Chapter 18

Migratory Game Birds

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I. INTRODUCTION – This chapter addresses management techniques for coots, cranes, crows, doves, ducks, geese, mergansers, rails, snipe and swans.

A. Species, Status, and Habitats in Wyoming –

Wyoming is within the breeding ranges of the following migratory game birds:

[1] mourning dove (*Zenaida macroura)*	[3] northern pintail (*A. acuta*)
[2] greater sandhill crane (*Grus c. tabida*)	[2] wood duck (*Aix sponsa*)
[1] common snipe (*Gallinago gallinago*)	[2] redhead (*Aythya americana*)
[1] sora rail (*Porzana carolina*)	[3] canvasback (*A. valisineria*)
[1] Virginia rail (*Ralus limicola*)	[2] lesser scaup (*A. affinis*)
[1] American coot (*Fulica americana*)	[2] ring-necked duck (*Aythya collaris*)
[1] Canada goose (*Branta canadensis*)	[4] common goldeneye (*Bucephala clangula*)
[1] mallard (*Anas platyrhynchos*)	[3] Barrow's goldeneye (*B. islandica*)
[1] gadwall (*A. strepera*)	[3] bufflehead (*B. albeola*)
[1] northern shoveler (*A. clypeata*)	[3] ruddy duck (*Oxyura jamaicensis*)
[1] wigeon (*A. americana*)	[4] harlequin duck (*Histrionicus histrionicus*)
[3] green-winged teal (*A. crecca*)	[3] red-breasted merganser (*M. serrator*)
[3] blue-winged teal (*A. discors*)	[1] common merganser (*Mergus merganser*)
[2] cinnamon teal (*A. cyanoptera*)	[3] trumpeter swan (*Cygnus buccinator*)

[1] common [2] locally common [3] uncommon [4] rare

Breeding populations of most migratory game birds in Wyoming were stable or increasing through 2003, based on 5- and 10-year data sets. Based on call count records, the mourning dove population declined slightly, but the decline was non-significant. Population trends of snipe and rails are unknown, but believed stable. For more complete information about life histories and management of migratory game birds, consult Bellrose (1976) and Tacha and Braun (1994).

Mourning doves typically nest within shelterbelts, riparian zones, sagebrush habitats, and urban areas throughout the state, but they are most abundant near irrigated, small grain fields. Sandhill cranes nest predominantly in shallow marshes and wet meadows within inter-mountain basins of northwest and western Wyoming. Smaller numbers nest along major river drainages and higher elevations in western and central Wyoming. Ducks of the genera *Anas*, *Aythya* and *Oxyura* (puddle ducks and diver ducks) nest throughout the state, within or near shallow marshes, oxbow wetlands, beaver ponds, natural lakes, playas, stock ponds, reservoir

backwaters and reclaimed mine ponds. Wood ducks are cavity nesters that breed predominantly within cottonwood-dominated riparian habitats of eastern Wyoming. Goldeneyes, buffleheads, and common mergansers are also cavity nesters, but goldeneyes and buffleheads nest in boreal forest habitats surrounding lakes and streams in northwest Wyoming. Common mergansers nest in cottonwood riparian zones along larger river corridors throughout the state. Red-breasted mergansers nest on the ground in a variety of sites near reservoirs and streams that sustain fish populations. Canada geese select larger waters with open, often overgrazed shorelines. Favored nest sites are islands, peninsulas and man-made, nesting platforms. Rails and coots nest in shallow to deep emergent zones of marshes, ponds and lakes. Snipe nest in grassy cover adjoining marshes, sloughs, beaver ponds, and wet meadows, often at higher elevations.

During spring and fall, other segments of the species that breed in Wyoming migrate through the state enroute to breeding or wintering grounds elsewhere. In addition, several species that do not nest in Wyoming migrate through the state or have been documented here. They include:

[2] snow goose (*Chen caerulescens*)	[4] oldsquaw (*Clangula hyemalis*)
[2] Ross' goose (*Chen rossii*)	[4] tufted duck (*Aythya fuligula*)
[4] white-fronted goose (*Anser albifrons*)	[4] black scoter (*Melanita nigra*)
[4] black brant (*Branta bernicula*)	[4] white-winged scoter (*Melanita fusca*)
[2] lesser sandhill crane (*Grus c. canadensis*)	[4] surf scoter (*Melanitta perspicillata*)
[3] tundra swan (*Cygnus columbianus*)	[4] Eurasian wigeon (*Anas penelope*)
[3] greater scaup (*Aythya marila*)	[4] American black duck (*Anas rubripes*)

[1] common [2] locally common [3] uncommon [4] rare

Dependable winter habitats for migratory game birds are generally limited in Wyoming. Most species that nest in, or migrate through Wyoming spend winter elsewhere, in less harsh climates. During milder years, a substantial population of Canada geese may remain through the winter in southeast Wyoming. Smaller numbers of Canada geese winter on open rivers below dams and reservoirs in other regions of the state. Moderate numbers of cold-hearty species such as trumpeter swans, mallards, mergansers, goldeneyes, and even coots may winter in locations where discharges from springs or reservoirs maintain open water. However, winter populations of migratory game birds much smaller than those present during the breeding season or spring and fall migrations.

B. Flyways/Management Units

B. Rationale – Southward in fall and northward in spring, waterfowl have migrated along ancestral routes or "flyways" since the retreating glaciers left landmarks and watery stepping-stones as guideposts. Scientists and others have observed these bird migrations for centuries, but here in North America, the routes were not delineated and named until the early 20th century.

Frederick Lincoln is generally regarded as the originator of the waterfowl flyway concept in North America. According to Lincoln, "Recovery of banded ducks and geese accumulated so rapidly that by 1930 it was possible to map out the four waterfowl flyways' great geographical regions, each with breeding and wintering grounds connected by a complicated series of migration routes."

Lincoln clearly recognized the importance of the flyways in his statement, "Conservationists now know that the birds have a strong attachment for the ancestral flyways and they recognize the significance of this fact."

Lincoln's four flyways – Atlantic, Mississippi, Central, and Pacific – were based largely on band recoveries. Historically, numbered bands were the only means of marking individual birds; color marking was later employed to identify population segments or individual birds. Colored markers enabled observers to record multiple sightings without capturing or harvesting the bird to read a leg band.

Lincoln's flyway concept became the foundation of the administrative units implemented in 1948 by the Service to regulate sport hunting and to manage populations of migratory birds. Surprisingly few modifications have been made to the four Flyway boundaries since then. The flyway concept has been applied with notable success to manage various populations of Canada geese. In some instances, flyways have been subdivided to manage specific stocks of ducks. The High and Low Plains units of the Central Flyway and the Columbia Basin of the Pacific Flyway are examples.

2. Application – Four administrative bodies called flyway councils were created to establish a system of state and federal coordination within the 4 flyways. Each council is comprised of representatives from member states within the flyway. Annual meetings are held to evaluate migratory game bird populations and recommend hunting seasons. A technical committee of waterfowl biologists was also established to serve each flyway council. The Technical Committees compile and analyze management data, and recommend management actions for consideration by the Councils.

   Two Council meetings are held each year. During March, in conjunction with the North American Wildlife and Natural Resource Conference, basic regulations and early season hunting frameworks are reviewed. At a second Council meeting in July, waterfowl breeding ground data are reviewed and recommendations for the regular (late) season hunting frameworks are forwarded to the U.S. Fish and Wildlife Service (Service). Technical Committee meetings are held prior to each of these Council meetings. Standing subcommittees of the technical committees are assigned to review data and other information pertaining to various populations of migratory game birds, as well as projects and special studies. Flyway goals and objectives are reassessed annually. The Technical Committees also conduct an additional work session each winter. The focus of the winter meeting is to work on management plans and larger programmatic issues. Because Wyoming is divided between the Central and Pacific Flyways, the state maintains membership in each.

3. Designations for Management – Several populations or geographic units have been defined to manage various stocks of migratory game birds. The flyways have developed plans to organize data, identify issues and establish management strategies and criteria for most of these units or populations. Management delineations for species that breed in, or migrate through Wyoming are listed below:

Species & Distribution	Management Unit or Population Designation	Responsible Organization
webless species statewide (doves, snipe, rails)	Central Management Unit	Central Flyway
greater sandhill cranes, west & central Wyoming	Rocky Mountain Population	Central and Pacific Flyways
lesser sandhill cranes, eastern Wyoming	Mid-Continent Population	Central Flyway
large Canada geese, west and central Wyoming	Rocky Mountain Population (predominantly)	Central and Pacific Flyways
large Canada geese, eastern Wyoming	Hi-Line Population (predominantly)	Central Flyway
small Canada geese, eastern Wyoming	Short-Grass Prairie Population (predominantly)	Central Flyway
snow & Ross' geese	West-Central Flyway Population	Central Flyway
trumpeter swans, western Wyoming	Rocky Mountain Population	Pacific Flyway
tundra swans, western Wyoming	Western Population of Tundra Swans	Pacific Flyway
tundra swans, eastern Wyoming	Eastern Population of Tundra Swans	Central Flyway
ducks west of the Continental Divide	Pacific Flyway	Pacific Flyway
mallards west of the Continental Divide	Western & Mid-Continent Mallard Populations	Pacific Flyway
ducks east of the Continental Divide	Central Flyway	Central Flyway
Mallards east of the Continental Divide	Mid-Continent Population of Mallards	Central Flyway
coots, crows, mergansers	administratively distinguished by flyway	Central or Pacific Flyway as applicable

C. North American Waterfowl Management Plan –

1. History and Purpose – The North American Waterfowl Management Plan (NAWMP) was developed after waterfowl populations reached historically low levels during the early 1980s. Declining populations were the consequence of long-term habitat loss, exacerbated

by severe drought. The NAWMP goals are habitat- and population-driven. The Plan's fundamental purpose is to establish an infrastructure needed to identify and recover habitats that will sustain waterfowl populations at objective levels. The Canadian Minister of Environment and the U.S. Secretary of Interior initially signed the plan in 1986. Mexico became a signatory when the plan was updated in 1994. The Plan's vision was expanded in 1998 to encompass the following principles:

1) strengthen the biological foundation (conservation planning based on best available science and data);
2) progress toward landscape conservation (ecosystem-based, multiple species); and
3) broaden the scope of partnerships (include other bird initiatives and funding sources).

The overriding goal of the NAWMP is to restore the habitat base needed to sustain waterfowl populations and other migratory birds at levels present during the 1970s.

2. Population Goals –

Table 1. NAWMP goals for breeding populations of the 10 most common duck species in the traditional survey area[a] (USFWS 2000).

Species	Goals[b]
Mallard	8,199,000
Northern pintail	5,596,000
Gadwall	1,518,000
American wigeon	2,974,000
Green-winged teal	1,858,000
Blue-winged/cinnamon teal	4,653,000
Northern shoveler	1,990,000
Redhead	639,000
Canvasback	542,000
Scaup	6,302,000

[a] The surveyed area includes strata 1-18, 20-50 and 75-77 in the Spring Breeding Population and Habitat Survey (USFWS 2000).
[b] The average of 1970-1979 for the traditional survey area.

Table 2. NAWMP goals for populations of geese with distributions that overlap Wyoming.

Species and Population	Winter Index Goals (Year 2000)
Canada Goose	
Shortgrass Prairie	150,000
Hi-line	80,000
Rocky Mountain	50,000
Snow Goose	
Mid-continent Lesser	1,000,000
Western Central Flyway	110,000
Ross' Goose	100,000[a]
White-fronted goose	
Pacific Flyway	300,000

[a] Breeding population goals.

Table 3. NAWMP goals for North American swan populations.

Species and Population	Autumn/Winter Index Goal (Year 2000)
Tundra Swans	
Eastern Population	80,000
Western Population	60,000
Trumpeter Swans	
Rocky Mountain	5% annual growth rate
Interior	2,500

3. Habitat Goals – The 1998 NAWMP update seeks to protect 12.2 million acres of wetland habitats and to restore and enhance 15.2 million acres.

4. Implementation – Joint Ventures (JVs) are partnerships that transform the goals of the North American Waterfowl Management Plan (Plan) into on-the-ground projects. JVs are comprised of individuals, businesses, conservation organizations, and local, state, provincial, and federal agencies. Each JV administers projects within a geographic region.

   Fourteen habitat joint ventures currently exist in the United States (11) and Canada (3). In addition, 3 international joint ventures have been formed to address monitoring and

research needs for selected species. They include the Black Duck, Arctic Goose and Sea Duck Joint Ventures. We expect additional Joint Ventures will be established in Mexico in the near future.

D. Waterfowl Season Setting –

1. Flyway Meetings –

a. Rationale – In 1951, the International Association of Fish and Wildlife Agencies (IAFWA) adopted a resolution calling for establishment of a Council within each of the 4 flyways, and a National Flyway Council (NFC). The Flyway Councils would represent the states in matters pertaining to the management of migratory game birds, including the annual setting of hunting seasons. The NFC would deal with issues of national or international scope that require inter-flyway coordination. Shortly thereafter, the states formally organized the 4 Flyway Councils and established technical committees to advise the Councils. This system of cooperative state and federal management remains in place today.

In 1995, the IAFWA (renamed "Association of Fish and Wildlife Agencies" or AFWA in 2006) undertook a review of the flyway system. The final report endorsed some fundamental changes to the flyway mission. Most notably, the long-term vision of the Flyway Council System should be expanded to accommodate all migratory birds. The system should evolve into a cooperative, international approach that links efforts of a broad range of partners and conservation initiatives. Conservation should be a science-based, publicly supported program of coordinated actions that benefit migratory birds and their habitats. At the time this chapter was written, management of migratory game birds continued to be the major focus of the Council System. Development of an infrastructure to deal with all migratory birds was just beginning.

b. Application – The regulatory cycle involves several meetings each year. The Service has assigned a representative to each flyway ("flyway representative") who serves as a liaison between the Service, the flyway Technical Committee and the Council at these meetings. During December or January, the technical committees each hold a work session to review and update management plans for various populations of migratory game birds and to discuss preliminary information the flyway representatives may convey about the upcoming regulatory cycle. The technical committees also take up various other topics and issues such as surveys, harvest strategies, population models, pertinent legislation, research projects, and funding requests.

Two regulatory processes are administered annually for early and late migratory game bird seasons. In January each year, the Service Regulations Committee (SRC) meets to identify issues potentially significant to both regulatory processes. This information is conveyed by the Flyway Representatives to the Technical Committees. Initial recommendations for early migratory bird seasons are made by the Technical Committees at "spring" meetings held in March each year. The Flyway Councils vote

on the technical committees' recommendations at a meeting held in conjunction with the North American Wildlife and Natural Resources Conference in late March or early April. In June, the SRC takes recommendations from all 4 flyways under advisement and formally promulgates the early migratory game bird seasons. These seasons are published in the Federal Register in July. Early migratory bird seasons include special early sandhill crane and Canada goose seasons, early September teal seasons, and seasons for doves, band-tailed pigeons, snipe, gallinule, extended falconry (days falconers can hunt outside the regular gun season), and special youth waterfowl hunting days.

The process for setting late migratory game bird seasons is similar to that for the early seasons. Technical Committees hold "summer" meetings in late July to make the initial recommendations. The Flyway Councils vote on the Technical Committee Recommendations later in the week, in meetings held at the same locations. And at the end of July or the first few days of August, the SRC meets to take Council recommendations under advisement, and formally promulgates the late migratory game bird seasons. These seasons are published in the Federal Register in mid-September. Late migratory game bird seasons include the regular duck and goose seasons, late sandhill crane seasons, and tundra swan seasons.

The Technical Committees and Flyway Councils may act on variety of topics in addition to hunting seasons, such as research funding, harvest strategies, adoption of management plans, setting population objectives, and other matters related to migratory bird conservation at both the spring and summer meetings. These are open public meetings, often attended by a wide range of interests.

2. Adaptive Harvest Management –

   a. Rationale – In 1995, the U.S. Fish and Wildlife Service (Service) modified the process used to regulate duck harvests by changing to a system based upon adaptive resource management. Adaptive Harvest Management (AHM), as it is called, employs quantitative criteria for selecting hunting frameworks. The criteria or thresholds are incorporated into models that describe relationships among breeding mallard populations, habitat conditions (an index to recruitment), regulatory frameworks and harvest. As experience is gained, the criteria, models, and frameworks are refined. The AHM process was originally conceived to reduce disagreements and political haggling during the season-setting process by making decisions more data-driven. Another purpose is to improve knowledge about relationships between hunting regulations and harvests.

   The adaptive approach explicitly recognizes the effects of hunting regulations cannot be predicted with certainty and provides a system for making objective decisions in the face of uncertainty. Fundamentally, AHM is an iterative cycle of monitoring, evaluation, decision-making, and adjustments to clarify relationships among hunting regulations, harvests, and waterfowl abundance.

b. Application – The 2 environmental variables used to select harvest regulations are: 1) an annual breeding ground survey of mallards in the Mid Continent Population, and 2) numbers of ponds holding water within the surveyed area in May. The selection is "optimized" by weights given 4 competing models. The 4 models reflect the following sets of assumptions: 1) harvest mortality is additive and recruitment is density-independent (most conservative); 2) harvest mortality is additive and recruitment is density-dependent; 3) harvest mortality is compensatory and recruitment is density-independent; and 4) harvest mortality is compensatory and recruitment is density-dependent (most liberal). Each year, the model weights are updated to provide the closest fit between modeled predictions and realized harvests and breeding populations. As years of data are accumulated, confidence in model weights and accuracy of predictions improves.

Initially, AHM was based upon breeding ground data collected within the traditional survey area for the Mid-Continent Population of Mallards. The Service assumed other stocks of ducks followed similar trends and the dynamics of the Mid-Continent Population would provide a satisfactory basis to set hunting seasons for most other ducks. However, experience has demonstrated trends of other duck populations can deviate from those of the Mid-Continent population. To more accurately depict geographic variations, an AHM model based on Eastern Mallards was developed for the Atlantic Flyway and another model is under development for Western Mallards. Eastern mallards are distinct, however Western mallards commingle with Mid-Continent mallards so the Western and Mid-Continent models will be jointly optimized to set seasons for the Pacific Flyway. A future priority is to develop AHM models for selected species other than mallards that do not necessarily follow trends of mallard populations. Although this approach will enable managers to increase the specificity of regulations for some non-mallard ducks, it will also increase the complexity of regulations. Costs and data requirements will impose some practical constraints. Therefore, it is unlikely AHM models will be developed for more than 1 or 2 other species. Regulatory frameworks for most species will continue to be based on mallard trends.

3. Hunting Season Frameworks –

a. Rationale – The 3 major purposes of hunting season frameworks are:
1) to regulate harvest;
2) to equitably distribute harvest opportunity; and
3) to take into account, cultural values and traditions

b. Application – Migratory waterfowl are a highly valued resource shared among several states and countries. To assure these species are harvested at sustainable levels, and to equitably distribute harvest opportunities, hunting seasons are set in accordance with international treaties and annual regulations promulgated by the U.S. Fish and Wildlife Service. The Migratory Bird Treaty Act of 1918 originally set forth the outside dates and allowable lengths of hunting seasons. Under the Treaty, no migratory game bird

can be hunted before 1 September or after 10 March, nor can any species be hunted more than 107 days during that period. Exceptions are allowed to manage depredation and overabundant populations. Although the Treaty establishes outside dates and maximum season lengths, more restrictive frameworks can be prescribed by regulation to assure species are harvested at sustainable levels. These restrictions include season lengths, bag limits, species limitations, and rules pertaining to configurations of geographic zones and season segments (splits) each state can adopt.

For ducks, 3 levels of regulatory packages have been defined to achieve target harvest rates – restrictive, moderate, and liberal. A fourth level, "very restrictive," was dropped from AHM in 2003. At the time this chapter was written, the following season lengths were applicable to Wyoming (Central Flyway includes additional "High Plains" season days):

	Season Length (days)	
Regulatory Alternative	Pacific Flyway	Central Flyway
Restrictive	60	51
Moderate	86	83
Liberal	107	97

c. Analysis – In general, a harvest of up to 10% of adult females and 20% of adult males is sustainable from the Mid-Continent Population of Mallards. Three regulatory frameworks have been devised to achieve the following overall harvest rates of mid-continent mallards (males and females combined):

Restrictive framework: 7%
Moderate framework: 11%
Liberal framework: 13%

The restrictive framework is designed to achieve growth toward population objectives. The moderate framework is intended to maintain the population and the liberal framework is intended to maintain or reduce the population. In the lower 48 states and Hawaii, the outside framework dates for moderate and liberal regulations are the Saturday nearest September 24 through the last Sunday in January. The outside framework dates for restrictive regulations are the Saturday nearest October 1 through the Sunday nearest January 20. Under each framework alternative, the Central Flyway portion of Wyoming is granted additional days known as the "High Plains" mallard season, which must be taken consecutively between the Saturday nearest December 10 and the close of the duck season.

The target harvest rates were originally estimated based upon outside framework dates between the Saturday nearest October 1 and the Sunday nearest January 20. In 2002, the outside framework dates for moderate and liberal regulatory alternatives were extended through a political action orchestrated by the southern tier of Mississippi

Flyway states. At the time this chapter was written, the Service was still evaluating the impact of framework extensions upon harvest rates.

E. Waterfowl Management Areas –

1. Rationale – In 1984, the Waterfowl Program delineated 19 geographic units to serve as waterfowl management areas. These correspond to major watersheds or segments thereof. In 1998, the waterfowl management areas were digitized and incorporated into the Department's geographic information system (GIS) database (Fig. 1).

2. Application – Waterfowl management areas were based on the following criteria:

   a. Boundaries were hydrographic divides between watersheds of 3rd, 4th and/or 5th order streams.

   b. Some watersheds were subdivided based on marked differences in climate, agricultural practices or other land use characteristics.

The waterfowl management areas (Table 4) are the basic geographic units for collecting, organizing, and reporting waterfowl population, harvest and habitat data. Waterfowl and sandhill crane objectives are established for each management area.

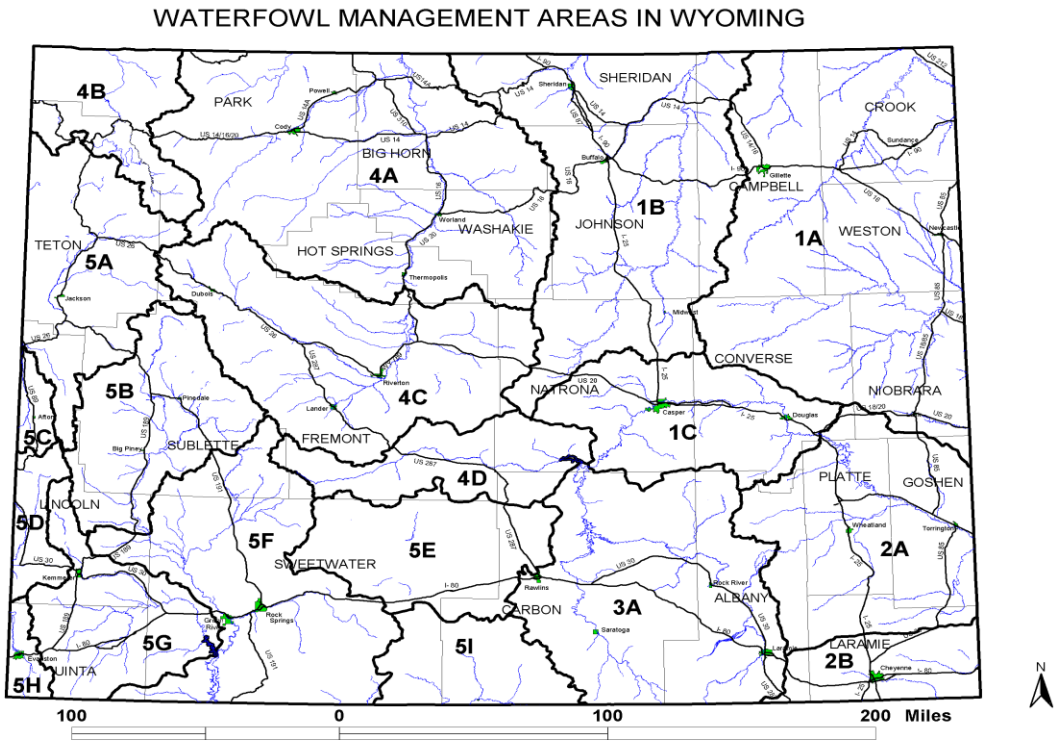

Fig. 1. Waterfowl management areas in Wyoming.

Table 4. Waterfowl/Wetland Management Areas in Wyoming.

WMA	Code	Flyway
Missouri, Cheyenne and Little Powder Rivers	1A	Central
Tongue, Little Bighorn and Powder Rivers	1B	Central
Central North Platte River	1C	Central
Lower North Platte River	2A	Central
South Platte River	2B	Central
Upper North Platte River	3A	Central
Laramie Plains	3B	Central
Big Horn River Basin	4A	Central
Madison - Yellowstone National Park	4B	Central/Pacific
Wind River Basin	4C	Central
Sweetwater River Basin	4D	Central
Snake River	5A	Pacific
Upper Green River Basin	5B	Pacific
Salt River	5C	Pacific
Lower Bear River	5D	Pacific
Great Divide Basin	5E	Pacific
Lower Green River Basin	5F	Pacific
Ham's Fork - Black Fork	5G	Pacific
Upper Bear River	5H	Pacific
Little Snake River	5I	Pacific

F. Management Area Codes –

1. Rationale – The waterfowl drainage codes identify geographic units in which data are collected. These codes area used to organize, sort, and compile data.

2. Application – Each record entered in the Wildlife Observation System (WOS) has a field in which the waterfowl drainage code can be recorded. The codes should be included in all waterfowl data entries. Codes are used to geographically index data.

II. CENSUS –

A variety of ground and aerial survey techniques are employed to monitor population trends of migratory game birds. Official surveys are not currently done to monitor crows, rails, snipe or mid-continent sandhill cranes.

A. Mourning Doves – Refer to: U.S. Fish and Wildlife Service Manual Part 722 Migratory Bird Surveys FW5 (USFWS 2003).

1. Call-Count Survey (CCS) –

   a. Rationale – Mourning doves are the most widely hunted game bird in the United States. Since 1960, dove populations have been divided into management units and hunting regulations are set accordingly. The units generally encompassed dove populations with similar characteristics, except the Central Management Unit includes 4 states divided between the Central and Pacific Flyways. Call-count surveys are done in late May and early June. Data from these counts are used to track population trends and set harvest regulations.

   b. Application – Eighteen call-count routes have been established in Wyoming. Route maps are on file in the Biological Services Section and at various field stations. All call-counts should be completed between May 20 and May 31. If inclement weather or other unavoidable circumstances delay the counts, the survey period can be extended to June 5. Do not conduct a survey if the wind exceeds 12 miles per hour or if precipitation is falling.

      Routes require approximately 2 hours to complete. Begin 0.5 hour before sunrise and maintain a driving speed of 35 mph between listening stations. Each route is 20 miles long beginning at the first listening station, with stops at 1-mile intervals thereafter. At each listening station, stop, turn the ignition off and step away from the vehicle. Listen and look for doves during a standard 3-minute interval. Record the following data: stop number, time of arrival, number of doves heard calling, and number of doves seen while stopped. Also count the number of doves seen while driving between stops and record this information on the data line of the prior stop. (Continue driving 1 mile past stop No. 20 to record data for that stop). Note any disturbances (noise, wind, etc.) or other conditions that may affect the observer's ability to detect doves at each station. At stations number 1 and 20, record air temperatures, vehicle mileage and wind velocity. Wind velocity is based on an index called the Beaufort scale outlined on the call-count survey form (Fig. 2).

   c. Analysis of Data – Talley doves heard and seen along each survey route. Results are reported as the mean number of doves heard calling per route in each state. Population trends are evaluated in each management unit.

   d. Disposition of Data – Mail the original forms directly to:

      Dove Section
      Division of Migratory Bird Management
      11500 American Holly Drive
      Laurel, Maryland 20708.

      Provide additional copies to the waterfowl biologist in Casper; Supervisor of Biological Services; and the Dove Survey Coordinator, US Fish & Wildlife Service, DMBM, P.O. Box 25486 DFC, Denver, CO 80225-0486. The observer should also retain one file copy. Contact Biological Services for instructs on submitting the data electronically to the Service.

Fig. 2. Mourning dove call-count survey form and instructions.

MOURNING DOVE CALL-COUNT SURVEY U.S. FISH AND WILDLIFE SERVICE, DIVISION OF MIGRATORY BIRD MANAGEMENT, 1150 AMERICAN HOLLY DR., LAUREL, MD USA 20708-4016		**SURVEY YEAR 2004**	
		STATE	**ROUTE NUMBER**
LOCATION OF ROUTE		**COUNTY**	**PHYSIOGRAPHIC REGION**
AT START - STOP NO. 1 WIND VELOCITY B- _____ TEMPERATURE _____F VEHICLE MILEAGE _____	**AT FINISH - MILE 20-0** WIND VELOCITY B- _____ TEMPERATURE _____F VEHICLE MILEAGE _____	**DATE OF SURVEY** _____/_____/_____ MONTH DAY YEAR	
		LAST YEAR'S OBSERVER	
OBSERVER'S NAME (PLEASE PRINT:FIRST - LAST) **-AGENCY STATE ___ FEDERAL ___ OTHER ___**		**LOCAL OFFICIAL SUNRISE TIME** _____A.M.	
-Telephone (A/C)			
MAILING ADDRESS		DID YOU ENTER RESULTS THROUGH THE INTERNET? YES____ NO____	

STOP NUMBER	**TIME AT STOP**	**DOVES HEARD**	**DOVES SEEN**		**DISTURBANCE**				**REMARKS** (or GPS coordinates)
		NO. OF INDIVIDUAL DOVES HEARD CALLING	WHILE STOPPED	WHILE DRIVING	NO	LOW	MOD	HI	
1									
2									
3									
4									
5									
6									
7									
8									
9									
10									
11									
12									
13									
14									
15									
16									
17									
18									
19									
20									
TOTALS					**TOTAL DOVES SEEN** (Stopped and Driving)				

FORM 3-159 (OVER) OMB FORM APPROVED NO. 1016-0010
(Revised August 2002) APPROVAL EXPIRES OCTOBER 31, 2005

INSTRUCTIONS FOR MOURNING DOVE CALL - COUNT SURVEY

DATES OF SURVEY Routes should be completed between **May 20 and May 31**, inclusive. *When unavoidable, the survey period will be extended to June 5.*

WEATHER CONDITIONS **Do not** conduct survey when (1) wind velocities exceed Beaufort 3 (12 mph), (2) rain or snow is falling

STARTING TIMES Start routes exactly **1/2 hour before sunrise.** Determine sunrise time from an official source adjusted to route locality.

OBSERVER When possible, the observer should run the same route in successive years. *The vehicle driver is the sole observer*. Persons accompanying the driver are not to assist the driver in the collection of dove data. When observer changes are being made and both observers are running the route, each person should record the data independently on separate forms without conferring.

SURVEY ROUTE Routes are 20 miles in length, with 20 stops (listening stations) at 1-mile intervals. The route begins at Stop #1 and ends 1-mile *past* Stop #20.

PROCEDURE

Special Note Survey requires about 2 hours to complete. Allow exactly 3 minutes for counts at each stop and an average of 3 minutes for recording and travel time between stops.

Bottom copy of the 5-ply survey form can be used as a field form.

At Stop #1 Record wind velocity a 0, 1, 2, 3, using Beaufort scale. Record temperature and vehicle mileage.

At Each Stop Stop vehicle, turn off ignition, leave vehicle. Listen and observe for **exactly 3 minutes**, standing away from vehicle.

Record:
(1) Actual time the count begins if different by more than 5 minutes from printed time.
(2) Total number of *individual doves* heard calling, **not individual calls**.
(3) Total number of doves seen while stopped.
(4) Disturbance affecting count at each stop.
(5) Remarks, if applicable to survey.

Between Stops Maintain driving speed of about **35 miles/hour** between stops.

Record: (1) Total number of doves seen while driving. Enter data on same line as previous stop number.

At Finish

Record:
(1) Weather conditions and vehicle mileage.
(2) Total all columns for doves heard and seen.

Check form for completeness and accuracy.

REPORTING ***Immediately after the completion of each route***:

(1) Mail the **original** form **directly** to Dove Survey, Division of Migratory Bird Management, 11500 American Holly Drive, Laurel, Maryland, 20708-4016.

(2) Mail the following to your State coordinator:
a. 1 copy of the form
b. 1 copy of the survey route map

(3) Retain a field copy for your personal file.

WIND VELOCITY

Beaufort Number	Velocity (mph)	Suggestions for Estimating Wind Velocity
0	Less than 1	Smoke rises vertically.
1	1 to 3	Direction of wind shown by smoke drift, but not by wind vanes.
2	4 to 7	Wind felt on face, leaves rustle, ordinary wind vanes moves.
3	8 to 12	Leaves and small twigs in constant motion, wind extends light flag.

DISTURBANCE

Disturbance	Description	Example
NO	No appreciate effect on route.	Occasional crow calling.
LOW	Slightly affecting count.	Distant tractor noise.
MOD	Moderately affecting count.	Intermittent traffic.
HI	Seriously affecting count.	Heavy-continuous traffic.

B. Rocky Mountain Population (RMP) of Greater Sandhill Cranes –

1. Fall Staging Survey –

a. Rationale – The crane population is estimated annually based on surveys conducted in mid-September to support harvest management decisions. The advantages of a survey at that time of year are: 1) The birds congregate on traditional staging areas before they migrate to the San Luis Valley, Colorado; and 2) there is minimal intermixing with other races/populations.

b. Application – The fall, pre-migration survey is a cooperative effort between the U.S. Fish and Wildlife Service and states within the range of the RMP. Survey area responsibilities are listed in the "Pacific Flyway Management Plan for the Rocky Mountain Population of Sandhill Cranes" (Pacific and Central Flyway Subcommittees for Rocky Mountain Population of Sandhill Cranes 2006). The Service's pilot/ biologist stationed in Denver selects the target dates during which all survey cooperators are requested to schedule their counts. The target period is 3 days within an outside window of 5 days. It is necessary to conduct all surveys during this period to obtain a maximum count, and to avoid duplicate counts of birds that may move from one staging area to another. The pilot/biologist relays the target survey dates to a member of the Pacific Flyway Study Committee, who is the keeper of the RMP Crane Plan. The keeper of the plan notifies all state cooperators of the survey dates, which are generally around 15 September.

The Service and WGFD share responsibilities for coverage of survey areas in Wyoming. The Department conducts aerial surveys within the Big Horn and Wind River Basins, and ground surveys within the Upper North Platte and Little Snake River Basins. The Service conducts aerial surveys within the Salt, Bear, and Blacks Fork River drainages, and the Farson-Eden area. In the past, a consultant has accompanied the Service during its portion of the surveys. The State Waterfowl Biologist maintains a file of survey coverage responsibilities.

Fly surveys on clear, calm days within the target period. If inclement weather prevents flying during the core, 3-day period, an additional 2 days are allowed for completion of the counts. The aircraft should be flown 70 knots (80 mph) or less, at an elevation of approximately 150 ft above ground level (AGL). Air speed should not exceed 90 knots (100 m.p.h.). The observer should direct the pilot to fly parallel strips or circle as needed to completely count each group of cranes encountered on the ground. Aerial counts are more effective on clear days when cranes cast shadows increase their contrast and visibility.

Record names of the pilot and observer, start and end times, wind speed, temperature, percent cloud cover and light conditions. Record numbers and locations (GPS coordinates) of each crane flock observed.

c. Analysis of Data – The waterfowl biologist transfers aerial survey data from a tape recorder to a database. All data collected by field personnel are entered on electronic forms and forwarded to the Waterfowl Biologist, who enters the information in the database. The waterfowl biologist compiles the counts for each waterfowl management area.

d. Disposition of Data – Counts are tallied for each survey area identified in the Flyway Management Plan, and then forwarded to the survey consultant and the U.S. Fish and Wildlife Service. The total RMP count is determined and included in a report prepared annually by the consultant. The total count is also recorded in a table that is updated annually in the Flyway Management Plan. The allowable harvest is determined using the fall, pre-migration count along with the result of an annual recruitment survey that is conducted in the San Luis Valley, Colorado, each October.

2. Establishment of New Hunt Areas for RMP Sandhill Cranes –
States within the range of the RMP may hunt cranes provided they meet the conditions and data collection requirements set forth by the Flyway Management Plan for Rocky Mountain Population of Greater Sandhill Cranes. Any proposal to establish a new hunt area must be submitted in writing, and is subject to approval of the Central and Pacific Technical Committees and Councils. The Management Plan for Rocky Mountain Sandhill Cranes has established monitoring requirements to determine the age, sex, and racial composition of the harvest. These data must be collected at check stations for 3 consecutive years and evaluated afterward, unless the new hunt area is exempted because other races of sandhill cranes are not present during the harvest period. Allowable, annual harvests are allocated on a statewide basis. Consequently, permits available in existing hunt areas may be reduced when a new hunt area is approved.

a. Permits and Check Station Requirements

i. Rationale – The RMP of greater sandhill cranes is comparatively small, numbering between 16,000 and 22,000. They are long-lived birds with relatively low annual recruitment (avg. = 8% juveniles). Consequently, harvest must be tightly regulated based on a permit quota system. When other subspecies are potentially present in a new hunt area, the proportion of the harvest that must be applied against the RMP quota is based on the racial composition of the harvest.

ii. Application – If cranes of mixed racial composition are potentially present in a new hunt area, mandatory check stations must be operated for a period of 3 years to obtain morphological data. Races of harvested birds are determined based on measurements of wing chord, tarsus, and posterior culmen (Schmitt and Hale 1977) or other appropriate methods. The following information must be reported annually during the first 3 years of the hunt:
Number of craned harvested;
Racial composition of the harvest (Schmitt and Hale 1997);

Age and sex composition of the harvest'
Numbers of cranes within the hunt area immediately before, during and after the hunting season;
Numbers of hunters participating;
Number of days all persons hunted;
Number of birds harvested per hunter (success rate; and
An assessment of the effectiveness of the hunting season.

When a new hunt becomes operational after the initial 3-year period, the state must continue to collect and report the following information annually:
Number of cranes harvested;
Number of hunters participating;
Number of days all persons hunted; and
Number of birds harvested per hunter (success rate).

During the 1980s and 1990s, endangered whooping cranes were introduced in the range of RMP sandhill cranes. The Whooping Crane Contingency Plan of the USFWS requires precautions to protect whooping cranes (*Grus americana*) that enter sandhill crane hunt areas, such as posting and partial closure of hunt areas, are required by the Service's Whooping Crane Contingency Plan. Whooping cranes were originally placed in the Pacific Flyway through experiments – several resulted from eggs that were cross-fostered into sandhill crane nests during the 1980s and 4 whooping cranes were released in conjunction with a migration study using an ultra-light aircraft in 1997-98. The experiments did not result in a self-sustaining population and at the writing of this chapter, only 2 free-flying whooping cranes were known to survive in the Rocky Mountain States. Cranes in both experiments were classified as "non-essential, experimental" under the Endangered Species Act.

iii. Analysis of Data – Check station data are compiled by the State Waterfowl Biologist and summarized in tabular format.

iv. Disposition of Data – The waterfowl biologist prepares a report that summarizes and evaluates all check station data. The report is presented to the Pacific Flyway Subcommittee for RMP Sandhill Cranes at the January work session. Total numbers of RMP cranes harvested by each state are recorded in a table that is appended to the Flyway Management Plan.

b. Morphological Measurements of Sandhill Cranes

i. Rationale – morphological measurements are used to distinguish several biological characteristics. These measurements are taken at check stations operated in conjunction with newly established hunt areas. The information is used to determine age, sex, and racial composition of hunted flocks.

ii. Application

age classes: Biologists distinguish 2 age classes of cranes for management purposes: adults have a bright, red crown on top of the head; juveniles exhibit gray or reddish-brown coloration on top of the head. This classification criterion is dependable until late October.

sex: Sex is determined by internal examination of sex organs. Instruct hunters not to field dress cranes before they are presented at check stations. Look for ovaries or testes inside the body cavity, next to the backbone at approximately the last set of ribs. Cut the left side of the abdominal cavity through the last rib. Lift viscera from the roof of the body cavity, exposing the left kidney and gonad, then press the viscera aside. Gonads are very small in immature cranes. Do not confuse them with the adrenal gland, which may be shaped like an ovary. Gonads are always whitish. Adrenal glands have more color – usually orange-yellow, occasionally light yellow, or in some instances, pink or red.

Testes lie on the roof of the body cavity, just forward of the kidneys. They are about the size of a little fingernail. The left teste is generally larger than the right. Testes appear as a smooth, solid mass compared to ovaries, which are pebbled or speckled. Testes can be light or dark-colored, but are usually darker in adults.

Just 1 ovary and 1 fully developed oviduct are present in most adult females. These are always on the left side. Many rounded follicles of differing sizes are visible within the ovary. These follicles are white or yellowish in the non-breeding season, when check stations are operated.

weight: Weight is one criterion used to distinguish subspecies. Always weigh birds whole, prior to field dressing, evisceration or examination of gonads. Weights of greater sandhill cranes range from 8 to 14 lbs and average 9.5 lbs.

culmen-postnares: The length of the upper bill (mandible) is measured from the rear edge of the nostril to the distal tip of the bill.

tarsus: The length is taken from articulation of the metatarsus and tibia (at the point of the joint) to the point of the joint at the base of the middle toe in front. The tarsometatarsus is to be articulated to show the position of the condyle.

wing chord: The length of the leading (anterior) edge of the wing is taken from the wrist joint to the end of the longest primary, with the wing closed in a naturally folded and unflattened position.

mid-toe: The length of the middle toe (phalanx) is taken along its dorsal surface from the articulation of the tarsometatarsus to the base of the claw at the distal end of the phalanx.

iii. Analysis of Data – Criteria described by Schmitt and Hale (1997) are applied to the above measurements to identify age, sex, and subspecies of sandhill cranes. This information is compiled to estimate the harvest composition within new hunt areas and to establish management guidelines. The State Waterfowl Biologist is responsible for interpreting measurement data and compiling results.

iv. Disposition of Data – Refer to Section II.B.2.a.iv. (Establishment of New Hunt Areas – Permits and Check Station Requirements)

C. Waterfowl Surveys –

1. Mid-Winter Waterfowl Survey –

a. Rationale – The annual mid-winter waterfowl survey is a coordinated census of waterfowl within major wintering areas throughout North America. This inventory was begun in 1934 and is the longest continually running survey. It is jointly conducted by federal and state wildlife agencies, although some private organizations have participated in the past. The major objective is to monitor the distribution and size of major waterfowl groups the winter in North America. The validity of population estimates obtained from this survey has been questioned, but it is the only practical means available to monitor trends of several waterfowl populations. Mid-winter counts are less useful for managing duck populations, but are the principal indices used to manage several goose and swan populations.

b. Application – Generally, mid-winter surveys are conducted between January 1 and 14. Each year, the USFWS selects the survey dates and notifies cooperators. Flights are scheduled during morning hours on days when light conditions are sufficient to distinguish and count species. The observer needs to be proficient at identifying waterfowl and at estimating large concentrations of birds, which in can sometimes number in the thousands. In Wyoming, 2 days are required for one observer to complete the Central Flyway portion of the survey. The central and lower North Platte River are flown in a day and the Big Horn, Shoshone and Wind River Systems also require a day. An observer can fly the Pacific Flyway portion of the survey (Snake, Salt, and lower Green rivers) in 1 day.

Mid-winter counts are conducted from a high wing monoplane with side-by-side or tandem seating, flown 150 feet above ground level. Both the pilot and observer should look for waterfowl. Identify and record all waterfowl seen. When large concentrations of birds are encountered, circle the group as necessary to estimate the number. Record all observations on a tape recorder.

In addition, record the date the survey is flown, names of the pilot and observer, make of aircraft, waterfowl drainage code, and an assessment of surface water, ice and

weather conditions (Fig. 3). Maintain a log of elapsed ferry and survey times and miles covered. The State Waterfowl Biologist retains survey route descriptions on file.

c. Analysis of Data – As soon as each survey is completed, transcribe all information from the tape recorder to data sheets. Tally counts of each species within each river drainage system and transfer the information to permanent forms. Beginning in 2004, the information is entered into a USFWS database file.

d. Disposition of Data – Copies of the permanent data forms are forwarded to the Service's 2 Flyway Representatives who incorporate the information into various Flyway reports. The State Waterfowl Biologist also retains copies of all data sheets and permanent forms. The State Waterfowl Biologist is responsible for submitting database files from both the Central and Pacific Flyway surveys to the Service.

2. Classification of Canada Geese –

a. Rationale – Different races of Canada geese often commingle on staging areas and winter habitats. At times, it is necessary to distinguish races for various management purposes including harvest regulation and population estimates. However, races cannot be distinguished reliably during aerial counts. Instead, samples of geese are classified on the ground based on morphological characteristics, and the proportions are extrapolated to estimate the composition of geese counted from the air. This method is used to estimate the numbers of geese from the Short Grass Prairie Population (small geese) and the Hi-Line Population (large geese) counted during the mid-winter survey in southeast Wyoming.

b. Application – Canada geese are generally classified in Wyoming between January 1 and 14, on days when light conditions are sufficient to distinguish size characteristics. A sample of 4,000 is needed. Several observers assist during the classification effort, which takes place in Goshen and Platte counties and within the North Platte River Valley downstream from Kortes Dam. Each observer attempts to classify at least 100 geese.

Small geese generally comprise 5-15% of the Canada goose harvest in eastern Wyoming. However, harvested geese are not used to estimate the composition of the mid-winter count because harvest takes place throughout the season and may reflect periods when the composition differs from that during the mid-winter count. In addition, morphological criteria applied to goose tail fans are not completely reliable to distinguish different races and results from the wing-bee are not available until later in the winter. Hunter selectivity for larger geese may also bias the tail fan collection.

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Fig. 3. Mid-winter waterfowl survey data form.

MID-WINTER WATERFOWL SURVEY	DATE:
OBSERVER:	PILOT:
AIRCRAFT:	PERCENT CLOUD COVER:
LIGHT CONDITIONS (excellent, good, fair, poor):	PERCENT SNOW COVER:
TEMPERATURE:	WIND SPEED AND DIRECTION:
WETLAND CONDITIONS:	
TIME DEPART AIRPORT:	TIME RETURN TO AIRPORT:
COUNT START:	COUNT END:
BREAK STARTS:	BREAK ENDS:
BREAK LOCATIONS:	

DRAINAGE CODE	LOCATION*	CAGO GEESE	DUCKS	BAEA AD	BAEA IMM	GOEA AD	GOEA IMM	SWANS

* At each location, count each duck, goose, eagle, and swan species. Also record percent ice on water bodies.

Small-bodied geese migrate in response to severe weather more readily than large geese. Consequently, the proportion of small geese in Wyoming during early January can vary markedly. Ordinarily, they are not very abundant and it is common to observe flocks of large geese with just a single small goose. When greater numbers of

small geese are present, they may segregate into family groups. Look for family groups of small geese on the ground, apart from larger geese.

Observers are instructed to classify geese on the ground, with the aid of a spotting scope and binoculars. Table 5 contrasts several morphological features of large and small geese. The observer should not attempt to classify geese in flight unless he is confident of his ability and visibility is perfect. Body size is the trait most commonly used to classify large and small geese. This method is most dependable when applied to mixed flocks in which smaller geese can be contrasted with larger geese, or when other species of waterfowl such as snow geese or mallards are nearby and provide a reference to size. Neck length and coloration are also useful characteristics. Giant Canada geese have the longest neck in proportion to their body, while cackling Canada geese have the shortest. The most common, large goose in Wyoming is *Branta canadensis moffitti* (the Western Canada goose), and the most common small goose is *B. c. parvipes* (the lesser Canada goose). Westerns have proportionally longer necks than lesser Canada geese. Neck length is especially useful to classify flocks of a single subspecies, including those that are of intermediate body size. In addition, large Canada geese tend to be lighter-colored than small Canada geese.

Observers are asked to record numbers of geese classified as large and small, general locations of flocks that are classified, and note any conditions that may affect the accuracy of classifications. If the geese in a flock cannot be reliably classified as large or small, do not include the flock in the classification sample.

Table 5. Some morphological characteristics of large and small Canada geese.

Size Class	Total Length (inches)	Weight (lbs)	Bill Length (inches)	Wing Length (inches)	Tail Length (inches0	Tarsus (inches)
Large	34.5[1]	8.2-12.5	2.0-2.4	18.6-20.5	5.7-6.3	3.7+
Small	no data[2]	4.8-6.1	1.3-1.7	14.3-17.4	4.6-4.8	2.5-3.4

[1] Average length of *B.c. moffiti*, (Bellrose 1976)
[2] Length of *B.c. parvipes* is generally shorter than *B.c. moffiti*, but some large individuals can overlap.

c. Analysis of Data – Results of individual classifications are forwarded to the Central Flyway Waterfowl Biologist. Numbers of large and small geese in the classification samples are tallied and the ratio is applied to estimate the composition of geese counted during the mid-winter survey.

d. Disposition of Data – Permanent data forms from the mid-winter waterfowl survey are forwarded to the USFWS Central and Pacific Flyway representatives for inclusion in various flyway reports. The Central Flyway goose counts include estimates of geese from the Hi-Line and Short Grass Prairie populations. The Waterfowl Biologist maintains copies of all data sheets and permanent forms.

3. Canada Goose Breeding Ground Survey

a. Rationale – An aerial survey is flown annually to monitor population trends of resident (breeding) Canada geese. All geese that nest in Wyoming are Great Basin or Western Canada geese (*B. c. moffitti*). In the early 1950s, permanent survey routes were established within the major drainages in the state to determine the distribution and size of resident goose populations. Data have been collected annually since then, and used to construct long-term trends. In northeast Wyoming, the survey has been expanded to include new areas in which nesting geese have pioneered. However, a large region from Lusk north is still not surveyed due to personnel and financial limitations.

b. Application – Breeding pair surveys are conducted immediately before clutches begin to hatch. Hatching dates vary annually depending on weather patterns. In general, flights should cover lower elevations during April and higher elevations in late April or early May. The survey in the Central Flyway portion of Wyoming is typically flown between April 15 and April 25. On the Pacific Flyway side, the appropriate survey period is the last two weeks of April and first week of May. Schedule flights on clear, calm days and complete the survey between 7 and 11 a.m. If necessary, surveys can be done between 4 and 7 p.m. weather permitting. However, surveys should not be during the midday period to flat light conditions. Survey procedures were developed and refined over a 50-year period. For general procedures and guidance regarding waterfowl surveys, refer to USFWS 1987 and 2003a.

The observer should be familiar with nesting habits of Canada geese as well as the area surveyed. Conduct all surveys from a high-wing monoplane at airspeeds of 50 to 80 miles per hour and an elevation of 200 feet or less above ground level. The same pilot and observer should conduct surveys from year to year to maintain consistent observer bias and survey coverage.

Systematically follow all river channels and shorelines of lakes and reservoirs. Both the pilot and observer should look for geese. Record the following information on a cassette tape: waterfowl drainage code, date, and numbers of pairs, females on nests, single birds and groups of birds encountered. Also note water levels and other information relevant to breeding conditions. The State Waterfowl Biologist maintains descriptions of survey routes.

c. Analysis of Data – As soon as each flight is concluded, transcribe all data from the tape recorder to appropriate forms (Fig. 4). Data are compiled and summarized for

each waterfowl management area. A breeding pair index is calculated by adding the numbers of females observed on nests, single geese representing males that are part of a pair bond, and pairs observed. The breeding population is estimated by doubling the number of females on nests and single males, and then adding the number of birds observed as pairs and groups. A nesting pair index is derived by adding the number of females on nests to the actual number of pairs observed. All estimates and indices are adjusted by a factor of 2.0 to account for visibility bias. Decreasing population trends should be examined closely. When decreasing trends span several years of records, potential causes should be investigated. Evaluate habitat conditions, harvest information, band recoveries and other relevant data to determine possible factors depressing the population.

d. Disposition of Data – All data sheets are submitted to the State Waterfowl Biologist, who in turn forwards copies to the Service Flyway Representatives and applicable Subcommittees. Population-wide trends are evaluated by assembling breeding data from all states and provinces within the breeding range. This information is appended to management plans and published in various Service reports. The State Waterfowl Biologist retains copies of all breeding survey data.

Fig. 4. Canada goose breeding ground survey data form.

CANADA GOOSE BREEDING SURVEY	DATE:
OBSERVER:	PILOT:
AIRCRAFT:	PERCENT CLOUD COVER:
LIGHT CONDITIONS (excellent, good, fair, poor):	PERCENT SNOW COVER:
TEMPERATURE:	WIND SPEED AND DIRECTION:
WETLAND CONDITIONS:	
TIME DEPART AIRPORT:	TIME RETURN TO AIRPORT:
COUNT START:	COUNT END:
BREAK STARTS:	BREAK ENDS:
BREAK LOCATIONS:	

DRAINAGE CODE	LOCATION OR RIVER REACH	FEMALE ON NEST	FEMALE ON STRUCTURE	SINGLE MALE	PAIRS	GROUPS

4. Duck Breeding Ground Survey. [The duck breeding pair survey was suspended in Wyoming after the 1999 flight due to logistical constraints and because the Service no longer directly uses the data from Wyoming].

   a. Rationale – Breeding ground surveys are done annually by the USFWS to monitor breeding duck populations and to evaluate habitat conditions. The surveys are flown throughout a traditional survey area in Canada, the Dakotas and eastern Montana. In addition, several state cooperators conduct surveys outside the traditional area. Data from the traditional survey area are used to set annual hunting seasons in the United States. However, Wyoming is not within the survey blocks from which the status of continental duck populations is determined annually.

   b. Application – About 54,250 mi^2 of Wyoming (half the State's surface) is considered potential breeding habitat for waterfowl. In 1954, the Waterfowl Section, assisted by the University of Wyoming Statistics Department, delineated sample areas (survey blocks) in which breeding pair counts would be conducted. However, the sample areas were not stratified according to habitat zones. Eight survey blocks comprising 209 mi^2 were established in the Pacific Flyway (west of the Continental Divide), and 48 survey blocks totaling 2,090 mi^2 were established in the Central Flyway. A higher density of survey blocks was selected in the Central Flyway to address sampling issues associated with denser waterfowl use and variable habitat conditions from year to year. Areas with extremely low densities of breeding waterfowl, including deserts, national forests, and Yellowstone National Park, were excluded from the areas surveyed. The official survey blocks have been delimited on BLM 1:100,000 surface maps that are used to locate survey boundaries from the air. The State Waterfowl Biologist maintains copies of the maps.

      Procedures for conducting breeding waterfowl counts and assessment of breeding habitat conditions are described generally in Series 700 of the U.S. Fish and Wildlife Service Manual. In Wyoming, the following procedures are used:

Duck breeding ground surveys are conducted during the middle 2 weeks of May and requiring about 80 hours of flight time. The observer should be proficient at identifying species and sex of waterfowl from the air. For consistency, the same observer and pilot should conduct surveys from one year to the next. A high-wing, monoplane with side-by-side or tandem seating is used. The aircraft is flown between 50 and 80 mph at an average elevation of 150 ft above ground level. Fly parallel strips in areas with extensive surface water, and follow drainages in areas of sparser water. In order to accurately classify larger groups of waterfowl, it is sometimes necessary to circle a water body. Optimally, surveys should be completed between a half hour before sunrise and 10:00 a.m. on calm, clear days. In the event of weather delays, afternoon flights can be done after 1600, weather permitting, but they are less effective than morning flights.

Record the date of the survey, names of the pilot and observer, make of aircraft, name of the survey block, county, waterfowl drainage code, an assessment of surface water, and weather conditions (Fig, 5). Maintain a log of elapsed ferry and survey times. Record all observations on a cassette tape. Both the observer and pilot should look for waterfowl. When waterfowl are encountered, count the numbers of pairs, single males, single females, and grouped birds of each species. Distinguish sex within groups as possible.

Fig. 5 Duck breeding ground survey recording form.

DUCK BREEDING GROUND SURVEY	DATE:
SURVEY AREA/NUMBER:	SQUARE MILES IN AREA:
OBSERVER:	PILOT:
AIRCRAFT:	PERCENT CLOUD COVER:
MORNING: OR EVENING: FLIGHT	
VISIBILITY [light and wind] (excellent, good, fair, poor):	
TEMPERATURE:	WIND SPEED AND DIRECTION:
TIME DEPART AIRPORT:	TIME RETURN TO AIRPORT:
COUNT START:	COUNT END:
BREAK STARTS:	BREAK ENDS:
BREAK LOCATIONS:	

SPECIES	**PAIRS**	**SINGLE MALES**	**SINGLE FEMALES**	**GROUPS/ # AND SEX**
COMMON MERGANSER				
MALLARD				
GADWALL				
AMERICAN WIGEON				
GREEN-WINGED TEAL				
BLUE-WINGED TEAL				
CINNAMON TEAL				
UNIDENTIFIED TEAL				
NORTHERN SHOVELER				
NORTHERN PINTAIL				
WOOD DUCK				
UNIDENTIFIED DUCK				
REDHEAD				

CANVASBACK				
LESSER SCAUP				
RING-NECKED DUCK				
COMMON GOLDENEYE				
BARROW'S GOLDENEYE				
BUFFLEHEAD				
RUDDY DUCK				
TRUMPETER SWAN				
SANDHILL CRANE				
AMERICAN COOT				
CANADA GOOSE BROOD				
BALD EAGLE NEST LOCATION				

HABITAT COMMENTS: Circle appropriate descriptors)	High water	River high	Ponds/Res. full	No runoff
	Low water	River low	Ponds/Res. low	Runoff started
No irrigation	Normal water	Trees leafed	Ponds/Res. dry	No water in canals
Fields flooded	Good count	Fair count	Poor count	
Single Males - includes single males and 2-3 flocked drakes. Two drakes and a hen, in a group, are recorded as one pair and a drake.				
Groups - are either 4 or more flocked drakes or mixed.				

Observers' abilities to detect and identify duck species from the air vary. For this reason, a correction factor must be determined for each observer and for each species. Correction factors are estimated by conducting ground checks in small areas within the survey area. Ground check plots are thoroughly surveyed by an experienced crew of 3 or 4 persons while the observer conducts the aerial survey at the same time. The assumption is the ground crew detects all ducks in the area. The aerial survey data are compared against the ground count data to estimate a visibility correction factor for the observer.

c. Analysis of Data – Raw data from the aerial survey are extrapolated twice to obtain statewide estimates. The first extrapolation is based on the visibility bias correction. The second extrapolation is a geographic expansion based on the area of potential breeding habitat (54,249 mi^2) divided by the area actually surveyed (2,299 mi^2). For example, assume the observer detects 50 mallard pairs within the ground check plots and the ground crew detects 80. The observer's visibility correction factor is 50/80 or 0.625. Now assume the observer recorded 600 mallard pairs during the entire survey. The corrected number is 600 /0.625 or 960 mallard pairs. The geographic expansion factor for the statewide estimate is 54,249/2,299 or 23.6. The statewide estimate of mallard pairs is 960 X 23.6 or 22,656.

A similar procedure is used to extrapolate the number of grouped birds observed per species. The statewide estimate for each species is determined by doubling the estimate of breeding pairs and adding the statewide estimate of grouped birds. The estimate of total ducks is the sum of all species estimates.

Two statistics are calculated for each species. One is the total number of breeding pairs and the second is the total abundance. Statistics from the current and prior year, and long-term averages are compared. Proportionate changes are determined. In addition, a projection of the Fall Flight Index is made based on breeding pairs and total numbers of ducks in the spring count, and an assessment of habitat conditions. This index is the number of ducks of each species expected to migrate south considering the spring population and expected recruitment.

d. Disposition of Data – Data from breeding duck surveys are forwarded to the U.S. Fish and Wildlife Service. The USFWS annually prepares a report that summarizes results of breeding duck surveys in traditional survey area, and data from state cooperators. The State Waterfowl Biologist maintains copies of all Wyoming data sheets.

5. Molting Canada Goose Survey –

a. Rationale – One of the management plan objectives for the Rocky Mountain Population (RMP) of Western Canada Geese is to maintain the distribution of molting geese within the population. Surveys are conducted annually to monitor numerical trends at known, major molting concentrations.

b. Application – All molting geese within the areas surveyed in Wyoming are considered RMP geese. Although HLP geese nest on the Laramie Plains, we don't currently know where they molt. We suspect they move north and east. The geographic divisions between RMP and HLP Canada geese are recognized differently for the goose breeding pair survey, the molting goose survey and harvest allocations.

The molting goose survey is conducted during the last week of June or first week of July. The objective is to fly when the geese are flightless. All Canada geese observed in each area are counted and the information is recorded on a cassette tape. The State Waterfowl Biologist maintains a list of areas surveyed. Because of distances and ferry time between molting areas, the survey requires 2 days to complete.

Obtain clearance from Teton National Park, the National Elk Refuge, and Yellowstone National Park, before flying over these administrative units. This is in part done as a courtesy, but also avoids complaints and inquiries after the flight is complete.

c. Analysis of Data – The waterfowl biologist transcribes data from tape to a spreadsheet after each flight. Numbers of geese counted are tallied for each molting area added to obtain a total count. The information is compared against counts from prior years to monitor trends.

d. Disposition of Data – Data from molting goose counts are summarized and forwarded annually to the Pacific Flyway Subcommittee for RMP Canada Geese (Subcommittee on Rocky Mountain Canada geese 1992). Results of molt surveys are periodically incorporated into updates of the RMP Management Plan.

D. Trumpeter and Tundra Swans

As there are no hunting seasons for swans in Wyoming. The Non-game Section has primary responsibility for swans (Refer to Chapter 19 – Non-game Birds). Swans observed during waterfowl surveys are recorded and the information is sent to the Non-game Section. The Pacific and Central Flyway Waterfowl biologists participate in swan subcommittees at the Flyway level.

III. HARVEST DATA –

A. Harvest Survey –

1. Rationale – Managers require estimates of migratory game bird harvests for a variety of purposes. Results from harvest surveys are used to determine if harvest quotas or objectives have been achieved or exceeded. Season structures are adjusted accordingly. Harvest mortality estimates are also included in population models for some species. Finally, harvest and effort data can provide useful insights regarding population trends of some species.

2. Application – Both the Department and the U.S. Fish and Wildlife Service conduct surveys to estimate migratory bird harvests. The Department obtains harvest information from its annual survey of small, upland game, and migratory game bird hunters. The survey is mailed to all persons who purchased a state game bird or small game license. Harvests of migratory game birds are estimated from data provided by the respondents who hunted migratory game birds. A third party contractor historically conducted the survey, however the Biological Services Section took it over following the 2002-03 hunting season. In addition, Biological Services does special surveys of limited quota permit holders for early sandhill crane and Canada goose hunts, and permit holders for the Light Goose Conservation Order.

   The U.S. Fish and Wildlife Service conducts harvest surveys through the Harvest Information Program (HIP). Each licensed hunter is required to obtain a HIP validation from each state in which the person hunts migratory game birds. When a HIP validation is issued, the person is asked to identify the species and numbers of migratory game birds harvested the prior year. The U.S. Fish and Wildlife Service uses this information to establish sample frames for conducting surveys to estimate harvests of various species. The Service also surveys holders of federal permits to hunt mid-continent, lesser sandhill cranes.

3. Analysis of Data – The Biological Services Section compiles harvest information obtained from the survey of small, upland game bird and migratory bird hunters. The Waterfowl Biologist compiles harvest information obtained from holders of limited quota permits for early sandhill crane and Canada goose hunts, and holders of permits for the Light Goose Conservation Order. Harvest estimates are simple extrapolations of the information provided by respondents, based on total numbers of licenses or permits issued. Harvest data are presumed the same for respondents and non-respondents to the small, upland

game bird and migratory bird harvest survey, so a correction for non-response bias is not applied. Non-response bias is corrected in the other two surveys by assuming harvest data for non-respondents are the same as data derived from respondents to a second mailing.

Based on HIP sample frames, the U.S. Fish and Wildlife Service develops harvest estimates of waterfowl and webless migratory game birds for each state and management zone. Annual harvest estimates from both state and federal surveys are appended to long-term data sets from which harvest trends and objectives can be evaluated.

4. Disposition of Data – The Department's estimates of migratory bird harvests are published in the "Annual Report of Upland Game and Furbearer Harvest." Both statewide and individual management area harvests are included. Harvest estimates from early sandhill crane and Canada goose hunts are summarized in spreadsheets provided to flyway subcommittees and the U.S. Fish and Wildlife Service. This information is periodically appended to tables in the applicable flyway management plans. Harvest estimates from the Light Goose Conservation Order are forwarded the U.S. Fish and Wildlife Service. The State Waterfowl Biologist maintains data files containing harvest estimates derived from all surveys conducted by the Department. Harvest estimates derived from the HIP are summarized in the annual flyway data books, prepared by the Service's Flyway Representatives.

IV. MORTALITY ESTIMATION (non-hunting) –

Sources of non-hunting mortality can include accidents (collisions with power lines and other obstacles, entanglement in nets or fishing line), diseases, poisoning from toxins or other environmental contaminants, entrapment in oil ponds, climatic events (hail, drought), poaching, predation, starvation, and agricultural activities such as haying and tilling. Impacts of most mortality events are localized, however some can have population-level significance. Waterfowl mortalities are predominantly detected through incidental observations. Structured surveys are only done to estimate losses during extremely large events such as cholera outbreaks, botulism poisoning, or oil spills.

A. Incidental Observations –

1. Rationale – Although many sources of mortality such as drought and disease are beyond the control of managers, the severity of some mortality events can be moderated if appropriate remedial actions are taken when a problem is identified. For this reason, mortalities of migratory game birds should be documented, especially when several mortalities are detected within a limited area or during a relatively short period. Mortality records can aid in identifying problems, provide useful evidence when illegal activities are suspected, and may provide a numerical basis to estimate the value of resources lost, for example, when oil and gas spills take place.

2. Application – Mortalities of migratory game birds should be recorded on wildlife observation forms for subsequent entry in the Department's Wildlife Observation System

database. Identify the cause of death when it is apparent, for example, collisions with a power line, fence, or other obstacle, entrapment in an oil pond, predation, and so forth. If disease or poisoning is suspected, notify the U.S. Fish and Wildlife Service agent in Casper and the Ecological Services Office in Cheyenne. Collect and preserve specimens in good condition for later necropsy and testing. Whenever illegal activities may be involved, notify a district game warden or the federal wildlife agent in Casper, but do not disturb the site. Always follow these notification procedures when a major mortality event is discovered (numerous dead or dying birds found within a limited area). If a large mortality event has taken place, it may be necessary to conduct a systematic survey of the area to estimate the total loss. The U.S. Fish and Wildlife Service will take the lead in determining appropriate methodologies for inventorying the site.

Remedial actions can be implemented when they are effective and economical. For example, a power line can be buried or markers attached to resolve chronic bird collisions in a specific location. Water level regimes can be managed to control avian botulism in ponds or wetlands that have water-regulating structures. In other cases, birds can be hazed away from areas in which toxic substances are chronically exposed. Habitats in which spent lead shot remain accessible to waterfowl can be disked to increase the depth toxic shot is buried. Oil waste ponds should be covered with mesh to exclude birds. Farmers can be encouraged to plant fall-seeded crops and to cut hay after mid-July to reduce mortality of nesting ducks. Predator control is sometimes justifiable in areas of unnaturally high predator densities and where non-indigenous predators have pioneered in response to land management practices. Other remedial actions must be tailored to address specific problems.

3. Analysis of Data – Mortality records provide important documentation. Compilations can be done to identify seasonal or spatial patterns, which can assist with identifying sources of mortality and planning remedial measures. Such records are especially useful in problem areas with recurring mortality events. When a significant mortality event has taken place, total losses are estimated by expanding (extrapolating) data from systematic surveys, based on the methodology employed.

4. Disposition of Data – All mortality records of migratory game birds are entered in the Department's Wildlife Observation System database. Any reports or other documentation prepared after major mortality events will be retained in the State Waterfowl Biologist's files and provided to the USFWS.

V. DISTRIBUTION AND MOVEMENT –

A detailed knowledge of seasonal ranges, migration corridors, crucial habitats, and population boundaries is essential to manage migratory game birds effectively. This information is also indispensable documentation for analyzing impacts of development projects and justifying mitigation. The Department often considers distribution and migration patterns when setting hunting seasons and the data are used for various planning purposes by other resource agencies, companies, and NGOs. Seasonal habitats and population boundaries are delineated on maps of waterfowl management areas maintained in the Casper Regional Office. Distribution and movement data are obtained from observations of marked birds, aerial surveys, and incidental observations.

A. Marking Studies –

1. Rational – Managers can obtain detailed information about migratory game bird distribution and movements from field studies of marked birds. Appropriate marking systems will depend on the study objectives, type of data required, observation or collection methods, and project budget. Birds can be fitted with leg bands, visible markers or radio signal transmitters.

2. Application – Depending on objectives of the study, locations of marked birds are recorded during systematic surveys, as legal harvests, or incidentally during other field activities. The information is accumulated in geographic databases.

3. Analysis of Data – Data are interpreted to improve knowledge about distribution, seasonal movements, and population interchange. Consideration is given to time of year, the effects of weather patterns such as snow cover and storm events, and hydrologic conditions.

4. Disposition of Data – Records of observations and other relevant information are compiled in a database and entered in the Wildlife Observation System. Conclusions are discussed in applicable JCRs. Interim and final project reports should be appended to the JCRs.

B. Aerial Surveys –

1. Rational – Aerial surveys are a relatively quick method used to document migratory game bird distributions and concentrations throughout large areas. Flights are scheduled to during the seasons in which distribution data are sought.

2. Application – Plan aerial surveys to make effective use of manpower, funds, and favorable weather conditions. Conduct flights in the early morning or late afternoon on clear days. Record drainage codes for each observation of a targeted species and enter this data in the Wildlife Observation System.

3. Analysis of Data – Compare distributions of migratory game birds documented during surveys to the seasonal habitats delineated on existing waterfowl management area maps. Update maps when seasonal distribution data obtained during normal or severe weather patterns indicate refinements are needed.

4. Disposition of Data – Results of distribution surveys should be evaluated and discussed the annual JCR. Enter each location into the Wildlife Observation System.

C. Incidental Observations –

1. Rationale – Knowledge of migratory game bird distribution is continually improved as additional data are gathered. Incidental observations are a non-structured means of obtaining data to document use of areas not previously surveyed, and may alert managers to shifts that have taken place in response to development or changing land management practices.

2. Application – Biologists should record incidental observations of migratory game birds when the location, time of year or other circumstances contribute further insight about distribution patterns. Give particular attention to areas in which changes in land uses are proposed or underway, and to previously unoccupied habitat.

3. Analysis of Data – Refer to Section V.B.3. (Aerial Surveys).

4. Disposition of Data – Records of incidental observations are entered in the Wildlife Observation System. Waterfowl management area maps are revised when distribution data indicate adjustments of boundaries or range delineations are warranted. All revisions and associated rationale should be described in the applicable JCR.

VI. CAPTURE METHODS –

A. Pre-season Duck Trapping and Banding –

1. Rationale – Recoveries of birds banded prior to the hunting season afford managers a means to estimate direct mortality rates attributed to hunting, and to map migration corridors from breeding areas to wintering grounds. Both a federal permit issued by the USFWS and a state permit issued by the jurisdictional wildlife agency are required to capture and band migratory birds. All prospective banders should obtain a copy of the *Bird Bander's Manual* (USFWS 1976) issued by the Service before attempting any banding.

2. Application – Several kinds of baited traps have been devised over the years to capture ducks. Some, like the Colorado ramp trap, require considerable effort to set up and are not very mobile. Panel-type traps, like the Salt Plains trap (Szymczak and Corey 1976) are easy to assemble and can be moved to new locations quite readily. Panel traps are used in Wyoming. The basic design of the Salt Plains trap is illustrated in Fig. 6. Baited traps are

usually set in lakes, marshes or sloughs. Traps should be located in open pockets of marsh vegetation or along shorelines accessible to both birds and banding personnel. The pond or marsh bottom should be firm for ease of walking. Pre-season trapping can begin in early August and continue until mid-September. Cereal grains are used as bait.

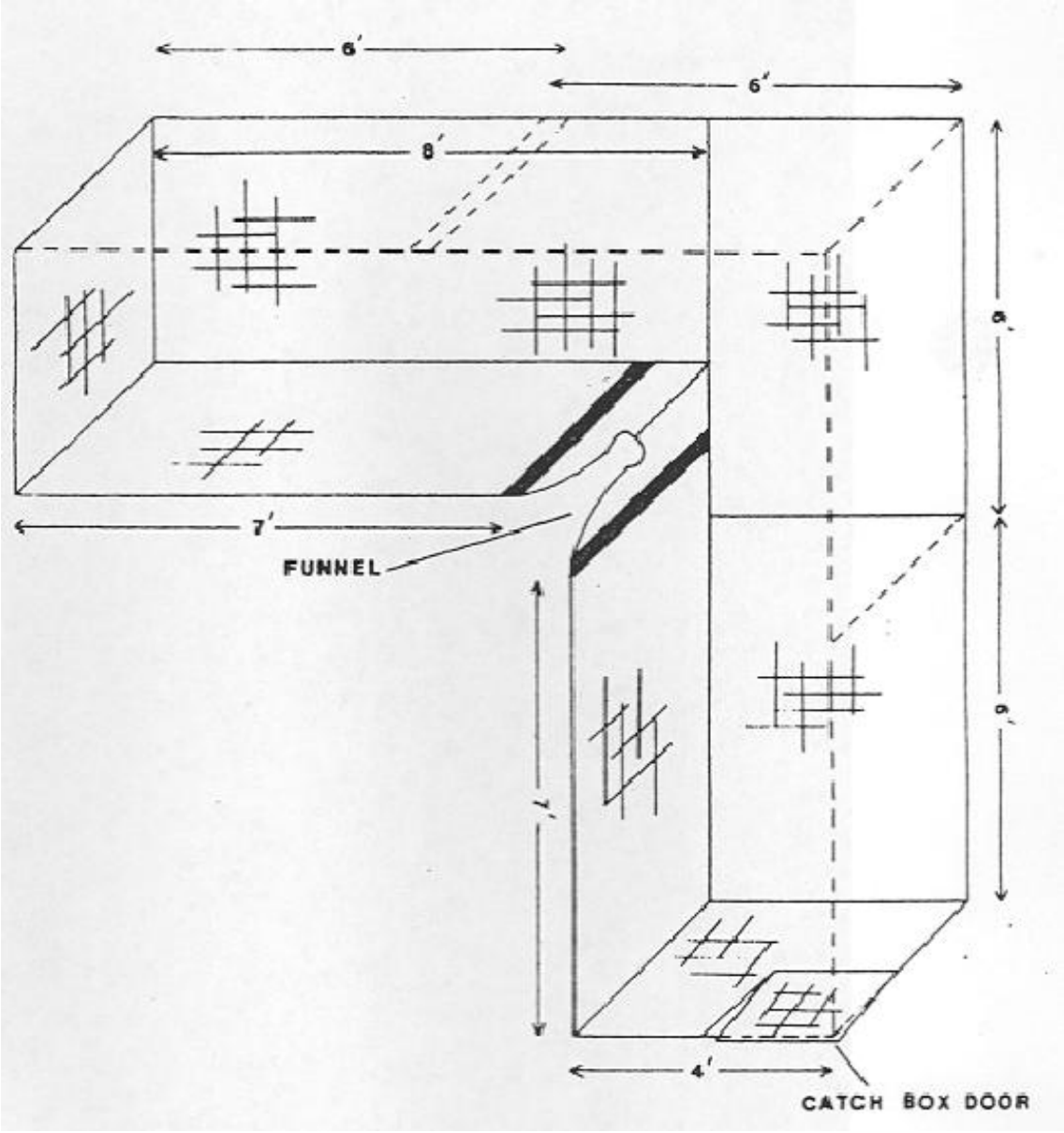

Fig. 6. Diagram of assembled modified salt plains duck trap (diagram by Shannon Heath).

It is more difficult to age and sex ducks captured during a pre-season banding operation than during winter trapping. A large variety of species in eclipse plumage and juveniles in

varying stages of development will be encountered. Consequently, numerous criteria are used to identify species, age and sex. References include Bellrose (1976) and *Waterfowl Identification in the Central Flyway* published by the Central Flyway Council (1999). Inexperienced personnel should consider attending one of the Flyway wingbees.

Cannon-nets are another effective means often used to capture large numbers of waterfowl. Either the mortar-type, which fires a projectile, or the newer rocket-propelled model is suitable. Cannon-nets are used to trap both geese and ducks, however one-inch mesh netting should be used to prevent ducks from entangling their wings. Suitable trapping sites include open fields and shorelines with low vegetation or crop stubble. Pre-baiting is essential to draw birds within the carrying distances of the netting. Refer to *Bird Bander's Manual* and to Dill (1969) for a detailed description of equipment and techniques.

The Supervisor of Biological Services orders all bands from the Bird Banding Laboratory, USGS Patuxent Wildlife Research Center, Laurel, Maryland. Refer to the *Bird Bander's Manual* to identify appropriate sizes of bands for various species. Reward bands are used in some studies to estimate band-reporting rates.

Always record the following information during banding operations: band number, species, age and sex when applicable, location and date. These data are entered on banding report forms and forwarded to the person responsible for maintaining the Band Manager Program in the Biological Services Section.

3. Analysis of Data – Whenever a banded duck or goose is recovered, the number of the band, name and address of the person who took the bird, and date and location of kill should be reported using the Bird Banding Laboratory's website. The Bird Banding Laboratory will notify the submitter of the date and location the bird was banded and the person or organization that banded the bird. Copies of this information should be sent to the person who harvested or found the banded bird, the person who reported the kill, the wildlife organization of the state in which the bird was recovered, and the bander. Band return data are subsequently analyzed to determine species movements, harvest mortality and effects of management adjustments. Returns from each banding location are plotted on band return maps of North America.

   Harvest is an important mortality factor in both duck and goose management. Continuous banding programs enable managers to estimate annual waterfowl mortality. Methods used to analyze band returns include Seber (1970), which applies only to adults, and Anderson and Burnham (1976), the time-varying survival rate method. Results of band data analyses are used to determine the geographic distribution of harvest and the impact of regulations on rates of harvest of various species.

4. Disposition of Data – Data from banding operations conducted in Wyoming are submitted to the Biological Services Section in Cheyenne at the end of the month in which the banding is conducted. Copies of the data are then forwarded to the USGS Bird Banding Laboratory by the 10th of the following month. The State Waterfowl Biologist also retains a copy in his files. Refer to the *Bird Bander's Manual* for band schedules and appropriate codes.

B. Post-season Duck Trapping and Banding –

1. Rationale – Waterfowl are banded on winter grounds, after the hunting season, to study movements and migration patterns. Historically, banding was done to define Flyway boundaries. Additional purposes, which aid in the management and conservation of various species, include studies of mortality, population dynamics, and migration chronology.

2. Application – Baited trap and cannon-net techniques, similar to those used in pre-season duck trapping, are used to capture waterfowl in winter. Post-season banding is usually done in areas that support concentrations of wintering birds. As availability of food and ice-free water decrease, birds congregate and larger numbers are trapped more efficiently.

   Baited traps are generally set up in locations that remain ice-free, such as warm water drains, creeks and rivers where birds concentrate. Trapping sites are pre-baited before and during trap construction to attract and precondition large numbers of birds. Trapping and banding usually begin in mid-January and continue through February. Baits vary with the location, but cereal grains are preferred in most cases.

   In Wyoming, mallards are generally targeted in post-season trapping and banding operations. Determining sex is no problem because plumage is distinctively dimorphic, but distinguishing immature and adult birds can be a challenge for inexperienced banders. Characteristics of the greater tertial coverts are the primary criteria used to determine ages of mallards. Immature birds have narrow and worn tertial coverts. In adults these feathers are broad and do not appear worn. Refer to Carney (1992) for a detailed explanation of age criteria. Anyone inexperienced at duck trapping and banding should consider attending one of the Flyway wingbees to learn wing characteristics used to identify species and determine ages and sexes of ducks.

3. Analysis of Data – Refer to Section VI.A.3. (Pre-season Duck Trapping and Banding).

4. Disposition of Data – Refer to Section VI.A.4. (Pre-season Duck Trapping and Banding).

C. Pre-season Canada Goose Trapping and Banding –

1. Rationale – Large numbers of Canada geese can be handled and banded efficiently at molt concentration areas during early summer. Recoveries of geese banded prior to the hunting

season enable managers to estimate direct (hunting-caused) mortality rates, examine patterns of exploitation, and identify migration paths and seasonal habitat use.

2. Application – Before a banding operation can begin, the leader must acquire necessary state and federal permits. All prospective banders should obtain a copy of the *Bird Bander's Manual* available from the U.S. Fish and Wildlife Service's Bird Banding Office.

   Canada geese instinctively congregate on larger, remote waters to molt. Yearling and non-breeding adult geese may undertake extended migrations to traditional molting grounds. Reproductive adults and flightless broods congregate on large wetlands and lakes near breeding areas. The State Waterfowl Biologist maintains records of molting areas where capture operations can be conducted effectively.

   In Wyoming, wing traps are used to capture molting geese. The last 2 weeks of June are the optimum time to capture flightless geese. Wing traps are erected on a point or channel between 2 portions of a lake. The trap enclosure (capture pen) is a circular fence of 4-ft high nylon mesh with a 2-ft wide entryway, large enough to hold the maximum number of geese that may be captured (Fig. 7). Wing fences extend in a "V" configuration, 200-300 yards from the entryway, with the open end facing the direction from which geese will be driven. Where possible, shoreline features are incorporated into the trap layout, to provide a natural corridor into the wing fences. Wing fences are constructed of nylon mesh at least 3 ft high and extend below the surface of the water. The angle between the wings is approximately 110 degrees. The capture pen and wing segments within 50 yards must be reinforced to prevent excited geese from knocking the fence down and escaping. The outlying 100 yards of wing fence needn't be 3 feet high, but the mesh should extend into the water so geese cannot escape beneath the fences.

   Use 2 or 3 small, outboard boats to slowly haze geese toward the open end of the wing fences and into the trap. Once geese are in the trap, avoid excessive disturbance and human activity near the geese. Remove goslings immediately and transfer them to a separate holding pen to prevent injury. Goslings are banded and placed back in the separate pen. As adults are removed from the capture pen and banded, they should be placed in a third holding pen. When banding is completed, release all geese at the same time – adults first and goslings immediately afterward.

   Male and female Canada geese have identical plumage, so sex is determined by internal, cloacal examination. However, sex of captured geese is not recorded in Wyoming. Geese trapped post-season are not aged because criteria are not available to reliably distinguish between adult and immature birds at this time of year.

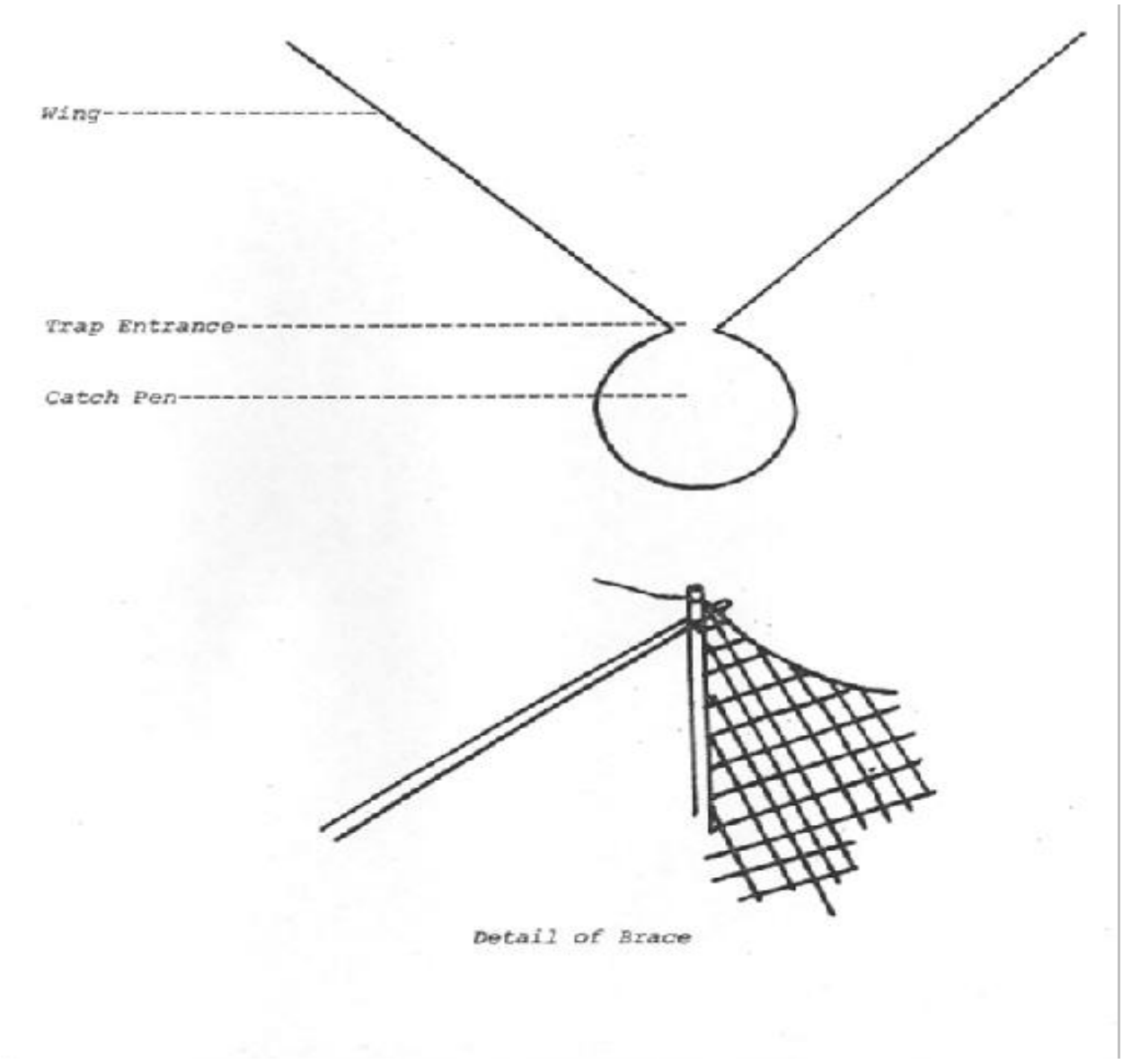

Fig. 7. Schematic diagram of Canada goose drive trap.

3. Analysis of Data – At the time of banding, the following data are recorded on forms provided by Waterfowl Biologist: band number, species, age and sex as applicable, location and date banded. Canada geese are classified as adult or juvenile. Since male and female geese cannot be distinguished based on plumage characteristics, sex of captured geese is not recorded in Wyoming. Sex can be determined through internal, cloacal examination.

   Harvest is an important mortality factor in management of Canada goose populations. When the number of direct (first year) band recoveries exceeds 20%, the population will generally begin to decline. Continuous banding programs enable managers to estimate annual mortality rates. Methods described by Seber (1970) and by Anderson and Burnham (1976) are commonly used. The Seber method applies only to banded adults. The Anderson and Burnham method is also known as the time-varying survival rate method. Results of band data analyses are used to determine the geographic distribution of harvest and the impact of regulations on rates of harvest, both major consideration in a waterfowl management program.

4. Disposition of Data – Data from all banding operations conducted in Wyoming are submitted to the Biological Services Section at the end of the month in which the banding is conducted. Copies of data are then forwarded to the USFWS Bird Banding Office by the 10^{th} of the following month. The State Waterfowl Biologist retains a copy in his files. Refer to the *Bird Bander's Manual* for band schedules and appropriate codes.

D. Relocating Canada Geese

1. Rationale – Historically, breeding populations were reestablished through gosling transplants in many areas of Wyoming. Goslings that are transplanted at an early age become imprinted on the transplant area, return to that location, and eventually nest there. Candidate areas should be evaluated to determine if suitable habitat is available to sustain nesting birds. In some cases, restricted hunting seasons may be necessary to protect the transplanted geese. Resident populations of Canada geese currently occupy suitable, vacant habitats in Wyoming, and in several cases, they are expanding into urban areas where they have increased to nuisance proportions. We do not anticipate a need for further transplants in Wyoming. However, transplants of goslings could potentially be considered to alleviate damage problems, provided this does not lead to further conflicts in the release area.

2. Application – Capture operations conducted during molting periods are the best source of goslings for transplants. Goslings should be at least six weeks old, but not capable of flying. The birds should always be transported in holding crates with proper ventilation. A trailer designed and constructed to transport geese is maintained on the Waterfowl Section's equipment inventory.

   Geese will not be transplanted for the purposes of establishing new populations when resident Canada goose populations are over objective.

3. Analysis of Data – All transplanted birds are banded to provide information on harvest distribution and mortality rates. Complete banding data forms as described in Section V.A.3 (Marking Studies). Consult the *Bird Bander's Manual* to obtain banding codes that designate transplanted birds.

4. Disposition of Data – Refer to Section VI. A. 4. (Pre-season Duck Trapping and Banding)

VIII. DEPREDATION

A. Rationale – Waterfowl depredation can damage growing, mature or stored crops, and grass on golf courses, pastures, and other locations. Crop depredation by waterfowl is often more perception than reality, however large concentrations of waterfowl can reduce crop yield when they feed on mature crops prior to harvest, or on growing crops. Waterfowl also cause problems in urban environments where they feed on lawns, parks and golf courses, and their excrements damage property, create public health and aesthetic issues, and impact water quality of urban ponds and lakes. In addition, airplane strikes have become serious safety hazards at some airports. Depredation takes place throughout the year.

In Wyoming, crop damage by cranes, ducks and geese is the most common form of waterfowl depredation. Cranes can damage crops from May through October, however most claims involve damage to grain crops during August through early September, just prior to harvest. Geese can damage emerging crops during spring through early summer, especially in fields near wetlands where broods are raised. Farmers tend to be concerned most about crop consumption by ducks and geese during August and September, prior to harvest of small grains, and during November when corn is harvested. Geese also forage on winter wheat during the fall and spring migration periods, however light to moderate grazing seldom reduce crop yield, because winter wheat re-sprouts after it is severed. Additional types of depredation can include consumption of grain and waste grain intended for livestock consumption in feedlots and harvested fields, respectively. In western Wyoming, we have received depredation complaints involving geese grazing in pastures and hayfields in spring and after the first cutting of hay in mid to late summer.

B. Application – State statute requires the Wyoming Game and Fish Department to compensate landowners for crop damage caused by big and trophy game animals or game birds. District game wardens investigate claims for compensation arising from damage allegations. Landowners experiencing damage often request advice or assistance from game wardens to protect their property. Various techniques are used to haze waterfowl away from fields in which depredation is taking place. Scare devices include products that discharge or explode (e.g., cracker shells), predator silhouettes, scarecrows, flagging, twirling objects, revolving lights, recorded alarm or distress calls, and other visual or noise-making deterrents. In some situations, chemicals are applied to make vegetation unpalatable. Drawbacks include costs and labor necessary to implement intensive measures, potential displacement of waterfowl depredation to other locations, and in some cases, acclimation of waterfowl to the scare device, which then loses its effectiveness. When damage occurs at times of year hunting is

allowed, sport hunting can be an effective deterrent. Hunting associates danger with the source of disturbance, so birds are less likely to become acclimated. Hunting can also increase the effectiveness of non-lethal, noise-making devices deployed in the same general area. Devices most commonly used in Wyoming are cherry bombs, bird bombs, cracker shells, and acetylene zon guns.

When migratory game birds are hazed away from an agricultural food source, alternative food sources should be available nearby to avoid merely relocating the depredation problem. It may be necessary to purchase lure crops or to grow food plots on habitat management areas or refuges to effectively alleviate depredation on private ground. If goose broods are damaging growing crops in the spring/summer period, erect low fences to prevent young and molting geese from accessing the fields. It may also be necessary to remove nesting structures from nearby wetlands.

C. Analysis – Personnel responsible for depredation management should continually assess effectiveness of various techniques and maintain written accounts for use by co-workers and successors. Workshop and symposia proceedings can sometimes be provide useful information. Additional references include: University of Nebraska (1994) and Demaree et al. (1991).

D. Disposition of Data – The following information is recorded during investigation and handling of depredation complaints: type of crops or other property affected, nature and amount of damage, location and timeframe, species and approximate number of birds or animals involved, prevention techniques deployed, equipment types and cost, and vehicle mileage and man-days expended to prevent or control damage. Data are compiled monthly and submitted to regional supervisors. Damage prevention reports and data compilations are maintained at regional offices. Reports should also be forwarded to the State Waterfowl Biologist when migratory game birds are involved. Formal claims for damage compensation are submitted to the Cheyenne Office of the Wyoming Game and Fish Department and maintained on record at that location.

VIII. EVALUATION AND MANAGEMENT OF WATERFOWL HABITAT

A. Wetlands – Wetlands are essential habitat for waterfowl and fulfill at least some seasonal habitat needs for 90% of all wildlife species in Wyoming (WY Game and Fish Dept. 1995). More than half the priority bird species listed in the Wyoming Non-Game Plan are wetland obligates (Oakleaf et al. 1996). Since the beginning of settlement, about 53 percent of wetland area in the conterminous United States (Dahl and Johnson 1991), and about 38% of the wetland area in Wyoming (Dahl 1990) have been eliminated.

1. Rationale – Wyoming is a semi-arid state with limited wetland resources comprising just 2 percent of the surface. In part because of their comparative scarcity, wetlands are an inordinately valuable resource in our State. However, various development activities and land use practices impact wetlands by converting them or otherwise decreasing their

effectiveness for waterfowl. Opportunities also exist to create new wetlands or enhance existing wetlands.

2. Application – The State Waterfowl Biologist provides technical recommendations to reduce or mitigate impacts, and improve wetlands, by participating in various review, coordination, and outreach processes. These responsibilities include participation in the Department's environmental review process, coordination of management activities on Department habitat areas, and coordination and consultation with external groups such as Ducks Unlimited, Waterfowl Joint Ventures, other wetland habitat initiatives, and private landowners. Some wetland inventory and design references pertinent to Wyoming include WY Game and Fish Department (2003), Tessmann (2004), and Patla and Lockman (2004).

3. Analysis – When actions are proposed that may impact wetlands, the State Waterfowl Biologist review the project and recommends measures to avoid, minimize, or mitigate the impacts. Principal authorities for such participation include the National Environmental Policy Act of 1969, Section 404 of the Clean Water Act, the Fish and Wildlife Coordination Act, Executive Orders 11990 (floodplains) and 11998 (wetlands), the National Wildlife Refuge Improvement Act, the Surface Mining Control and Reclamation Act, and other federal permitting and planning legislation. In addition, the State Waterfowl Biologist participates in resource evaluation, planning, and grant application for wetland projects conducted by Ducks Unlimited, the Waterfowl Habitat Joint Ventures, and other wetland improvement initiatives.

4. Disposition of Data. The Wyoming portion of the National Wetland Inventory is key documentation used to support wetland protection or mitigation recommendations, and planning activities associated with wetland acquisition or enhancement projects. This database is housed in the Biological Services Section in Cheyenne. All project comments submitted through the Department's formal environmental review process are retained in an electronic database housed on the Department's intranet. The State Waterfowl Biologist also retains copies of wetland comments and project documentation in his files.

B. Goose Nest Structures and Islands

1. Rationale – Canada geese often nest at higher densities, and with greater success, in locations where artificial structures are available. State and federal agencies, clubs, and private individuals have installed and maintained nest structures for generations to enhance local goose production. Many river corridors and reservoirs within Wyoming lack secure nest sites, but have otherwise suitable habitat (food availability, cover, open water) to support goose broods. The Department began a nest structure program in the early 1950s when managers recognized a lack of suitable nest sites was limiting goose production on the Bear River. Artificial islands are also widely used to improve nesting success.

2. Application – Effective nest structures for Canada geese include large, wooden boxes or wash tubs mounted on posts or in trees, 55-gallon drums cut lengthwise in half and fixed to metal posts, and "missile" type structures which consist of a used tire attached to a platform of boards or plywood mounted on a single, metal post. The latter is the most widely used nest structure in Wyoming.

   Goose nest structures can be located on shorelines of lakes, including prominent points and bays, and in shallow water where ice action will not damage the structure. On rivers, structures should be located on inside bends where bank erosion is not a problem. Steel or wooden posts are driven into the substrate, at a sufficient depth to support the structure. If structures are placed on land or in shallow water, the nest platform should be sufficiently high to deter jumping predators – usually 7 ft above ground. Structures should be placed in open areas, away from low trees or brush, affording geese an unobstructed view. Structures should also be located in places that are reasonably free of human disturbance during the nesting season.

   Nest structures require annual maintenance. During late winter, after the hunting season and prior to arrival of breeding geese, personnel should place fresh straw in the bottoms of nest compartments. Any damage to structures should be repaired at this time. The latter half of February is a good time to do nest structure maintenance in Wyoming. Landscaping chips or scoria gravel are alternative bedding materials that persist in windy regions and do not require annual maintenance.

   Artificial islands initially cost more to build, but can provide longer-term benefits with less maintenance. The Department has constructed a number of islands on its habitat units by depositing gravel and soil on ice during winter months. The material settles to the bottom as ice melts. In other cases, earth-moving equipment has been used to formed islands within basins of newly constructed wetlands and impoundments prior to flooding or during drought cycles.

   Islands should be at least 50-100 feet from shore, and in deep enough water (24-30 inches) to discourage most mammalian predators. It is preferable to locate them in bays and other sheltered areas where wave action is minimal. The size of islands can vary, but they should be at least large enough to stabilize and persist for several years. Earthen islands can be seeded with a sod-forming grass mixture to prevent erosion and provide nesting cover. Islands can be made even more attractive to nesting geese by erecting nest platforms on them.

3. Analysis – An inventory of nesting structures should be maintained and their effectiveness (occupancy rate, hatching success) and condition should be continually monitored. Structures that are seldom used should be removed or relocated. Monitoring data will help managers improve design and placement of future structures. Maintenance records will assure structures are kept in serviceable condition.

4. Disposition of Data – The State waterfowl biologist maintains a statewide inventory of goose nesting structures. He is responsible for coordinating annual maintenance and for updating records in the database.

C. Other Habitats – A treatise on all aspects of managing migratory game bird habitats is beyond the scope of this chapter. The literature is replete with habitat studies and management publications the reader can consult. Two additional habitats bear brief mentioning. They are "dense nesting cover" and "winter habitat."

Dense nesting cover is the most cost-effective means of increasing duck and mourning dove production in prairie environments. However, geese and cranes prefer to nest in sparser cover in which they can detect approaching predators. If the objective is to increase duck and dove production, then the area should be managed to provide dense nesting cover. If the objective is to provide crane and goose nesting habitat, cover should be kept short, for example, through grazing. Frequent prescribed burning (every 5-7 years) is an effective technique to manage for dense nesting cover. Burns should be rotated so no more than 1/3 of an area is treated at any one time.

Suitable winter habitats include permanently open water that is reasonably secure from disturbance, and is located near food sources such as waste grains or winter wheat. Because winter habitats are extremely limited in Wyoming, most waterfowl leave the state during the coldest months. The Department and cooperating organizations currently operate aerators in 3 locations to maintain open water throughout the late hunting season and winter period. These are located at Ocean Lake near Riverton, and at the Springer Reservoir and Table Mountain Units in Goshen County. In addition, several reservoirs and stream reaches are closed to hunting and serve as refuges that hold waterfowl later in the season. However, the high elevations and northerly latitude of Wyoming greatly limit the potential to manage areas of the state as winter habitat. Any effort to sustain large numbers of waterfowl over winter would be cost-prohibitive.

IX. SUPPLEMENTAL FEEDING – Supplemental feeding is not necessary to sustain waterfowl populations and is not practiced in Wyoming. Furthermore, intentional feeding immediately before or during the hunting season could constitute baiting under federal regulations. Forage crops are sometimes planted on Department habitat areas and lure crops have been grown to reduce depredations by cranes, ducks, and geese on private lands.

X. JOB COMPLETION REPORTS – Management information from the migratory game bird program is summarized annually in a Job Completion Report (JCR) prepared by the Waterfowl Section. Each Migratory Game Bird JCR includes results of aerial surveys, harvest data, classification data, disease assessments, management evaluations, applicable research reports, hunting seasons and justifications, and other pertinent information. The report also compares current survey and harvest data with recent trends. Copies of these reports are available at each regional office and the Cheyenne headquarters.

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