

A HARVEST MANAGEMENT STRATEGY FOR CANADA GEESE IN THE WESTERN MISSISSIPPI FLYWAY

Management of Canada goose (*Branta canadensis*) harvest in the Mississippi Flyway became increasingly complex during the 1980s. A greater number and proportion of Eastern Prairie Population (EPP) geese remained in Minnesota during late fall and winter; e.g. mid-December numbers in Missouri declined 49% from the early to late 1980s (Gamble 1992). Numbers of small Canada geese (*B.g. hutchinsii/parvipes*, assumed to be Tallgrass Prairie Population - TGP) increased as well; up to 80,000 were estimated in Missouri (Sullivan et al. 1993). Numbers of giant Canada geese (*B.g. maxima*, thought to be extinct during the 1950s, see Hansen (1965) increased from <100,000 in the 1970s to more than 300,000 by 1990 (Gamble 1992). Breeding populations occurred in each state of the Mississippi Flyway, and excessive local populations were issues in 9 states (Nelson and Oetting 1993).

Harvest of Canada geese in western Mississippi Flyway states (Minnesota, Iowa, Missouri, Arkansas, and Louisiana) increased from an average 108,500 during 1971-80 (Carney et al. 1983) to 124,400 during 1981-90 (Ken Gamble pers. commun.). Harvest during the 1970s was more local in nature than during the 1980s. For example, an average 1,000 or more geese were harvested per year in 13 counties of the western Mississippi Flyway (70% of 108,500 geese, Carney et al. 1983). These same counties accounted for 50% of the harvest during the 1980s (62,700 of 124,400 geese), and 1,000 or more geese were harvested in 24 counties (70% of western Mississippi Flyway harvest).

During 5 years, 1970-74, harvest regulations were restricted to promote growth of the EPP; winter survey estimates increased from 106,600 (1969) to 205,800 (1973). Hunting regulations gradually were relaxed through 1979. Following a population decline during the latter 1970s (270,200 in winter 1977 to 145,300 in 1981), hunting seasons again were curtailed. In contrast to 5 years during the 1970s, harvest restrictions were in place every year of the 1980s.

A strategy for managing harvest was outlined in a management plan for the EPP (Mississippi Flyway Technical Section 1992:14-15); however, more specific strategies that include provisions for other Canada goose populations are needed. This document will serve as a more specific amendment to strategies in the EPP management plan and will apply to all Canada geese in the western Mississippi Flyway. In addition to EPP Canada geese, primary components considered will be giant Canada geese (both locally and in migration) and small Canada geese (assumed to be TGP).

OBJECTIVE:

Provide the maximum hunting opportunity and sustained harvest of Canada geese that are consistent with the status of populations in the western Mississippi Flyway.

ASSUMPTIONS:

Harvestable numbers of Canada geese will be determined by population size, annual production, and fall and winter distribution (largely affected by weather and the distribution of refuge and food resources). Management plans for different populations include different objectives for population size and habitat; however, certain assumptions will be necessary to develop a comprehensive strategy for goose harvest management in the western Mississippi Flyway.

Management of individual populations based on breeding ground distribution and breeding season status has become an essential element of goose management. The utility of winter surveys, the traditional indices to Canada goose status, has become questionable because of mixing of populations during migration and winter (Nelson and Bartonek 1990, Trost et al. 1990). Use of breeding ground surveys (recommended by Bishop and Williams 1990), would ensure timely, population-specific information for goose management. Recognition of different life history characteristics among subspecies (also the substantial differences between ducks and geese) and design of management programs accordingly are essential to maintain genetic diversity among Canada goose stocks and to ensure that no race is jeopardized by over-exploitation (Table 1). In the Pacific Flyway, for example, protection of dusky and cackling Canada geese through lower bag limits, shorter seasons, and emergency closures, occurred during a period when total Canada goose numbers were near all-time highs (Childress and Rothe 1990). Failure to consider the status of each population can result in substantial losses of hunting opportunity.

Table 1. Selected life history characteristics of Canada geese and mallards

Trait	Large Geese	Medium Geese	Small Geese	Mallards
Body size	9-12 lbs.	7-9 lbs.	4-7 lbs.	2-4 lbs.
Breeding areas	S of 54 latitude	54-60 latitude	N of 60 latitude	37-70 latitude
Wintering areas	40-45 latitude	35-40 latitude	S of 35 latitude	25-60 latitude
Migrations	Short	Medium	Long	Variable
Clutch Size	5-7 eggs	3-5 eggs	2-5 eggs	7-10 eggs
Age at first breeding	2 years	4 years	4 years	1 year
Reproductive success	High, constant	Medium, fluctuates	low, boom-bust	Low, variable
Adult survival	90 + %	70-90 %	Less then 70 %	54 % - female 62 % - male
Exposure to hunting	50-90 days	120 days	106 days plus subsistence	140 days
Subsistence harvest	Limited	low-Moderate	Low-Moderate	limited
Recent trend	Rapid increase	Fluctuating	Fluctuating	Stagnate-low

* From Anderson (1975)

The amount of funding for Canada goose management and survey programs will affect the degree to which hunting opportunity can be optimized. A cooperative EPP management program (10 years) was approved by the Mississippi Flyway Council in 1987 and expanded in 1990 to ensure operational banding and surveys (ca. \$48,000/year). Limited funding for banding small Canada geese and state/provincial efforts for giants have provided information for management of these populations in the short-term. A comprehensive approach including all Canada goose stocks is needed to ensure collection of these data in the long term; adequate funding will be the primary limitation.

Data required to manage populations of Canada geese include:

- Breeding ground surveys (existing for EPP, needed for giants and small Canada geese).
- Operational breeding ground banding (existing for EPP, coordination needed for giants, and needed for small Canadas -- most likely will include color marking).
- An index to production (existing for EPP, a low priority for most giants, and needed for small Canada geese).
- Species-specific harvest data (needed for all populations)
- Fall/winter surveys in primary harvest areas (existing for all populations; however, methods are needed to separate populations).

Sport harvest is assumed to be an important factor determining the status of Canada goose populations. Although believed to be an important influence on Canada goose status, harvest has not clearly been demonstrated to be the primary variable involved (e.g. Rexstad 1992). Empirical evidence, however, suggests that hunting can have substantial effects on regional abundance (e.g. Rusch et al. 1985).

Consistently high numbers of breeding-age geese will be required to sustain high harvest rates. Management objectives based on stable fall flights or winter population levels often have not adequately considered variable age structure of populations and differential productivity among cohorts. For example, all 3-year old geese and a portion of 2-year olds were assumed to be productive when an objective of 200,000 EPP geese (winter survey) was established in the 1970s (Babcock et al. 1978). Moser and Rusch (1989) found breeding rates of $\leq 40\%$ for geese 4 years of age and younger. Thus, both age structure and population size are important when harvest objectives are considered.

Substantial shifts in harvest patterns have been typical of the 50-year history of Canada goose management. Changes in the distribution of geese during the 1980s was not unlike that documented during 1940-70. Reasons for these short-term changes are not clear; however, changes in agriculture, river control projects (Funk and Robinson 1974), impacts of northern refuge and habitat management (Hankla and Rudolph 1967), and differential harvest (Crissey 1968, Raveling 1978) all have been implicated. Migration patterns of Canada geese appear to be extremely dynamic, and continued changes should be expected in the future. The challenge for managers is to document and/or predict these changes and modify harvest and habitat management to provide for the broadest distribution of hunting opportunity without jeopardizing population status.

Fall and winter distribution appear primarily to be dependant on weather and habitat conditions. Efforts to change distribution through habitat management (or reduced management or increased disturbance) and through differential management of segments appear largely to have been unsuccessful. Rusch et al. (1985) concluded that geese that moved from Horicon NWR following hazing efforts most likely were shot and did not move further south. Tacha et al. (1991) concluded that aggregations of MVP Canada geese were not manageable as independent units. Although Sullivan et al. (1993) identified early and late migrant EPP geese at Swan Lake NWR, no differential harvest approach has been implemented. Annual differences in weather appear to affect winter distribution of geese (Trost et al. 1980, Humburg et al. 1985); however these variables can neither be predicted nor controlled.

There are substantial economic and recreational values related to Canada goose resources. For example, Henderson (1965) estimated the value of goose hunting near Swan Lake, Missouri in 1964 to be nearly \$0.5 million. In the 1980s, the economic value of Canada goose hunting in local areas harvesting MVP Canada geese ranged from \$1.5 to \$6 million (summarized in MVP management plan, Mississippi Flyway Technical Section, July 1991:25-27). Numbers of geese harvested and numbers of hunting trips are lower when hunting seasons are restricted or populations decline. In northcentral Missouri, numbers of hunting trips declined 67% and Canada goose harvest 56% when the average Swan Lake Zone population declined 35%, 1979-89. Hunting benefits derived from Canada geese can only be sustained if populations are maintained at or near population objectives.

Population objectives will be limited by landowner tolerance and habitat capacity, and current objectives cannot completely provide for hunter expectation and demand. Considerable time and expense are incurred each year near other goose concentration areas to provide technical assistance for landowners with depredation problems (e.g. Kahl and Sampson 1984, Rollins and Bishop 1993, Zenner and LaGrange 1993, Heinrich et al. 1993). Landowners in Manitoba receive 80-100% compensation for damage to agricultural crops. Despite local economic benefit from Canada goose flocks, objectives for numbers of geese and hunting opportunity must be balanced with habitat capacity and landowner tolerance.

Although population objectives will be shared among states/province in the western Mississippi Flyway, different hunting regulations may be used to accomplish the same harvest management objective. In most regions, season length and bag limit will be the primary harvest management tools used to affect hunting opportunity and harvest. Goose management zones (typically with quotas) will be used in areas where geese and hunters are concentrated. Adjustments in season timing (e.g. delayed or extended seasons -- earlier than 1 October or later than 31 January) may be necessary to protect certain goose stocks or to provide opportunities to harvest others at greater rates. Canada goose seasons split into more than 2 segments likely will be necessary to provide greater harvest management flexibility.

The degree to which harvest is regulated will determine hunting opportunity. Expectations by hunters for "reasonable" seasons may not necessarily imply maximum harvest; a balance among well-understood regulations (not necessarily simplified), acceptable season lengths (at least 50 days) and bag limits (2 Canada geese/day in most areas), seasons as consistent as possible among years, and perceived "fairness" among states are more desirable than extremes in hunting opportunity requiring dramatic annual changes in hunting regulations. The rationale for seasons must be communicated to hunters. In light of the growing complexity of goose management; however, hunting regulations will not likely be simplified without penalty. Seasons restricted to protect the "least common denominator" (e.g. cackling Canada geese) will substantially reduce hunting opportunity, while seasons liberalized to allow greater harvest of growing populations (e.g. local giants) may be at the expense of Canada goose segments that are in jeopardy.

HARVEST STRATEGIES FOR CANADA GOOSE POPULATIONS IN THE WESTERN MISSISSIPPI FLYWAY:

Eastern Prairie Population

The EPP Management Plan was approved by the Mississippi Flyway Council in July 1992. This plan outlines a harvest management strategy for Eastern Prairie Population Canada geese that specifies harvest rates based on breeding population levels and indices of production (MFTS 1992:14):

"STRATEGY: Annually develop and implement hunting regulations consistent with the 300,000 breeding population objective, age structure of the population, and reproductive parameters according to the following prescriptions:

Breeding population estimate at or below 300,000 (\pm 40,000):

Implement regulations for EPP harvest similar to those in 1990-91.

Breeding population estimate at or below 260,000:

Implement regulations that will result in a 25% reduction in EPP harvest until the breeding population reaches or exceeds 300,000 birds for 2 consecutive years.

Breeding population estimate at or below 225,000:

Implement regulations that will result in a 50% reduction in EPP harvest until the breeding population reaches or exceeds 260,000 birds for 2 consecutive years; subsequently, maintain a 25% reduction in EPP harvest until the breeding population reaches or exceeds 300,000 for 2 consecutive years.

Production bust indicated (population at or below objective, 300,000 \pm 40,000):

Implement regulations for a single year that will result in a 50% reduction in EPP harvest below that normally prescribed. Poor production will be indicated by any 2 of the 3 threshold criteria: 1) less than 20% of the estimated breeding population comprised of singles (as determined by the breeding grounds survey), 2) average clutch size of 3.2 eggs or less, and 3) a median hatch later than 1 July (as determined from Cape Churchill nesting surveys).

Breeding population estimate exceeds 340,000:

Implement regulations to allow a 25% increase in EPP harvest until the breeding population reaches 300,000. An increase in harvest opportunity may not be considered if a production bust is indicated."

The following information and strategies are intended to provide a more specific basis for harvest management of the EPP.

Distribution of EPP Harvest

Historically, the province/states that have set regulations based on the status of EPP Canada geese have been Manitoba, Minnesota, Iowa, Missouri, and Arkansas. Canada goose seasons were closed in Arkansas from 1979-87, and only limited seasons (≤ 23 days) have been held since. In the past 15 years, EPP Canada goose fall and winter distribution, and subsequently harvest has shifted to the north (Table 2). In addition, the proportion of the EPP harvest outside the traditional EPP states/province has increased.

Table 2. Distribution (%) of EPP harvest (as reflected by direct and indirect band recoveries) by state/province during 1977-81, 1982-86, and 1987-91, based on recoveries of Canada geese banded on the breeding grounds (Appendix A).

Area	Period			Trend
	1977-81	1982-86	1987-91	
Manitoba	18.7	25.8	23.0	+,0
Minnesota	40.2	37.6	35.5	-
Iowa	2.4	3.9	2.7	0
Missouri	<u>26.2</u>	<u>18.6</u>	<u>13.2</u>	-
Subtotal-EPP areas	87.5	85.9	74.4	-
South Dakota	0.9	3.8	5.2	+
Wisconsin	2.1	1.0	3.5	0
Illinois	4.2	4.0	9.7	+
Kentucky/Tennessee	2.0	2.6	2.8	0
Other	<u>3.3</u>	<u>2.7</u>	<u>4.4</u>	0
	100.0	100.0	100.0	

Index of the proportion of Canada goose harvest comprised of EPP geese

Canada goose harvest in all EPP states/province is made up of a mixture of small, medium, and large geese. Currently, we do not have a direct measure of the proportional distribution of these groups in the harvest (except for some check station data). Rusch et al. (undated) provided estimates of distribution of harvest based on band recoveries and population size (December goose count). An index based on band recovery distribution and estimated harvest can also be calculated for comparison.

In 1990 and 1991, Minnesota required all goose hunters in the West Central Goose Zone (WCGZ, including Lac qui Parle -- LQP) to obtain a permit. A sample of these hunters was surveyed by post-season questionnaire. This data and the band recovery distribution can be used to provide an index to harvest, similar to that calculated from Swan Lake, MO banding and harvest data (Humburg and Sullivan 1992).

Retrieved Canada goose harvest in the WCGZ was approximately 25,500 (1990-91 average). Check station data indicate that about 67% of the geese harvested on LQP WMA were medium-sized (EPP) geese, but for these calculations we assume 75% of the zone harvest is medium geese due to potential bias of greater proportion of harvest of large geese near the refuge. Approximately 21% of the 1990-91 EPP band recoveries were within Minnesota's West Central Goose Management Block (which is similar but slightly larger than the WCGZ). Retrieved harvest of medium-sized geese in the WCGZ was approximately 19,200 ($=0.75 \times 25,500$). This should be approximately 21% of the total EPP harvest, therefore EPP harvest was 91,500 ($=19,200 / .21$).

We then can use the distribution of band recoveries to represent distribution of harvest and use FWS/CWS harvest estimates to approximate the proportion of state/province Canada goose harvest that is comprised of EPP geese (Table 3).

Table 3. Proportion of state/province Canada goose harvest comprised of Eastern Prairie Population Canada geese, 1990-91.

Area	% EPP band recoveries ^a	EPP harvest ^b	FHE -1990-91 average	% EPP ^c	WCWRU Est. % EPP ^d
MB	23.0	21,045	64,550	33	40
MN	35.5	32,483	92,350	35	51
IA	2.7	2,471	28,350	9	24
MO	13.2	12,078	32,500	37	44
IL	9.7	8,876	89,900	10	7
SD	5.2	4,758	58,817	8	
WI	3.5	3,203	122,400	3	2
OTHER	7.2	6,588			

^adistribution of EPP harvest determined from criteria in Appendix A.

^b% of EPP band recoveries*91,500.

^c(EPP harvest/FHE)*100.

^dfrom Rusch et al. Progress Report - Distribution and derivation of harvest of Canada geese in the Mississippi Flyway. undated.

Potential EPP Harvest Management Zones

Density distribution of EPP band recoveries (which reflect distribution of harvest) was plotted based upon number of recoveries per 10' latitude/longitude blocks. These can be partitioned from highest to lowest density based on 10' blocks where approximately 33, 50, 75, and 100% of the band recoveries occurred based on descending frequency. This allows delineation of areas where the EPP harvest is concentrated, both including all EPP fall and winter use areas (Appendix B) and also including only traditional EPP states and provinces (Appendix C, recoveries from Manitoba, Minnesota, Iowa, and Missouri; Arkansas recoveries excluded due to low recoveries).

There were 973 band recoveries from 1987-91 (see criteria in Appendix A). When all EPP harvest areas are included, 33.6% of the band recoveries are from 5 10' blocks (Lac qui Parle, MN=132 recoveries; Oak Hammock, MB=81; Swan Lake, MO=58; Thief Lake, MN=20; and Big Stone, MN-SD=15). Fifty percent of the recoveries were in blocks with >5 recoveries, 75% in blocks with ≥ 2 recoveries. When we include only the four major EPP states/province, the distribution is similar (except the Big Stone 10' block is excluded because 58% of the recoveries within this 10' block were in South Dakota).

It would be difficult to regulate EPP harvest throughout their distribution (Appendix B) because 25% of the harvest occurs in "non-EPP" states. Canada goose regulations in Wisconsin and Illinois are based on the status of MVP and local-breeding geese; EPP geese make up a relatively small portion of the harvest (although increasing in Illinois, Table 2). The only other area outside the primary 4 states/provinces that has a concentration of recoveries is northeast South Dakota. A large number of Canada geese are harvested in this area; however, goose regulations in Grant County, SD (including Big Stone Power Plant) could be influenced by status of the EPP.

Considering harvest in EPP states/province only, each political entity could delineate zones to isolate the majority of EPP harvest. In general, Canada goose harvest in Iowa primarily is large Canada geese, and most of the state could be considered a giant Canada goose harvest zone. Among states, most zones could be relatively discrete within state/province boundaries (e.g. Interlake MB, northwest MN, Swan Lake, MO); however, south central MN/north central IA and west-central MN/northeast SD potentially could be managed by similar Canada goose regulations, based on the status of EPP geese.

Distribution of EPP Harvest Restrictions

Given that 25% of the EPP harvest occurs in areas that are not impacted by EPP Canada goose regulations, the ability to achieve a 25 or 50% reduction in EPP harvest becomes more difficult. It is not stated in the EPP Plan (1992) whether the harvest rate reduction would be only in major EPP states/provinces. Note that if we reduce harvest only in the major states/provinces, a 25% reduction actually would be only a 19% reduction in total EPP harvest (.75 of the harvest* .25 harvest reduction). Assuming stable harvest in the non-EPP states, a 33% reduction in the EPP states/province harvest would be required to achieve a 25% reduction in EPP harvest.

Areas of low EPP harvest could be managed as giant Canada goose harvest zones (for example, Appendix C, exclude the 25% of the EPP harvest that occurs in low density areas (represented by the single dot). If this were implemented, however, restrictive regulations only would impact 56.25% (.75 of harvest in EPP states*.75 of total EPP harvest) of the EPP harvest. To achieve a 25 or 50% reduction in harvest, EPP harvest rate would have to be reduced by 45 or 89%, respectively. It may be necessary to accept a lower reduction in harvest rate or increase the numbers/size of areas affected by restrictive regulations.

Harvest Management Tools

Tools used to manage EPP harvest include season length, bag limit, quotas, zones, splits, season timing, and shooting hours. While the major tools are season length and bag limit, quotas are important in a few areas. Within the EPP range, statewide Canada goose harvest quotas have not been set. Quotas have been used to ensure that an excessive kill does not occur on a few key staging and wintering areas where the potential exists for high goose harvest in a short period of time. Numeric quotas currently are only established for two areas within the EPP range: Swan Lake Quota Zone, MO (1960-present) and Lac qui Parle Quota Zone, MN (LQP, 1975-present). Quotas were also used at Oak Hammock, MB from 1975-77. In general, goose harvest even in the quota zones is regulated by season length and bag limit. Canada goose regulations in EPP states are modified to influence EPP harvest rate based upon breeding population size and indices of production (median hatch date, clutch size, and indices from aerial surveys).

Quota zones within the EPP range have become less effective as the population shifted fall/winter distribution to the north. Approximately 42% (range 35-50%), 36% (range 21-43%), and 26% (range 17-32%) of EPP band recoveries were within quota zones in 1976-80, 1981-85, and 1986-91, respectively. Most of this decline has been due to reduced harvest in Missouri's Swan Lake Zone (from 24% in 1976-80 to 9% in 1986-91),

while Minnesota's Lac qui Parle Zone has maintained about 17% of the EPP harvest in all 3 periods. Harvest in Manitoba and some non-EPP states (SD, IL) increased.

Part of the EPP harvest strategy requires a 50% reduction in harvest during poor production years. Changes in the timing of the regulations cycle in Canada, however, would have limited Manitoba's ability to react to the "bust" production criteria listed in the EPP management plan. Thus, a change in criteria is necessary to ensure regulation response in a year of poor production (see strategies below).

Each political entity should continue to have the flexibility to use whatever harvest management tools are most effective to achieve harvest objectives. For example, when restrictions were required in 1987, each state or province used a combination of season length, bag limit, zones, and/or season timing to achieve harvest reductions. Greater flexibility in selection of harvest management methods may be necessary in the future (e.g. different shooting hours, possession limits, season timing, etc.). Changes in harvest regulations recommended in the EPP plan were based on experience with populations, harvest, and goose distribution during the 1970s and 1980s. Modifications in harvest management likely will be necessary among years of variable production, higher populations, and changes in harvest distribution.

Principles

1. Canada goose harvest in EPP states/provinces can be regulated within zones by seasons length, bag limit, and season timing, except that quotas will be required to provide a fail-safe at most major harvest areas to ensure that excessive harvest does not occur.
2. The harvest strategy will need to be flexible to adjust for future changes in the fall/winter distribution of EPP geese. There may be a need to include nontraditional EPP harvest areas in future harvest restrictions, eg. South Dakota, southern Illinois.
3. When the population is at or near objective level, harvest management primarily will involve regulations changes at major harvest areas. However, when the population declines to lower levels, restrictive regulations may be required in low EPP harvest areas.
4. Quotas should be based on population levels (considering use-days and turnover) at each location during the hunting season. Rate of turnover will vary between migration/staging areas and wintering/terminal migration areas.
5. Direct recovery rate of Canada geese banded on the EPP breeding grounds will be the index used to measure harvest rate.

Strategies

1. When the EPP declines below objective levels (see EPP plan), harvest opportunity (regulation effect ultimately will be reflected by changes in the direct recovery rate of EPP Canada geese and breeding ground population) will be reduced by the prescribed proportion (25-50%) in the portions of each state/province where 75% of the EPP band recoveries occurred during 1987-91 (see Appendix C) until the population exceeds the objective for two consecutive years.
2. The strategy for responding to a "bust" in production will be modified as follows: **Production bust indicated (population at or below objective, 300,000 \pm 40,000):** Implement regulations for a single year that will result in a 50% reduction in EPP harvest below that normally prescribed. Poor

production will be indicated by: 1) > 625 heating degree days in May at Churchill, MB and 2) no nests initiated by June 1 at Cape Churchill.

3. Each state/province will be responsible for developing regulations to achieve the harvest objectives.

Information Needs

1. The changing geographic and temporal distribution of EPP Canada geese should be monitored and regulations strategies identified to address emerging EPP harvest areas (e.g. eastern South Dakota and southern Illinois).
2. Investigate methods to improve harvest monitoring in quota zones (see EPP Plan, pg. 15, Task 1).

Small Canada Geese

Limited information is available to characterize the distribution of numbers and harvest of small Canada geese in the Western Mississippi Flyway. Little banding was conducted in Arctic nesting areas or during migration/winter until 1987, and no method is used to apportion U.S. harvest data among Canada goose subspecies. Band recoveries from small Canada geese marked on West Hudson Bay predominately occurred in the Central Flyway (primarily North Dakota, South Dakota, and Texas). Banded geese from Baffin Island were recovered in the Mississippi Flyway (Missouri, Wisconsin, and Illinois) and Texas from the Central Flyway (Appendix D & E, Table 4).

Studies in Missouri indicated that numbers of small Canada geese increased dramatically during the 1980s; the proportion of small Canadas detected at Swan Lake PHA check station increased from a range of 0-7%, 1965-82 to a range of 13-34%, 1983-91. The mean proportion of total Canada goose use-days by small Canada geese increased from 22% during 1984-1987 to 46% during 1988-1991. Initial migrations occur by the last week of September, peak numbers (> 70,000 in 1988 and 1989) in mid-October, and emigration occurs by late November (Missouri Department of Conservation, unpubl. data). The proportion of small Canada geese neckbanded on Baffin Island, 1989-91 and observed at Swan Lake during the subsequent fall/winter (21.9%, n=2032) was higher than for geese marked on western Hudson Bay, 1987-91 (0.6%, n=3109) and Southampton Island during 1991 (0.6%, n=163) (Appendix F, Sullivan et al. 1993).

Principles/Strategies

No specific harvest regulations have been established for small Canada geese in the western Mississippi Flyway. Appropriate principles and harvest strategies are not yet apparent. Limited data are available to indicate population size, migration phenology, harvest rates, and current harvest levels. In the interim the following strategies should be employed:

1. Use emerging data from band recoveries, neckband observations, and harvested geese to identify primary areas used by small Canada geese in the western Mississippi Flyway.
2. Band and collar small Canada geese at Baffin Island, West Hudson Bay, and Southampton Island through 1995 and maintain observations at selected migration and wintering areas through 1996.
3. Analyze band recovery and neckband data to determine survival and harvest rates.
4. Determine, through measurements of tail fans collected in the U.S. Fish and Wildlife Service Parts

Table 4. Breeding ground bandings and direct and indirect recoveries for small Canada geese, 1987-91

Band Reg	Year	Age	#Banded	#Collar	Recovery Region (Number of Recoveries)																			
					Ar	Il	Ky	Ia	La	Mi	Mn	Mo	Wi	Ks	Ne	Nd	Ok	Sd	Tx	Mb	Sk	Mx	Unk	Tot
WHB*	1987	I	225	225												1		2			1			4
		A	357	357												2		5	1					8
	1988	I	328	320												4	1	4	6	1			1	17
		A	767	767											1	2	1	6	5	3		1		19
	1989	I	444	444												2		2	2	2				8
		A	584	584							1					6	2	1		2				12
	1990	I	130	129							1					1			1					3
		A	338	338		1					1							4			3			9
	1991	I	749	237		1					2				1	2	1	1	3	4	1			16
		A	990	972							2					5	1		2	3	1			14
Total indirect recoveries from WHB									1		1			3	5	12	2	7	19	7	1			58
BI**	1989	I	0	0																				0
		A	576	576	1			1			1	4	1			1	1		8					18
	1990	I	747	1		3		1	1		2	4	5						2	1				19
		A	892	890		6		2	1	1	2	12	5		2			1	11				1	44
	1991	I	938	98		1		1		2			3						7					14
		A	480	480		5	1				1	1	1				1		9	1				20
Total indirect recoveries from BI					1	6		1		1	1	5	3				1	1	15					35

* West Hudson Bay -- Banded west of 80° and east of 100°

** Baffin Island -- Banded east of 80°

Collection Survey, the proportion of small vs. intermediate and larger Canada geese among Canada geese harvested in the western Mississippi Flyway.

5. Initiate development of a management plan for small Canada geese in the western Mississippi Flyway by 1995.

Information Needs

An evaluation of data needs by the Arctic Goose Joint Venture Technical Committee identified population status/assessment and population definition/delineation as high priority areas for study (AGJV 1992) as follows:

1. Review historical banding data; develop a cooperative banding and marking program (currently in progress until 1995) across the arctic breeding range to identify biological population units and recommend population monitoring programs.
2. Investigate genetic variability and differences across the breeding range to illustrate historical range and perceived shifts, degree of heterogeneity, and define existing demes.
3. Use emerging information from population delineation projects to define population units, design status assessment surveys, and institute operational banding.
4. Develop improved survey methods to estimate Canada goose size ratios.
5. Design and institute breeding trend surveys across the TGP/SGP range and refine with delineation information.

Medium priority information needs included aspects of population dynamics and harvest assessment:

1. Design and implement breeding ground research to describe and evaluate factors influencing production.
2. Design and initiate a cooperative banding and marking program (in conjunction with delineation programs) to derive survival estimates for identifiable population segments.
3. Develop and test new methods of discerning identity of harvested Canada geese from tail fans or other practical morphological parameters.
4. Develop harvest estimates from resighting/recovery data on marked birds, in conjunction with population delineation projects and compare these numbers with traditional estimates and harvest derivation assumptions.

Giant Canada Geese

Giant Canada geese have successfully been reintroduced to nearly all of their former nesting range in the Midwest. Numbers of giant Canada geese in the Midwest increased dramatically during the past decade, and barring dramatic changes in hunting regulations, habitat conditions, or weather, will continue to increase, and the nesting range will expand in the future. Concurrently, giant Canada geese represent an increasingly important and desirable part of goose hunters' bags in the western Mississippi Flyway. Much of this has occurred in traditional interior Canada goose harvest areas. For purposes of this harvest management strategy,

giant Canada geese that either nest or are harvested in Manitoba, Minnesota, Iowa, Missouri, Arkansas, or Louisiana will be considered.

The distribution of band recoveries for Midwest giant Canada geese during 1987-91 indicates that these birds were shot in large numbers throughout the EPP, MVP, and TGP fall and winter ranges (Appendix G). Because the distribution of these band recoveries is dependent upon banding effort (Table 5, Appendix H), population size, banding distribution, and hunting pressure, and other variables, these data should be viewed cautiously. Most of the high band recovery/harvest areas are directly associated with giant Canada goose banding sites. At present, it is difficult to accurately weight banding data to estimate the portion of the Canada goose harvest that is attributable to giant Canada geese because actual numbers and distribution of giant Canada geese in the Midwest are unknown.

Table 5. Canada geese banded by region and status during 1987-91

Banding Region	Status at Banding ¹					Total
	300	302	200	202	Misc.	
IL	13,339	1,528	1,143		54	16,064
IA	6,016	471	2,588	201	401	9,677
MN	5,825	2,888	769	170	7	9,659
MO	9,953	1,707	831		20	12,511
WI	6,160	4,750	772	1,098	1	12,781
ND	1,162	134	2,965		471	4,732
SD	10,053				1,040	11,093
MB-GIANTS	275	395			6	676
MB-EPP	9,360	4,769			783	14,912

¹300 = Leg banded only

302 = Leg banded and neckbanded

200 = Leg banded and transported outside 10-min. block

202 = Leg banded, neckbanded, and transported outside 10-min block

Understanding the impact of giant Canada geese on goose harvest in the Mississippi Flyway is further complicated because giant Canada geese cannot simply be grouped into discrete local populations within state boundaries. For example, only 55% of the giant Canada geese banded during the summer in Iowa from 1987-91 were recovered by hunters within Iowa. The remaining 45% were recovered outside Iowa, with Minnesota and Missouri hunters reporting 22% and 11% of the recoveries, respectively. While most giant Canada geese in the Midwest are the result of restoration efforts, other flocks, such as giant Canada geese from Manitoba's Interlake region or cliff-nesting geese along the Missouri River may be remnants of Canada geese indigenous to the Midwest. Thus, giant Canada geese, often viewed as recently established, non-migratory (local) populations, must be viewed as a shared migratory resource that is recovering or has been restored.

The increase in giant Canada goose numbers has been a mixed blessing for Canada goose management in the Mississippi Flyway. Giant Canada geese successfully have been reintroduced to nearly all of the former

nesting range, and recreational opportunities, especially in areas where few interior geese historically were found, have been enhanced. However, the growing giant Canada goose population also has created management challenges, such as depredation and nuisance complaints, in many areas of the Midwest. Additionally, interpretation of fall and winter surveys has been confounded, and breeding season surveys (needed for giants) are necessary to adequately monitor population size. Without adequate population data, harvest opportunities for all Canada geese within the flyway will be lower and the status of specific segments could be in jeopardy.

Many giant Canada geese are harvested in areas where few interior Canada geese are shot. However, high densities of giant Canada goose recoveries often overlap areas of low/medium EPP band recovery densities (e.g. Interlake of Manitoba; Fergus Falls, Talcot Lake, and Rochester areas in Minnesota; northeastern South Dakota; the Spirit Lake area in northwest Iowa; the Schell-Osage and Duck Creek/Mingo areas in Missouri; and the southern Illinois area). Balancing harvests of giants and EPP geese will especially be challenging in areas of overlap and when population trends are conflicting; more complex, imaginative, and flexible regulations will be required in these instances. Such tools might include 3-way split seasons, additional zones, splitting seasons within zones, changing bag limits within seasons, setting subspecies limits, or opening the regular Canada goose season earlier than the Saturday nearest October 1. Seasons opening earlier than traditional frameworks could increase harvest pressure on local giants in areas where they are abundant without increasing the harvest of geese from other populations.

Principles

1. Giant Canada geese have been reintroduced to nearly all of their former nesting range in the Midwest. Numbers have increased significantly in the past decade and likely will continue to increase in the near future.
2. Giant Canada geese represent an increasingly important component of goose harvest in the western Mississippi Flyway. Increased numbers of giant Canada geese have improved Canada goose harvest opportunities in many states, and harvest likely will increase as the population grows. Strategies should promote sustained harvests in the future.
3. Giant Canada geese move within and among states and should be considered a shared, migratory resource.
4. Giant Canada goose harvest has increased in areas traditionally characterized by harvest of subarctic geese. This has complicated traditional harvest strategies and will require greater flexibility in setting harvest regulations.

Strategies

1. All or parts of states will be considered giant Canada goose harvest regions if densities of band recoveries from sub-arctic Canada geese are low (≤ 2 recoveries per 10' block, Appendix C) or recoveries only occur in isolated 10' blocks. Harvest regulations will be consistent with giant Canada goose status unless the status of other goose populations dictate restriction (e.g. EPP < 225,000).
2. Regulations in giant Canada goose harvest regions usually will be more liberal than those in subarctic Canada goose harvest regions (70-day season and 2/4 bag/possession limit during the regular season).

3. Non-traditional, regulatory tools may be needed to provide flexibility in hunting regulations in areas where harvests of giant and other Canada goose populations are high. Such tools might include 3-way split seasons, additional zones, splitting seasons within zones, changing bag limits within seasons, setting subspecies limits, or establishing September seasons (via early season regulations process) timed before the majority of subarctic Canada goose migration to ensure greater harvest of giants without increasing harvest of geese from other populations.
4. A management plan for giant Canada geese in the Midwest should be prepared by the MFCTS Giant Canada Goose Committee by 1995.

Information Needs

1. Develop a breeding grounds survey to monitor giant Canada goose populations by province, state, and/or region.
2. Develop methods to separate harvested geese by subspecies (FWS Parts Collection Survey) and provide more reliable harvest estimates for regions within a state (FWS Waterfowl Harvest Survey).
3. Coordinate banding of giant Canada geese within the Flyway.

STATE/PROVINCE PERSPECTIVES

Manitoba

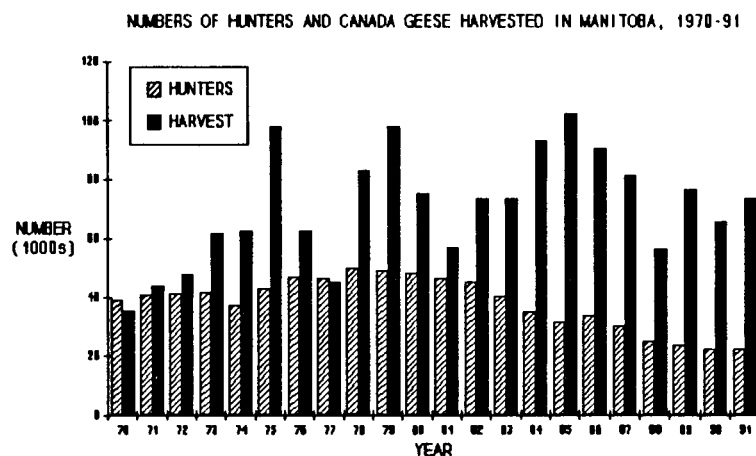
The opportunity to harvest EPP Canada geese in Manitoba is highly variable and influenced by environmental factors. Weather conditions have a direct effect on the period of departure from the northern breeding grounds as well as the length of stay on southern staging areas. The rate of agricultural harvest on southern Manitoba farmlands determines the amount and availability of food resources for Canada geese; delayed harvest allows birds to remain longer whereas early harvest means an early departure of migrant birds.

Manitoba is divided into 4 Migratory Bird Hunting Zones with W1 in the north and W4 in the south. Historically the season opened on September 1 in W1 with a progressive 1-week delay for each zone to the south (W2 = Sept 7, W3 = Sept 14, W4 = Sept 21).

The harvest of Canada geese in Manitoba occurs largely in the southern portion of the province and is centered around the Interlake area between lakes Winnipeg and Manitoba. The heaviest concentration of hunters and geese occurs within and around the Oak Hammock Managed Hunting Area. Throughout southern Manitoba, the majority of the goose hunting occurs on private agricultural fields.

Since the initiation of managed hunting at Oak Hammock, a number of mechanisms have been put in place to control harvest and hunters. Restrictions on number of hunters allowed per 1/4 section of land, limiting the number of trips, and bag limit reductions have been used to control the number of birds

harvested. These mechanisms have been successful in controlling harvest at an acceptable level within the managed hunting area. Elsewhere in the province the daily bag limit has generally remained constant at 5 Canada geese per day.



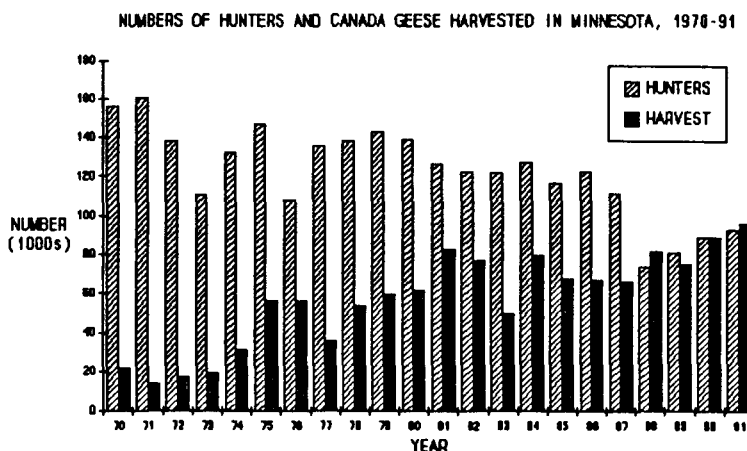
Goose use of agricultural areas in southern Manitoba has increased significantly from the mid-1960s. The amount of time that geese spend on southern staging areas is directly related to the chronology of the agricultural harvest and local weather conditions. In dry years when harvest of cereal crops is completed early and little sprouting of waste grain has occurred, geese pass through the province quickly with no noticeable buildups on major staging areas. However, in wet years numbers build to peaks of several hundred thousand birds on many staging areas. During wet conditions, significant damage to crops occurs from the feeding geese. The result often is expenditures of hundreds of thousands of dollars to compensate farmers for losses. Manitoba operates an extensive crop damage prevention program aimed at reducing damage during peak periods of migration. This involves maintaining lure crops, placing of propane exploders and other scare devices, and chasing geese from farmers' fields. Farmers also perceive the activities of hunters as an important method of reducing crop damage.

Minnesota

Canada goose harvest has increased in Minnesota since the 1960's. This increase is due both to changing fall/winter distribution of migrant Canada goose populations and dramatic increase in the size of the Minnesota-breeding Canada goose population. While Minnesota's total Canada goose harvest has increased, the proportion of EPP harvest that occurs in Minnesota has been 40, 37, and 35% during 1977-81, 1982-86, and 1987-91, respectively.

Minnesota currently has 4 regular-season goose harvest zones. These include the Lac qui Parle (LQP) Quota Zone, which was established in 1975 after 9, 12, 21, and 30-day seasons during 1971-1974 in the majority of Minnesota. The quota has been reached 7 times in the 18 years the quota has been in effect. The West Central Goose Zone (WCGZ) surrounds the LQP Quota Zone and was established in 1987 to reduce EPP harvest in the area outside the LQP Quota Zone. The majority of Minnesota's EPP Canada goose harvest occurs in the LQP and WC goose zones. The Southeast Goose Zone was established in 1971. Harvest in the SE Zone is mostly comprised of Interlake-Rochester giants and Twin Cities-breeding geese. Regulations in the remainder of the state zone is managed based on EPP and Minnesota-breeding Canada goose status.

In addition to the regular season zones, Minnesota has 4 zones for September or December goose hunting opportunity. These include the Twin Cities Metropolitan, Olmsted County, Fergus Falls/Alexandria, and Southwest Border.



Breeding Canada geese have been banded in three major areas in recent years. The majority of the harvest on these geese occurs within Minnesota (Table 6). Minnesota currently uses special seasons and additional regular season opportunities to provide additional harvest pressure on these rapidly increasing populations.

Minnesota may use of a variety of harvest management tools and strategies to regulate goose harvest in the 1990's. These potentially include: 1) increased use of zones to isolate EPP harvest when necessary, 2) earlier framework date, 3) use of split or special seasons to provide late (December) goose hunting opportunity, and 4) expanded use of seasons outside the regular goose season framework dates and split goose seasons to increase harvest pressure on Minnesota breeding geese while limiting harvest pressure on subarctic-nesting migrant Canada geese.

Table 6. Distribution (%) of recoveries of Minnesota summer-banded geese by banding area, 1986-91^a.

Band Area	MN	IA	MO	IL	Other	n
Fergus Falls	86.1	0.1	3.1	1.1	9.6	458.9
Southwest	71.6	14.2	5.6	1.2	7.4	368.9
Twin Cities	52.3	1.7	16.2	20.0	9.8	413.6
All ^b	65.1	5.1	11.7	8.4	9.7	1650.1

^a Direct and indirect recoveries, including shot geese only, solicited bands weighted by a factor of 0.33 to adjust for reporting rate, geese transported and hand-reared were deleted.

^b Includes geese not banded in the three major banding areas, including molt migrants banded at Duluth.

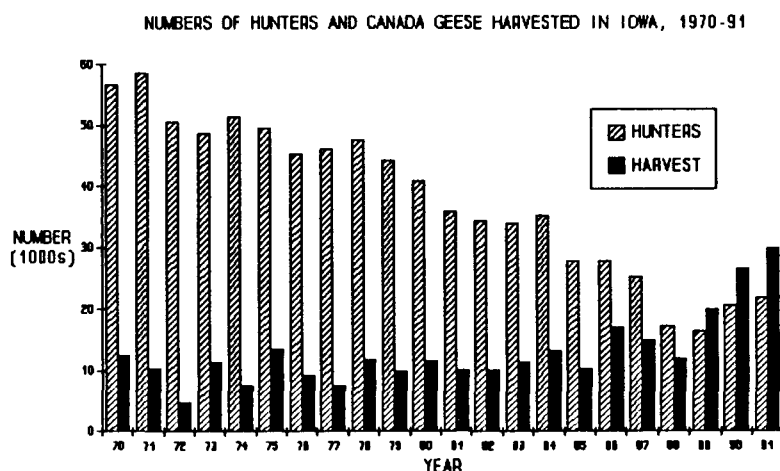
Iowa

Iowa's Canada goose seasons predominantly have been 70 days in length during 1962-91. Bag limits most commonly have been 2 Canada geese/day, 4 in possession. Season lengths and bag limits were reduced when EPP numbers declined. No zones have been established in Iowa to specifically manage Canada goose harvest. A goose hunting zone was established in southwest Iowa in 1984 so goose seasons could open 2 weeks later than the rest of the state and correspond to the snow goose migration.

Iowa's Canada goose harvest was nearly constant from 1962-81, averaging 9,600 geese taken by 43,300 active waterfowl hunters (FWS estimates). During 1982-86, an average 12,500 Canada geese were shot/year by 31,900 hunters. During 1987-91, mean Canada goose harvest increased to 20,800 while hunter numbers dropped to a mean of 20,400. Canada goose harvest increased at average annual rates of 14% and 16% during 1982-86 and 1987-91, respectively. Harvest rate increases parallel Iowa's giant Canada goose population growth.

Giant Canada geese were reintroduced to Iowa in 1964 to restore the species to its native range and provide increased harvest opportunities. Indices indicate this population has grown significantly in the past 20 years. Iowa's giant Canada goose population grew at average annual rates of 25%, 18%, and 15% during 1972-81, 1982-86, and 1987-91, respectively.

Giant Canada geese nest in all Iowa counties; highest nest densities occur in north central Iowa. Large areas were closed to Canada goose hunting in restoration areas to reduce harvest of local nesting geese. In 1975, the 4 areas closed to Canada goose hunting totaled 352 mi². By 1980, 8



areas, encompassing 555 mi², were closed to Canada goose hunting. In 1992, 11 areas were closed to Canada goose hunting, ranging in size from 17.5-321 mi² and totaling 1,215 mi².

The majority of banded Canada geese recovered by hunters in Iowa during 1987-91 were giant Canada geese. Main sources of "foreign" giants were southern Minnesota, Wisconsin, and Illinois (Table 7). Highest band recovery densities occurred in northern and south central Iowa and along the Mississippi River. Recovery distributions were nearly identical to the distribution of harvest (FWS survey) and the distribution of nesting giant Canada geese in Iowa.

Table 7. Distribution (region of banding) of direct and indirect band recoveries in Iowa (September-December), 1987-91; includes hunter-shot (code=01) and reported (code=21), normal wild Canada geese (AOU=172.0).

Region of Banding	DIRECT			INDIRECT			TOTAL		
	N	%	Cumm %	n	%	Cumm %	n	%	Cumm %
IA	137	66.8	66.8	475	68.8	68.6	612	68.6	68.6
IL	21	10.2	77.1	70	10.1	79.0	91	10.2	78.8
MN	16	7.8	84.9	30	4.3	83.3	46	5.2	84.0
North MB	10	4.9	89.8	19	2.8	86.1	29	3.3	87.2
MO	1	0.5	90.2	24	3.5	89.6	25	2.8	90.0
WI	7	3.4	93.7	8	1.2	90.7	15	1.7	91.7
KS	3	1.5	95.1	11	1.6	92.3	14	1.6	93.3
MO - Fall*	0	0.0	95.1	13	1.9	94.2	13	1.5	94.7
SD	3	1.5	96.6	9	1.3	95.5	12	1.3	96.1
North ONT	4	2.0	98.5	5	0.7	96.2	9	1.0	97.1
OTHER	3	1.5	100.0	26	3.8	100.0	29	3.2	100.0
TOTAL	205	100		690	100		895	100	

* Banded during September-January. Other recoveries are from geese banded June-August.

Iowa hunters recovered only 2.6% of the banded EPP Canada geese harvested during 1987-91. The majority of EPP band recoveries in Iowa were reported in the northwest, the same area where high numbers of giant Canada goose band recoveries were reported. Iowa's portion of the EPP harvest, as indicated by band recoveries, has declined every 5-year period during the past 20 years.

The temporal distribution of Canada goose band recoveries in Iowa indicates that nearly half the giant Canada goose harvest occurs during the first 10 days of the season. Nearly 60% of the EPP bands are recovered during the first 20 days of the season. However, the sample of EPP bands is so small that it is difficult to accurately illustrate temporal distribution. The temporal distribution of band recoveries in Iowa mirrors the temporal distribution of the Canada goose harvest indicated by the FWS Waterfowl Harvest Survey.

Iowa's Canada goose management strategy will continue to focus on giant Canada geese. Canada goose harvest in Iowa likely will increase in the next 5 years because numbers of giant Canada geese probably will increase. Given present trends and barring major changes in goose staging behavior, the proportion of subarctic Canada geese in Iowa's harvest will continue to decline. Iowa's geographical position in relation to major EPP staging sites, especially Lac qui Parle, makes it unlikely that large numbers of EPP birds will stop in Iowa in the future. EPP geese have shown a tendency to linger on staging areas in Minnesota and Manitoba until severe weather conditions force them south over Iowa to Missouri and southern Illinois.

Missouri

Numbers of Canada geese in Missouri increased during the early 1940s at Swan Lake NWR to 100,000 birds by 1954. Growth continued throughout the following 20 years to a peak of 232,200 in 1977. Moderate numbers (<25,000) of migrant Canada geese also were present in West Central (near Schell-Osage and Montrose conservation areas) and in Southeast Missouri (near Duck Creek CA and Mingo NWR).

Peak goose numbers in the Swan Lake Zone declined to 76,375 in 1984 (-67% from 1977), greater than the decline of the EPP as a whole (-22%). Lower numbers initially corresponded to incidence of poor production (1978 and 1983). During 1984-91, the EPP increased in number (from 177,400 to 308,100, breeding ground surveys); however, numbers at Swan Lake did not increase (mean peak 1978-83=135,200 vs. 1984-91=86,500). Delays in migration and greater dispersal in Missouri (e.g. mean peak at Schell-Osage/Montrose did not decline: 33,400 vs. 36,500 during 1978-83 vs. 1984-91, respectively) account for declines in numbers in the Swan Lake Zone.

Propagation of giant Canada geese began in Northwest Missouri (near Trimble WA, now Smithville Reservoir) during the 1950s. Following establishment, this flock was the primary source for reintroduction efforts throughout Missouri. By 1990, Canada geese nested in at least 80 of 114 counties; the breeding season population likely exceeded 20,000 (including nonbreeders).

Numbers of small Canada geese increased at Swan Lake during the 1980s. Peak numbers exceeded 70,000 by the late 1980s.

Canada goose harvest in Missouri followed trends of population size and distribution. A hunting program was initiated on Swan Lake NWR in 1955, a goose management zone and quota (20% of the peak population, with harvest monitored during the season) was established by 1960, and few dramatic changes in basic harvest management have occurred since. Season length ranged from 14-70 days, quotas ranged 14,000-30,000, and daily bag limits were 1 or 2 Canada geese.

Statewide, Canada goose harvest ranged from 22,700-81,800 during 1962-92 (FWS survey). Mean annual harvest declined 27% from the 1970s to the 1980s. Swan Lake Zone harvest declined at a greater rate (-41%). The proportion of the statewide harvest occurring in the Swan Lake Zone declined from >80% to near 50% during the same period. Harvest of small Canada geese at Swan Lake also followed population trends. The proportion of Swan Lake harvest comprised of small Canadas increased from an average 3.9% (1-7%, mean=700 harvested) prior to 1983 to 19% (7-34%, mean=1,400 harvested) during 1984-91. Harvest of giant Canada geese likely increased as well; however, no method was in use to determine the proportion of Swan Lake Zone or statewide harvest comprised of giant Canada geese (or small Canadas).

Canada goose seasons ranged from 40 to 50 days during 1987-91. In North Missouri (including the Swan Lake Zone), a split season was initiated in 1988 (9 to 12-day closed period) to delay a portion of the season. Among regions of Missouri, the greatest proportion of Canada geese was harvested in the Swan Lake region (46.1%, FWS surveys). Moderate harvest occurred in West central (16.7%), Southeast (12.8%), and East Central (8.8%) portions of Missouri. Goose harvest was 2-3x higher during early November (corresponding

to opening day) than during the remainder of November or December. Low, but gradually increasing harvest occurred in January when only southern portions of Missouri remained open for hunting.

The majority (64%) of EPP band recoveries, 1987-91 occurred in the Swan Lake region. Moderate proportions of EPP recoveries were from Southeast and West Central portions of the state (14% and 10%, respectively). Only the Southeast Region was important as an area of MVP band recoveries (96% of MVP recoveries in Missouri). Bands from migrant giant Canada geese were recovered throughout Missouri (Table 8). Recoveries among regions varied in their origin; Wisconsin and eastern Minnesota were most well represented in eastern Missouri recoveries, while western Missouri recoveries primarily were from Iowa and southwestern Minnesota. The greatest number of recoveries were from giant Canada geese banded in Missouri; most local giants were recovered in the region of banding.

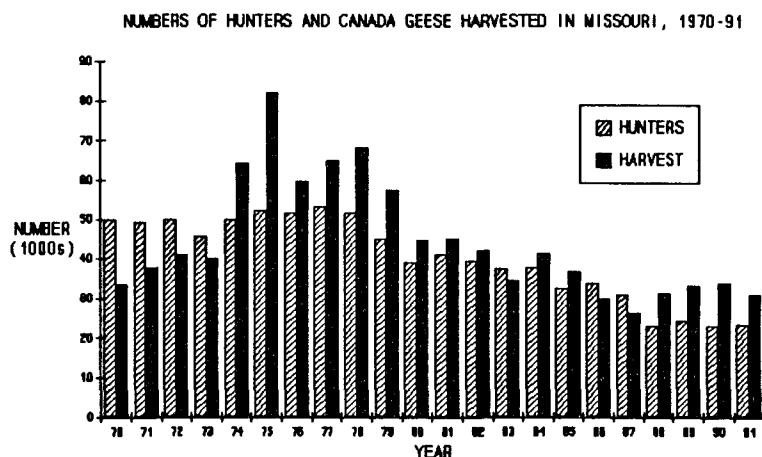


Table 8. Distribution of indirect band recoveries (%) from giant Canada geese among regions of Missouri, 1987-90

Missouri Recovery Area	Location of Banding							n
	MB	E.MN	W.MN	IA	IL	WI	Other	
East Central	2.3	46.5	2.3	2.3	20.9	23.2	2.3	43
Swan Lake	9.4	3.1	28.1	31.3	18.8	0	9.4	32
Other North	0	0	25.0	50.0	20.0	0	0	10
West Central	0	10.9	18.1	63.6	3.6	0	3.6	55
Ozark	0	0	0	100.0	0	0	0	8
Southeast	3.1	34.4	3.1	9.4	6.2	37.5	6.2	32

Challenges in Missouri involve the following:

1. Provide harvest opportunity for EPP Canada geese that is consistent with population status (overall numbers), availability (numbers in Missouri), annual productivity (proportion of immatures in fall flight), age composition (number of immatures remaining upon arrival), and overall harvest prior to arrival. This will have to be considered in the context of hunter expectations (based on 1970s experience) and existing population status (fewer EPP geese at Swan Lake).
2. Promote increased numbers of small Canada geese using Missouri areas. Determine the impact of variable harvest rates on flock status in Missouri. Continue to define breeding, migration, and wintering area affiliations of small Canada geese. Determine habitat needs and management methods conducive to small Canada geese.
3. Encourage growth of MVP segments using Southeast Missouri.
4. Determine the size of the breeding population of Canada geese in Missouri, and determine the affiliations of giant Canada geese migrating to and from Missouri. Determine the impact of special seasons on the size and distribution of local populations of giant Canada geese.
5. In light of limited manpower and budgets, determine the degree of attention to habitat management, regulations, research, and surveys that is required/acceptable for Canada geese and goose hunting.

Arkansas

Numbers of Canada geese that winter in Arkansas represent a small proportion of Canada geese in the flyway or of the Eastern Prairie Population. However, numbers of Canada geese surveyed in Arkansas, and the proportion of flyway goose populations that these numbers represent, have shown increases since 1980.

Low numbers of Canada geese in Arkansas offer very limited hunting opportunity; seasons since 1962 have predominantly been closed. Arkansas offered Canada goose hunting statewide in the mid-1970s with fairly liberal season lengths (up to 50 days). Canada goose seasons were closed from 1979 until 1988 when Arkansas began offering very conservative seasons (16-23 days).

Little tradition for hunting geese exists (remains) in Arkansas. Increasing numbers of snow, white-fronted, and Canada geese are attracting increasing, but still low numbers of hunters to goose hunting. Annual Canada goose harvest in Arkansas remains extremely low.

Annual Canada goose harvest in Arkansas averaged 4,200 during the mid-1970s and only 1,600 during 1988-91. This represented about 2.1% and 0.7% of the Canada geese harvested in states of the EPP and Manitoba during those 2 time periods, respectively. During 1988-91, Arkansas accounted for an average of <1% of the indirect recoveries of Canada geese banded at Swan Lake, Missouri.

Louisiana

The hunting season for Canada geese in Louisiana was closed for almost 30 years (1962-1990) due to low wintering populations. Since the early 1980s, however, increasing numbers of Canada geese (primarily small Canadas) have occurred in southwest Louisiana's rice prairies. Surveys since 1985 have documented an increasing trend with an observed peak number of 23,000 in 1989. Observed peak numbers have averaged 13,000 since 1989. Canada geese are late migrants into Louisiana, with few available during the mid-

December inventory. There is a gradual increase in goose numbers through December that intensifies in early January with peak numbers in late January/early February.

A 3-year experimental hunting season in a southwest zone was initiated in January 1991. Results from hunter questionnaires during the first 2 years of this season indicated a harvest of less than 500 Canada geese each year during the 9-day season. Analysis of neck collar observations and body measurements of harvested geese have verified that Canada geese wintering in Louisiana are affiliated with breeding areas in the eastern Arctic. An operational hunting season similar to that of the experimental period will be requested. In the long-term, hunter opportunity should be increased contingent upon expansion of the Canada goose population in Louisiana and the status of small goose populations. There are no plans to establish a resident Canada goose population in Louisiana.

INTEGRATED HARVEST MANAGEMENT

Consideration of each additional population/segment of Canada geese will add a layer of complexity to harvest management in the western Mississippi Flyway. Harvest strategies developed in the early 1990s could well be inappropriate within a few years as distribution, population status, harvest rates, or habitat conditions change. Population-specific information about population size, harvest, and production will be required to maximize harvest opportunity of one flock (e.g. giant Canada geese) while maintaining the status of another (e.g. small Canada geese). In addition to the strategies listed in each population section (pp. 6-16) the following guidelines will direct harvest management in the western Mississippi Flyway:

1. Regulations will be maintained as consistent as possible among years and among areas of similar Canada goose harvest composition.
2. The status of the EPP will be the primary determinant of hunting regulations in the western Mississippi Flyway during periods when the EPP is below objective levels.

LITERATURE CITED

- Anderson, D. R. 1975. Population ecology of the mallard. V. Temporal and geographic estimates of survival, recovery, and harvest rates. *Resour. Publ. 125. U.S. Fish and Wildl. Serv.* 110 pp.
- Bishop, R. A. and B. K. Williams. 1990. Needs, capabilities and prospects for the future of goose management in North America. *Trans. N. Amer. Wildl. and Nat. Resour. Conf.* 55:374-377.
- Carney, S. M., M. F. Sorensen, and E. M. Martin. 1983. Distribution of waterfowl species harvested in states and counties during 1971-80 hunting seasons. *Wildl. No. 254. U. S. Fish and Wildl. Serv.* 114 pp.
- Crissey, W. F. 1968. Informational needs for Canada goose management programs. Pages 141-147 in R. L. Hine and C. Schoenfeld, eds. *Canada goose management. Dembar Educational Research Services, Madison, Wisconsin.* 195 pp.
- Funk, J. L. and J. W. Robinson. 1974. Changes in the channel of the lower Missouri River and effects on fish and wildlife. *Missouri Dept. of Conser. Aquatic Ser. 11.* 52 pp.
- Gamble, K. 1992. Waterfowl harvest and population survey data. *U.S. Fish and Wildl. Serv.* 79 pp.

- Hankla, D. J. and R. R. Rudolph. 1967. Changes in the migration and wintering habits of Canada geese in the lower portions of the Atlantic and Mississippi Flyways--with special reference to national wildlife refuges. *Proc. S.E. Assoc. Game and Fish Comm.* 21:133-144.
- Hanson, H. C. 1965. The giant Canada goose. Southern Illinois Univ. Press, Carbondale. 226 pp.
- Heinrich, J. W. and S. R. Craven. 1993. Attitudes of farmers toward Canada geese near Horicon National Wildlife Refuge, Wisconsin. *Proc. Intern. Canada Goose Symp. Milwaukee, Wisconsin:In Press.*
- Henderson, U. B. 1965. An economic analysis of the waterfowl resource of the Swan Lake National Wildlife Refuge and the impact upon the rural community. Ph.D. diss., Univ. of Missouri, Columbia, Missouri.
- Humburg, D. D., D. A. Graber, and K. M. Babcock. 1985. Factors affecting autumn and winter distribution of Canada geese. *Trans. N. Amer. Wildl. and Nat. Resour. Conf.* 50:525-539.
- _____, and B. D. Sullivan. 1992. Status of the Eastern Prairie Population of Canada geese in 1992. Missouri Dept. Cons. unpubl. rep. 25 pp.
- Kahl, R. B. and F. B. Sampson. 1984. Factors affecting yield of winter wheat grazed by geese. *Wildl. Soc. Bull.* 12:256-262.
- LaGrange, T. G. and G. G. Zenner. 1993. Canada goose harvest in Iowa: population derivation and distribution. *Proc. Intern. Canada Goose Symp. Milwaukee, Wisconsin:In Press.*
- Mississippi Flyway Technical Section. 1992. A management plan for the Eastern Prairie Population of Canada geese. Missouri Dept. Cons. publ. 48 pp.
- Nelson, H. K. and J. C. Bartonek. 1990. History of goose management in North America. *Trans. N. Am. Wildl. and Nat. Resour. Conf.* 55:286-292.
- _____, and R. B. Oetting. 1993. Recent Urbanization of Canada geese. *Proc. Intern. Canada goose Symp. Milwaukee, Wisconsin:In Press.*
- Raveling, D. G. 1978. Dynamics of distribution of Canada geese in winter. *Trans. N. Amer. Wildl. and Nat. Resour. Conf.* 43:206-225.
- Rexstad, E. A. 1992. Effect of hunting on annual survival of Canada geese in Utah. *J. Wildl. Manage.* 56:297-305.
- Rollins, K. S. and R. C. Bishop. 1993. Canada goose damage abatement and farmer compensation at Wisconsin's Horicon Marsh. *Proc. Intern. Canada goose Symp. Milwaukee, Wisconsin:In Press.*
- Rusch, D. H., S. R. Craven, R. E. Trost, J. R. Cary, R. L. Drieslein, J. W. Ellis, and J. Wetzel. 1985. Evaluation of efforts to redistribute Canada geese. *Trans. N. Amer. Wildl. and Nat. Resour. Conf.* 50:506-524.
- Samuel, M. D., D. H. Rusch, and S. R. Craven. 1990. Influence of neck bands on recovery and survival rates of Canada geese. *J. Wildl. Manage.* 45:817-829.

- Sullivan, B. D., D. D. Humburg, L. D. Burger, L. M. Mechlin, and D. A. Graber. 1993. Components of the Canada goose flock at Swan Lake National Wildlife Refuge. Proc. Intern. Canada goose Symp. Milwaukee, Wisconsin: In Press.
- Tacha, T. C., A. Woolf, W. D. Klimstra, and K. F. Abraham. 1991. Migration patterns of the Mississippi Valley Population of Canada geese. J. Wildl. Manage. 55:94-102.
- Trost, R. E., D. H. Rusch, and D. H. Orr. 1980. Population affiliation of Canada geese from six southern refuges. Proc. S.E. Assoc. Fish and Wildl. Agenc. 34:598-606.
- _____, K. E. Gamble, and D. J. Nieman. 1990. Goose surveys in North America: current procedures and suggested improvements. Trans. N. Am. Wildl. and Nat. Resour. Conf. 55:338-349.

APPENDIX A. Criteria used to determine distribution of harvest.

Canada goose band recovery data were obtained from the U.S. Fish and Wildlife Service Bird Banding Laboratory. Recoveries of EPP Canada geese were selected according to the following criteria:

1. Banded on the EPP breeding grounds (as defined in EPP plan (1992:7-8) during June - August. Excludes bandings of geese north of 52° 30' latitude, due to mixing of small and medium sized geese in this area.
2. Only recoveries of birds shot from September - February were included.
3. Canada geese of all status codes were included in analysis. This included geese with normal wild leg banded only, neckbanded birds, radio-marked, and miscellaneous codes which included birds that were neckbanded and with blood samples collected. While neckbands or other additional marks can influence reporting rate (Samuel et al. 1990) distribution of harvest of these birds should be similar to birds that received legbands only.
4. Only geese captured in flocks of breeding adults and young were included in this analysis. Nonbreeders were excluded since this includes many molt migrant giants that have been banded in recent years. Nonbreeders were excluded according to criteria provided by M. Gillespie and G. Ball, Manitoba DNR:

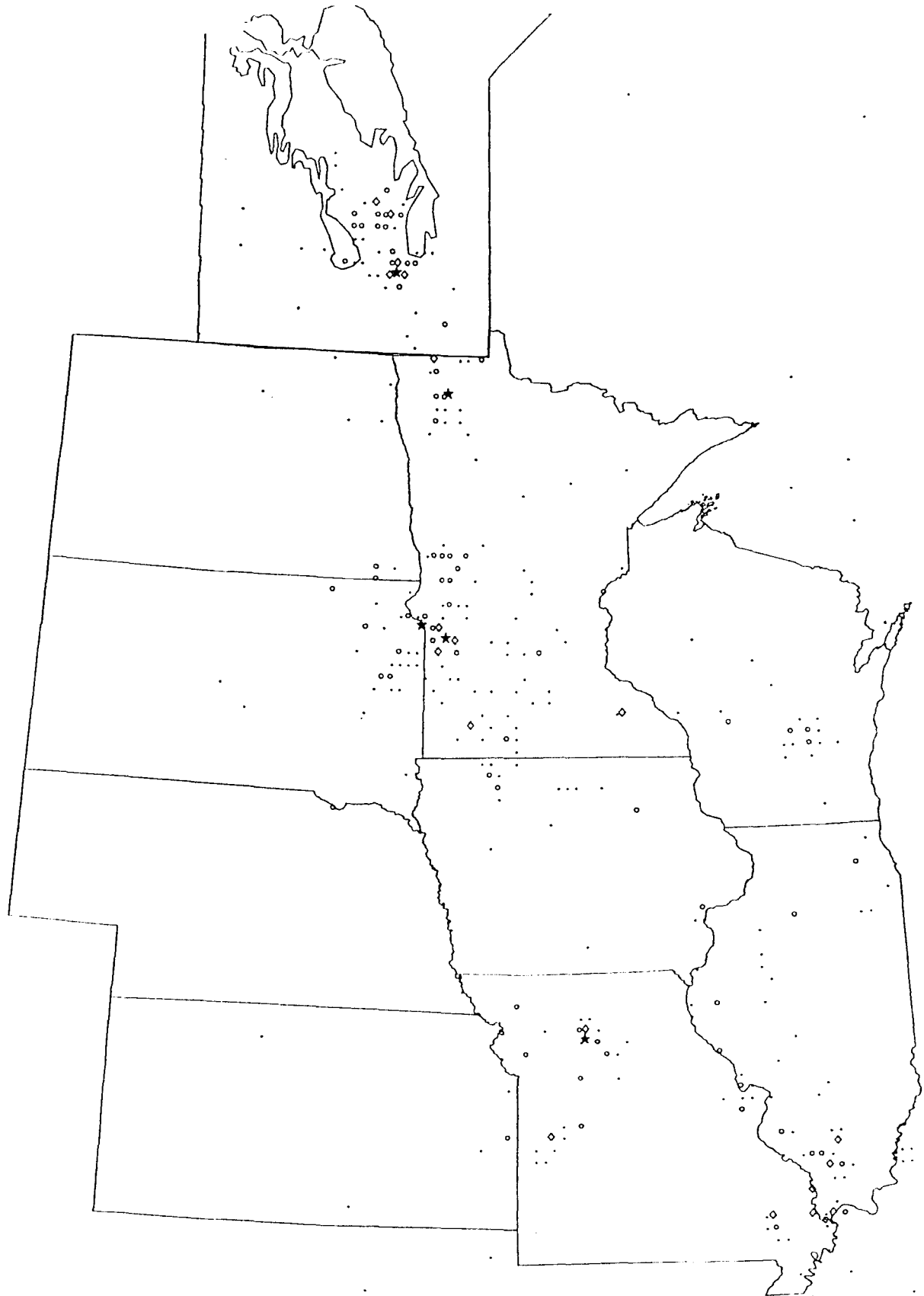
Few nonbreeders were banded prior to 1981.

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1981: IF BMO=7 AND BDAY=29 AND AGE=1 THEN TYPE='NB';
1982: BREEDERS ONLY;
1983: IF BMO=7 THEN DELETE;
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      IF BMO=8 AND BDAY=9 AND AGE=1 THEN TYPE='NB';
      IF BMO=8 AND BDAY=10 AND AGE=1 THEN TYPE='NB';
      IF BMO=8 AND BDAY=14 THEN TYPE='NB';
1984: IF BMO=7 AND BDAY=23 AND AGE=1 THEN TYPE='NB';
1985: IF BMO=7 AND BDAY<=21 AND AGE=1 THEN TYPE='NB';
1986: IF BMO=7 AND BDAY<=27 AND AGE=1 THEN TYPE='NB';
      IF BMO=7 AND BDAY=29 THEN TYPE='NB';
1987: IF BMO=7 AND BDAY<=28 AND AGE=1 THEN TYPE='NB';
1988: IF BMO=7 THEN TYPE='NB';
1989: BREEDERS ONLY;
1990: IF BMO=7 THEN TYPE='NB';
1991: IF BMO=7 AND BDAY<30 THEN TYPE='NB';
IF BANDNO=74867595 THEN TYPE='BD';
IF BANDNO=74868214 THEN TYPE='BD';
IF BANDNO=74868511 THEN TYPE='BD';
IF BANDNO=74868513 THEN TYPE='BD';
IF BANDNO=74868518 THEN TYPE='BD';
IF BANDNO=74868520 THEN TYPE='BD';
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5. Solicited bands (WHY=0,2) were weighted 0.33 since we estimate one-third of the bands reported.

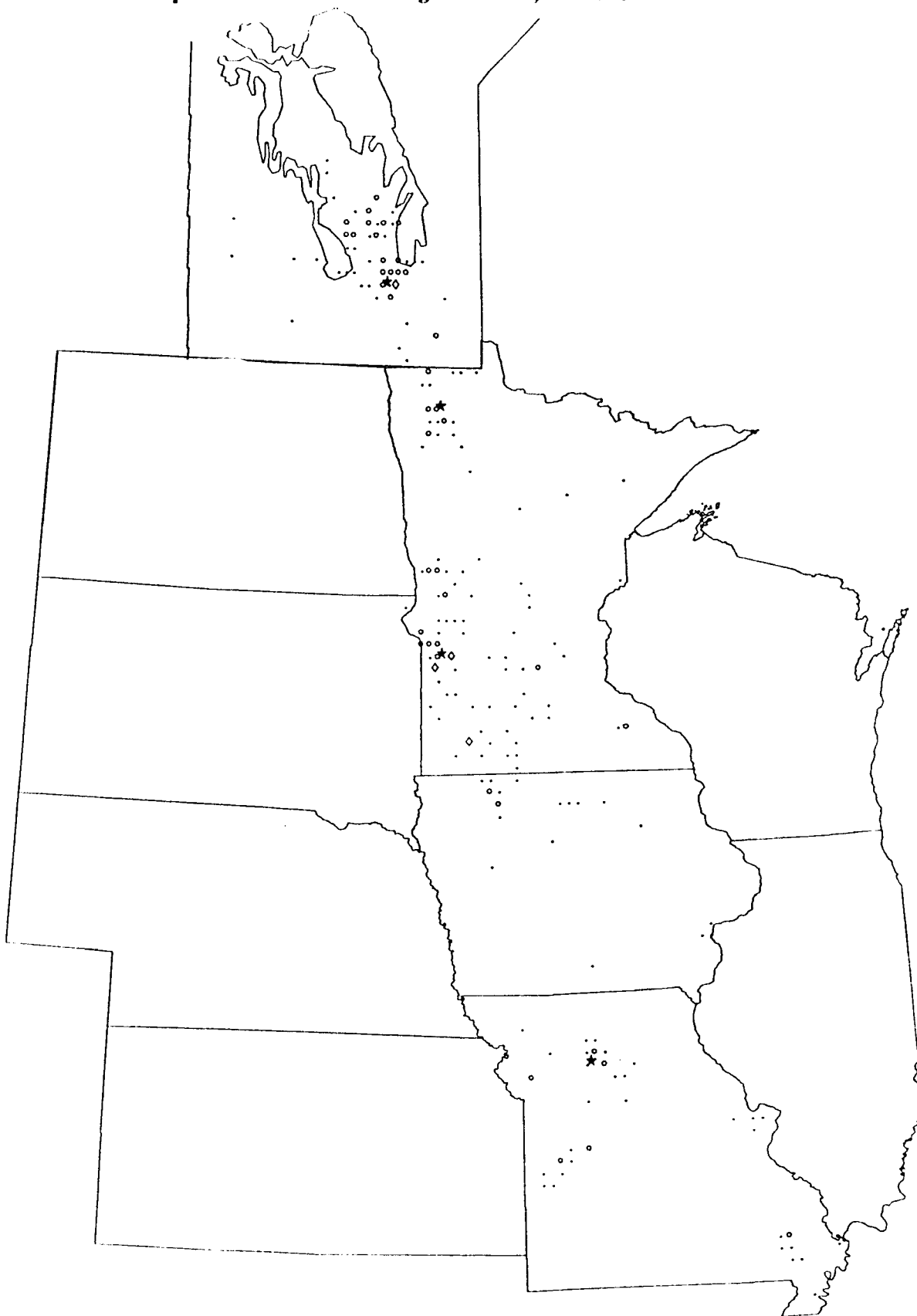
Programs were written in PC SAS to provide frequency distribution and maps of recovery distribution.

APPENDIX B. Distribution of EPP harvest based on density of band recoveries per 10 minute latitude/longitude block, 1987-91.



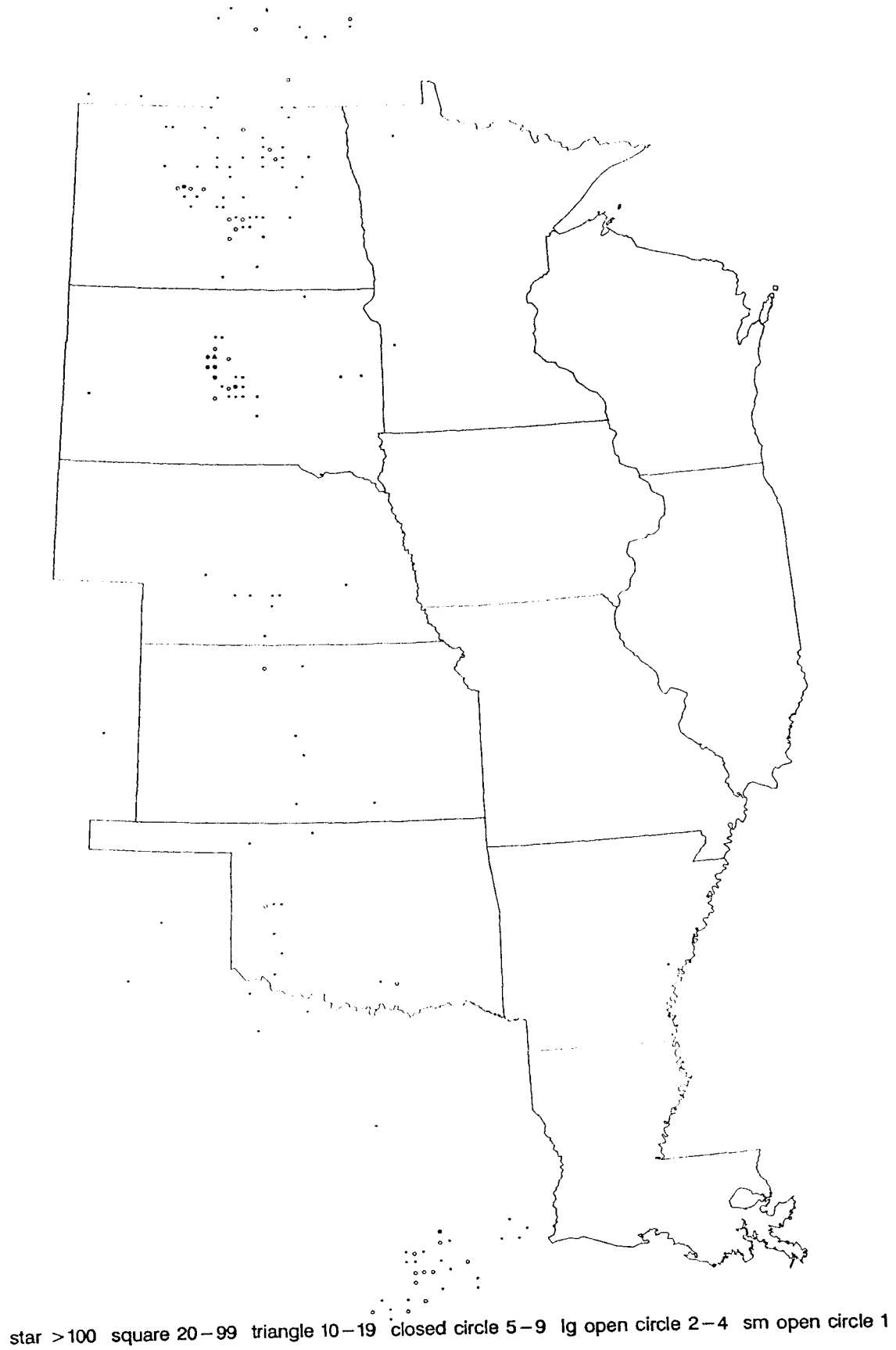
★ - 33% ◇ - 50% ○ - 75% · - 100% OF EPP HARVEST

APPENDIX C. Distribution of EPP harvest in EPP states/province (MB, MN, IA, MO) based on density of band recoveries per 10 minute latitude/longitude block, 1987-91.

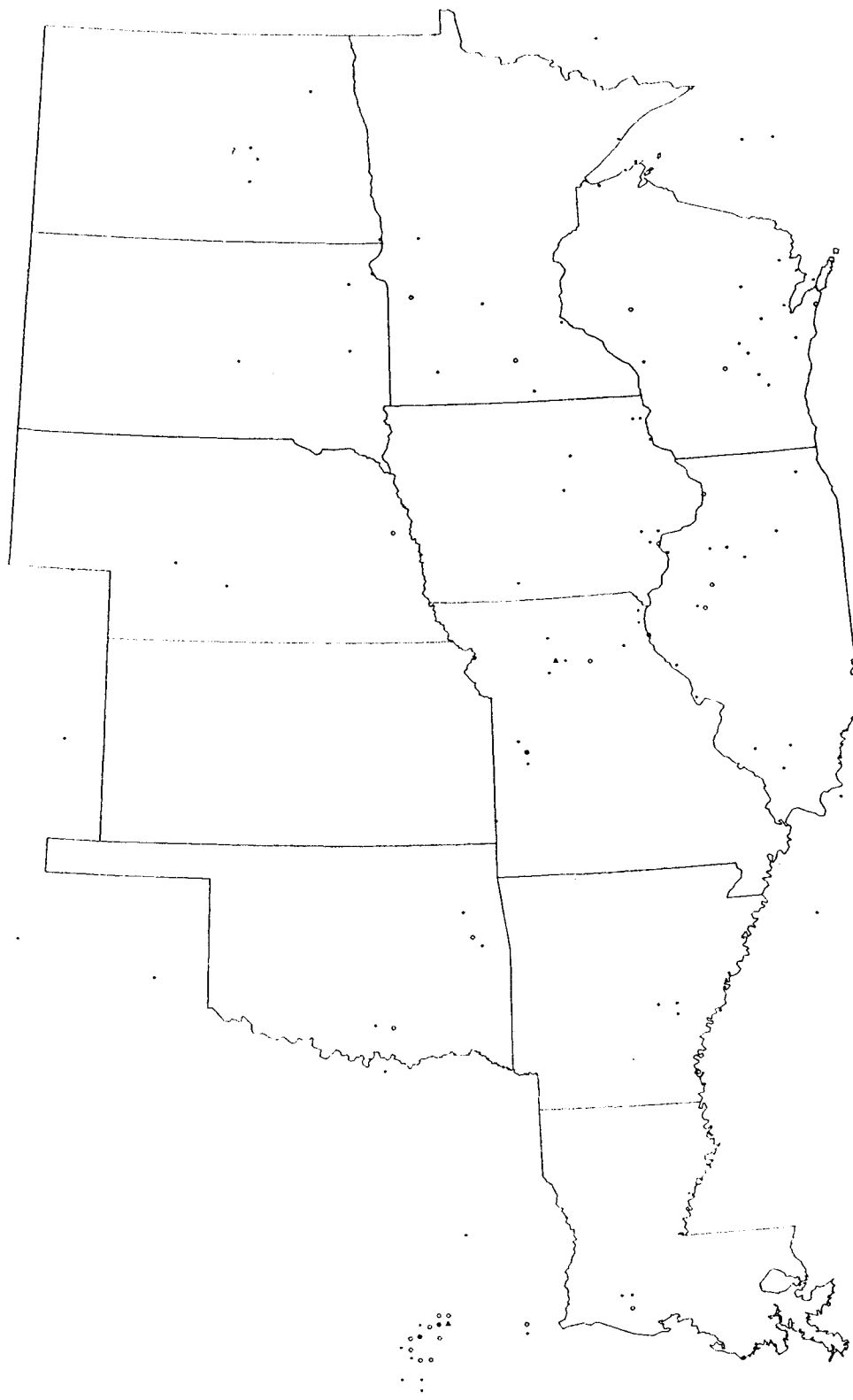


★ - 43% ◇ - 50% ○ - 75% . - 100% OF EPP HARVEST

APPENDIX D. Distribution of recoveries of small Canada geese banded in the Keewatin District, NWT, 1987-91.

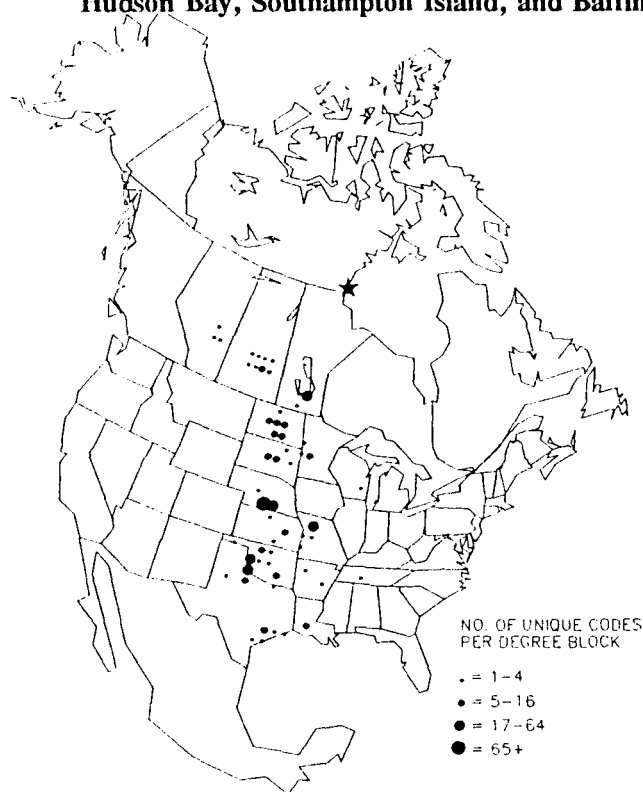


APPENDIX E. Distribution of recoveries of small Canada geese banded in the Franklin District, NWT, 1987-91.

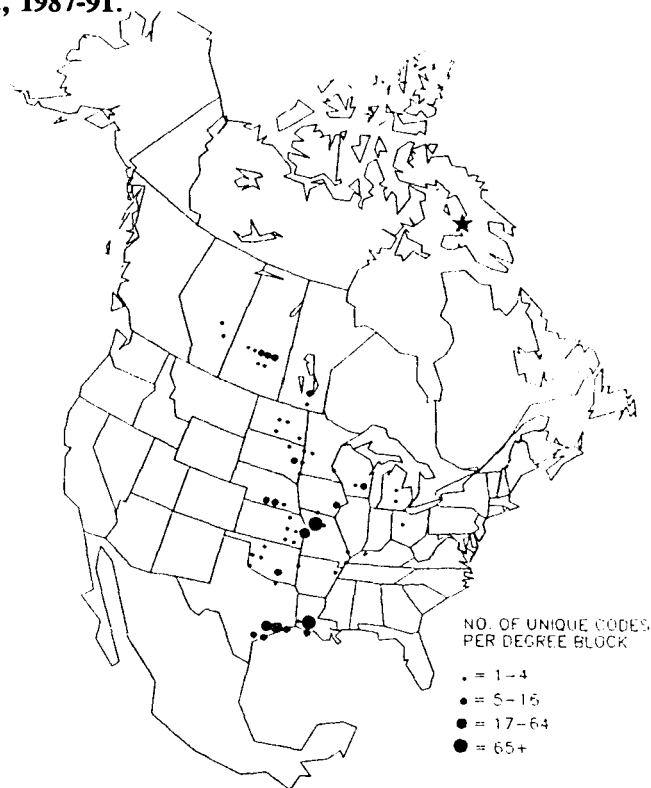


star >100 square 20-99 triangle 10-19 closed circle 5-9 lg open circle 2-4 sm open circle 1

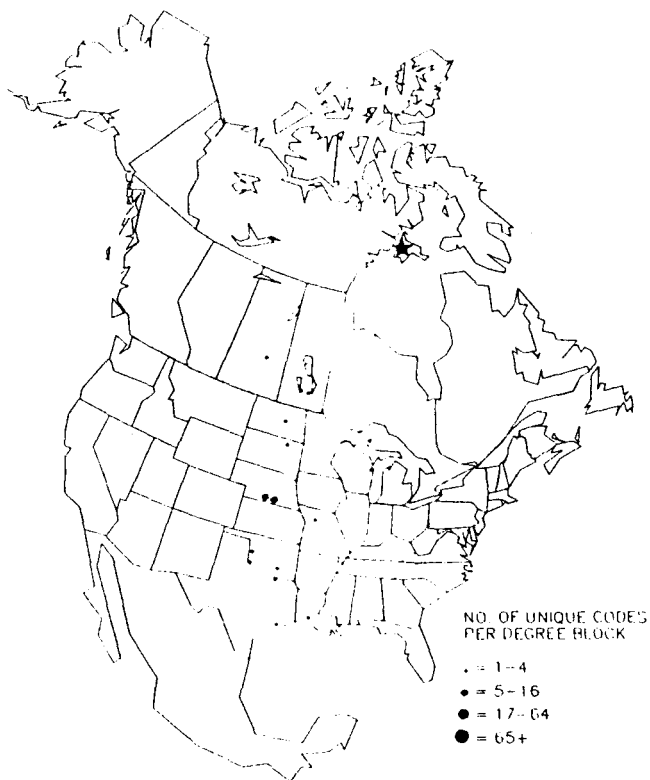
APPENDIX F. Distribution of observations during 1991-92 of small Canada geese marked on West Hudson Bay, Southampton Island, and Baffin Island, 1987-91.



SMALL CANADA GEESE NECKBANDIED ON WEST HUDSON BAY ★ 1987-91
OBSERVED AUGUST 1991 TO JULY 1992

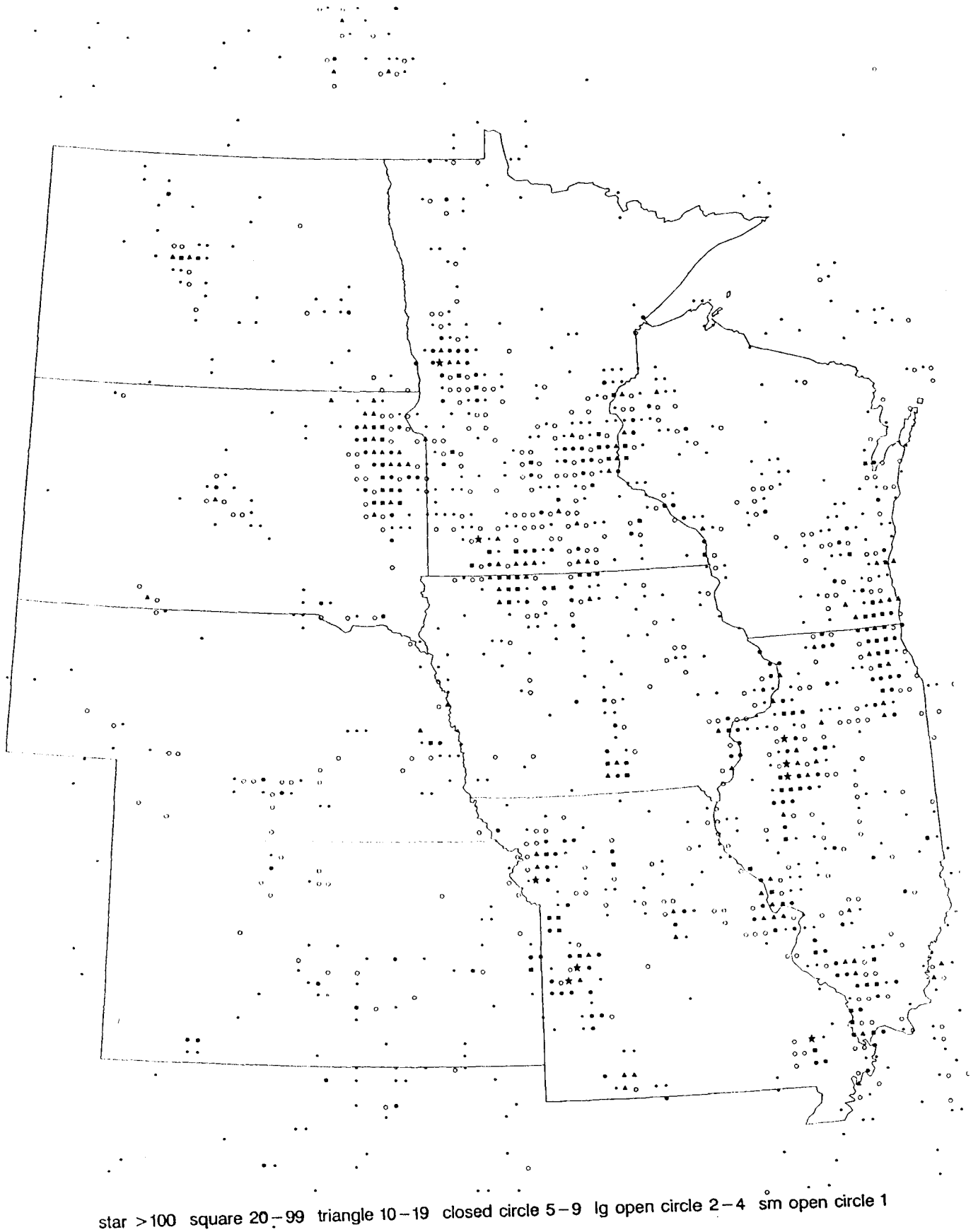


SMALL CANADA GEESE NECKBANDIED ON BAFFIN ISLAND ★ 1987-91
OBSERVED AUGUST 1991 TO JULY 1992

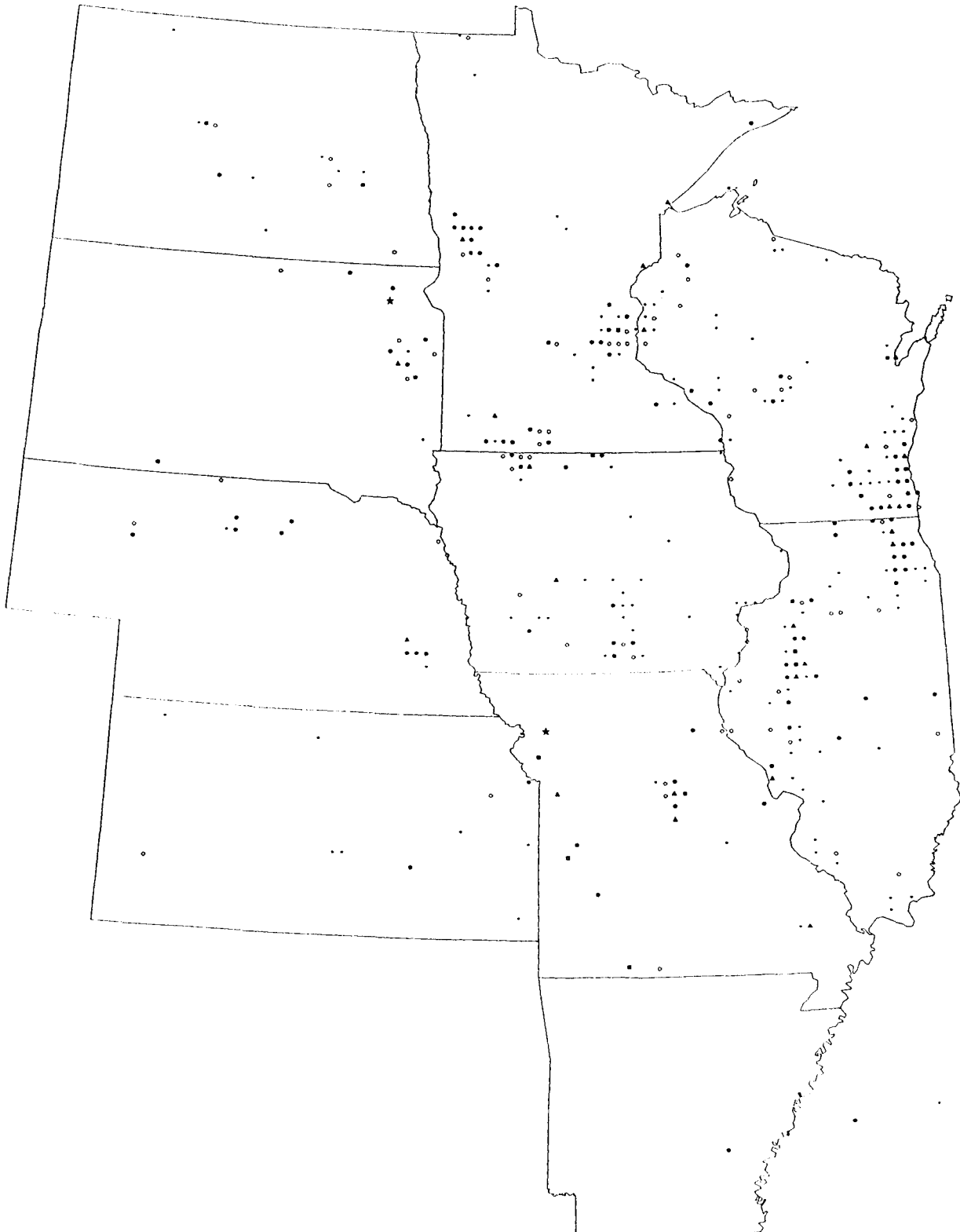


SMALL CANADA GEESE NECKBANDIED ON SOUTHAMPTON ISLAND ★ 1991
OBSERVED AUGUST 1991 TO JULY 1992

APPENDIX G. Distribution of direct and indirect giant Canada goose band recoveries, 1987-91
 (includes only normal wild, banded and neckbanded geese during June-August in S. MB, ND, SD, MN,
 IA, MO, WI, and IL; solicited bands weighted by a factor of 0.33)



APPENDIX H. Distribution of giant Canada goose banding, 1987-91 (includes only normal wild, banded and neckbanded geese during June-August).



star >2000 square 1000-2000 triangle 500-999 closed circle 100-499 lg open circle 50-99 sm open circle <50