Refuges and large marshes. Samples on refuges may be on a more intensive scale than those for WPA surveys. Productivity rates for the local area are needed for evaluating management practices and special studies. The refuge productivity rate data can also be used in conjunction with that from WPA and Research Division surveys to estimate productivity rates for Districts and large habitat blocks.

Sample units may use one or more, or combinations of the standard methods (auto transects, boat and motor runs, canoe runs, observation points, walk/wade, beat-out, and possibly marsh vehicle transects).

The sampling should be distributed so that all major marsh units are covered; thus, the habitat manipulations in part of the refuge will not introduce a major bias into the brood data.

Sites subject to extreme variation in brood visibility due to changes in emergent vegetation should not be used unless vegetation control measures are planned. Uniformity should be expected for relatively long periods of time (e.g., 10 years)

Sampling frequency. Data from three refuges were examined to compare the weekly auto transect count index with that obtained from two, three, or five counts (Agassiz, 1959-1965, Lostwood, 1963-1966, and J. Clark Salyer, 1956-1965). We assume that 11-12 weekly counts gives a precise index to season's production. We found that broods seen on two counts, if adjusted, made up a reasonably consistent fraction of the total for 11 or 12 (95 percent confidence limits within plus or minus 2 percent at J. Clark Salyer). (See Appendices i, ii, iii, pp. 21, 22, 23).

Two-count sampling. Two counts made July 12 and August 15 will adequately span the brood season in most years.

Brood ages through Class III must be tabulated.

If the first count is made July 12, about 10 percent of the total season's pintail hatches will be missed in about half the years. Blue-winged teal hatched July 12 would not reach flight stage until August 16.

In years when general observations indicate that large numbers of early-hatched broods are appearing, a count may be made June 24 to permit adjustment of the brood index.

1st count.....July 12 2nd count.....August 15

The interval between counts should be approximately 34 days.

Three-count sampling. Three sampling periods provide a more adequate index. Where early nesting species make up a substantial portion of the total breeding population...three counts are recommended. We have found it essential that three-count sampling be used on auto transects. Class III young cannot be separated from flying young unless the latter are flushed. Blue-winged teal are often in this age class stage on the August count.

On the 1st count, June 24, mallards and pintails are tabulated through class III; other species through IIB.

On the 2nd count, July 20, all species are tabulated through IIB.

On the 3rd count, August 15, all species are tabulated through IIB.

The span of 26 days between counts will allow no species to hatch and leave class IIB age without opportunity for observation.

Target dates for both two-and-three-count sampling should be within 3 days of June 24, July 12 and July 20. The August count should be no earlier than August 15, but may be extended through August 19. Normally this span will permit selection of days with suitable weather conditions.

Note: In using 2 or 3 count sampling, care must be used to make surveys under optimum weather conditions. If there is doubt about the reliability of the sample, it should be re-run.

Frequent-count sampling. If relatively unbiased hatching curves or intensive sampling is desired, the following schedule should be followed (tabulating ages through class IIb):

Make 20 weekly tabulations, but only 9 or 10 actual counts, depending upon appearance of the first broods.

1. May 14 ... Obtained by analysis of hatch dates on first and second counts.
2. May 21 ... " " " " " " " "
3. May 28 ... " " " " " " " "
4. June 4 ... First count; or estimated from analysis of hatch dates on June 18 count if significant numbers of broods have not appeared.
5. June 11... Obtained by interpolation.
6. June 18... Second count.
7. June 25... Obtained by interpolation.
8. July 2 ... Third count.
9. July 9 ... Fourth count.
10. July 16... Fifth count.
11. July 23... Sixth count.
12. July 30... Seventh count.
13. August 6 Eighth count.
14. August 13.....Obtained by interpolation.
15. August 20.....Ninth count.
16. August 27.....Obtained by interpolation.
17. September 3 ..Tenth count.
- 18, 19, 20 (September 10, 17, and 24 - obtained by extension of tenth count.)

III. SAMPLING METHODS.

Selection of the sampling methods will be determined by:

1. Objectives of the survey ... intensive or extensive.
2. Time and manpower available.
3. Size of the survey block being considered.
4. Physical characteristics of the sample unit:

- a. Location of all-weather roads or trails.
- b. Presence of elevated margin along marsh or water body.
- c. Presence of towers.
- d. Channels for boat passage through sites used by broods.
- e. Location and character of emergent and marginal vegetation.
- f. Location of brood habitat in relation to above.

A. Vehicle transects are useful for brood sampling in two types of habitat.

- 1. Where water bodies are relatively close together with all-weather roads or trails through the habitat block. Major roads should be avoided because of hazards (except that observation points off the highways might be used).
- 2. Where elevated roads, dikes and trails permit good view of representative brood habitat in large marshes.

The observer sits higher in pickup trucks than passenger cars and when shoreline vegetation restricts view of the water surface, there may be a difference in number of broods observed. The same type vehicle should be used for a sample unit each run and each year if possible.

Standard procedures (in part from Murdy and Anderson, 1955) are:

- 1. Vehicle speed on transect routes at maximum of 5-10 mph while passing water bodies.
- 2. If water area is near trail, do not stop unless brood is observed or one is believed to be present.
- 3. If water area extends some distance from trail (up to 1/8 mile), the water surface should be scanned once with binoculars or spotting scope from the best vantage point.
- 4. Large water areas are to be scanned from the best location. All visible broods are to be counted even if species cannot be identified.

5. When regular observation points are used (as No. 4) they should be plotted on the transect map and pertinent instructions written into the inventory procedures plan.
6. Off-road observation points are desirable if readily accessible and used in a consistent manner (plot and describe on maps and in survey plan).
7. Do not observe for long periods at stopping points...glass the visible water surface once, then move on. Considerable bias may be introduced because more broods will be seen on a 15-minute stop than on a 1-minute stop and different observers are apt to stop for variable time periods.
8. The primary objective is to record "broods". Do not spend extra time trying to "stretch" glasses to identify, age, and count young in distant broods. Simply record them as unidentified broods, age and number of young unknown.

Note: If transects are run to obtain information on brood age for constructing hatching date tables, extra time will be needed to determine age. Spotting scopes may be used, areas may be scanned several times, and disturbance may be made at points close to car in order to flush additional broods. Do not combine this activity with auto transect data in such a manner that brood index will be biased.

Platforms were mounted for standing observer on top of pickup cab at J. Clark Salyer. An additional man was used to drive the vehicle.

B. Boat and Motor runs. This is a good sampling method where major portions of large marshes cannot be readily viewed from vehicles. A larger and better brood sample often can be obtained per unit of time than from auto transects. The primary requirements are:

1. Channels which permit boat and motor travel at all ordinary water levels, and after submerged vegetation growth is at a maximum (late July).

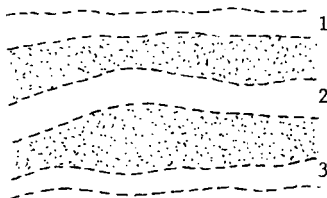
2. The runs should permit view of representative portions of the brood habitat, e.g., bays, wide channels, shallow open-water areas.

Standard procedures are:

1. Decide whether one man or two always will be available for the sample run. Two men will see more broods, but using only one will be a more efficient use of manpower and normally is recommended.
2. Cruise at moderately fast speed; slow down or stop if necessary when broods are sighted. Faster speeds can be used when passing through waters where broods are unlikely to occur and to pass broods apt to bunch up in narrow channels.
3. In open water bodies, broods of some species (especially mallards) move toward shore as soon as they are disturbed. Shorelines must be scanned regularly long distances ahead to detect these.
4. Stops may be made to stand up or leave boat to scan water areas not readily visible from a sitting position. These stops should be made each time the run is made. Stopping points and a sketch of the area scanned should be shown on maps. This is necessary to insure that a consistent sampling pattern will be followed.
5. Details and special aspects of the boat run should be described in the "procedures section" of the Inventory Plan.

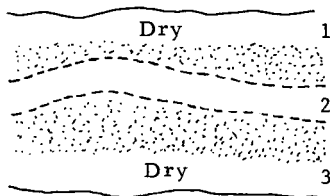
NOTE: Open-water channels may provide a high percentage of the total wetland acreage during drought or drawdown periods and broods will be concentrated in them. This introduces a major bias and its reduction or elimination may be difficult. In a J. Clark Salyer sample, satisfactory adjustment was made as shown on page 9.

Normal
Marsh
Boundary



Three zones commonly
used by broods. Only
zone 2 normally visible
from boat = 1.3
of total.

Water boundary
during drought
year



All broods confined to
zone 2. A correction:
broods observed/3, gave
a reasonable value for
comparison with other
years. 1/

1/ A correction factor of 2.5 was used in the J.Clark Salyer 1949-1962
brood report



..... Closed



..... Open water (brood habitat)



..... Water margin

- C. Canoe (boat) runs without motor. Some water bodies can be most efficiently counted by canoe manned by two observers or one observer moving downwind. A dog running the shoreline will chase many broods into open water. This technique is used often on wooded lakes.

Shallow-water areas containing dense submerged vegetation can be covered.

Canoe should be moved quietly and close to the shoreline.

- D. Observation points can be very useful for obtaining brood index data, especially where large blocks of brood habitat can be scanned. An elevated position is desirable; i.e., a hilltop or tower.

Broods of some species will head for emergent cover as soon as disturbed. The observation point should be accessible without causing brood movement. Broods heading for cover should be counted immediately. It often may be desirable to reach a concealed vantage point on foot.

The objective for index purposes is to count all broods present on a definite sample of open water at the time the observer arrives.

For intensive sampling of special study areas where disturbance causes broods to hide, the observer should hide quietly and wait for normal brood activity to be resumed.

- E. Walk/wade. Shorelines having little emergent vegetation can be walked efficiently. A high proportion or all of the broods present may be seen. An advantage of this method is that counts may be made throughout the day.

Small wetlands must be approached carefully since some broods of some species (especially mallards and pintails) may move overland as the observer enters the wetland. Two or more observers may be needed if the marginal vegetation is dense enough to conceal broods as they leave the water.

A trained dog is useful in flushing broods from the shore. If sample counts are to be consistent from year to year, a dog always should be used.

Marsh vehicles or 4-wheel drive pickups can be substituted for walking and wading.

In wetlands without marginal vegetation, broods may be forced to use brush patches up to 100 feet or more from the water area during mid-day, presumably for shade.

- F. Brood beat-out techniques are described in Blankenship, et. al. (1953). They will be used primarily for special studies. Considerable manpower is needed for beat-outs in large wetlands with much emergent vegetation. It is difficult to correctly ascertain the proportion of broods not observed. Brood beat-outs usually are impractical on large marshes.

- G. Combination of sampling methods may be desirable in a unit sampling plan. For example, some wetlands may be walked during the day and observed from auto transects or observation points during optimum morning or evening hours.

An index for a single marsh may combine boat and canoe runs with vehicle transects, observation points and walking.

IV. TIME OF DAY.

Brood surveys on most samples should be completed during the two hour period beginning 10 to 15 minutes after sunrise or ending 10 to 15 minutes before sunset.

Walk/wade samples may be counted during daylight periods when weather permits.

V. WEATHER.

Diem and Lu (1960: Factors influencing waterfowl censuses in the Parklands, Alberta, Canada. Journ. Wildl. Mgt., 24 (2): 113-133.) found the number of broods frequenting open portions of ponds to be more representative of actual brood populations when temperatures were moderate, winds 4 to 10 miles per hour and the sky overcast.

Overcast skies reduce brood visibility and generally should be avoided if a storm is likely to occur during the counting period.

VI. HUMAN FACTORS.

Human factors may bias the sample data to a varying degree. Mental attitude, visual acuity, hearing, experience and physical condition are a few factors of importance.

Variables such as direction of travel, selection of observation or stopping points and length of time water area is scanned should be standardized by preparation of a detailed brood inventory plan.

When changes in observers are anticipated, the old and new observer should conduct the surveys together one time.

VII. EQUIPMENT NEEDS.

1. Tally counter.
2. Field glasses.
3. Spotting scope.

4. Colored (black, red, blue, green) pencils or pens.
5. Manual of game investigational techniques.
6. Camera (to record emergent vegetation pattern from observation points).
7. Brood aging guide.

For safety, install slow-moving vehicle signs and/or use flashing warning lights. Never park below the crest of a hill that screens approaching traffic.

VIII. RECORDING DATA.

- A. Maps showing travel routes and the exact boundary of water areas to be scanned should be prepared.

On large marshes it will be desirable to measure changes in brood use resulting from management or changes in natural conditions. Sample units should be sub-divided so that data for the major brood habitat blocks can be separated. Natural or artificial boundaries should be used to separate samples and these should be described in the Wildlife Inventory Plan.

Observation points or auto transects used on lakes or large wetlands which are only partially sampled should be shown on maps.

Maps for auto transects in wetland habitats should show all basins visible from the road and any basins to be viewed from off-road observation points.

It will be desirable to delineate interspersions of open water and emergent vegetation on maps during the first survey year. Major changes which may modify brood observability in later years, should be recorded and reported in the annual brood index survey. Effects of these changes on the brood index can be attempted.

Aerial oblique photographs showing vegetative interspersions of major brood waters will be valuable for the initial record and for evaluation of later changes. Photos from observation points can provide a good record of changes in the proportion of open water which can be scanned.

Dry wetlands may be colored red and the location of emergent vegetation shown in green on maps used for sample units. Solid green or red would mean that potholes need not be scanned further during the season unless summer rains re-flood them.

(See pp. 3-4 of the 1966 Waterfowl Breeding Population Survey Manual for additional comments on maps).

- B. General Record Data. Refer to applicable sections of this manual, pp. 6-14.
- C. When recording ecological data, observers should adequately describe water levels and water conditions on the sample unit. They should also reflect important changes in brood observability and variations in emergent vegetation due to changes in water levels.

Forms 5.1 and 5.2 are available for field use and preliminary summaries. Data will be recorded for each water body scanned.

Either forms 5.1b or 5.2 may be used in the field.

If 5.1b is used, transfer Ecol. Data and number of broods to form 5.2.

If 5.2 is used, enter brood age and number of young per brood opposite species, using as many columns as needed for the individual water body.

Broods positively identified (for species, age and number per brood) should be transferred to form 5.7, after initial recording on either form 5.1b or 5.2.

Instructions for Form 5.2

Form 5.2. Summary sheet for WPA brood sample units, or individual large water bodies on refuges. Data transferred from field form 5.1.

Instructions: Ecological data will be needed for all water bodies on each survey. This may be tabulated on a separate sheet if water bodies are dry, nearly dry, if there are no broods or if there are no management recommendations.

Page. Use as many pages as needed, numbering each as indicated.
1) No. Number of sampling unit as assigned by Refuge Manager.
See page 2 WATERFOWL BROOD SURVEY MANUAL for explanation of sample unit.

Location. District, County (ies), nearest town, etc.

7) Map No. As shown in Inventory Plan

8) Photo No. File reference number(s) or photo number(s) if assigned and available.

Count Method. See pages 5 to 12 SURVEY MANUAL. If more than one method is used for the sample unit indicate as Comb.

Observer(s). Indicate field observer by name.

12) Time. Time of day is standardized but should be indicated.

Weather. See BREEDING POPULATION SURVEYS manual, pp. 12 to 13.

Counting Frequency. Number of counts per year, usually two or three. For BROODS below: Two counts, enter brood ages through class III: three counts, 1st - mall. & pin. through III, other through IIb; 2nd & 3rd - all spp. through IIb.

ECOLOGY

11) Number. Number of water body on brood survey unit, or sample number on large water body. Normally these will be consecutive numbers.

14.1 Type. Standard wetland type as defined in Spec. Sci. Rept. 20, USFWS. If "Stewart-type" is used, make appropriate notation in left margin.

Items: These 5 item numbers are used to facilitate tabulations on summary sheets.

1. Basin size. Usually obtained from aerial photographs. If only a portion of a large marsh or lake is included in the sample unit, the basin size is the acreage which would be scanned during highest water level. Calculate acreage of potholes to nearest 1/100; of large water bodies to nearest 1/10.
2. Water area. Water surface area at time of survey. Enter acreage, as for basin size. It includes both open and closed marsh. See note under Basin size if only a portion of a large marsh or lake is included in the sample unit. Water area can be sketched on field map and acreage calculated later.
3. Percent open water. A visual estimate of the percent of water surface open enough to permit observation of broods. Thin emergent vegetation may be classed as open if inspection with binoculars or spotting scope suggests that most broods would be seen. If done accurately, this estimate will measure major changes in water levels and area covered by emergent vegetation from year to year. Aerial photographs may be a desirable supplement in some instances, but for this purpose we are measuring brood visibility on the basis of a ground observation.

Percent
Open Water

81 to 100
61 to 80
41 to 60
21 to 40
0 to 20

Percent open water should be estimated to nearest 10 percent.

4. No. 2 x No. 3 = acres of open water. Item 2 (water surface area in acres) times item 3 (percent of water surface on which broods were visible) equals acres of open water for the water body (or portion of water body scanned).
5. Habitat class. An arbitrary attempt to rate the water body (or the portion scanned) in terms of its usefulness to broods. Obviously many factors may be involved, e.g.:
 - a. Water level. Dry or nearly dry potholes have low value. Large open-water lakes may not be attractive, except for the bays and coves.
 - b. Size. Small potholes with diameters of 25 feet or less are usually used only as transient areas to better brood habitat. Attractiveness generally increases as size increases to the 5-10 acre class.
 - c. Loafing sites. An important factor for both dabblers and divers. (May be mudflats, hay piles, large stones, matted vegetation, stone piles, old boards, posts, logs, etc.)
 - d. Emergent vegetation pattern. Various combinations of emergent pattern increase attractiveness. Marshes with dense emergent vegetation are less attractive, particularly if the water surface is covered with matted vegetation. Open water is less attractive if wave action limits food, cover and protection.
 - e. Duck species. Wood ducks use heavy emergent cover, fallen timber areas and flooded brush. Diving ducks may avoid such locations entirely. Dabblers may use moderately dense white-top sedge sloughs where brood visibility will be very low.

- f. Food. Abundance of invertebrates and plants.
- g. Algal and pondweed mats. Broods are seldom seen where swimming and diving is hindered by this vegetation.

Assignment of habitat class may be quite subjective but it may be useful in data analysis. Where the classification applies to particular species or special cases this should be noted, and a description of the conditions given (reverse of form).

Code
Number

- 5 Water bodies highly attractive because of combination of factors (a to g) above.
- 4 Water bodies having "good" value.
- 3 Water bodies having "moderate" value.
- 2 Water bodies having "fair" value.
- 1 Water bodies of no value dry or nearly dry; entirely overgrown with rank and matted vegetation; small; etc.

16.1) Water level

Code
Number

- 5 Average water level high.
- 4 Above normal.
- 3 Normal.
- 2 Below normal.
- 1 Dry or nearly dry.

If gauges are present, enter gauge reading.

BROODS

The total number of individual broods and broody hens from the field form (5.1) is entered here. Hens flushed and making a distraction display will be considered broody. See note under Counting frequency to determine age classes entered.

Young coots are difficult to group as true broods so only the total young on the sample should be recorded.

Correction for brood visibility. For purposes of analysis we will assume that, within a given marsh visibility class (percent open), the proportion of broods seen will tend to remain constant, even though the total may vary between water areas.

Example:

A whitetop covered wetland with 10 percent open water (where broods would be visible) will contain more broods if this is the only large wetland in the locality than if there were many brood areas.

In the former case, 20 broods may be actually present; 4 seen (20 percent)

In the latter case, 4 broods may be actually present; 1 seen (25 percent)

Correction factors will be presented below in an attempt to smooth some of the major bias due to differences in water level between years, the differences in amounts of emergent vegetation between years and the differences in degree of use which may occur because of variation in number and dispersion of water areas per habitat block.

The size and relative scale of the correction factors at present are "educated guesses" which may be refined later by special studies.

Dabbling duck correction factors follow approximately the reciprocal of the percentages of open water, except for the 0 to 20 percent class, where a correction factor of 10 would have been expected. In densely vegetated wetlands, the broods tend to frequent the open-water portions, hence the correction value of 5 was used. For this reason it is possible there may be over-correction in the lower classes.

Diving duck broods tend to frequent open-water portions of densely vegetated wetlands even more than dabblers....hence the generally lower correction value used.

<u>Percent Open Water Code Number</u>	<u>Percent Open</u>	<u>Dabbling and Coot Correction Scale</u>	<u>Diver Correction Scale</u>
5	81 to 100	1.0	1.0
4	61 to 80	1.3	1.2
3	41 to 60	2.0	1.5
2	21 to 40	3.3	1.7
1	0 to 20	5.0	2.0

A method of combining all "percent open water" data for the complete sample unit, rather than for the individual water bodies is needed. This may be possible after data from several years are available.

- 29) Mgt. Recomm. See code numbers in BREEDING POPULATION MANUAL, page 25, 26.

Special factors influencing production. Available information on factors which may have influenced nesting success of brood survival in survey areas will be recorded on a supplementary sheet and submitted with form 5.3 by August 31. Such factors might be:

- 1) Heavy rains.
- 2) Late heavy snowfall, hail.
- 3) Early or late hay mowing dates.
- 4) Delayed tillage operations.
- 5) Late or early harvest of small grain crops.
- 6) Extensive drying of brood waters, causing excessive brood movement.
- 7) Other abnormalities noted in dates of brood appearance, brood size, etc.

D. Waterfowl Data.

1. Record species, if known; make a reasonable guess, if practical, or enter unknown, e.g.:

Known species.....BWT
Possible species.....BWT? or Dab., or Div.
Unknown species.....?

2. Record number in brood:

Exact count.....9
Approximate count....9+
Minimum count.....9+
Unknown.....?

3. Record age according to Gollop & Marshall. (1954. A Guide for Aging Duck Broods in the Field. Duplicated leaflet for Miss. Flyway Council, Technical Section.)

Good Data.....IIa
Questionable data.....IIa?
Unknown.....?

4. Record actively displaying broody hens (BH) as broods, e.g.:

Gad (BH)...number in brood and age unknown.

5. Young ducks not attended by a female will be assigned to a nearby brood of the same species and age if one is seen. Otherwise, enter them as broods.

6. Combined broods:

14 or more bluewings, redheads....
12 or more other species.....

will be tabulated as 2 or more broods, arbitrarily splitting the number into approximately equal-sized groups. Usually combined broods would be split into units of 8 to 10 (if class I) or 6-7 (if class II or III).

7. Coots are recorded in groups (male and female each take part of brood) if they conveniently occur in that way. They are aged according to relative size compared to adult, e.g.:

n.h. = newly hatched 1/5, 1/4, 1/3, 1/2, etc.,
grown.

If birds are scattered or mixed record only total for water body or sample.

E. Forms.

5.1a is suitable for field tallies where no ecological data are recorded. Several samples can be entered on a page by writing in sample numbers or names. This is to be used on large marshes or lakes. A column is provided for entering hatch dates.

5.1b is intended for field tallies where ecological data is required. Data would usually be transferred to form 5.2. Primarily for use on transects where data on many water bodies or samples are recorded.

5.2 is the standard WPA brood transect form. It may be used in place of 5.1b for field recording, eliminating a data transfer step. Unit summaries can be obtained directly from the totals of the 5.2 forms.

This form also would be valuable for brood runs on some refuges. If used only once every few years, changes in brood "observability" (due to variations in emergent vegetation and water levels) would be detected.

5.3 is a brood survey summary on which ecological data and brood sightings for each survey unit are tabulated. It is forwarded to Area Biologist by August 31.

5.4 is a brood unit summary on which total unit brood sightings are entered each year. Both WPA manager and Area Biologist will maintain a copy.

Other forms for summary and reporting will be used (See Appendix v)... examples and discussions are given in the Data Analysis section of most WPA waterfowl inventory plans.

IX. PROCEDURE FOR CALCULATING PRODUCTION.

Productivity rates calculated by the method illustrated on page 21 will be calculated for larger refuges and areas where the pair data and the brood index are representative of a production habitat block. Note that this method may be used for individual species, for groups (i.e., dabblers; divers) or for all species combined.

The procedure for Wetland Districts is outlined in the Data Analysis section of the District inventory plans (this section is included as a supplement to this PRODUCTION SURVEY manual; appendix iv).

Wetland Managers will forward both breeding population data (on form 4.3) and a summary of brood data from each survey unit (on form 5.3) to the Area Biologist following the completion of the pair count (June 15) and the completion of brood counts (August 31).

The Area Biologist will then calculate the brood/pair indexes and indicated productivity rates by area (or Districts) and send this back to the Wetland Managers. From this and the projected WPA pair samples, a production estimate for individual water bodies (including WPAs) and blocks of habitat can be obtained each year.

Managers will also be supplied a summary of information about other factors apt to influence productivity, e.g., spring temperature, dummy nest loss rates.

Assistance may be required from WPA managers in compiling, interpreting and reporting data.

Method of Calculating Productivity Rate & Production

- Assumptions:
1. Average fall age ratio was 1.25 young per adult, average productivity rate was 0.45 broods per pair, and average brood size to flight was 5.5 young.
 2. The pair and brood samples recorded a constant proportion of the pairs present and the broods produced each year. A total estimate of breeding population will be available.

<u>Year</u>	<u>Hypothetical population and productivity rates occurring</u>			<u>Total Pair Count</u>	<u>Brood Sample (20%) 1/</u>	<u>Brood/Pair Index 2/</u>	<u>Calculated Productivity Rate</u>	<u>Broods Produced</u>
	<u>Pairs</u>	<u>Productivity Rate</u>	<u>Broods Produced</u>					
1959	100	20%	20	100	4	0.04	20%	20
1960	200	60	120	200	24	0.12	60	120
1961	300	45	135	300	27	0.09	45	135
1962	400	55	220	400	44	0.11	55	220
1963	500	36	180	500	36	0.07	36	180
Total	1500	--	675	1500	135	--	--	675
Average	300	45%	135	300	27	0.09	45%	135

1/ This percent would be unknown until after data for several years were available. It could be any reasonable value, preferably estimated at 10 percent of the breeding pairs or greater. Should aim at sampling a constant proportion of total broods present each year.

2/ Brood/Pair Index = Brood sample divided by pair count.

Calculation: (Year 1959 used as an example)

$$\frac{\text{Brood/Pair Index (=0.04)}}{\text{Average Brood/Pair Index (=0.09)}} = \frac{\text{Productivity Rate in 1959 ("X")}}{\text{Assumed ave. Productivity Rate (0.45)}}$$

"X" = 0.20 (20%) for 1959....Calculated Productivity Rate

BROOD SIZE DATA

Samples of true brood size data at flight age are difficult to obtain.

Data from wetland habitat, where broods are somewhat isolated, are apt to be more reliable than that from large marshes.

Major portions of total brood mortality occurs during the first week of life (about 43 percent of the total mortality during the first 18 days for gadwalls; Gates, 1962).

Decline between average class I size and flying:

J. Clark Salyer, all species..... $17 \pm 4\%$
Utah, gadwall (Gates, 1962).....23% (hatch to flying)
Could use 20% as a round number.
Average Class I time (x) 0.80 = brood size at flight age.

Recorded Class III sizes quite variable from different areas:

<u>Species</u>	<u>Griffith</u> <u>1949-1950</u>	<u>J.Clark Salyer</u>	<u>Stoudt</u> <u>1952-1964</u>	<u>Gates</u>
Mallard	6.22	4.8	6.22	
Gadwall	6.80	6.1		5.8
Widgeon	5.82	5.4?		
Pintail	5.82	4.3		
Bluewing	6.15	4.8	7.66	
Greenwing	6.15			
Shoveler	6.10	5.8?		
Redhead	6.44	6.0?		
Canvasback	5.90	4.3?	5.35	
Scaup	4.64	6.5?		
Ruddy duck	4.92	3.6		

Suggested STANDARD flight age values

Mallard	6.0
Gadwall	6.0
Widgeon	6.0
Pintail	6.0
Bluewing.	7.0
Greenwing	7.0
Shoveler.	6.0
Redhead	6.0
Canvasback.	5.0
Scaup	6.0
Ruddy duck.	4.0

BROOD SURVEYSComparisons between different counting frequencies, J. Clark Salyer, 1956 - 1965.South + North Brood Chronology

Year	11 Count	5 Count	% 5 Count	3 Count	% 3 Count	2 Count + BW Correction 1/	% 2 Count
1965	597	229	38.36	143	23.95	91	15.24
1964	415	148	35.66	83	20.00	65	15.66
1963	604	195	32.28	134	22.19	87	14.40
1962	746	259	34.72	136	18.23	112	15.01
Sum	2362	831	141.02	496	84.37	355	60.31
Mean	590	208	35.26	124	21.09	89	15.08
S^2			6.3140		6.2524		0.2764
$S\bar{x}$			1.26		1.25		0.26
$t_{.05}$			3.182		3.182		3.182
$t_{.05}S\bar{x}$			4.01		3.98		0.83
95% Conf. Interval for Mean			31.25-39.27		17.11-25.07		14.25-15.91

South Brood Chronology

1965	401	149	37.16	73	18.20	75	18.70
1964	287	105	36.59	53	18.47	40	13.94
1963	422	156	36.97	84	19.91	58	13.74
1962	517	174	33.66	97	18.76	89	17.21
1961	433	153	35.33	123	28.41	74	17.09
1960	369	142	38.43	79	21.41	59	15.99
1959	254	79	31.10	63	24.80	51	20.08
1958	288	129	44.79	69	23.96	51	17.71
1957	368	140	38.04	58	15.76	49	13.31
1956	248	77	31.05	71	28.63	32	12.90
Sum	3587	1304	363.17	770	218.31	578	160.67
Mean	359	130	36.32	77	21.83	58	16.07
S^2			15.9603		19.7215		6.1850
$S\bar{x}$			1.26		1.40		0.79
$t_{.05}$			2.262		2.262		2.262
$t_{.05}S\bar{x}$			2.85		3.17		1.79
95% Conf. Interval for Mean			33.47-39.17		18.66-25.00		14.28-17.86

Counting dates (plus or minus about 3 days):

2-Count: July 2 and August 13 + 11.3% of bluewings added for correction.

3-Count: June 17 (June 26 used); July 18-19; August 13.

5-Count: June 7 (est. from June 28); June 28; July 19; August 9; August 30.

11-Count: June 24; June 30; July 8; July 15; July 22; July 29; August 5;
August 12; August 17; August 25; September 1.

Lostwood Refuge Brood Chronology 1963-1966

Count Number	Date	Percent of Season's Total Observed Broods				Partial Sample Periods					
		1963	1964	1965	1966	A	B	C	D	E	F
1	6/23	2.43	0.71	0.54	1.55		X				
2	6/30	4.26	1.43	1.08	3.61	X			X		
3	7/7	6.49	5.00	2.17	5.15			X		X	
4	7/14	13.39	11.79	8.67	12.11						X
5	7/21	14.40	10.36	15.72	17.78		X		X		
6	7/28	16.43	18.93	15.45	18.56			X			
7	8/4	16.43	18.93	22.49	19.07						
8	8/11	15.42	21.07	19.24	12.37	X			X	X	X
9	8/18	10.75	11.79	14.63	9.79		X	X			
						<u>Total</u>	<u>Average</u>	<u>Range</u>			
A		19.68	22.50	20.32	15.98	78.48	19.62	6.52			
B		26.57	24.29	30.89	29.12	110.87	27.72	6.60			
C		33.67	35.72	32.25	33.50	135.14	33.78	3.47			
D		34.08	32.86	36.04	33.76	136.74	34.18	3.18			
E		21.91	26.07	21.41	17.52	86.91	21.73	8.55			
F		28.81	32.86	27.91	24.48	114.06	28.51	8.38			

A is Standard 2-Count sample.

B is Standard 3-Count sample.

The best estimate of the 9-period total was given by sample periods C and D (three-count samples). The standard 3-count sample (B) gave a poorer estimate.

Target dates for C and D would be:

<u>C</u>	<u>D</u>
July 7	June 30
July 28	July 21
August 18	August 11

Example: In 1966 sample D would have estimated the total brood chronology run index as $131/0.3418 = 383$ broods....388 were counted. Using the range for other years would give 363 to 399 broods for the chronology run index.

Variation in Species Observability

Broods of various species are known to vary in the amount of time spent on open water and the relative amounts of emergent vegetation present in water areas preferred. For this reason, a greater proportion of the broods actually present is seen for some species (e.g., gadwalls, canvasbacks) than others (e.g., mallard, pintails, bluewings).

Some insight can be obtained into relative differences in brood observability from ratios of broods to pairs obtained from analysis of the species composition of pair counts and the species composition of brood counts. Hammond worked with a sizeable sample available several years (from state and federal waterfowl survey reports and reports from special studies) and compiled the following average for relative species observability.

The values are based upon a unit of 1.00 for the Canvasback...e.g., if an equal number of mallards and canvasbacks were on the block sampled (speaking of broods), one could expect to see only about half (1/2.20) as many mallard broods as canvasback broods.

The values are expressed as correction factors, which would theoretically be multiplied by number of broods observed to give all a value near that actually present. This would give some degree of under-estimation, since we assume that all the canvasback broods would be seen.

Mallard	2.20
Gadwall.....	1.41
Widgeon.....	2.06
Pintail.....	3.48
Bluewing.....	2.26
Shoveler.....	2.84
Greenwing.....	2.32
Redhead.....	1.30
Canvasback.....	1.00
Ruddy duck.....	1.48
Scaup.....	1.00

A further comment: the factors are based upon the assumption that the average productivity rate is the same for all species. If one species has a lower than average reproductive rate, the correction factor above would be too low and should be adjusted upward.

WILDLIFE INVENTORY PROCEDURE

Refuge: Waterfowl Production Areas Procedure No. 7.3
 Species: Ducks and Coots Reliability Data Class: C
 Title: Analysis of breeding population and brood data to determine productivity rates and production.

PURPOSE

7.3A

The production analysis will determine the annual approximate productivity rate for the WPA habitat blocks surveyed for breeding pairs and broods. By using supplemental information from sources listed below, we will project the habitat block data to district and state levels. This projection should measure the major annual changes in productivity. Over a period of time the analysis will determine average breeding populations and production for individual WPA blocks, easement habitat blocks, districts and their ecological sub-units and a complete program evaluation with regards to waterfowl productivity.

PROCEDURE

- 7.31 Breeding population data from all regularly conducted annual surveys will be assembled.
- a. WPA managers and specified Refuge managers (e.g., Lostwood and Tewaukon...with pothole habitat) will forward pair data from WPA block counts to Area Biologist by June 15. Use form 4.3. A form 4.4 for each sample unit will be filled out by Manager and Area Biologist.
 - b. Area Biologist will visit State Conservation Department Waterfowl Biologist between June 1 to 10 and obtain tabulations by Districts and sub-units. State Biologist may agree to forward this information, if prior arrangements are made. Breeding population data from annually conducted surveys will be entered on forms 4.3 and 4.4 by Area Biologist.
 - c. Between June 1 to 10 Area Biologist will visit GMA or Flyway Biologist responsible for aerial breeding ground surveys. Prior arrangements may be made to obtain this data. Information will be entered on forms 4.3 and 4.4 by Area Biologist.

- d. Area Biologist will request Special Study Area data from Division of Wildlife Research (NPWRC) on areas sampled on an annual basis. Data will be entered on forms 4.3 and 4.4 by Area Biologist.

7.32 Breeding population and water condition data will be tabulated by Area Biologist according to District and sub-units. Dates... June 15 to 20. Form 5.6 will be used (WATERFOWL BREEDING POPULATION AND PRODUCTION SUMMARY); it will be completed after brood data are available.

7.33 Brood samples

- a. After completion of the final brood count managers will fill out form 5.3 BROOD SURVEY SUMMARY in duplicate; retain one copy and forward one copy to the Area Biologist by August 31.

Area Biologists will obtain brood data from other annual survey sources, e.g.:

- 1) State Conservation Departments.
- 2) GMA or Flyway Biologist for Breeding Ground Surveys.
- 3) Special Study Areas (NPWRC).
- 4) Refuges.
- 5) Banding crews working on WPAs and capturing local ducks.

- b. WPA managers and Area Biologist will complete form 5.4, WATERFOWL BROODS, Sample Unit Summary, for WPA brood survey data.

Area Biologist will complete forms 5.4 and 5.5 (Waterfowl Productivity Rates for Sample Unit) for all data sources, including those listed under 7.33a above. He will send a copy of both forms to Manager each year for an accuracy check and for record.

Brood data obtained by banding crews will be forwarded to WPA Managers for permanent record.

Area Biologist will then complete form 5.6 (Waterfowl Breeding Population and Production Summary) for all pair and brood samples for which useful comparison may be made.

- c. Managers will complete and forward form 5.7 (Record of Brood Size) to Area Biologist by August 31, along with form 5.3 (See 7.33a, above).

7.34 Delineation of Geographic Areas with Similar Productivity Rates.

- a. Area Biologist will compile supplementary information related to productivity rate:
- 1) April-June temperatures and predicted effect on productivity rate.
 - 2) Annual dummy nest surveys and predicted effect on productivity rate.
 - 3) Special weather conditions (blizzards, heavy rains, hail) and predicted effect on productivity rate.
- b. From all data sources, Area Biologist will prepare a map or description of areas probably having uniform productivity rates, together with the estimated productivity rate within each area. It is expected that ability to estimate ranges in productivity rate will improve after several years data have been examined. It should be possible to place area productivity rate within these classes:

	<u>Median</u>
1) Below normal, rate 15 to 34 percent	25%
2) Normal rate, 35 to 50 percent	42%
3) Above normal, rate 51 to 80 percent	70%

7.35 Waterfowl Productivity Report. (Due September 30)

- a. Area Biologist will prepare an annual Waterfowl Productivity Report. Copies of this and the map prepared in 7.34b will be distributed to:
- 1) All interested WPA and Refuge Managers.
 - 2) Northern Prairie Wildlife Research Center.
 - 3) Regional Office (Refuges and Game Management).
 - 4) Flyway Biologists (Central and Mississippi).
 - 5) GMA concerned with population and brood surveys.
 - 6) State Conservation Department.
- b. The Report will cover the following material:
- Part I. Table giving area productivity rates (form 5.9).
- Part II. Factors affecting production; for each area there will be a discussion of the following:
- 1) Spring temperatures.
 - 2) Weather.
 - 3) Water conditions.
 - 4) Dummy nest surveys.
 - 5) Brood size.

- 6) Important differences between species.
- 7) Suggestions for the following year.
- 8) Modifications of past data as new averages are drawn.
- 9) Comparisons with wing collection age data for past years.

Part III. Analysis of brood size data submitted by managers on form 5.7.

7.36 Estimating Production.

WPA Managers will use the estimated productivity rates to calculate production of WPAs or other habitat blocks within their Districts. See pages 18 to 20 of WATERFOWL PRODUCTION SURVEYS.

- a. WPAs or WPA blocks upon which pair counts were made.
 - 1) For each species, multiply breeding population pairs by estimated productivity rate to get estimated broods produced.
 - 2) Multiply broods produced by brood size at flight age to get estimated young produced. Use standard sizes, p. 20 WATERFOWL PRODUCTION SURVEYS or annual data from WATERFOWL PRODUCTIVITY REPORT, if available.
- b. WPAs or WPA blocks with no prior breeding population counts.
 - 1) Wildlife Inventory punch cards will be prepared as time permits for each WPA block. These will have a listing of:
 - a) Number of water bodies by size class.
 - b) Length of shoreline by character class for each large water body.
 - 2) Average breeding pair use data by size class and shoreline length will be compiled annually by Area Biologist (at the time ecological data are summarized with NPWRC) and forwarded to Managers.
 - 3) The average use data in 2) will be applied to data of item 1) to give estimated average population. Manager will need to consider current water condition as it may modify item 1).
 - 4) Annual productivity rate for area may be applied to each WPA for which an Inventory Card has been prepared.

- 5) It will be desirable to wait until approximately 5 year's pair and brood data averages have been assembled before making projections for unsampled WPAs. Rough, preliminary estimates can be made immediately, however.
- 7.37 Once each year (December) Area Biologist will meet with NPWRC and Flyway Biologist(s) to review the data collected and reported.
- 7.38 The Manager (or Area Biologist if Manager lacks time) will tabulate all breeding population and brood data according to ecological factors being studied by the NPWRC. It may be desirable to have NPWRC Biologist assume responsibility for this phase of the program. This tabulation should be completed by December 31.

COST ANALYSIS

Manpower and costs for Manager's data tabulation and the data analysis by Area Biologist are tentatively estimated. After the procedure has been used one season they can be more accurately determined.

<u>Form</u>	<u>Title or Description</u>	<u>Manager Est. Hours</u>	<u>Area Biol. Est. Hours</u>
4.3	Annual Block Breeding Pop. Summary	2.0	4.0
Map	Dist. Water Condition, June 1	2.0	
4.4	Breed. Pop. Sample Unit Summary	0.5	4.0
5.3	Brood Survey Summary	4.0	8.0
5.4	Brood Sample Unit Summary	0.5	4.0
5.5	Waterfowl Prod. Rates for Sample Units		4.0
5.6	Breeding Pop. and Production Summary		8.0
5.7	Brood Size Record	2.0	8.0
5.8	Analysis of Brood Size		4.0
5.9	With Area Biologist's Waterfowl Prod. Report		16.0
	Manager's reports of production on specific WPA's, blocks, refuges; for NR, et.al.	8.0	
	TOTAL	<u>19.0</u>	<u>60.0</u>

Additional extra time will be required by Area Biologist to contact the information sources listed under 7.33a during the first year. Presumably this can be handled by mail in later years.

Sources listed under 7.33a will need to spend some extra time to put data in usable form for Area Biologist...estimate 1 to 2 hours for each man concerned.

SAMPLE BROOD SURVEY FORMS

- 5.1a Notebook size for field tallies, no ecological data.
Used mostly on large marshes or lakes.
- 5.1b Notebook size for field tallies with ecological data.
Used for brood transects with many water bodies or
many samples.
- 5.2 Standard WPA brood transect form and unit summary form.
- 5.3 Brood survey summary of survey units, submitted to
Area Biologist by August 31.
- 5.4 Brood survey unit record, maintained by Refuge Manager
and Area Biologist.
- 5.5 Productivity rate calculations for habitat block,
prepared by Area Biologist.
- 5.6 Waterfowl breeding population and production summary
sheet, with summary of ecological data. Prepared by
Area Biologist.
- 5.7 Record of brood sizes. Positively identified brood data,
for critical analysis of brood size data. Submitted to
Area Biologist by August 31.
- 5.8 Analysis of brood size. Data analysis sheet for data
from form 5.7. Prepared by Area Biologist.
- 5.9 Area waterfowl productivity rate. Calculations of area
productivity rates for dabblers, diving ducks and coots
(possibly for well represented species also). Used as
part of Area Biologist's annual WATERFOWL PRODUCTIVITY
REPORT.

Samples of each form on following pages.

1) No:

SAMPLE UNIT BROOD SURVEY

2) Name: _____ Location: _____ MO Day Yr _____

7) Map No: 8) Photo No: Count Method: Observer(s):

12) Time: Start End Total 13) Weather:

Counting frequency: _____

ECOLOGY

[illegible]

Special notes on influencing factors on supplementary sheet.

BROOD SURVEY - Summary

Year: _____

District or Location: _____ State: _____ Observer(s): _____
 Date(s) counts were made: _____ (Applies to one survey; from form _____.)

(This form prepared by Manager, sent to Area Biologist by August 31)

NOTE: This page must be filled out on each survey.

Brood Sample Unit Number	Name	County(ies)	Item 1		2		4		4/2	2/1	4/1
			Main Geol. Zone	Total Basin Acres	Total Water Area Acres	Total Open Water Acres	Relative Brood Observ.	Water Condition	Combined Factor		

Totals

SUM AND PERCENT OF TOTAL WATER SURFACE AREA IN HABITAT RATING CLASSES

From Sample Unit Brood Survey form _____. Tabulate sum of acres of water area (item 2) in each habitat class (item 5).

Habitat Class	1		2		3		4		5		6		TOTAL	
	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%
1														
2														
3														
4														
5														
TOTAL														

Submit to Area Biologist by August 31. Include a supplementary sheet describing factors which may have influenced productivity rates in brood survey units (See instructions for Form 5.2).

SUMMARY OF BROODS COUNTED

Location: _____

Survey date(s): _____

Species	Unit No. Broods	Unit No. Broods	Unit No. Broods	Unit No. Broods	Unit No. Broods	Unit No. Broods	Total Broods
Mallard							
Black duck							
Gadwall							
Widgeon							
Greenwing							
Bluewing							
Shoveler							
Pintail							
Wood duck							
Dabblers							
Corr. Dab.							
Redhead							
Canvasback							
Less. Scaup							
Ringneck							
Ruddy duck							
Divers							
Corr. Div.							
TOTAL BROODS							
CORR. BROODS							
YG. COOTS							
CORR. COOTS							

Data for all (2 or 3) Counts
entered here.

1) No.: _____

WATERFOWL BROODS
Sample Unit Summary

2) Brood Sample Unit Name: _____ 3) Location: _____
 7) Map Nos.: _____ 8) Photo Nos.: _____ Observers: _____

Maintain a separate form for each Brood Sample Unit. Both Manager and Area Biologist will keep a copy. Data obtained from Form 5.3, BROOD SURVEY SUMMARY.

<u>Species or Group</u>	<u>1st Year</u>	<u>2nd Year</u>	<u>2 year Total</u>	<u>2 year Ave.</u>	<u>3rd Year</u>	<u>3 year TOTAL</u>	<u>3 year Ave.</u>	<u>4th Year</u>	<u>4 year Total</u>	<u>4 year Ave.</u>	
Dabblers											
Corr. Dab.											
Divers											
Corr. Div.											
TOTAL											
Corr. TOT.											
COOTS											
Corr. COOTS											

NOTE: This form may also be used for combined sample units.

Names and locations of sample units used as source of data: _____

[illegible]

ANALYSIS OF BROOD SIZE

Species: _____ Age group: _____

Year: _____

Area: _____

Weekly Period	NUMBER OF YOUNG												Others Specify	Total Broods
	3	4	5	6	7	8	9	10	11	12	13	14		
4/30-5/6														
5/7-13														
14-20														
21-27														
28-6/3														
6/4-10														
11/17														
18-24														
25-7/1														
7/2-8														
9-15														
16-22														
23-29														
30-8/5														
8/6-12														
13-19														
20-26														
TOTAL														

Ave. size, $\pm$ s: _____. Is average significantly different from STANDARD SIZE? _____. Size at flight age:

Size at flight age determined by: 1) average of I Ib-III ages, 2) average of Ia age minus standard loss rate,

3) standard size from Brood Survey Manual?....: _____.

Development of a wild duckling as viewed under ideal conditions (from Gollop and Marshall, 1954). See Table 6.2 for use in aging.

Plumage Class	Subclass	Description
I	a	" <u>Bright Ball of Fluff.</u> " Down bright. Patterns distinct (except diving ducks). Body rounded. Neck and tail not prominent.
Downy young; no feathers visible	b	" <u>Fading Ball of Fluff.</u> " Down color fading, patterns less distinct. Body still rounded. Neck and tail not yet prominent.
	c	" <u>Gawky-Downy.</u> " Down color and patterns faded. Neck and tail become prominent. Body becomes long and oval.
II	a	" <u>First Feathers.</u> " First feathers show on side under ideal conditions, stays in this class until side view shows one-half of side and flank feathered.
Partly feathered as viewed from the side	b	" <u>Mostly Feathered.</u> " Side view shows one-half of side and flank feathered. Primaries break from sheaths. Stays in this class until side view shows down in one or two areas only (nape, back or upper rump).
	c	" <u>Last Down.</u> " Side view shows down in one or two areas only (nape, back or upper rump). Sheaths visible on erupted primaries through this class. Stays in this class until profile shows no down.
III	a	" <u>Feathered-Flightless.</u> " No down visible. Primaries fully out of sheaths but not fully developed. Stays in this class until capable of flight.
Fully-feathered as viewed from side		

Approximate age-span and midpoint (in days) for each plumage subclass for eleven ducks, with supplementary data (after Gollop and Marshall, 1954)

Species	Plumage Subclass (see Table 6.1)							Fly- ing	Pri- maries break from sheaths	Areas of last down visible
	Ia	Ib	Ic	IIa	IIb	IIc	IIIa			
Mallard	1-4-6	7-10-12	13-16-18	19-22-25	26-31-35	36-41-45	46-51-55	52-60	35 days	Rump
Black Duck	1-3-5	6-9-12	13-16-18	19-22-25	26-30-33	34-39-43	44-52-60	58-63		
Gadwall	1-4-6	7-11-14	15-17-18	19-23-27	28-33-38	39-42-44	45-48-50	48-52	31	Nape and back
Baldpate	1-4-7	8-10-12	13-16-18	19-23-26	27-31-35	36-39-41	42-46-50	47+	30	Nape and rump
Pintail	1-3-5	6-9-12	13-16-18	19-21-23	24-29-33	34-39-43	44-48-51	46-57	31	Back
Blue-winged Teal	1-3-5	6-8-9	10-12-13	14-18-21	22-26-30	31-34-36	37-39-40	35-44	30	Nape and rump
Shoveller	1-4-6	7-10-13	14-16-17	18-23-27	28-32-35	36-40-44	45-48-50	47-54	33	Nape and back
Redhead	1-4-6	7-13-18	19-22-24	25-29-32	33-36-45	46-50-54	55-58-60	60-63	43	Rump and back
Ring-necked Duck	1-3-5	6-8-10	11-14-16	17-21-24	25-28-30	31-35-38	39-44-49	49-53		
Canvasback*	1-5-9	10-14-18	19-22-25	26-29-32	33-37-42	43-48-53	54-59-65	56-68	40	Rump and back
Lesser Scaup	1-3-6	7-10-13	14-17-20	21-25-28	29-31-33	34-38-42	43-47-50	47+		

*Dzubin (1959) gives a waterline (swim) ratio of length of young: adult hen: 1 day old--1:3; Subclass IIa--2:3; Subclass IIIa--3:3.

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