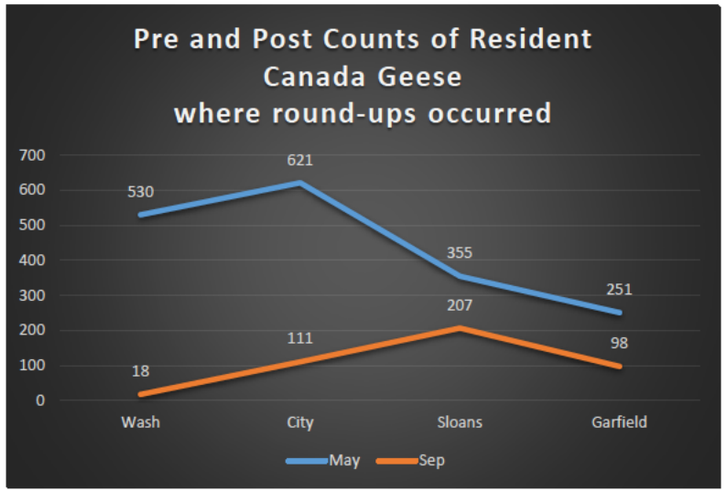
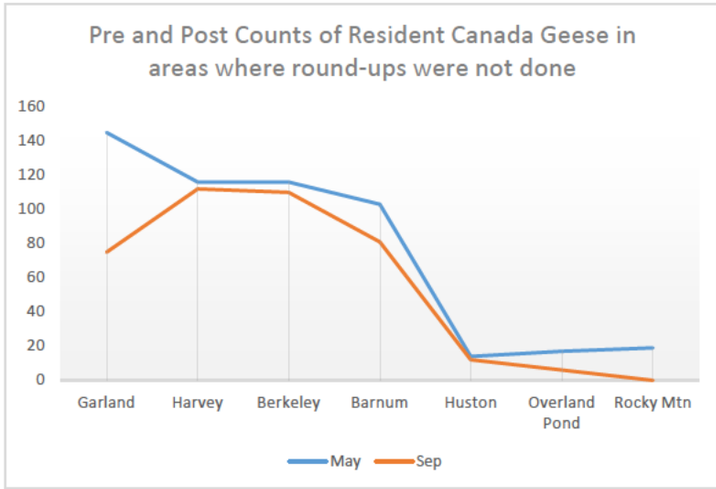
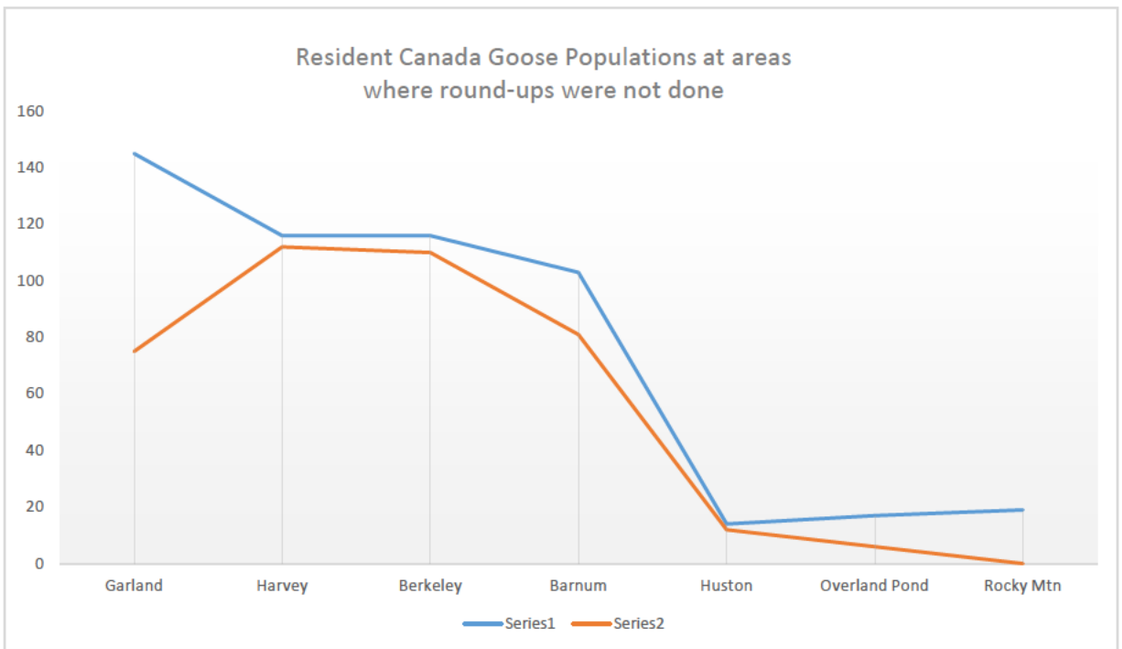
PARK	TOTAL	Date	Time	Eggs Oiled
Wash Park	554	23-May	2pm	0
	495	31-May	10am	0
	540	10-Jun	9am	0
	18	24-Sep	9am	
City Park	350	23-May	1pm	0
	468	28-May	11am	0
	526	6-Jun	11am	0
	111	24-Sep	9am	
Sloan's Lake	355	28-May	2pm	632
	288	5-Jun	10am	0
	207	24-Sep	10am	
Garland	83	23-May	10am	0
	145	28-May	12pm	0
	75	24-Sep	10am	
Garfield	163	24-May	9am	0
	251	28-May	1pm	0
	98	24-Sep	9am	
Harvey	116	28-May	1pm	0
	112	24-Sep	11am	
Rocky Mtn	4	21-May	11am	0
	16	30-May	11am	0
	19	10-Jun	10am	0
	0	24-Sep	10am	
Huston	3	24-May	2pm	0
	14	28-May	10am	0
	12	24-Sep	10am	
Berkeley	116	21-May	12pm	0
	116	30-May	10am	0
	110	24-Sep	9am	
Barnum	103	21-May	1pm	0
	81	5-Jun	12pm	0
	81	24-Sep	11am	
Overland Pond	17	23-May	11am	0
	6	28-May	3pm	0
	6	24-Sep	9am	
USDA Treated Eggs				
DPR Treated Eggs				
AVG TOTAL		**1,863**		

	May	Sep
Wash	530	18
City	621	111
Sloans	355	207
Garfield	251	98

	May	Sep
Garland	145	75
Harvey	116	112
Berkeley	116	110
Barnum	103	81
Huston	14	12
Overland Pond	17	6
Rocky Mtn	19	0







U.S. DEPARTMENT OF AGRICULTURE
ANIMAL AND PLANT HEALTH INSPECTION SERVICE
WILDLIFE SERVICES

PERMIT REVIEW

☒ **RENEWAL**
Permit No:
☐ Without Change

1. Name, Address, and Telephone Number	2. Location of Damage	
MARTIN LOWNEY 12345 W ALAMEDA PKWY LAKEWOOD, CO 80228 Telephone ☐ Home ☒ Work Fax/Email: MARTIN.S.LOWNEY@USDA.GOV	CITY PARK	
	3. County DENVER	4. State CO

5. RESOURCE/DAMAGE ESTIMATE

A. Resources Damaged	B. Description of Damage
TURFGRASS, HUMAN HEALTH AND SAFETY, PROPERTY	FECAL MATTER, AGGRESSIVE BEHAVIOR, TURF DAMAGE

6. MIGRATORY BIRD SPECIES		7. PERMIT RECOMMENDATION		
Depredating Species	Number Involved	Take Recommendation	Number Recommended	Methods
1. CANADA GOOSE	526	☒ Yes ☐ No	506	ALL LEGAL METHODS
2.		☐ Yes ☐ No		
3.		☐ Yes ☐ No		
4.		☐ Yes ☐ No		

8a. PREVIOUS ACTIONS TO ADDRESS PROBLEM AND RESULTS OF THOSE ACTIONS:

ACTIVE HAZING AND HARASSMENT PROGRAM BY DPR STAFF WITH GOOSINATOR, DOGS, AND USED EXCLUSION BARRIERS IN CERTAIN AREAS WITH LITTLE TO NO SUCCESS. HAZING AT LEAST 15 YEARS AND EGG OILING AT LEAST 5 YEARS.

8b. COMMENTS:

PERMISSION TO REMOVE GEESE DURING THE MOLT. TO SUPPLEMENT CURRENT MANAGEMENT METHODS. ACTIONS ARE CONSISTENT WITH 2005 FWS RESIDENT CANADA GOOSE EIS, 2013 WS-CO BIRD DAMAGE MGMT EA, AND 2019 STATE OF COLORADO RESIDENT GOOSE PLAN.

9. RECOMMENDED ACTIONS

Action:

☒ Harassment ☒ Habitat Alteration ☐ Husbandry ☒ Exclusion ☐ Lethal trapping ☒ Chemical repellent

☐ Capture and relocation ☒ Egg/nest destruction ☒ Shooting ☒ Other:

10A. WS Investigator Name and Address: *(Print)*	10B. WS Investigator Signature
(b) (6) 12345 W ALAMEDA PKWY LAKEWOOD, CO 80228 Telephone Number: (b) (6) Email: (b) (6) @USDA.GOV	(b) (6) Date: 06/12/2019

WS Form 37 (2011) OMB Control No. 0579-0335

Approved: X
Denied: ____

Martin S. Lowney

U.S. DEPARTMENT OF AGRICULTURE
ANIMAL AND PLANT HEALTH INSPECTION SERVICE
WILDLIFE SERVICES

PERMIT REVIEW

☒ **RENEWAL**
Permit No:
☐ Without Change

1. Name, Address, and Telephone Number	2. Location of Damage	
MARTIN LOWNEY 12345 W ALAMEDA PKWY LAKEWOOD, CO 80228 Telephone ☐ Home ☒ Work Fax/Email: MARTIN.S.LOWNEY@USDA.GOV	WASHINGTON PARK 3. County: DENVER	4. State: CO

5. RESOURCE/DAMAGE ESTIMATE

A. Resources Damaged	B. Description of Damage
TURFGRASS, HUMAN HEALTH AND SAFETY, PROPERTY	FECAL MATTER, AGGRESSIVE BEHAVIOR, TURF DAMAGE

6. MIGRATORY BIRD SPECIES / 7. PERMIT RECOMMENDATION

Depredating Species	Number Involved	Take Recommendation	Number Recommended	Methods
1. CANADA GOOSE	540	☒ Yes ☐ No	520	ALL LEGAL METHODS
2.		☐ Yes ☐ No		
3.		☐ Yes ☐ No		
4.		☐ Yes ☐ No		

8a. PREVIOUS ACTIONS TO ADDRESS PROBLEM AND RESULTS OF THOSE ACTIONS:

ACTIVE HAZING AND HARASSMENT PROGRAM BY DPR STAFF WITH GOOSINATOR, DOGS, AND USED EXCLUSION BARRIERS IN CERTAIN AREAS WITH LITTLE TO NO SUCCESS. HAZING AT LEAST 15 YEARS AND EGG OILING AT LEAST 5 YEARS.

8b. COMMENTS:

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9. RECOMMENDED ACTIONS

Action:

☒ Harassment ☒ Habitat Alteration ☐ Husbandry ☒ Exclusion ☐ Lethal trapping ☒ Chemical repellent

☐ Capture and relocation ☒ Egg/nest destruction ☒ Shooting ☒ Other:

10A. WS Investigator Name and Address: *(Print)*	10B. WS Investigator Signature
(b) (6) 12345 W ALAMEDA PKWY LAKEWOOD, CO 80228 Telephone Number: (b) (6) Email: (b) (6) @USDA.GOV	(b) (6) Date: 06/12/2019

WS Form 37 (2011) OMB Control No. 0579-0335

Approved: X
Denied: ____

Mart S. Lowney

2020-APHIS-04219-F 00004

U.S. DEPARTMENT OF AGRICULTURE
ANIMAL AND PLANT HEALTH INSPECTION SERVICE
WILDLIFE SERVICES

PERMIT REVIEW

☒ **RENEWAL**
Permit No:
☐ Without Change

1. Name, Address, and Telephone Number	2. Location of Damage	
MARTIN LOWNEY 12345 W ALAMEDA PKWY LAKEWOOD, CO 80228 Telephone ☐ Home ☒ Work Fax/Email: MARTIN.S.LOWNEY@USDA.GOV	SLOAN'S LAKE PARK	
	3. County DENVER	4. State CO

5. RESOURCE/DAMAGE ESTIMATE

A. Resources Damaged	B. Description of Damage
TURFGRASS, HUMAN HEALTH AND SAFETY, PROPERTY	FECAL MATTER, AGGRESSIVE BEHAVIOR, TURF DAMAGE

6. MIGRATORY BIRD SPECIES		7. PERMIT RECOMMENDATION		
Depredating Species	Number Involved	Take Recommendation	Number Recommended	Methods
1. CANADA GOOSE	355	☒ Yes ☐ No	335	ALL LEGAL METHODS
2.		☐ Yes ☐ No		
3.		☐ Yes ☐ No		
4.		☐ Yes ☐ No		

8a. PREVIOUS ACTIONS TO ADDRESS PROBLEM AND RESULTS OF THOSE ACTIONS:

ACTIVE HAZING AND HARASSMENT PROGRAM BY DPR STAFF WITH GOOSINATOR, DOGS, AND USED EXCLUSION BARRIERS IN CERTAIN AREAS WITH LITTLE TO NO SUCCESS. HAZING AT LEAST 15 YEARS AND EGG OILING AT LEAST 5 YEARS.

8b. COMMENTS:

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9. RECOMMENDED ACTIONS

Action:

☒ Harassment ☒ Habitat Alteration ☐ Husbandry ☒ Exclusion ☐ Lethal trapping ☒ Chemical repellent

☐ Capture and relocation ☒ Egg/nest destruction ☒ Shooting ☒ Other:

10A. WS Investigator Name and Address: *(Print)*	10B. WS Investigator Signature
(b) (6) 12345 W ALAMEDA PKWY LAKEWOOD, CO 80228 Telephone Number: (b) (6) Email: (b) (6) @USDA.GOV	(b) (6) Date: 06/12/2019

WS Form 37 (2011) OMB Control No. 0579-0335

Approved: X
Denied: ____

Martin S. Lowney

U.S. DEPARTMENT OF AGRICULTURE
ANIMAL AND PLANT HEALTH INSPECTION SERVICE
WILDLIFE SERVICES

PERMIT REVIEW

☒ **RENEWAL**
Permit No:
☐ Without Change

1. Name, Address, and Telephone Number	2. Location of Damage	
MARTIN LOWNEY 12345 W ALAMEDA PKWY LAKEWOOD, CO 80228 Telephone ☐ Home ☒ Work Fax/Email: MARTIN.S.LOWNEY@USDA.GOV	ROCKY MOUNTAIN LAKE PARK 3. County: DENVER	4. State: CO

5. RESOURCE/DAMAGE ESTIMATE

A. Resources Damaged	B. Description of Damage
TURFGRASS, HUMAN HEALTH AND SAFETY, PROPERTY	FECAL MATTER, AGGRESSIVE BEHAVIOR, TURF DAMAGE

6. MIGRATORY BIRD SPECIES		7. PERMIT RECOMMENDATION		
Depredating Species	Number Involved	Take Recommendation	Number Recommended	Methods
1. CANADA GOOSE	19	☒ Yes ☐ No	19	ALL LEGAL METHODS
2.		☐ Yes ☐ No		
3.		☐ Yes ☐ No		
4.		☐ Yes ☐ No		

8a. PREVIOUS ACTIONS TO ADDRESS PROBLEM AND RESULTS OF THOSE ACTIONS:

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9. RECOMMENDED ACTIONS

Action:

☒ Harassment ☒ Habitat Alteration ☐ Husbandry ☒ Exclusion ☐ Lethal trapping ☒ Chemical repellent

☐ Capture and relocation ☒ Egg/nest destruction ☒ Shooting ☒ Other:

10A. WS Investigator Name and Address: *(Print)*	10B. WS Investigator Signature
(b) (6) 12345 W ALAMEDA PKWY LAKEWOOD, CO 80228 Telephone Number: (b) (6) Email: (b) (6) @USDA.GOV	(b) (6) Date: 06/12/2019

WS Form 37 (2011) OMB Control No. 0579-0335

Approved: X
Denied: ____

Martin S. Lowney

U.S. DEPARTMENT OF AGRICULTURE
ANIMAL AND PLANT HEALTH INSPECTION SERVICE
WILDLIFE SERVICES

PERMIT REVIEW

☒ **RENEWAL**
Permit No:
☐ Without Change

1. Name, Address, and Telephone Number	2. Location of Damage	
MARTIN LOWNEY 12345 W ALAMEDA PKWY LAKEWOOD, CO 80228 Telephone ☐ Home ☒ Work Fax/Email: MARTIN.S.LOWNEY@USDA.GOV	OVERLAND POND PARK	
	3. County DENVER	4. State CO

5. RESOURCE/DAMAGE ESTIMATE

A. Resources Damaged	B. Description of Damage
TURFGRASS, HUMAN HEALTH AND SAFETY, PROPERTY	FECAL MATTER, AGGRESSIVE BEHAVIOR, TURF DAMAGE

6. MIGRATORY BIRD SPECIES		7. PERMIT RECOMMENDATION		
Depredating Species	Number Involved	Take Recommendation	Number Recommended	Methods
1. CANADA GOOSE	17	☒ Yes ☐ No	17	ALL LEGAL METHODS
2.		☐ Yes ☐ No		
3.		☐ Yes ☐ No		
4.		☐ Yes ☐ No		

8a. PREVIOUS ACTIONS TO ADDRESS PROBLEM AND RESULTS OF THOSE ACTIONS:

ACTIVE HAZING AND HARASSMENT PROGRAM BY DPR STAFF WITH GOOSINATOR, DOGS, AND USED EXCLUSION BARRIERS IN CERTAIN AREAS WITH LITTLE TO NO SUCCESS. HAZING AT LEAST 15 YEARS AND EGG OILING AT LEAST 5 YEARS.

8b. COMMENTS:

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9. RECOMMENDED ACTIONS

Action:

☒ Harassment ☒ Habitat Alteration ☐ Husbandry ☒ Exclusion ☐ Lethal trapping ☒ Chemical repellent

☐ Capture and relocation ☒ Egg/nest destruction ☒ Shooting ☒ Other:

10A. WS Investigator Name and Address: *(Print)*	10B. WS Investigator Signature
(b) (6) 12345 W ALAMEDA PKWY LAKEWOOD, CO 80228 Telephone Number: (b) (6) Email: (b) (6) @USDA.GOV	(b) (6) Date: 06/12/2019

WS Form 37 (2011) OMB Control No. 0579-0335

Approved: X
Denied: ____

Martin S. Lowney

U.S. DEPARTMENT OF AGRICULTURE
ANIMAL AND PLANT HEALTH INSPECTION SERVICE
WILDLIFE SERVICES

PERMIT REVIEW

☒ **RENEWAL**
Permit No:
☐ Without Change

1. Name, Address, and Telephone Number	2. Location of Damage	
MARTIN LOWNEY 12345 W ALAMEDA PKWY LAKEWOOD, CO 80228 Telephone ☐ Home ☒ Work Fax/Email: MARTIN.S.LOWNEY@USDA.GOV	HUSTON PARK	
	3. County DENVER	4. State CO

5. RESOURCE/DAMAGE ESTIMATE

A. Resources Damaged	B. Description of Damage
TURFGRASS, HUMAN HEALTH AND SAFETY, PROPERTY	FECAL MATTER, AGGRESSIVE BEHAVIOR, TURF DAMAGE

6. MIGRATORY BIRD SPECIES		7. PERMIT RECOMMENDATION		
Depredating Species	Number Involved	Take Recommendation	Number Recommended	Methods
1. CANADA GOOSE	14	☒ Yes ☐ No	14	ALL LEGAL METHODS
2.		☐ Yes ☐ No		
3.		☐ Yes ☐ No		
4.		☐ Yes ☐ No		

8a. PREVIOUS ACTIONS TO ADDRESS PROBLEM AND RESULTS OF THOSE ACTIONS:

ACTIVE HAZING AND HARASSMENT PROGRAM BY DPR STAFF WITH GOOSINATOR, DOGS, AND USED EXCLUSION BARRIERS IN CERTAIN AREAS WITH LITTLE TO NO SUCCESS. HAZING AT LEAST 15 YEARS AND EGG OILING AT LEAST 5 YEARS.

8b. COMMENTS:

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9. RECOMMENDED ACTIONS

Action:

☒ Harassment ☒ Habitat Alteration ☐ Husbandry ☒ Exclusion ☐ Lethal trapping ☒ Chemical repellent

☐ Capture and relocation ☒ Egg/nest destruction ☒ Shooting ☒ Other:

10A. WS Investigator Name and Address: *(Print)*	10B. WS Investigator Signature
(b) (6) 12345 W ALAMEDA PKWY LAKEWOOD, CO 80228 Telephone Number: (b) (6) Email: (b) (6) @USDA.GOV	(b) (6) Date: 06/12/2019

WS Form 37 (2011) OMB Control No. 0579-0335

Approved: X
Denied: _____

Marcus D. Tuney

U.S. DEPARTMENT OF AGRICULTURE
ANIMAL AND PLANT HEALTH INSPECTION SERVICE
WILDLIFE SERVICES

PERMIT REVIEW

☒ **RENEWAL**
Permit No:
☐ Without Change

1. Name, Address, and Telephone Number	2. Location of Damage	
MARTIN LOWNEY 12345 W ALAMEDA PKWY LAKEWOOD, CO 80228 Telephone ☐ Home ☒ Work Fax/Email: MARTIN.S.LOWNEY@USDA.GOV	HARVEY PARK	
	3. County DENVER	4. State CO

5. RESOURCE/DAMAGE ESTIMATE

A. Resources Damaged	B. Description of Damage
TURFGRASS, HUMAN HEALTH AND SAFETY, PROPERTY	FECAL MATTER, AGGRESSIVE BEHAVIOR, TURF DAMAGE

6. MIGRATORY BIRD SPECIES		7. PERMIT RECOMMENDATION		
Depredating Species	Number Involved	Take Recommendation	Number Recommended	Methods
1. CANADA GOOSE	116	☒ Yes ☐ No	96	ALL LEGAL METHODS
2.		☐ Yes ☐ No		
3.		☐ Yes ☐ No		
4.		☐ Yes ☐ No		

8a. PREVIOUS ACTIONS TO ADDRESS PROBLEM AND RESULTS OF THOSE ACTIONS:

ACTIVE HAZING AND HARASSMENT PROGRAM BY DPR STAFF WITH GOOSINATOR, DOGS, AND USED EXCLUSION BARRIERS IN CERTAIN AREAS WITH LITTLE TO NO SUCCESS. HAZING AT LEAST 15 YEARS AND EGG OILING AT LEAST 5 YEARS.

8b. COMMENTS:

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9. RECOMMENDED ACTIONS

Action:
☒ Harassment ☒ Habitat Alteration ☐ Husbandry ☒ Exclusion ☐ Lethal trapping ☒ Chemical repellent
☐ Capture and relocation ☒ Egg/nest destruction ☒ Shooting ☒ Other:

10A. WS Investigator Name and Address: *(Print)*	10B. WS Investigator Signature
(b) (6) 12345 W ALAMEDA PKWY LAKEWOOD, CO 80228 Telephone Number: (b) (6) Email: (b) (6) @USDA.GOV	(b) (6) Date: 06/12/2019

WS Form 37 (2011) OMB Control No. 0579-0335

Approved: X
Denied: _____

Martin S. Lowney

U.S. DEPARTMENT OF AGRICULTURE
ANIMAL AND PLANT HEALTH INSPECTION SERVICE
WILDLIFE SERVICES

PERMIT REVIEW

☒ **RENEWAL**
Permit No:
☐ Without Change

1. Name, Address, and Telephone Number	2. Location of Damage	
MARTIN LOWNEY 12345 W ALAMEDA PKWY LAKEWOOD, CO 80228 Telephone ☐ Home ☒ Work Fax/Email: MARTIN.S.LOWNEY@USDA.GOV	GARLAND PARK	
	3. County DENVER	4. State CO

5. RESOURCE/DAMAGE ESTIMATE

A. Resources Damaged	B. Description of Damage
TURFGRASS, HUMAN HEALTH AND SAFETY, PROPERTY	FECAL MATTER, AGGRESSIVE BEHAVIOR, TURF DAMAGE

6. MIGRATORY BIRD SPECIES		7. PERMIT RECOMMENDATION		
Depredating Species	Number Involved	Take Recommendation	Number Recommended	Methods
1. CANADA GOOSE	145	☒ Yes ☐ No	125	ALL LEGAL METHODS
2.		☐ Yes ☐ No		
3.		☐ Yes ☐ No		
4.		☐ Yes ☐ No		

8a. PREVIOUS ACTIONS TO ADDRESS PROBLEM AND RESULTS OF THOSE ACTIONS:

ACTIVE HAZING AND HARASSMENT PROGRAM BY DPR STAFF WITH GOOSINATOR, DOGS, AND USED EXCLUSION BARRIERS IN CERTAIN AREAS WITH LITTLE TO NO SUCCESS. HAZING AT LEAST 15 YEARS AND EGG OILING AT LEAST 5 YEARS.

8b. COMMENTS:

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9. RECOMMENDED ACTIONS

Action:

☒ Harassment ☒ Habitat Alteration ☐ Husbandry ☒ Exclusion ☐ Lethal trapping ☒ Chemical repellent

☐ Capture and relocation ☒ Egg/nest destruction ☒ Shooting ☒ Other:

10A. WS Investigator Name and Address: *(Print)*	10B. WS Investigator Signature
(b) (6) 12345 W ALAMEDA PKWY LAKEWOOD, CO 80228 Telephone Number: (b) (6) Email: (b) (6) @USDA.GOV	(b) (6) Date: 06/12/2019

WS Form 37 (2011) OMB Control No. 0579-0335

Approved: X
Denied: ____

Martin S. Lowney

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WILDLIFE SERVICES

PERMIT REVIEW

☒ **RENEWAL**
Permit No:
☐ Without Change

1. Name, Address, and Telephone Number	2. Location of Damage	
MARTIN LOWNEY 12345 W ALAMEDA PKWY LAKEWOOD, CO 80228 Telephone ☐ Home ☒ Work Fax/Email: MARTIN.S.LOWNEY@USDA.GOV	GARFIELD LAKE PARK 3. County: DENVER	4. State: CO

5. RESOURCE/DAMAGE ESTIMATE

A. Resources Damaged	B. Description of Damage
TURFGRASS, HUMAN HEALTH AND SAFETY, PROPERTY	FECAL MATTER, AGGRESSIVE BEHAVIOR, TURF DAMAGE

6. MIGRATORY BIRD SPECIES		7. PERMIT RECOMMENDATION		
Depredating Species	Number Involved	Take Recommendation	Number Recommended	Methods
1. CANADA GOOSE	251	☒ Yes ☐ No	231	ALL LEGAL METHODS
2.		☐ Yes ☐ No		
3.		☐ Yes ☐ No		
4.		☐ Yes ☐ No		

8a. PREVIOUS ACTIONS TO ADDRESS PROBLEM AND RESULTS OF THOSE ACTIONS:

AACTIVE HAZING AND HARASSMENT PROGRAM BY DPR STAFF WITH GOOSINATOR, DOGS, AND USED EXCLUSION BARRIERS IN CERTAIN AREAS WITH LITTLE TO NO SUCCESS. HAZING AT LEAST 15 YEARS AND EGG OILING AT LEAST 5 YEARS.

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9. RECOMMENDED ACTIONS

Action:
☒ Harassment ☒ Habitat Alteration ☐ Husbandry ☒ Exclusion ☐ Lethal trapping ☒ Chemical repellent
☐ Capture and relocation ☒ Egg/nest destruction ☒ Shooting ☒ Other:

10A. WS Investigator Name and Address: *(Print)*	10B. WS Investigator Signature
(b) (6) 12345 W ALAMEDA PKWY LAKEWOOD, CO 80228 Telephone Number: (b) (6) Email: (b) (6) @USDA.GOV	(b) (6) Date: 06/12/2019

WS Form 37 (2011) OMB Control No. 0579-0335

Approved: ☒
Denied: ____

Marti S. Lowney

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ANIMAL AND PLANT HEALTH INSPECTION SERVICE
WILDLIFE SERVICES

PERMIT REVIEW

☒ **RENEWAL**
Permit No:
☐ Without Change

1. Name, Address, and Telephone Number	2. Location of Damage	
MARTIN LOWNEY 12345 W ALAMEDA PKWY LAKEWOOD, CO 80228 Telephone ☐ Home ☒ Work Fax/Email: MARTIN.S.LOWNEY@USDA.GOV	BARNUM PARK	
	3. County DENVER	4. State CO

5. RESOURCE/DAMAGE ESTIMATE

A. Resources Damaged	B. Description of Damage
TURFGRASS, HUMAN HEALTH AND SAFETY, PROPERTY	FECAL MATTER, AGGRESSIVE BEHAVIOR, TURF DAMAGE

6. MIGRATORY BIRD SPECIES		7. PERMIT RECOMMENDATION		
Depredating Species	Number Involved	Take Recommendation	Number Recommended	Methods
1. CANADA GOOSE	103	☒ Yes ☐ No	83	ALL LEGAL METHODS
2.		☐ Yes ☐ No		
3.		☐ Yes ☐ No		
4.		☐ Yes ☐ No		

8a. PREVIOUS ACTIONS TO ADDRESS PROBLEM AND RESULTS OF THOSE ACTIONS:

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9. RECOMMENDED ACTIONS

Action:

☒ Harassment ☒ Habitat Alteration ☐ Husbandry ☒ Exclusion ☐ Lethal trapping ☒ Chemical repellent

☐ Capture and relocation ☒ Egg/nest destruction ☒ Shooting ☒ Other:

10A. WS Investigator Name and Address: *(Print)*	10B. WS Investigator Signature
(b) (6) 12345 W ALAMEDA PKWY LAKEWOOD, CO 80228 Telephone Number: (b) (6) Email: (b) (6) @USDA.GOV	(b) (6) Date: 06/12/2019

WS Form 37 (2011) OMB Control No. 0579-0335

Approved: X
Denied: ____

Mark S. Lowney

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WT Detail Page

WorkTask for: (b) (6) **Direct Control**	
Work Date:	07/01/2019 (Entry Date: 07/15/2019)
Agreement:	DENVER PARKS
Property:	DENVER PARKS
Activity: 204399148822	FIELD WRK (PERFORMED)
Activity Measurements:	9 HOURS
Conflict & Loss:	GEESE, CANADA damage threat of **PROPERTY (GENERAL)**
Components & Take/Samples:	Cmp: TRAPS, DRIVE APPLIED/USED 1 EA Cmp Take: 592 EA GEESECANAD KILLED Int Trgt Prmt: FWS CY19 WS DEPREDATION Take Left Report for Permit Nr: MB715492-0
Remarks:	
Project:	CITY PARK Remove from this project

Go to Work Task Tab
Go to My Calendar
Go to ToDo Tab

Go to Reports Tab

Enter New DC Task
Enter New TA Task
Enter New Admin Task
Enter New Admin W/Prop
Enter New Aerial Task

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WT Detail Page

WorkTask for: (b) (6) **Direct Control**	
Work Date:	06/21/2019 (Entry Date: 10/31/2019)
Agreement:	DENVER PARKS
Property:	DENVER PARKS
Activity: 204399148819	FIELD WRK (PERFORMED)
Activity Measurements:	8 HOURS
Conflict & Loss:	GEESE, CANADA damage threat of **PROPERTY (GENERAL)** -> Verified BROWSING/GRAZING losses to 8 (INCIDENT) PROPERTY (GENERAL) valued at $544000
Components & Take/Samples:	Cmp: TRAPS, DRIVE APPLIED/USED 1 EA Cmp Take: 401 EA GEESECANAD KILLED Int Trgt Prmt: FWS CY19 WS DEPREDATION Take Left Report for Permit Nr: MB715492-0
Remarks:	
Project:	WASHINGTON PARK Remove from this project

Go to Work Task Tab
Go to My Calendar
Go to ToDo Tab

Go to Reports Tab

Enter New DC Task
Enter New TA Task
Enter New Admin Task
Enter New Admin W/Prop
Enter New Aerial Task

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WT Detail Page

WorkTask for: (b) (6) **Direct Control**	
Work Date:	07/08/2019 (Entry Date: 10/31/2019)
Agreement:	DENVER PARKS
Property:	DENVER PARKS
Activity: 204399148824	FIELD WRK (PERFORMED)
Activity Measurements:	9 HOURS
Conflict & Loss:	GEESE, CANADA damage threat of **PROPERTY (GENERAL)**
Components & Take/Samples:	Cmp: TRAPS, DRIVE APPLIED/USED 1 EA Cmp Take: 111 EA GEESECANAD KILLED Int Trgt Prmt: FWS CY19 WS DEPREDATION Take Left Report for Permit Nr: MB715492-0
Remarks:	
Project:	CITY PARK Remove from this project
FlaggedX by: (b) (6) on 10/02/19 ***Corrected by:*** (b) (6) on 10/31/19	(b)(5) DPP

Go to Work Task Tab
Go to My Calendar
Go to ToDo Tab

Go to Reports Tab

Enter New DC Task
Enter New TA Task
Enter New Admin Task
Enter New Admin W/Prop
Enter New Aerial Task

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WT Detail Page

WorkTask for: (b) (6) **Direct Control**	
Work Date:	06/25/2019 (Entry Date: 07/15/2019)
Agreement:	DENVER PARKS
Property:	DENVER PARKS
Activity: 204399148820	FIELD WRK (PERFORMED)
Activity Measurements:	9 HOURS
Conflict & Loss:	GEESE, CANADA damage threat of **PROPERTY (GENERAL)**
Components & Take/Samples:	Cmp: TRAPS, DRIVE APPLIED/USED 1 EA Cmp Take: 175 EA GEESECANAD KILLED Int Trgt Prmt: FWS CY19 WS DEPREDATION Take Left Report for Permit Nr: MB715492-0
Remarks:	
Project:	WASHINGTON PARK Remove from this project

Go to Work Task Tab
Go to My Calendar
Go to ToDo Tab

Go to Reports Tab

Enter New DC Task
Enter New TA Task
Enter New Admin Task
Enter New Admin W/Prop
Enter New Aerial Task

<-Go back to the previous menu Help

WT Detail Page

WorkTask for: (b) (6) **Direct Control**	
Work Date:	07/09/2019 (Entry Date: 10/31/2019)
Agreement:	DENVER PARKS
Property:	DENVER PARKS
Activity: 204399148825	FIELD WRK (PERFORMED)
Activity Measurements:	11 HOURS
Conflict & Loss:	GEESE, CANADA damage threat of **PROPERTY (GENERAL)**
Components & Take/Samples:	Cmp: TRAPS, DRIVE APPLIED/USED 1 EA Cmp Take: 148 EA GEESECANAD KILLED Int Trgt Prmt: FWS CY19 WS DEPREDATION Take Left Report for Permit Nr: MB715492-0
Remarks:	
Project:	GARFIELD Remove from this project
FlaggedX by: (b) (6) on 10/02/19 ***Corrected by:*** (b) (6) on 10/31/19	(b)(5) DPP

Go to Work Task Tab
Go to My Calendar
Go to ToDo Tab

Go to Reports Tab

Enter New DC Task
Enter New TA Task
Enter New Admin Task
Enter New Admin W/Prop
Enter New Aerial Task

<-Go back to the previous menu Help

WT Detail Page

WorkTask for: (b) (6) **Direct Control**	
Work Date:	07/03/2019 (Entry Date: 07/15/2019)
Agreement:	DENVER PARKS
Property:	DENVER PARKS
Activity: 204399148823	FIELD WRK (PERFORMED)
Activity Measurements:	10 HOURS
Conflict & Loss:	GEESE, CANADA damage threat of **PROPERTY (GENERAL)**
Components & Take/Samples:	Cmp: TRAPS, DRIVE APPLIED/USED 1 EA Cmp Take: 235 EA GEESECANAD KILLED Int Trgt Prmt: FWS CY19 WS DEPREDATION Take Left Report for Permit Nr: MB715492-0
Remarks:	
Project:	SLOANS LAKE Remove from this project

Go to Work Task Tab
Go to My Calendar
Go to ToDo Tab

Go to Reports Tab

Enter New DC Task
Enter New TA Task
Enter New Admin Task
Enter New Admin W/Prop
Enter New Aerial Task

	Adults	Goslings	Date	Time	Eggs Oiled
Wash Park	399	155	23-May	2pm	
	361	134	31-May	10am	
	384	156	10-Jun	9am	
City Park	350	0	23-May	1pm	
	460	8	28-May	11am	
	506	20	6-Jun	11am	
Sloan's Lake	344	11	28-May	2pm	632
Garland	44	39	23-May	10am	
	101	44	28-May	12pm	
Garfield	132	31	24-May	9am	
	210	41	28-May	1pm	
Harvey	111	5	28-May	1pm	
Rocky Mtn	4	0	21-May	11am	
	15	0	30-May	11am	
	19	0	10-Jun	10am	
Huston	3	0	24-May	2pm	
	14	0	28-May	10am	
Berkeley	0	0	21-May	12pm	
	0	0	30-May	10am	
Barnum	51	52	21-May	1pm	
	37	44	5-Jun	12pm	
Overland Pond	6	11	23-May	11am	
	4	2	28-May	3pm	

U.S. DEPARTMENT OF AGRICULTURE
ANIMAL AND PLANT HEALTH INSPECTION SERVICE
WILDLIFE SERVICES

PERMIT REVIEW

☒ **RENEWAL**
Permit No:
☐ Without Change

1. Name, Address, and Telephone Number	2. Location of Damage	
MARTIN LOWNEY 12345 W ALAMEDA PKWY LAKEWOOD, CO 80228 Telephone ☐ Home ☒ Work Fax/Email: MARTIN.S.LOWNEY@USDA.GOV	BARNUM PARK	
	3. County DENVER	4. State CO

5. RESOURCE/DAMAGE ESTIMATE

A. Resources Damaged	B. Description of Damage
TURFGRASS, HUMAN HEALTH AND SAFETY, PROPERTY	FECAL MATTER, AGGRESSIVE BEHAVIOR, TURF DAMAGE

6. MIGRATORY BIRD SPECIES		7. PERMIT RECOMMENDATION		
Depredating Species	Number Involved	Take Recommendation	Number Recommended	Methods
1. CANADA GOOSE	103	☒ Yes ☐ No	83	ALL LEGAL METHODS
2.		☐ Yes ☐ No		
3.		☐ Yes ☐ No		
4.		☐ Yes ☐ No		

8a. PREVIOUS ACTIONS TO ADDRESS PROBLEM AND RESULTS OF THOSE ACTIONS:

ACTIVE HAZING AND HARASSMENT PROGRAM BY DPR STAFF WITH GOOSINATOR, DOGS, AND USED EXCLUSION BARRIERS IN CERTAIN AREAS WITH LITTLE TO NO SUCCESS. HAZING AT LEAST 15 YEARS AND EGG OILING AT LEAST 5 YEARS.

8b. COMMENTS:

PERMISSION TO REMOVE GEESE DURING THE MOLT. TO SUPPLEMENT CURRENT MANAGEMENT METHODS. ACTIONS ARE CONSISTENT WITH 2005 FWS RESIDENT CANADA GOOSE EIS, 2013 WS-CO BIRD DAMAGE MGMT EA, AND 2019 STATE OF COLORADO RESIDENT GOOSE PLAN.

9. RECOMMENDED ACTIONS

Action:

☒ Harassment ☒ Habitat Alteration ☐ Husbandry ☒ Exclusion ☐ Lethal trapping ☒ Chemical repellent

☐ Capture and relocation ☒ Egg/nest destruction ☒ Shooting ☒ Other:

10A. WS Investigator Name and Address: *(Print)*	10B. WS Investigator Signature
(b) (6) DA PKWY LAKEWOOD, CO 80228 Telephone Number: (b) (6) Email: (b) (6) @USDA.GOV	Date: 06/12/2019

WS Form 37 (2011) OMB Control No. 0579-0335

Approved: ____ _____
Denied: _____ _____

Privacy Act Notice

Title 5. United States Code, Section 552a(e)(3) requires that each agency that maintains a system of records provide each individual from whom the agency solicits information with the following information.

Authority for Requesting Information

Title 7, United States Code, Section 426-426c, and Title 16 United States Code, Section 667, authorizes officers, agents, and employees of the USDA, APHIS, Wildlife Services to conduct a program of wildlife services and to enter into agreements with States, local jurisdictions, individuals, and public and private agencies, organizations, and institutions for the purpose of conducting such services.

Nature of Your Disclosure of Information

Disclosure of information solicited by USDA, APHIS, Wildlife Services is voluntary.

Principle Purpose for Which the Information is Solicited

Information is solicited from you for the purpose of executing and implementing agreements for control of wildlife damage.

Routine Uses Which May be Made of the Information

(1) To cooperative Federal, State, Tribal, and local government officials, employees, or contractors, and other parties as necessary to carry out the program; and other parties engaged to assist in administering the program. Such contractors and other parties will be bound by the nondisclosure provisions of the Privacy Act. This routine use assists the agency in carrying out the program, and thus is compatible with the purpose for which the records are created and maintained;

(2) To the appropriate agency, whether Federal, State, local, Tribal, or foreign, charged with responsibility of investigating or prosecuting a violation of law or of enforcing, implementing, or complying with a statute, rule, regulation, or order issued pursuant thereto, of any record within this system when information available indicates a violation or potential violation of law, whether civil, criminal, or regulatory in nature, and either arising by general statute or particular program statute, or by rule, regulation, or court order issued pursuant thereto;

(3) To the Department of Justice when the agency, or any component thereof, or any employee of the agency in his or her official capacity, or any employee of the agency in his or her individual capacity where the Department of Justice has agreed to represent the employee, or the United States, in litigation, where the agency determines that litigation is likely to affect the agency or any of its components, is a party to litigation or has an interest in such litigation, and the use of such records by the Department of Justice is deemed by the agency to be relevant and necessary to the litigation; provided, however, that in each case, the agency determines that disclosure of the records to the Department of Justice is a use of the information contained in the records that is compatible with the purpose for which the records were collected;

(4) For use in a proceeding before a court or adjudicative body before which the agency is authorized to appear, when the agency, or any component thereof, or any employee of the agency in his or her official capacity, or any employee of the agency in his or her individual capacity where the agency has agreed to represent the employee, or the United States, where the agency determines that litigation is likely to affect the agency or any of its components, is a party to litigation or has an interest in such litigation, and the agency determines that use of such records is relevant and necessary to the litigation; provided, however, that in each case, the agency determines that disclosure of the records to the court is a use of the information contained in the records that is compatible with the purpose for which the records were collected;

(5) To appropriate agencies, entities, and persons when the agency suspects or has confirmed that the security or confidentiality of information in the system of records has been compromised; the agency has determined that as a result of the suspected or confirmed compromise, there is a risk of harm to economic or property interests, a risk of identity theft or fraud, or a risk of harm to the security of integrity of this system or other systems or programs (whether maintained by the agency or another agency or entity) that rely upon the compromised information; and the disclosure made to such agencies, entities, and persons is reasonably necessary to assist in connection with the agency's efforts to respond to the suspected or confirmed compromise and prevent, minimize, or remedy such harm;

(6) To USDA contractors, partner agency employee or contractors, or private industry employed to identify patterns, trends, or anomalies indicative of fraud, waste, or abuse;

(7) To land management agencies, such as the Bureau of Land Management and the U.S. Fish and Wildlife Service relating to wildlife damage on grazing allotments;

(8) To consumer reporting agencies in accordance with section 31 U.S.C. 3711(e);

(9) To Federal, State, Tribal, and local regulatory agencies and their employees and contractors who collaborate with Wildlife Services in implementation of, or agencies that regulate, wildlife management projects or programs, or who have an interest in, or regulate, animal or public health, or national security;

(10) To State- or Federal Government-level representatives of the U.S. Environmental Protection Agency, in compliance with the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) mandate (FIFRA Sec. 8, 7 U.S.C. 136f, and FIFRA 7 U.S.C. 136i-l), of the location on a cooperator's property where certain regulated pesticide devices are deployed or regulated pesticides are applied; and

(11) To the National Archives and Records Administration (NARA) or to the General Services Administration for records management inspections conducted under 44 U.S.C. 2904 and 2906.

Effects of Failure to Furnish Information

Failure to provide the solicited information will not subject you to penalties or adverse consequences.

U.S. DEPARTMENT OF AGRICULTURE
ANIMAL AND PLANT HEALTH INSPECTION SERVICE
WILDLIFE SERVICES

PERMIT REVIEW

☒ **RENEWAL**
Permit No:
☐ Without Change

1. Name, Address, and Telephone Number	2. Location of Damage	
MARTIN LOWNEY 12345 W ALAMEDA PKWY LAKEWOOD, CO 80228 Telephone ☐ Home ☒ Work Fax/Email: MARTIN.S.LOWNEY@USDA.GOV	CITY PARK	
	3. County DENVER	4. State CO

5. RESOURCE/DAMAGE ESTIMATE

A. Resources Damaged	B. Description of Damage
TURFGRASS, HUMAN HEALTH AND SAFETY, PROPERTY	FECAL MATTER, AGGRESSIVE BEHAVIOR, TURF DAMAGE

6. MIGRATORY BIRD SPECIES		7. PERMIT RECOMMENDATION		
Depredating Species	Number Involved	Take Recommendation	Number Recommended	Methods
1. CANADA GOOSE	526	☒ Yes ☐ No	506	ALL LEGAL METHODS
2.		☐ Yes ☐ No		
3.		☐ Yes ☐ No		
4.		☐ Yes ☐ No		

8a. PREVIOUS ACTIONS TO ADDRESS PROBLEM AND RESULTS OF THOSE ACTIONS:

ACTIVE HAZING AND HARASSMENT PROGRAM BY DPR STAFF WITH GOOSINATOR, DOGS, AND USED EXCLUSION BARRIERS IN CERTAIN AREAS WITH LITTLE TO NO SUCCESS. HAZING AT LEAST 15 YEARS AND EGG OILING AT LEAST 5 YEARS.

8b. COMMENTS:

PERMISSION TO REMOVE GEESE DURING THE MOLT. TO SUPPLEMENT CURRENT MANAGEMENT METHODS. ACTIONS ARE CONSISTENT WITH 2005 FWS RESIDENT CANADA GOOSE EIS, 2013 WS-CO BIRD DAMAGE MGMT EA, AND 2019 STATE OF COLORADO RESIDENT GOOSE PLAN.

9. RECOMMENDED ACTIONS

Action:

☒ Harassment ☒ Habitat Alteration ☐ Husbandry ☒ Exclusion ☐ Lethal trapping ☒ Chemical repellent

☐ Capture and relocation ☒ Egg/nest destruction ☒ Shooting ☒ Other:

10A. WS Investigator Name and Address: *(Print)*	10B. WS Investigator Signature
(b) (6) 12345 W ALAMEDA PKWY LAKEWOOD, CO 80228 Telephone Number: (b) (6) Email: (b) (6) @USDA.GOV	Date: 06/12/2019

WS Form 37 (2011) OMB Control No. 0579-0335

Approved: ____ _____
Denied: _____ 2020-APHIS-04219-F-00022

Privacy Act Notice

Title 5. United States Code, Section 552a(e)(3) requires that each agency that maintains a system of records provide each individual from whom the agency solicits information with the following information.

Authority for Requesting Information

Title 7, United States Code, Section 426-426c, and Title 16 United States Code, Section 667, authorizes officers, agents, and employees of the USDA, APHIS, Wildlife Services to conduct a program of wildlife services and to enter into agreements with States, local jurisdictions, individuals, and public and private agencies, organizations, and institutions for the purpose of conducting such services.

Nature of Your Disclosure of Information

Disclosure of information solicited by USDA, APHIS, Wildlife Services is voluntary.

Principle Purpose for Which the Information is Solicited

Information is solicited from you for the purpose of executing and implementing agreements for control of wildlife damage.

Routine Uses Which May be Made of the Information

(1) To cooperative Federal, State, Tribal, and local government officials, employees, or contractors, and other parties as necessary to carry out the program; and other parties engaged to assist in administering the program. Such contractors and other parties will be bound by the nondisclosure provisions of the Privacy Act. This routine use assists the agency in carrying out the program, and thus is compatible with the purpose for which the records are created and maintained;

(2) To the appropriate agency, whether Federal, State, local, Tribal, or foreign, charged with responsibility of investigating or prosecuting a violation of law or of enforcing, implementing, or complying with a statute, rule, regulation, or order issued pursuant thereto, of any record within this system when information available indicates a violation or potential violation of law, whether civil, criminal, or regulatory in nature, and either arising by general statute or particular program statute, or by rule, regulation, or court order issued pursuant thereto;

(3) To the Department of Justice when the agency, or any component thereof, or any employee of the agency in his or her official capacity, or any employee of the agency in his or her individual capacity where the Department of Justice has agreed to represent the employee, or the United States, in litigation, where the agency determines that litigation is likely to affect the agency or any of its components, is a party to litigation or has an interest in such litigation, and the use of such records by the Department of Justice is deemed by the agency to be relevant and necessary to the litigation; provided, however, that in each case, the agency determines that disclosure of the records to the Department of Justice is a use of the information contained in the records that is compatible with the purpose for which the records were collected;

(4) For use in a proceeding before a court or adjudicative body before which the agency is authorized to appear, when the agency, or any component thereof, or any employee of the agency in his or her official capacity, or any employee of the agency in his or her individual capacity where the agency has agreed to represent the employee, or the United States, where the agency determines that litigation is likely to affect the agency or any of its components, is a party to litigation or has an interest in such litigation, and the agency determines that use of such records is relevant and necessary to the litigation; provided, however, that in each case, the agency determines that disclosure of the records to the court is a use of the information contained in the records that is compatible with the purpose for which the records were collected;

(5) To appropriate agencies, entities, and persons when the agency suspects or has confirmed that the security or confidentiality of information in the system of records has been compromised; the agency has determined that as a result of the suspected or confirmed compromise, there is a risk of harm to economic or property interests, a risk of identity theft or fraud, or a risk of harm to the security of integrity of this system or other systems or programs (whether maintained by the agency or another agency or entity) that rely upon the compromised information; and the disclosure made to such agencies, entities, and persons is reasonably necessary to assist in connection with the agency's efforts to respond to the suspected or confirmed compromise and prevent, minimize, or remedy such harm;

(6) To USDA contractors, partner agency employee or contractors, or private industry employed to identify patterns, trends, or anomalies indicative of fraud, waste, or abuse;

(7) To land management agencies, such as the Bureau of Land Management and the U.S. Fish and Wildlife Service relating to wildlife damage on grazing allotments;

(8) To consumer reporting agencies in accordance with section 31 U.S.C. 3711(e);

(9) To Federal, State, Tribal, and local regulatory agencies and their employees and contractors who collaborate with Wildlife Services in implementation of, or agencies that regulate, wildlife management projects or programs, or who have an interest in, or regulate, animal or public health, or national security;

(10) To State- or Federal Government-level representatives of the U.S. Environmental Protection Agency, in compliance with the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) mandate (FIFRA Sec. 8, 7 U.S.C. 136f, and FIFRA 7 U.S.C. 136i-l), of the location on a cooperator's property where certain regulated pesticide devices are deployed or regulated pesticides are applied; and

(11) To the National Archives and Records Administration (NARA) or to the General Services Administration for records management inspections conducted under 44 U.S.C. 2904 and 2906.

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U.S. DEPARTMENT OF AGRICULTURE
ANIMAL AND PLANT HEALTH INSPECTION SERVICE
WILDLIFE SERVICES

PERMIT REVIEW

☒ **RENEWAL**
Permit No:
☐ Without Change

1. Name, Address, and Telephone Number	2. Location of Damage	
MARTIN LOWNEY 12345 W ALAMEDA PKWY LAKEWOOD, CO 80228 Telephone ☐ Home ☒ Work Fax/Email: MARTIN.S.LOWNEY@USDA.GOV	GARFIELD LAKE PARK	
	3. County DENVER	4. State CO

5. RESOURCE/DAMAGE ESTIMATE

A. Resources Damaged	B. Description of Damage
TURFGRASS, HUMAN HEALTH AND SAFETY, PROPERTY	FECAL MATTER, AGGRESSIVE BEHAVIOR, TURF DAMAGE

6. MIGRATORY BIRD SPECIES		7. PERMIT RECOMMENDATION		
Depredating Species	Number Involved	Take Recommendation	Number Recommended	Methods
1. CANADA GOOSE	251	☒ Yes ☐ No	231	ALL LEGAL METHODS
2.		☐ Yes ☐ No		
3.		☐ Yes ☐ No		
4.		☐ Yes ☐ No		

8a. PREVIOUS ACTIONS TO ADDRESS PROBLEM AND RESULTS OF THOSE ACTIONS:

AACTIVE HAZING AND HARASSMENT PROGRAM BY DPR STAFF WITH GOOSINATOR, DOGS, AND USED EXCLUSION BARRIERS IN CERTAIN AREAS WITH LITTLE TO NO SUCCESS. HAZING AT LEAST 15 YEARS AND EGG OILING AT LEAST 5 YEARS.

8b. COMMENTS:

PERMISSION TO REMOVE GEESE DURING THE MOLT. TO SUPPLEMENT CURRENT MANAGEMENT METHODS. ACTIONS ARE CONSISTENT WITH 2005 FWS RESIDENT CANADA GOOSE EIS, 2013 WS-CO BIRD DAMAGE MGMT EA, AND 2019 STATE OF COLORADO RESIDENT GOOSE PLAN.

9. RECOMMENDED ACTIONS

Action:

☒ Harassment ☒ Habitat Alteration ☐ Husbandry ☒ Exclusion ☐ Lethal trapping ☒ Chemical repellent

☐ Capture and relocation ☒ Egg/nest destruction ☒ Shooting ☒ Other:

10A. WS Investigator Name and Address: *(Print)*	10B. WS Investigator Signature
(b) (6) 12345 W ALAMEDA PKWY LAKEWOOD, CO 80228 Telephone Number: (b) (6) Email: (b) (6) @USDA.GOV	Date: 06/12/2019

WS Form 37 (2011) OMB Control No. 0579-0335

Approved: ____ _____
Denied: _____ 2020-APHIS-04219-F-00024

Privacy Act Notice

Title 5. United States Code, Section 552a(e)(3) requires that each agency that maintains a system of records provide each individual from whom the agency solicits information with the following information.

Authority for Requesting Information

Title 7, United States Code, Section 426-426c, and Title 16 United States Code, Section 667, authorizes officers, agents, and employees of the USDA, APHIS, Wildlife Services to conduct a program of wildlife services and to enter into agreements with States, local jurisdictions, individuals, and public and private agencies, organizations, and institutions for the purpose of conducting such services.

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(2) To the appropriate agency, whether Federal, State, local, Tribal, or foreign, charged with responsibility of investigating or prosecuting a violation of law or of enforcing, implementing, or complying with a statute, rule, regulation, or order issued pursuant thereto, of any record within this system when information available indicates a violation or potential violation of law, whether civil, criminal, or regulatory in nature, and either arising by general statute or particular program statute, or by rule, regulation, or court order issued pursuant thereto;

(3) To the Department of Justice when the agency, or any component thereof, or any employee of the agency in his or her official capacity, or any employee of the agency in his or her individual capacity where the Department of Justice has agreed to represent the employee, or the United States, in litigation, where the agency determines that litigation is likely to affect the agency or any of its components, is a party to litigation or has an interest in such litigation, and the use of such records by the Department of Justice is deemed by the agency to be relevant and necessary to the litigation; provided, however, that in each case, the agency determines that disclosure of the records to the Department of Justice is a use of the information contained in the records that is compatible with the purpose for which the records were collected;

(4) For use in a proceeding before a court or adjudicative body before which the agency is authorized to appear, when the agency, or any component thereof, or any employee of the agency in his or her official capacity, or any employee of the agency in his or her individual capacity where the agency has agreed to represent the employee, or the United States, where the agency determines that litigation is likely to affect the agency or any of its components, is a party to litigation or has an interest in such litigation, and the agency determines that use of such records is relevant and necessary to the litigation; provided, however, that in each case, the agency determines that disclosure of the records to the court is a use of the information contained in the records that is compatible with the purpose for which the records were collected;

(5) To appropriate agencies, entities, and persons when the agency suspects or has confirmed that the security or confidentiality of information in the system of records has been compromised; the agency has determined that as a result of the suspected or confirmed compromise, there is a risk of harm to economic or property interests, a risk of identity theft or fraud, or a risk of harm to the security of integrity of this system or other systems or programs (whether maintained by the agency or another agency or entity) that rely upon the compromised information; and the disclosure made to such agencies, entities, and persons is reasonably necessary to assist in connection with the agency's efforts to respond to the suspected or confirmed compromise and prevent, minimize, or remedy such harm;

(6) To USDA contractors, partner agency employee or contractors, or private industry employed to identify patterns, trends, or anomalies indicative of fraud, waste, or abuse;

(7) To land management agencies, such as the Bureau of Land Management and the U.S. Fish and Wildlife Service relating to wildlife damage on grazing allotments;

(8) To consumer reporting agencies in accordance with section 31 U.S.C. 3711(e);

(9) To Federal, State, Tribal, and local regulatory agencies and their employees and contractors who collaborate with Wildlife Services in implementation of, or agencies that regulate, wildlife management projects or programs, or who have an interest in, or regulate, animal or public health, or national security;

(10) To State- or Federal Government-level representatives of the U.S. Environmental Protection Agency, in compliance with the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) mandate (FIFRA Sec. 8, 7 U.S.C. 136f, and FIFRA 7 U.S.C. 136i-l), of the location on a cooperator's property where certain regulated pesticide devices are deployed or regulated pesticides are applied; and

(11) To the National Archives and Records Administration (NARA) or to the General Services Administration for records management inspections conducted under 44 U.S.C. 2904 and 2906.

Effects of Failure to Furnish Information

Failure to provide the solicited information will not subject you to penalties or adverse consequences.

U.S. DEPARTMENT OF AGRICULTURE
ANIMAL AND PLANT HEALTH INSPECTION SERVICE
WILDLIFE SERVICES

PERMIT REVIEW

☒ **RENEWAL**
Permit No:
☐ Without Change

1. Name, Address, and Telephone Number	2. Location of Damage	
MARTIN LOWNEY 12345 W ALAMEDA PKWY LAKEWOOD, CO 80228 Telephone ☐ Home ☒ Work Fax/Email: MARTIN.S.LOWNEY@USDA.GOV	GARLAND PARK	
	3. County DENVER	4. State CO

5. RESOURCE/DAMAGE ESTIMATE

A. Resources Damaged	B. Description of Damage
TURFGRASS, HUMAN HEALTH AND SAFETY, PROPERTY	FECAL MATTER, AGGRESSIVE BEHAVIOR, TURF DAMAGE

6. MIGRATORY BIRD SPECIES		7. PERMIT RECOMMENDATION		
Depredating Species	Number Involved	Take Recommendation	Number Recommended	Methods
1. CANADA GOOSE	145	☒ Yes ☐ No	125	ALL LEGAL METHODS
2.		☐ Yes ☐ No		
3.		☐ Yes ☐ No		
4.		☐ Yes ☐ No		

8a. PREVIOUS ACTIONS TO ADDRESS PROBLEM AND RESULTS OF THOSE ACTIONS:

ACTIVE HAZING AND HARASSMENT PROGRAM BY DPR STAFF WITH GOOSINATOR, DOGS, AND USED EXCLUSION BARRIERS IN CERTAIN AREAS WITH LITTLE TO NO SUCCESS. HAZING AT LEAST 15 YEARS AND EGG OILING AT LEAST 5 YEARS.

8b. COMMENTS:

PERMISSION TO REMOVE GEESE DURING THE MOLT. TO SUPPLEMENT CURRENT MANAGEMENT METHODS. ACTIONS ARE CONSISTENT WITH 2005 FWS RESIDENT CANADA GOOSE EIS, 2013 WS-CO BIRD DAMAGE MGMT EA, AND 2019 STATE OF COLORADO RESIDENT GOOSE PLAN.

9. RECOMMENDED ACTIONS

Action:

☒ Harassment ☒ Habitat Alteration ☐ Husbandry ☒ Exclusion ☐ Lethal trapping ☒ Chemical repellent

☐ Capture and relocation ☒ Egg/nest destruction ☒ Shooting ☒ Other:

10A. WS Investigator Name and Address: *(Print)*	10B. WS Investigator Signature
(b) (6) 12345 W ALAMEDA PKWY LAKEWOOD, CO 80228 Telephone Number: (b) (6) Email: (b) (6) @USDA.GOV	Date: 06/12/2019

WS Form 37 (2011) OMB Control No. 0579-0335

Approved: ____ _____
Denied: ____ 2020-APHIS-04219-F-00026

Privacy Act Notice

Title 5. United States Code, Section 552a(e)(3) requires that each agency that maintains a system of records provide each individual from whom the agency solicits information with the following information.

Authority for Requesting Information

Title 7, United States Code, Section 426-426c, and Title 16 United States Code, Section 667, authorizes officers, agents, and employees of the USDA, APHIS, Wildlife Services to conduct a program of wildlife services and to enter into agreements with States, local jurisdictions, individuals, and public and private agencies, organizations, and institutions for the purpose of conducting such services.

Nature of Your Disclosure of Information

Disclosure of information solicited by USDA, APHIS, Wildlife Services is voluntary.

Principle Purpose for Which the Information is Solicited

Information is solicited from you for the purpose of executing and implementing agreements for control of wildlife damage.

Routine Uses Which May be Made of the Information

(1) To cooperative Federal, State, Tribal, and local government officials, employees, or contractors, and other parties as necessary to carry out the program; and other parties engaged to assist in administering the program. Such contractors and other parties will be bound by the nondisclosure provisions of the Privacy Act. This routine use assists the agency in carrying out the program, and thus is compatible with the purpose for which the records are created and maintained;

(2) To the appropriate agency, whether Federal, State, local, Tribal, or foreign, charged with responsibility of investigating or prosecuting a violation of law or of enforcing, implementing, or complying with a statute, rule, regulation, or order issued pursuant thereto, of any record within this system when information available indicates a violation or potential violation of law, whether civil, criminal, or regulatory in nature, and either arising by general statute or particular program statute, or by rule, regulation, or court order issued pursuant thereto;

(3) To the Department of Justice when the agency, or any component thereof, or any employee of the agency in his or her official capacity, or any employee of the agency in his or her individual capacity where the Department of Justice has agreed to represent the employee, or the United States, in litigation, where the agency determines that litigation is likely to affect the agency or any of its components, is a party to litigation or has an interest in such litigation, and the use of such records by the Department of Justice is deemed by the agency to be relevant and necessary to the litigation; provided, however, that in each case, the agency determines that disclosure of the records to the Department of Justice is a use of the information contained in the records that is compatible with the purpose for which the records were collected;

(4) For use in a proceeding before a court or adjudicative body before which the agency is authorized to appear, when the agency, or any component thereof, or any employee of the agency in his or her official capacity, or any employee of the agency in his or her individual capacity where the agency has agreed to represent the employee, or the United States, where the agency determines that litigation is likely to affect the agency or any of its components, is a party to litigation or has an interest in such litigation, and the agency determines that use of such records is relevant and necessary to the litigation; provided, however, that in each case, the agency determines that disclosure of the records to the court is a use of the information contained in the records that is compatible with the purpose for which the records were collected;

(5) To appropriate agencies, entities, and persons when the agency suspects or has confirmed that the security or confidentiality of information in the system of records has been compromised; the agency has determined that as a result of the suspected or confirmed compromise, there is a risk of harm to economic or property interests, a risk of identity theft or fraud, or a risk of harm to the security of integrity of this system or other systems or programs (whether maintained by the agency or another agency or entity) that rely upon the compromised information; and the disclosure made to such agencies, entities, and persons is reasonably necessary to assist in connection with the agency's efforts to respond to the suspected or confirmed compromise and prevent, minimize, or remedy such harm;

(6) To USDA contractors, partner agency employee or contractors, or private industry employed to identify patterns, trends, or anomalies indicative of fraud, waste, or abuse;

(7) To land management agencies, such as the Bureau of Land Management and the U.S. Fish and Wildlife Service relating to wildlife damage on grazing allotments;

(8) To consumer reporting agencies in accordance with section 31 U.S.C. 3711(e);

(9) To Federal, State, Tribal, and local regulatory agencies and their employees and contractors who collaborate with Wildlife Services in implementation of, or agencies that regulate, wildlife management projects or programs, or who have an interest in, or regulate, animal or public health, or national security;

(10) To State- or Federal Government-level representatives of the U.S. Environmental Protection Agency, in compliance with the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) mandate (FIFRA Sec. 8, 7 U.S.C. 136f, and FIFRA 7 U.S.C. 136i-l), of the location on a cooperator's property where certain regulated pesticide devices are deployed or regulated pesticides are applied; and

(11) To the National Archives and Records Administration (NARA) or to the General Services Administration for records management inspections conducted under 44 U.S.C. 2904 and 2906.

Effects of Failure to Furnish Information

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U.S. DEPARTMENT OF AGRICULTURE
ANIMAL AND PLANT HEALTH INSPECTION SERVICE
WILDLIFE SERVICES

PERMIT REVIEW

☒ **RENEWAL**
Permit No:
☐ Without Change

1. Name, Address, and Telephone Number	2. Location of Damage	
MARTIN LOWNEY 12345 W ALAMEDA PKWY LAKEWOOD, CO 80228 Telephone ☐ Home ☒ Work Fax/Email: MARTIN.S.LOWNEY@USDA.GOV	HARVEY PARK	
	3. County DENVER	4. State CO

5. RESOURCE/DAMAGE ESTIMATE

A. Resources Damaged	B. Description of Damage
TURFGRASS, HUMAN HEALTH AND SAFETY, PROPERTY	FECAL MATTER, AGGRESSIVE BEHAVIOR, TURF DAMAGE

6. MIGRATORY BIRD SPECIES		7. PERMIT RECOMMENDATION		
Depredating Species	Number Involved	Take Recommendation	Number Recommended	Methods
1. CANADA GOOSE	116	☒ Yes ☐ No	96	ALL LEGAL METHODS
2.		☐ Yes ☐ No		
3.		☐ Yes ☐ No		
4.		☐ Yes ☐ No		

8a. PREVIOUS ACTIONS TO ADDRESS PROBLEM AND RESULTS OF THOSE ACTIONS:

ACTIVE HAZING AND HARASSMENT PROGRAM BY DPR STAFF WITH GOOSINATOR, DOGS, AND USED EXCLUSION BARRIERS IN CERTAIN AREAS WITH LITTLE TO NO SUCCESS. HAZING AT LEAST 15 YEARS AND EGG OILING AT LEAST 5 YEARS.

8b. COMMENTS:

PERMISSION TO REMOVE GEESE DURING THE MOLT. TO SUPPLEMENT CURRENT MANAGEMENT METHODS. ACTIONS ARE CONSISTENT WITH 2005 FWS RESIDENT CANADA GOOSE EIS, 2013 WS-CO BIRD DAMAGE MGMT EA, AND 2019 STATE OF COLORADO RESIDENT GOOSE PLAN.

9. RECOMMENDED ACTIONS

Action:

☒ Harassment ☒ Habitat Alteration ☐ Husbandry ☒ Exclusion ☐ Lethal trapping ☒ Chemical repellent

☐ Capture and relocation ☒ Egg/nest destruction ☒ Shooting ☒ Other:

10A. WS Investigator Name and Address: *(Print)*	10B. WS Investigator Signature
(b) (6) 12345 W ALAMEDA PKWY LAKEWOOD, CO 80228 Telephone Number: (b) (6) Email: (b) (6) @USDA.GOV	Date: 06/12/2019

WS Form 37 (2011) OMB Control No. 0579-0335

Approved: ____ _____
Denied: _____ 2020-APHIS-04219-F_00028

Privacy Act Notice

Title 5. United States Code, Section 552a(e)(3) requires that each agency that maintains a system of records provide each individual from whom the agency solicits information with the following information.

Authority for Requesting Information

Title 7, United States Code, Section 426-426c, and Title 16 United States Code, Section 667, authorizes officers, agents, and employees of the USDA, APHIS, Wildlife Services to conduct a program of wildlife services and to enter into agreements with States, local jurisdictions, individuals, and public and private agencies, organizations, and institutions for the purpose of conducting such services.

Nature of Your Disclosure of Information

Disclosure of information solicited by USDA, APHIS, Wildlife Services is voluntary.

Principle Purpose for Which the Information is Solicited

Information is solicited from you for the purpose of executing and implementing agreements for control of wildlife damage.

Routine Uses Which May be Made of the Information

(1) To cooperative Federal, State, Tribal, and local government officials, employees, or contractors, and other parties as necessary to carry out the program; and other parties engaged to assist in administering the program. Such contractors and other parties will be bound by the nondisclosure provisions of the Privacy Act. This routine use assists the agency in carrying out the program, and thus is compatible with the purpose for which the records are created and maintained;

(2) To the appropriate agency, whether Federal, State, local, Tribal, or foreign, charged with responsibility of investigating or prosecuting a violation of law or of enforcing, implementing, or complying with a statute, rule, regulation, or order issued pursuant thereto, of any record within this system when information available indicates a violation or potential violation of law, whether civil, criminal, or regulatory in nature, and either arising by general statute or particular program statute, or by rule, regulation, or court order issued pursuant thereto;

(3) To the Department of Justice when the agency, or any component thereof, or any employee of the agency in his or her official capacity, or any employee of the agency in his or her individual capacity where the Department of Justice has agreed to represent the employee, or the United States, in litigation, where the agency determines that litigation is likely to affect the agency or any of its components, is a party to litigation or has an interest in such litigation, and the use of such records by the Department of Justice is deemed by the agency to be relevant and necessary to the litigation; provided, however, that in each case, the agency determines that disclosure of the records to the Department of Justice is a use of the information contained in the records that is compatible with the purpose for which the records were collected;

(4) For use in a proceeding before a court or adjudicative body before which the agency is authorized to appear, when the agency, or any component thereof, or any employee of the agency in his or her official capacity, or any employee of the agency in his or her individual capacity where the agency has agreed to represent the employee, or the United States, where the agency determines that litigation is likely to affect the agency or any of its components, is a party to litigation or has an interest in such litigation, and the agency determines that use of such records is relevant and necessary to the litigation; provided, however, that in each case, the agency determines that disclosure of the records to the court is a use of the information contained in the records that is compatible with the purpose for which the records were collected;

(5) To appropriate agencies, entities, and persons when the agency suspects or has confirmed that the security or confidentiality of information in the system of records has been compromised; the agency has determined that as a result of the suspected or confirmed compromise, there is a risk of harm to economic or property interests, a risk of identity theft or fraud, or a risk of harm to the security of integrity of this system or other systems or programs (whether maintained by the agency or another agency or entity) that rely upon the compromised information; and the disclosure made to such agencies, entities, and persons is reasonably necessary to assist in connection with the agency's efforts to respond to the suspected or confirmed compromise and prevent, minimize, or remedy such harm;

(6) To USDA contractors, partner agency employee or contractors, or private industry employed to identify patterns, trends, or anomalies indicative of fraud, waste, or abuse;

(7) To land management agencies, such as the Bureau of Land Management and the U.S. Fish and Wildlife Service relating to wildlife damage on grazing allotments;

(8) To consumer reporting agencies in accordance with section 31 U.S.C. 3711(e);

(9) To Federal, State, Tribal, and local regulatory agencies and their employees and contractors who collaborate with Wildlife Services in implementation of, or agencies that regulate, wildlife management projects or programs, or who have an interest in, or regulate, animal or public health, or national security;

(10) To State- or Federal Government-level representatives of the U.S. Environmental Protection Agency, in compliance with the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) mandate (FIFRA Sec. 8, 7 U.S.C. 136f, and FIFRA 7 U.S.C. 136i-l), of the location on a cooperator's property where certain regulated pesticide devices are deployed or regulated pesticides are applied; and

(11) To the National Archives and Records Administration (NARA) or to the General Services Administration for records management inspections conducted under 44 U.S.C. 2904 and 2906.

Effects of Failure to Furnish Information

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U.S. DEPARTMENT OF AGRICULTURE
ANIMAL AND PLANT HEALTH INSPECTION SERVICE
WILDLIFE SERVICES

PERMIT REVIEW

☒ **RENEWAL**
Permit No:
☐ Without Change

1. Name, Address, and Telephone Number	2. Location of Damage	
MARTIN LOWNEY 12345 W ALAMEDA PKWY LAKEWOOD, CO 80228 Telephone ☐ Home ☒ Work Fax/Email: MARTIN.S.LOWNEY@USDA.GOV	HUSTON PARK	
	3. County DENVER	4. State CO

5. RESOURCE/DAMAGE ESTIMATE

A. Resources Damaged	B. Description of Damage
TURFGRASS, HUMAN HEALTH AND SAFETY, PROPERTY	FECAL MATTER, AGGRESSIVE BEHAVIOR, TURF DAMAGE

6. MIGRATORY BIRD SPECIES		7. PERMIT RECOMMENDATION		
Depredating Species	Number Involved	Take Recommendation	Number Recommended	Methods
1. CANADA GOOSE	14	☒ Yes ☐ No	14	ALL LEGAL METHODS
2.		☐ Yes ☐ No		
3.		☐ Yes ☐ No		
4.		☐ Yes ☐ No		

8a. PREVIOUS ACTIONS TO ADDRESS PROBLEM AND RESULTS OF THOSE ACTIONS:

ACTIVE HAZING AND HARASSMENT PROGRAM BY DPR STAFF WITH GOOSINATOR, DOGS, AND USED EXCLUSION BARRIERS IN CERTAIN AREAS WITH LITTLE TO NO SUCCESS. HAZING AT LEAST 15 YEARS AND EGG OILING AT LEAST 5 YEARS.

8b. COMMENTS:

PERMISSION TO REMOVE GEESE DURING THE MOLT. TO SUPPLEMENT CURRENT MANAGEMENT METHODS. ACTIONS ARE CONSISTENT WITH 2005 FWS RESIDENT CANADA GOOSE EIS, 2013 WS-CO BIRD DAMAGE MGMT EA, AND 2019 STATE OF COLORADO RESIDENT GOOSE PLAN.

9. RECOMMENDED ACTIONS

Action:

☒ Harassment ☒ Habitat Alteration ☐ Husbandry ☒ Exclusion ☐ Lethal trapping ☒ Chemical repellent

☐ Capture and relocation ☒ Egg/nest destruction ☒ Shooting ☒ Other:

10A. WS Investigator Name and Address: *(Print)*	10B. WS Investigator Signature
(b) (6) PKWY LAKEWOOD, CO 80228 Telephone Number: (b) (6) Email: (b) (6) @USDA.GOV	Date: 06/12/2019

WS Form 37 (2011) OMB Control No. 0579-0335

Approved: ____ _____
Denied: _____ 2020-APHIS-04219-F 00030

Privacy Act Notice

Title 5. United States Code, Section 552a(e)(3) requires that each agency that maintains a system of records provide each individual from whom the agency solicits information with the following information.

Authority for Requesting Information

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Nature of Your Disclosure of Information

Disclosure of information solicited by USDA, APHIS, Wildlife Services is voluntary.

Principle Purpose for Which the Information is Solicited

Information is solicited from you for the purpose of executing and implementing agreements for control of wildlife damage.

Routine Uses Which May be Made of the Information

(1) To cooperative Federal, State, Tribal, and local government officials, employees, or contractors, and other parties as necessary to carry out the program; and other parties engaged to assist in administering the program. Such contractors and other parties will be bound by the nondisclosure provisions of the Privacy Act. This routine use assists the agency in carrying out the program, and thus is compatible with the purpose for which the records are created and maintained;

(2) To the appropriate agency, whether Federal, State, local, Tribal, or foreign, charged with responsibility of investigating or prosecuting a violation of law or of enforcing, implementing, or complying with a statute, rule, regulation, or order issued pursuant thereto, of any record within this system when information available indicates a violation or potential violation of law, whether civil, criminal, or regulatory in nature, and either arising by general statute or particular program statute, or by rule, regulation, or court order issued pursuant thereto;

(3) To the Department of Justice when the agency, or any component thereof, or any employee of the agency in his or her official capacity, or any employee of the agency in his or her individual capacity where the Department of Justice has agreed to represent the employee, or the United States, in litigation, where the agency determines that litigation is likely to affect the agency or any of its components, is a party to litigation or has an interest in such litigation, and the use of such records by the Department of Justice is deemed by the agency to be relevant and necessary to the litigation; provided, however, that in each case, the agency determines that disclosure of the records to the Department of Justice is a use of the information contained in the records that is compatible with the purpose for which the records were collected;

(4) For use in a proceeding before a court or adjudicative body before which the agency is authorized to appear, when the agency, or any component thereof, or any employee of the agency in his or her official capacity, or any employee of the agency in his or her individual capacity where the agency has agreed to represent the employee, or the United States, where the agency determines that litigation is likely to affect the agency or any of its components, is a party to litigation or has an interest in such litigation, and the agency determines that use of such records is relevant and necessary to the litigation; provided, however, that in each case, the agency determines that disclosure of the records to the court is a use of the information contained in the records that is compatible with the purpose for which the records were collected;

(5) To appropriate agencies, entities, and persons when the agency suspects or has confirmed that the security or confidentiality of information in the system of records has been compromised; the agency has determined that as a result of the suspected or confirmed compromise, there is a risk of harm to economic or property interests, a risk of identity theft or fraud, or a risk of harm to the security of integrity of this system or other systems or programs (whether maintained by the agency or another agency or entity) that rely upon the compromised information; and the disclosure made to such agencies, entities, and persons is reasonably necessary to assist in connection with the agency's efforts to respond to the suspected or confirmed compromise and prevent, minimize, or remedy such harm;

(6) To USDA contractors, partner agency employee or contractors, or private industry employed to identify patterns, trends, or anomalies indicative of fraud, waste, or abuse;

(7) To land management agencies, such as the Bureau of Land Management and the U.S. Fish and Wildlife Service relating to wildlife damage on grazing allotments;

(8) To consumer reporting agencies in accordance with section 31 U.S.C. 3711(e);

(9) To Federal, State, Tribal, and local regulatory agencies and their employees and contractors who collaborate with Wildlife Services in implementation of, or agencies that regulate, wildlife management projects or programs, or who have an interest in, or regulate, animal or public health, or national security;

(10) To State- or Federal Government-level representatives of the U.S. Environmental Protection Agency, in compliance with the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) mandate (FIFRA Sec. 8, 7 U.S.C. 136f, and FIFRA 7 U.S.C. 136i-l), of the location on a cooperator's property where certain regulated pesticide devices are deployed or regulated pesticides are applied; and

(11) To the National Archives and Records Administration (NARA) or to the General Services Administration for records management inspections conducted under 44 U.S.C. 2904 and 2906.

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U.S. DEPARTMENT OF AGRICULTURE
ANIMAL AND PLANT HEALTH INSPECTION SERVICE
WILDLIFE SERVICES

PERMIT REVIEW

☒ **RENEWAL**
Permit No:
☐ Without Change

1. Name, Address, and Telephone Number	2. Location of Damage	
MARTIN LOWNEY 12345 W ALAMEDA PKWY LAKEWOOD, CO 80228 Telephone ☐ Home ☒ Work Fax/Email: MARTIN.S.LOWNEY@USDA.GOV	OVERLAND POND PARK	
	3. County DENVER	4. State CO

5. RESOURCE/DAMAGE ESTIMATE

A. Resources Damaged	B. Description of Damage
TURFGRASS, HUMAN HEALTH AND SAFETY, PROPERTY	FECAL MATTER, AGGRESSIVE BEHAVIOR, TURF DAMAGE

6. MIGRATORY BIRD SPECIES		7. PERMIT RECOMMENDATION		
Depredating Species	Number Involved	Take Recommendation	Number Recommended	Methods
1. CANADA GOOSE	17	☒ Yes ☐ No	17	ALL LEGAL METHODS
2.		☐ Yes ☐ No		
3.		☐ Yes ☐ No		
4.		☐ Yes ☐ No		

8a. PREVIOUS ACTIONS TO ADDRESS PROBLEM AND RESULTS OF THOSE ACTIONS:

ACTIVE HAZING AND HARASSMENT PROGRAM BY DPR STAFF WITH GOOSINATOR, DOGS, AND USED EXCLUSION BARRIERS IN CERTAIN AREAS WITH LITTLE TO NO SUCCESS. HAZING AT LEAST 15 YEARS AND EGG OILING AT LEAST 5 YEARS.

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☐ Capture and relocation ☒ Egg/nest destruction ☒ Shooting ☒ Other:

10A. WS Investigator Name and Address: *(Print)*	10B. WS Investigator Signature
(b) (6) 12345 W ALAMEDA PKWY LAKEWOOD, CO 80228 Telephone Number: (b) (6) Email: (b) (6) @USDA.GOV	Date: 06/12/2019

WS Form 37 (2011) OMB Control No. 0579-0335

Approved: ____ _____
Denied: _____

2020-APHIS-04219-F 00032

Privacy Act Notice

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(2) To the appropriate agency, whether Federal, State, local, Tribal, or foreign, charged with responsibility of investigating or prosecuting a violation of law or of enforcing, implementing, or complying with a statute, rule, regulation, or order issued pursuant thereto, of any record within this system when information available indicates a violation or potential violation of law, whether civil, criminal, or regulatory in nature, and either arising by general statute or particular program statute, or by rule, regulation, or court order issued pursuant thereto;

(3) To the Department of Justice when the agency, or any component thereof, or any employee of the agency in his or her official capacity, or any employee of the agency in his or her individual capacity where the Department of Justice has agreed to represent the employee, or the United States, in litigation, where the agency determines that litigation is likely to affect the agency or any of its components, is a party to litigation or has an interest in such litigation, and the use of such records by the Department of Justice is deemed by the agency to be relevant and necessary to the litigation; provided, however, that in each case, the agency determines that disclosure of the records to the Department of Justice is a use of the information contained in the records that is compatible with the purpose for which the records were collected;

(4) For use in a proceeding before a court or adjudicative body before which the agency is authorized to appear, when the agency, or any component thereof, or any employee of the agency in his or her official capacity, or any employee of the agency in his or her individual capacity where the agency has agreed to represent the employee, or the United States, where the agency determines that litigation is likely to affect the agency or any of its components, is a party to litigation or has an interest in such litigation, and the agency determines that use of such records is relevant and necessary to the litigation; provided, however, that in each case, the agency determines that disclosure of the records to the court is a use of the information contained in the records that is compatible with the purpose for which the records were collected;

(5) To appropriate agencies, entities, and persons when the agency suspects or has confirmed that the security or confidentiality of information in the system of records has been compromised; the agency has determined that as a result of the suspected or confirmed compromise, there is a risk of harm to economic or property interests, a risk of identity theft or fraud, or a risk of harm to the security of integrity of this system or other systems or programs (whether maintained by the agency or another agency or entity) that rely upon the compromised information; and the disclosure made to such agencies, entities, and persons is reasonably necessary to assist in connection with the agency's efforts to respond to the suspected or confirmed compromise and prevent, minimize, or remedy such harm;

(6) To USDA contractors, partner agency employee or contractors, or private industry employed to identify patterns, trends, or anomalies indicative of fraud, waste, or abuse;

(7) To land management agencies, such as the Bureau of Land Management and the U.S. Fish and Wildlife Service relating to wildlife damage on grazing allotments;

(8) To consumer reporting agencies in accordance with section 31 U.S.C. 3711(e);

(9) To Federal, State, Tribal, and local regulatory agencies and their employees and contractors who collaborate with Wildlife Services in implementation of, or agencies that regulate, wildlife management projects or programs, or who have an interest in, or regulate, animal or public health, or national security;

(10) To State- or Federal Government-level representatives of the U.S. Environmental Protection Agency, in compliance with the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) mandate (FIFRA Sec. 8, 7 U.S.C. 136f, and FIFRA 7 U.S.C. 136i-l), of the location on a cooperator's property where certain regulated pesticide devices are deployed or regulated pesticides are applied; and

(11) To the National Archives and Records Administration (NARA) or to the General Services Administration for records management inspections conducted under 44 U.S.C. 2904 and 2906.

Effects of Failure to Furnish Information

Failure to provide the solicited information will not subject you to penalties or adverse consequences.

U.S. DEPARTMENT OF AGRICULTURE
ANIMAL AND PLANT HEALTH INSPECTION SERVICE
WILDLIFE SERVICES

PERMIT REVIEW

☒ **RENEWAL**
Permit No:
☐ Without Change

1. Name, Address, and Telephone Number	2. Location of Damage	
MARTIN LOWNEY 12345 W ALAMEDA PKWY LAKEWOOD, CO 80228 Telephone ☐ Home ☒ Work Fax/Email: MARTIN.S.LOWNEY@USDA.GOV	ROCKY MOUNTAIN LAKE PARK	
	3. County DENVER	4. State CO

5. RESOURCE/DAMAGE ESTIMATE

A. Resources Damaged	B. Description of Damage
TURFGRASS, HUMAN HEALTH AND SAFETY, PROPERTY	FECAL MATTER, AGGRESSIVE BEHAVIOR, TURF DAMAGE

6. MIGRATORY BIRD SPECIES		7. PERMIT RECOMMENDATION		
Depredating Species	Number Involved	Take Recommendation	Number Recommended	Methods
1. CANADA GOOSE	19	☒ Yes ☐ No	19	ALL LEGAL METHODS
2.		☐ Yes ☐ No		
3.		☐ Yes ☐ No		
4.		☐ Yes ☐ No		

8a. PREVIOUS ACTIONS TO ADDRESS PROBLEM AND RESULTS OF THOSE ACTIONS:

ACTIVE HAZING AND HARASSMENT PROGRAM BY DPR STAFF WITH GOOSINATOR, DOGS, AND USED EXCLUSION BARRIERS IN CERTAIN AREAS WITH LITTLE TO NO SUCCESS. HAZING AT LEAST 15 YEARS AND EGG OILING AT LEAST 5 YEARS.

8b. COMMENTS:

PERMISSION TO REMOVE GEESE DURING THE MOLT. TO SUPPLEMENT CURRENT MANAGEMENT METHODS. ACTIONS ARE CONSISTENT WITH 2005 FWS RESIDENT CANADA GOOSE EIS, 2013 WS-CO BIRD DAMAGE MGMT EA, AND 2019 STATE OF COLORADO RESIDENT GOOSE PLAN.

9. RECOMMENDED ACTIONS

Action:

☒ Harassment ☒ Habitat Alteration ☐ Husbandry ☒ Exclusion ☐ Lethal trapping ☒ Chemical repellent

☐ Capture and relocation ☒ Egg/nest destruction ☒ Shooting ☒ Other:

10A. WS Investigator Name and Address: *(Print)*	10B. WS Investigator Signature
(b) (6) 12345 W ALAMEDA PKWY LAKEWOOD, CO 80228 Telephone Number: (b) (6) Email: (b) (6) @USDA.GOV	Date: 06/12/2019

WS Form 37 (2011) OMB Control No. 0579-0335

Approved: ____ _____
Denied: _____ 2020-APHIS-04219-F-00034

Privacy Act Notice

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Nature of Your Disclosure of Information

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Principle Purpose for Which the Information is Solicited

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Routine Uses Which May be Made of the Information

(1) To cooperative Federal, State, Tribal, and local government officials, employees, or contractors, and other parties as necessary to carry out the program; and other parties engaged to assist in administering the program. Such contractors and other parties will be bound by the nondisclosure provisions of the Privacy Act. This routine use assists the agency in carrying out the program, and thus is compatible with the purpose for which the records are created and maintained;

(2) To the appropriate agency, whether Federal, State, local, Tribal, or foreign, charged with responsibility of investigating or prosecuting a violation of law or of enforcing, implementing, or complying with a statute, rule, regulation, or order issued pursuant thereto, of any record within this system when information available indicates a violation or potential violation of law, whether civil, criminal, or regulatory in nature, and either arising by general statute or particular program statute, or by rule, regulation, or court order issued pursuant thereto;

(3) To the Department of Justice when the agency, or any component thereof, or any employee of the agency in his or her official capacity, or any employee of the agency in his or her individual capacity where the Department of Justice has agreed to represent the employee, or the United States, in litigation, where the agency determines that litigation is likely to affect the agency or any of its components, is a party to litigation or has an interest in such litigation, and the use of such records by the Department of Justice is deemed by the agency to be relevant and necessary to the litigation; provided, however, that in each case, the agency determines that disclosure of the records to the Department of Justice is a use of the information contained in the records that is compatible with the purpose for which the records were collected;

(4) For use in a proceeding before a court or adjudicative body before which the agency is authorized to appear, when the agency, or any component thereof, or any employee of the agency in his or her official capacity, or any employee of the agency in his or her individual capacity where the agency has agreed to represent the employee, or the United States, where the agency determines that litigation is likely to affect the agency or any of its components, is a party to litigation or has an interest in such litigation, and the agency determines that use of such records is relevant and necessary to the litigation; provided, however, that in each case, the agency determines that disclosure of the records to the court is a use of the information contained in the records that is compatible with the purpose for which the records were collected;

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(6) To USDA contractors, partner agency employee or contractors, or private industry employed to identify patterns, trends, or anomalies indicative of fraud, waste, or abuse;

(7) To land management agencies, such as the Bureau of Land Management and the U.S. Fish and Wildlife Service relating to wildlife damage on grazing allotments;

(8) To consumer reporting agencies in accordance with section 31 U.S.C. 3711(e);

(9) To Federal, State, Tribal, and local regulatory agencies and their employees and contractors who collaborate with Wildlife Services in implementation of, or agencies that regulate, wildlife management projects or programs, or who have an interest in, or regulate, animal or public health, or national security;

(10) To State- or Federal Government-level representatives of the U.S. Environmental Protection Agency, in compliance with the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) mandate (FIFRA Sec. 8, 7 U.S.C. 136f, and FIFRA 7 U.S.C. 136i-l), of the location on a cooperator's property where certain regulated pesticide devices are deployed or regulated pesticides are applied; and

(11) To the National Archives and Records Administration (NARA) or to the General Services Administration for records management inspections conducted under 44 U.S.C. 2904 and 2906.

Effects of Failure to Furnish Information

Failure to provide the solicited information will not subject you to penalties or adverse consequences.

U.S. DEPARTMENT OF AGRICULTURE
ANIMAL AND PLANT HEALTH INSPECTION SERVICE
WILDLIFE SERVICES

PERMIT REVIEW

☒ **RENEWAL**
Permit No:
☐ Without Change

1. Name, Address, and Telephone Number	2. Location of Damage	
MARTIN LOWNEY 12345 W ALAMEDA PKWY LAKEWOOD, CO 80228 Telephone ☐ Home ☒ Work Fax/Email: MARTIN.S.LOWNEY@USDA.GOV	SLOAN'S LAKE PARK	
	3. County DENVER	4. State CO

5. RESOURCE/DAMAGE ESTIMATE

A. Resources Damaged	B. Description of Damage
TURFGRASS, HUMAN HEALTH AND SAFETY, PROPERTY	FECAL MATTER, AGGRESSIVE BEHAVIOR, TURF DAMAGE

6. MIGRATORY BIRD SPECIES		7. PERMIT RECOMMENDATION		
Depredating Species	Number Involved	Take Recommendation	Number Recommended	Methods
1. CANADA GOOSE	355	☒ Yes ☐ No	335	ALL LEGAL METHODS
2.		☐ Yes ☐ No		
3.		☐ Yes ☐ No		
4.		☐ Yes ☐ No		

8a. PREVIOUS ACTIONS TO ADDRESS PROBLEM AND RESULTS OF THOSE ACTIONS:

ACTIVE HAZING AND HARASSMENT PROGRAM BY DPR STAFF WITH GOOSINATOR, DOGS, AND USED EXCLUSION BARRIERS IN CERTAIN AREAS WITH LITTLE TO NO SUCCESS. HAZING AT LEAST 15 YEARS AND EGG OILING AT LEAST 5 YEARS.

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Action:

☒ Harassment ☒ Habitat Alteration ☐ Husbandry ☒ Exclusion ☐ Lethal trapping ☒ Chemical repellent

☐ Capture and relocation ☒ Egg/nest destruction ☒ Shooting ☒ Other:

10A. WS Investigator Name and Address: *(Print)*	10B. WS Investigator Signature
(b) (6) 12345 W ALAMEDA PKWY LAKEWOOD, CO 80228 Telephone Number: (b) (6) Email: (b) (6) @USDA.GOV	Date: 06/12/2019

WS Form 37 (2011) OMB Control No. 0579-0335

Approved: ____ _____
Denied: _____ 2020-APHIS-04219-F 00036

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U.S. DEPARTMENT OF AGRICULTURE
ANIMAL AND PLANT HEALTH INSPECTION SERVICE
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PERMIT REVIEW

☒ **RENEWAL**
Permit No:
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1. Name, Address, and Telephone Number	2. Location of Damage	
MARTIN LOWNEY 12345 W ALAMEDA PKWY LAKEWOOD, CO 80228 Telephone ☐ Home ☒ Work Fax/Email: MARTIN.S.LOWNEY@USDA.GOV	WASHINGTON PARK	
	3. County DENVER	4. State CO

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6. MIGRATORY BIRD SPECIES		7. PERMIT RECOMMENDATION		
Depredating Species	Number Involved	Take Recommendation	Number Recommended	Methods
1. CANADA GOOSE	540	☒ Yes ☐ No	520	ALL LEGAL METHODS
2.		☐ Yes ☐ No		
3.		☐ Yes ☐ No		
4.		☐ Yes ☐ No		

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(b) (6) 12345 W ALAMEDA PKWY LAKEWOOD, CO 80228 Telephone Number: (b) (6) Email: (b) (6) @USDA.GOV	Date: 06/12/2019

WS Form 37 (2011) OMB Control No. 0579-0335

Approved: ____ _____
Denied: _____

2020-APHIS-04219-F 00038

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Canada Goose Working Group

Colorado Parks and Wildlife, Northeast Office

6060 Broadway, Denver, CO

Agenda

March 14, 2019

1:00 Welcome

Purpose of Working Group

Crystal Chick, Area Wildlife Manager, CPW – perspective about Canada goose management in metropolitan Denver area

Jordan McCormick, Superintendent, Mariana Butte Golf Course – perspective about Canada goose management at a golf course.

Tim Eubank, Up and Away Goose Control; Terry Hardey, Hardey Border Collies; and Tom , Foothills Parks and Recreation - perspective about a Canada goose management from goose hazing companies.

4:00 Adjourn

DENVER
PARKS & RECREATION

2019

City and County of Denver

Goose Management Program

Natural Resources Office of the City Naturalist

2020-APHIS-04219-F 00049

Table of Contents

I. Introduction

Urban goose management is a complicated and controversial issue that affects urban areas nationwide. Canada geese (Branta Canadensis) have been a part of the Denver Parks and Golf Courses landscape for many decades. The increasing populations of resident Canada geese throughout North America, and more specifically in the Denver Metro and Front Range area has resulted in increasing numbers of conflicts with human activities and concerns related to human health and safety. Much larger increases in the human population along the Front Range have also contributed to human-goose conflicts. The more common issues identified by the public are related to unacceptable and potentially dangerous accumulation of feces on turf and pavement, goose aggression during nesting season, over grazing of landscape vegetation, and safety hazards for vehicles. Canada geese, on the other hand, along with other wildlife, provide people with a valuable connection to nature. Because of their prolific nature, site tenacity, longevity, size, and tolerance of human activities they are, however, considered a nuisance by some park users. Understanding the ecology of giant Canada geese plays a crucial role in managing urban–suburban problems.

Under federal regulations, non-lethal control activities for Canada geese, such as hazing and harassment, habit management and repellants, can be used without a permit at any time. All control devices that involve direct contact with geese require a federal permit issued by the U.S. Fish and Wildlife Service (USFWS). This plan defines Denver Parks and Recreations (DPR) goals, objectives and strategies for managing damage to Denver park properties related to Canada geese and aligns with the Colorado Parks and Wildlife (CPW) Colorado Resident Canada Goose Management Plan.

A. General Biology and Reproduction

Canada geese are herbivores. During spring and summer, they selectively graze on plants, or parts of plants, that are high in protein, such as grass shoots, seed heads, and aquatic vegetation. Canada geese have many natural predators. Raccoons, skunks, foxes, crows, and snakes, prey on their eggs; snapping turtles, foxes, bobcats, hawks, coyotes, and raccoons, prey on goslings; and coyotes, bobcats, and people prey on the adults. Geese generally start breeding at three years of age. Nest construction and egg-laying begins in late March or early April, depending upon latitude. Geese tend to nest on islands, muskrat houses, or nesting platforms that are surrounded by water. Such sites offer additional

security, although the male guards the female and the nest, protecting his territory from other geese and predators. Geese lay 4 to 8 eggs; incubation begins when the last egg is laid and lasts about 28 days. Hatching occurs from late April through mid-May. About mid-June, adult geese shed (molt) their long flight feathers to grow new ones. They are flightless for 30-45 days. (Gosser, A. L., M. R. Conover, and T. A. Messmer 1997)

B. Migration Flyways

Flyway is a flightpath used by large numbers of birds while migrating between their breeding grounds and where they overwinter. (North American Migration Flyways March 2017). Colorado is in the central flyway where millions of waterfowl migrate to warmer regions in search of food and habitat.

C. Migratory Canada Geese

These are birds that nest and raise their young in Canada and Alaska. Migratory Canada geese make seasonal movements to areas that are outside of the area in which they nest and raise their young. Large numbers (hundreds of thousands) of Canada geese that breed in Canada migrate through and/or spend the fall and winter in Colorado. All Canada geese that nest anywhere in Canada and Alaska are considered migratory.

D. Resident Canada Geese

These are birds that nest and/or reside on a year-round basis within the Central Flyway. They are hatched and/or nest in the United States. Resident geese spend most of the year near their breeding areas, although many in the northern latitudes do make seasonal movements. Although there are no statewide rigorous breeding population surveys of Canada geese conducted by CPW or USFWF in Colorado, CPW has assisted DPR with annual and winter surveys of geese at specific Denver park properties to determine resident Canada Goose populations. (J. Gammonley, CWP Avian Researcher 2019)

E. Colorado's Resident Canada Geese Populations

Locally breeding Canada geese populations in Colorado were established by CPW and the USFWS during the 1950s to the 1970s. Breeding Canada geese now occur throughout most of Colorado, but the highest concentrations of resident

Canada geese are along the Front Range foothills and plains north of Denver and the Denver metro area. (J. Gammonley, CWP Avian Researcher 2017)

In the metro area, urban corridors and landscapes, such as river corridors, parks and golf courses are the perfect habitat for Canada geese. Habitat conditions influence the movement patterns and home range size in waterfowl and many other animals (Eberhardt et al. 1989, Dzus and Clark 1997, Didiuk and Rusch 1998, Yerkes 2000).

Agricultural development – to the creation of more water reservoirs – to fresh cut green grassland in city parks, golf courses and cemeteries, has also been a contributor to the encouragement and establishment of new goose populations over the last few centuries.

Geese are extremely adaptable and may use the food and protection provided by humans in urban landscapes for nesting, raising young, molting, feeding, and resting. This has led to increasing numbers of conflicts of Canada geese and people. (Smith, Craven, Curtis, 1998)

Results from an intensive statewide banding program conducted by CPW in 2000 provided a benchmark of approximately 17,400 to 26,100 resident Canada geese statewide, with much of the population residing along the Front Range. (CPW Colorado Resident Goose Management Plan April 2019)

F. Background of Goose Management in Denver Parks

Park visitors and resident Canada geese find city parks, golf courses and other recreational facilities such as picnic areas and lawns attractive and enticing, and potentially creating conflicts between the human park users and geese. Although other impacts are present, the most prevalent impacts of the resident goose populations are accumulations of feces in areas where park users are recreating in.

Canada geese are protected by the Migratory Bird Treaty Act of 1918. This Act gives the USFWS the authority to set limits, make regulations, and issue permits to harvest or take waterfowl. The year 2002, was the pilot year for using Colorado's federal permit allowing the oiling of Canada goose eggs along the Denver Metro and Front Range area.

II. Denver Parks & Recreation Resident Canada Goose Management Plan

The most effective approach to resolve the conflict between park users and the high populations of geese in Denver parks is to integrate a multi-strategy approach of using several methods of control simultaneously or sequentially. The best combination of effective management methods should be implemented in a cost-effective manner while minimizing potential harm to humans, the resident Canada geese and the environment.

An Integrated Canada Goose Management Plan is important to have in place for guidance to DPR management, park district field staff, and partner wildlife government agencies such as CPW, USFWS, and U.S. Department of Agriculture (USDA) to insure everyone is operating under the same guidelines and principles. The Plan will include a comprehensive description of DPR's goose management strategies and measures. The Plan will also provide for recording of all measures taken and their results and should reflect a progression of measures from non-lethal to lethal. All management measures will follow conditions as stated in the USFWS Resident Canada Goose Permit. Denver Parks and Recreation's management goal for resident Canada geese in Denver parks is to maximize recreational opportunities, habitat constraints and public tolerance, and to maintain a health citywide population of resident Canada geese.

A. Objectives

The objectives of Denver's Goose Management Plan are to 1) prevent current resident populations from increasing through using various methods and techniques, and 2) to define the public tolerance levels in an area for Canada goose populations and to maintain healthy goose populations that are consistent with the goal of this plan. Conducting a survey about public attitudes towards geese will also be useful in this process. Total elimination of geese from any area would never be successful, is unrealistic and would not be a desirable outcome by DPR.

B. Current Goose Management Strategies

The primary methods deployed by DPR include Egg Oiling, Hazing and Habitat Management. This multi-strategy approach is used to make geese as uncomfortable as possible to encourage them to leave, migrate or keep moving elsewhere.

Federal and State Wildlife Agencies approve of egg oiling and addling to help landowners respond to Canada goose issues and conflicts. Other agencies such as the Humane Society of the United States, US Department of Agriculture, PETA, and other animal welfare organizations approve of egg addling as a humane method of management for Canada geese.

1. Egg Oil Method

Since 2002, DPR has participated in CPW's Egg Oiling Program as a sub-permittee under their Federal Special Canada Goose Permit, which is the only approved lethal control method at this time for reducing goose populations on city park property.

Because geese tend to return to the area they were born in subsequent years, local breeding populations, as we've seen, can grow rapidly over time if geese are successful at nesting and raising their young. During the breeding season, March – June, staff and volunteers locate nests throughout the parks, and spray 100% grade corn oil on goose eggs. The corn oil blocks the air passages of the egg shell and prevents the embryo from developing. This method is quite successful due to the minimal disturbance to the nest, allowing the female goose to continue incubation of the treated eggs and minimizes her chance of re-nesting.

a. Results from Egg Oiling in Denver Parks

2002 to 2007 - Since the inception of this program within the Denver park system, past records of egg oiling were not found.

2008 - 166 goose eggs oiled with an approx. 15% gosling success
2009 - 185 goose eggs oiled with an approx. 30% gosling success
2010 - 2012 - no data found
2013 - 428 goose eggs oiled with an approx. 15% gosling success
2014 - no data found
2015 - 950 eggs oiled with an approx. 1% gosling success
2016 - 2,800 eggs oiled with approx. less than 1% gosling success
2017 - 3,834 eggs oiled with approx. 1.8% gosling success
2018 - 3,034 eggs oiled with approx. 1.4% gosling success

Since the adoption of the Egg Oil program in 2002, where approximately 200 eggs were oiled that first year at various parks, the

numbers of eggs oiled have consistently increased dramatically resulting in fewer gosling numbers.

2. Hazing Method

The second method of goose population control that DPR deploys is active hazing during the months when migratory goose populations have joined with the resident populations from September through March.

DPR uses a remote-controlled machine that is fiercely painted and looks like a predator called the *Goosinator.* The machine makes a noise that is undesirable to geese and chases the geese away from turf, water, snow, and ice. DPR has been using the *Goosinator* since 2013 and it has proven to be a successful tool in our attempt to haze geese from the more concentrated parks such as Washington and City Park. The *Goosinator* is deployed during the hazing season from September through March in parks that have a water feature. Washington Park, City Park and Sloan's Lake have been the priority locations for controlling goose populations where the larger numbers of geese have made those parks their home. In winter months from approximately November to February, the goose population can more than triple the resident population. The goal of the Goosinator is to encourage geese to keep moving period. Besides the direct impact of Canada geese residing in urban areas, they can act as decoys for migratory geese, causing periodic increase in urban goose populations. (Smith, Craven, Curtis 1998)

Although successful in hazing and moving geese around from location to location, the downside of using the *Goosinator* is that DPR does not have the required resources (personnel and funding) that's necessary to gain full potential results of the machine. Full potential of the *Goosinator*'s success in minimizing goose populations would require deployment at least 2 times a day, 4 to 5 times a week, using two machines at once. In addition, the park would have to change its traditional layout of landscaping, making a park undesirable for geese to be there. Landscape changes to traditional parks is an unrealistic expectation of park usage and another controversial issue amongst park users.

a. Goose Population Survey Results – Migratory Goose Season (Sept – March)

Goose Population Survey Results from 2015-2016
The *Goosinator* was deployed at 9 Denver parks: Washington Park, City Park, Sloan's Lake, Berkeley, Rocky Mountain, Harvey, Huston, Garfield, and Garland Park, resulting in approximately 11,000 geese that have been hazed with the *Goosinator*.

Goose Population Survey Results from 2016-2017
The *Goosinator* was deployed at 8 Denver parks: Washington Park, City Park, Sloan's Lake, Berkeley, Rocky Mountain, Harvey, Huston, Garfield, resulting in approximately 98,245 geese that have been hazed with the *Goosinator*.

Goose Population Survey Results from 2017-2018
The *Goosinator* was deployed at 9 Denver parks: Washington Park, City Park, Sloan's Lake, Berkeley, Rocky Mountain, Harvey, Huston, Garfield, and Garland Park, resulting in approximately 60,868 geese hazed.

Goose Population Survey Results from 2018-2019
The *Goosinator* was deployed at 9 Denver parks: Washington Park, City Park, Sloan's Lake, Berkeley, Rocky Mountain, Harvey, Huston, Garfield, and Garland Park, resulting in approximately 62,085 geese hazed.

3. Effectiveness of Various Strategies

Each Denver park and each local population of Canada geese are unique. As such, techniques that work best at one area may or may not be appropriate at another area. As an agency that has the responsibility to manage parks for the benefit of its users and the resource, we must be flexible in our approach to how we manage goose populations due to the differing and opposing opinions about geese. How DPR manages geese in Denver, has a cumulative effect on the overall Front Range and Colorado goose population that is accessible to other publics, such as hunters, bird watchers, wildlife lovers, and other outdoor and natural resource enthusiasts. It will be important to consider the overall effects of how DPR manages geese.

C. Executive Director and Deputy Executive Director of Denver Parks & Recreation Responsibilities

The DPR Executive Director and Deputy Executive Director will have the responsibility of making the final decision on implementation of a Management Plan pertaining to other forms of lethal control of resident geese in Denver parks. Those decisions will be based on assessment of the local resident Canada geese population, the impacts at each Denver Park and public acceptance of lethal methods.

When it is determined that resident Canada geese populations have no impact and control measures are not necessary, the current strategies for controlling goose populations will remain in effect and no plan for lethal control (other than egg oiling) is needed. For parks that have been identified as having major impacts to the landscape, safety or health hazards to park users, or for other extenuating reasons determined by the Executive and Deputy Director of Parks, the current control measures will be assessed for efficacy and may result in the consideration and implementation of lethal control measures. This Management Plan will be reviewed and updated annually by Denver Parks Natural Resources/Office of the City Naturalist.

D. Responsibilities of the Natural Resources/Office of the City Naturalist

The Wildlife Program Administrator under the Office of the City Naturalist will be responsible for the implementation, evaluation, and maintenance of DPR's Resident Canada Goose Management Plan. In addition, the Wildlife Program Administrator will provide the Executive Director and Deputy Executive Director of Parks, an annual report of goose population management measures, their effectiveness, and population numbers. Current data and research of goose management strategies used by other park and wildlife agencies throughout the states will continue to be assessed and considered in future management strategies of Denver Parks and Recreation.

E. Other Nonlethal Methods for Managing Geese in Denver Parks

The success of a cost-effective and implementable management plan for resident Canada geese depends on identifying the site characteristics of each park that attract geese (food, nesting structure, security, water, etc.) and the use of various techniques. Lessening the attractiveness of the site to geese may lessen the

goose population at that site. Nonlethal control techniques may include elimination of food handouts, exclusion, landscape modification, the use of frightening devices, hazing, and repellents.

Points to consider when deciding the appropriate technique to use in Canada geese management: A single, quick fix solution is unlikely to reduce goose problems over time. An integrated approach using several techniques in combination is much more likely to be successful in time.

- Timing is critical.
- Public relations or outreach is important to success.
- Use common sense.
- It is rarely desirable or possible to eliminate all geese in an area. Most management programs strive for maintaining a population or a reduction in goose numbers and related problems to a level that can be tolerated. "Tolerated" is subjective and will be different for each person. It is not DPR's mission to eliminate all geese from all parks.
- No matter what strategy is used (lethal or nonlethal), the plan is to use that method repeatedly, year after year. Funding allocated for this program will be imperative.

1. Elimination of Food Handouts

Feeding waterfowl and other birds is a popular pastime for many people and is a major cause of high urban bird populations, especially during harsh winters when natural food sources are in short supply. Canada geese do not need handouts to exist. Feeding waterfowl encourages them to congregate in an area and may make geese more aggressive toward people. (Smith, Craven, Curtis 1998)

2. Exclusion and Landscape Alterations

Can be very effective nonlethal techniques in controlling goose damage. Canada geese prefer to feed, roost, and loaf near water where they can escape if threatened. (Gosser, A. L., M. R. Conover, and T. A. Messmer 1997). ("Managing Problems Caused by Urban Canada Geese" Berryman Institute Publication 13, Utah State University). Techniques such as removing desirable habitat and landscape alterations can be costly, challenging and controversial amongst park users. Most park users prefer manicured, wide open spaces with mowed grass landscaping and water features which is

the perfect habitat for geese. Some areas within certain parks lend themselves to landscape modifications, where others do not.

3. Harassment

Other than the Goosinator, harassment techniques can be stepped up with the use of volunteers or park staff. Harassment through personal tactics such as redirecting geese out of an area using a variety of methods as needed to discourage them from moving/staying on the grass as geese leave the water and access the park. Examples may include using noisemakers, flags, etc. to warn the geese that they are not welcome in those areas. This would be performed by district or seasonal parks staff and possibly volunteers.

4. Mylar Tape or Flags

Mylar tape or Flagging has been used in some areas of parks. It may be installed around some of the lakes as needed and along the water's edge. Can be labor intensive however, because it should be moved every few days.

5. Noise Devices or Scare Techniques

Depending on park rules and regulations, other hazing and scare tactics can be used to frighten geese from problem sites such as pyrotechnics and noise devices. If implemented, these techniques would be performed by a trained park ranger, natural resource staff or wildlife service contractor.

6. Chemical Control Agents

Repellent treatment - Chemical repellents may be used as needed. Approved methods registered with the U. S. Environmental Protection Agency are ReJex-iT ®, GooseChase®, Goose-B-Gone®, and Bird Shield® and Flight Control®. Repellent treatment is most successful where smaller areas are treated; treatment of larger areas is not as effective a control. Only park staff who are certified to apply chemicals can apply these repellants. Some Denver parks are using repellants for goose management.

7. Removal/Relocation

Relocation of Canada geese in Denver parks was discontinued in 1999 by CPW for various reasons. This method of goose control was costly, labor intensive, no other states wanted Colorado's nuisance geese, and it required a special permit. The major problem with relocating geese to a new area is that geese imprint on the area they came from in an urban environment and return. Soon after this management strategy was discontinued, egg oiling was implemented.

8. Public Support

Besides hazing and egg treatment, the next most important part of a Resident Canada Goose Management Plan is public outreach and support. The public's understanding of the specific measures being performed, and their support of those strategies are necessary for the success or failure of a control program.

Funding for continued goose management activities are currently funded through the Natural Resource Operations budget, however additional funding sources will be necessary to continue the existing multi-strategy approach and implementation of new strategies and approaches (if and when appropriate) for managing geese in the city. Public acceptance of lethal control, partnerships and assistance from state and federal wildlife agencies, and Denver City Council support will also be sought.

9. Enforcement

Enforcement of the "No Feeding wildlife" policy by Denver Park Rangers will be enforced. New "No Feeding Wildlife" signs have been installed in the parks where goose management strategies are being used.

10. Education and Outreach

Notification boards, bulletin boards or goose management brochures could be utilized in/near high usage areas of each park to educate the public about DPR's Goose Management Program on a periodic basis. DPR's Goose Management Program outlining the strategies utilized to manage geese could be added to the Natural Resources already existing educational programs and displays. This material would be prepared and maintained by The Office of the City Naturalist staff.

Although not a goose population management method, DPR will seek new ideas and technology for addressing the goose poop situation in the parks. Possibly the use of different maintenance equipment such as sweepers, blowers or vacuums to keep the sidewalks and park paths free of goose poop.

F. Removal through Capture and Euthanization

It is important to understand the differences between dispatching geese and capture and euthanization. Dispatching removes selected individuals from a population of geese to reinforce pyrotechnics and to remove problem individuals. Capture and euthanization removes and eliminates an entire population of geese.

The opinions about how to manage goose populations in urban settings varies. There are those who have an expressed opposition to the culling of geese, those who express their desire for taking more drastic measures to manage populations, those who believe capturing and relocating to another area will alleviate damages and threats to human safety, and those who believe that culling goose populations will remedy goose damage. (Gosser, Conover, Messmer 1997)

Annual roundups and euthanization have been criticized as inhumane. Critics claim that these measures do not permanently rid a community of Canada geese; they only clear the habitat for other geese to move in the following year. DPR has participated in past goose roundups and relocation and this program was unsuccessful. Humane organizations maintain that by stopping the feeding of geese, habitat management, use of chemical repellents, and diverting birds to other areas will be enough to manage any resident Canada geese population. Some organizations even oppose removal of individual geese from a local population. A few organizations will claim treating eggs is not considered a humane management method.

Process for capture and euthanasia - When all other management methods for controlling resident Canada goose populations fail, capture and euthanization may be a viable alternative. Resident geese are usually captured by herding into a corral or fenced area and then carried into a trailer and taken off site. This method would be performed by the U.S. Department of Agriculture/Animal & Plant Health Inspection Service (APHIS). The time for capturing resident Canada geese is during their molting period, from June through July/August. Migratory Canada geese would not be affected since they are only present in Colorado from

mid-September through March. Once captured, it is the preference of DPR Management, that goose carcasses be utilized.

The advantage of this lethal management is that it is applied directly to the problem goose population, its effects are obvious and immediate, and carries no risk that the geese will return immediately or move and create conflicts elsewhere. However, the possibility of another population re-establishing is possible over time.

Because these measures are, however, subject to much public criticism, and opposition, and is a solution that will require yearly maintenance, the final determination to capture and euthanize resident Canada geese at any one park would have to be a decision made and endorsed by the DPR Executive Director and Deputy Executive Director. (See II C - Executive Director and Deputy Executive Director of Denver Parks & Recreation Responsibilities) before implementation. The plan must include documentation as to dates, times, places, and persons where non-lethal and lethal measures had been used and were not successful. The plan would also include how the birds would be rounded up, penned, shipped and finally euthanized in a humane way. If the birds are to be processed for human consumption, the name of the processing location, costs and final distribution location must be included in the request. If the birds are to be destroyed, the disposition of the dead birds must be indicated.

The Office of the City Naturalist would either acquire a Depredation Permit from USFWS or fall under a Depredation Permit of the USDA-Wildlife Services, or CPW.

The Annual Depredation permit issued by the US Fish and Wildlife Service authorizes the take of a specific number of Canada geese each year.

G. Record Keeping and Reporting

If DPR acquires a Depredation Permit, DPR will be required to submit an annual report to the US Fish and Wildlife Service detailing activities, including the time, numbers and location of birds, eggs, and nests taken and non-lethal techniques utilized, before the end of each year. (50CFR21.26) If DPR is operating under USDA-Wildlife Services or CPW's Depredation Permit, those numbers will be recorded on that agencies permit.

A log will be maintained for each park implementing/continuing goose control measures to record the number of nests, eggs and geese affected, time, date, and location of use. These logs will be maintained and kept for a minimum of five (5) years, as required by US Fish and Wildlife Service. These records provide

valuable information regarding geese populations at specific areas. Although the US Fish and Wildlife Service indicate record retention for five years, records may be maintained longer to support specific management strategies for resident Canada geese populations.

At the end of each year, the Wildlife Program Manager of the City Naturalists Office will submit a final report of goose management activities to the Executive Director and Deputy Executive Director.

Wildlife is regarded as providing ecological, educational, economic, recreational and aesthetic benefits, and there is enjoyment in knowing that wildlife exists and contributes to natural ecosystems. Canada geese, like all wildlife, provide people with a valued connection to nature, wildlife viewing opportunities, and they contribute to the quality of life in the City and County of Denver and the state of Colorado.

This Plan has been approved and endorsed by the DPR Executive Director and Deputy Executive Director.

III. Appendices

A. Methods of Control Available to reduce goose damage

1. Eliminate Artificial Feeding
2. Habitat Modification
3. Harassment
4. Chemical Repellents
5. Lethal Management
6. Methods that ARE NOT recommended

1. Eliminate Artificial Feeding

All artificial feeding by park users should be stopped immediately. New signs have been posted in the parks that say, "Do Not Feed Waterfowl." People who feed the geese need to be educated about the problems they are creating. When fed by hand, geese become concentrated, making them more aggressive toward people because they are expecting to be fed. Hand feeding also makes geese more susceptible to diseases, such as avian botulism and avian cholera. Moreover, artificial feeding, especially with bread, rarely provides the proper nutrients that geese require. Park Rangers will enforce this rule.

2. Habitat Modification

Habitat modifications can either be permanent or temporary. For many of the parks permanent modifications will be costly and inappropriate. Where site renovations and re-landscaping are being planned, considerations should be made to incorporate permanent habitat modifications into the landscape design. When permanent modifications are inappropriate, temporary modifications may be considered and used.

Permanent Modifications

Canada geese provide an excellent example of a wildlife species whose behavior can be somewhat modified by managing the landscape. They not only prefer to walk between water and land but also must be able to walk to grazing areas when molting or escorting goslings. Habitat modifications can be made that eliminate or reduce those landscape features that geese prefer and/or add specific features that make a site appear inconvenient or unsafe to geese. The following landscape principles can be effective in minimizing the attractiveness of an area to geese.

- Reduce sightlines to less than thirty feet
- Use landscaping that physically reduces access to forage areas
- Reduce the size of foraging areas
- Reduce the palatability of the forage vegetation. Use coarse grasses rather than the goose preferred grasses like Kentucky Blue, fescues or timothy.

Grasses and shrubs that grow as little as eighteen inches high can be placed in a ten-foot band at the water's edge to serve as a deterrent to geese. These grasses and shrubs will impede their access to grazing and block their view of predators. There are side benefits to this kind of landscape alteration as well. It reduces mowing, filters the runoff of fertilizers and herbicides from lawn surfaces, increases habitat for other wildlife species such as songbirds, and has an aesthetic appeal to many that is more satisfying than the homogeneous and neatly trimmed lawn run down to water's edge.

Canada geese prefer a gentle, grassy slope coming out of the water that enables them to easily walk into and out of the water to feed or rest. If access to the water is poor, the adult geese may leave that area to raise their young elsewhere. To steepen the shoreline, a vertical seawall about 3 feet above the surface of the water may be built or create a 63-degree angle slope from the water's edge. Riprap, while ineffective on gentle slopes, is often effective on steeper ones.

Canada geese typically prefer to use a route from a body of water that allows them a clear view of predators. By planting large, dense shrubs or placing large rocks (2 feet in diameter or more) along a shoreline; a barrier is created that geese will be reluctant to penetrate.
Note: Sometimes giant Canada geese adapt to rocks and vegetation barriers. If so, fencing may need to be added.

Using Plants as Management Tools
Planting with vegetation that is undesirable to geese may discourage them from remaining in an area.

Geese prefer:

- Kentucky bluegrass (Poa pratensis)
- Brome grass (Bromus inermis)
- Canary grass (Phalaris arundinacea)

Geese do not prefer:

- Yellow indiangrass (Sorghastrum nutans)
- Switchgrass (Panicum virgatum)

- Timothy (Phleum pretense)
- Perennial ryegrass (Lolium perenne)
- Perennial bent grass (Agrostis palustris)
- Quackgrass (Briza maxima)
- Red fescue (Festuca rubra var. rubra)
- White clover (Trifolium repens)
- Indian blanket (Gaillardia pulchella)
- Prairie cordgrass (Spartina pectinate)
- Nebraska sedge (Carexnebrascensis)
- Common rush (Juncus effuses L.)

Temporary Modifications

Permanent habitat modifications may not be acceptable because of the costs associated with these changes or because of new landscaping. Temporary measures may be just as effective as permanent modifications. Fencing acts as a sufficient barrier, and while it lacks many of the side benefits of habitat changes; it can be put up before nesting season to discourage geese and then removed when nesting has begun elsewhere. Fencing is also effective during the flightless periods. This allows grass and shrubs to grow in ten-foot bands around ponds. These will impede goose access to grazing areas and block their view of predators.

Water Surface Covering

Canada geese may be excluded from ponds using overhead wire grids or "ball blankets. Wire grids and "ball blankets" with balls approximately five inches in diameter work best on small ponds but may be considered aesthetically unappealing to some people. Both the grids and blankets will make a pond unusable for boating, swimming, fishing and other water type activities.

3. Harassment

Canada geese seek areas where they can go about their daily activities with minimum disturbance. If someone or something bothers them enough, they usually will find another area where they will not be disturbed. However, they sometimes become accustomed to some harassment techniques when they learn they won't be harmed.

Mylar Tape, Flagging and Balloons

Mylar tape, flagging and balloons are visual deterrents that can be used in conjunction with other exclusion methods. Mylar tape is ½ inch wide, red on one side and shiny on the other. To use Mylar tape as a fence, string one or two strands between two posts and twist the tape two or three times. When

the wind blows, the tape rotates; balloons and flagging will create a flashing action. This unfamiliar flash acts as a visual barrier and makes the geese shy away from the area.

Harassment techniques usually will not stop damage once it has started. They are, however, useful in preventing damage before it begins. If Canada geese were raised in an area or have become accustomed to using it for feeding, they will be more difficult to move.

Dogs

Using dogs to harass geese from an area is a popular method of hazing geese. While some nuisance animal businesses use highly trained border collies, just about any athletic, medium-large dog capable of obeying commands can be used. Control of the dog is vital because dogs used in this manner are legally considered an extension of your hand and must not be allowed to catch, injure or kill a Canada goose. DPR has chosen to use the Goosinator in place of a trained dog, as both operate in the same manner, stocking the geese and chasing them off an area. As with the Goosinator, harassment must continue and be repeated until the geese leave the area permanently. State regulations prohibit the use of dogs to harass geese from April 1 to July 31.

DPR will begin a pilot project in 2017-2018 using trained dogs on Park Golf Courses.

Pyrotechnics

Although not all geese react to pyrotechnics, most do. Pyrotechnics are specially designed Class C fireworks that are used to frighten wildlife. The types of pyrotechnics in this class include:

- Shellcrackers, firecrackers fired from a 12-gauge shotgun

The distance a pyrotechnic device will travel varies from 50 to several hundred yards depending on manufacturer and type. Check with the manufacturer to be sure that the appropriate device fits your needs. Individuals using pyrotechnics should be trained in their use and should wear eye and ear protection. Be cautious when using them in populated areas. Pyrotechnics are enhanced when used with dispatching individuals from the general goose population. Used alone, geese get habituated to the noise produced, but when individuals are removed from that same population the fight or flight response is maintained.

Chasing

Chasing geese on foot or in a golf cart is labor intensive; but in conjunction with other harassment methods, it can be successful if people are persistent. The idea is to chase geese long enough to cause them to go elsewhere, where they can live without being chased. This could possibly be a method done by volunteers.

Lasers

It has been found that lasers can be used effectively to harass and scare off resident geese. The lasers are used at dawn, dusk, and at night during the times that flocks of geese are preparing to bed for the evening. The geese think that the lasers are predators and will not land for the evening. Lasers are an alternative to pyrotechnics and propane cannons when the effect of noise from these other techniques is undesirable.

Other Techniques

Other techniques that can be used to harass Canada geese include:

- high pressure water sprayers
- air horns
- beating pots and pans together (more for private landowners)

When coupled with other techniques, they encourage Canada geese to move from an area. The key is to be more persistent than the geese are. The mentioned harassment techniques are legal and cannot physically harm the geese.

4. Chemical Repellants

Chemical repellents applied to lawns and other vegetation where there are high numbers of geese do work. These repellents are water soluble; therefore, moderate to heavy rain or daily watering and/or mowing will remove them from treated vegetation and additional applications may be required. These chemicals cause geese to move to nearby untreated areas. Chemical repellents work best when smaller areas are to be treated. Treatment of larger areas is less effective.

Methyl anthranilate is a registered repellent for Canada geese, which is marketed under the trade names ReJeX-it, GooseChase, Goose-B-Gone, and Bird Shield. These products help change the bird's behavior. When applied to grass where geese feed, methyl anthranilate makes the grass unpalatable. Geese may still frequent the treated area, but they will not feed there.

Anthraquinone, trade name Flight Control has also been used for Canada geese control. Anthraquinone repels geese in two ways. First, geese experience a harmless "gut reaction" after eating the grass. Secondly, the grass appears unnatural and uninviting because the chemical brings out the ultraviolet spectrum when applied to turf. The combined strange look of the grass with the intestinal reaction experienced, geese will look elsewhere to loaf and feed. Flight Control will not wash off after a rain but needs to be reapplied after mowing. This chemical has low toxicity to birds and mammals.

5. Lethal Methods

Lethal methods to control resident Canada geese include nest/egg destruction, live capture and transportation to poultry processing facilities, live capture and euthanization, and dispatching (shooting). Lethal methods are allowed year-round with a permit from the U.S. Fish and Wildlife Service.

Nest & Egg Destruction

Addling, oiling, freezing, or puncturing prevents the embryo from developing. Egg destruction can reduce production of goslings, which slows the rapid growth of local goose populations and eliminates the aggression of adult geese protecting their young. Oiling is the only approved lethal method used by DPR by spraying the eggs with 100% grade corn oil using a sprayer. Allows for minimal disruption to the nest and incubation process minimizing the female goose from abandoning the nest.

Dispatching (Shooting)

Dispatching geese can be highly effective in removing individual birds from specific areas and in supplementing harassment. Shooting a few individuals from a large flock can reinforce birds' fear of pyrotechnic techniques. The birds do not know when the noise is fake or a real danger. Taking geese in this manner is used to reduce goose problems when lethal methods are determined to be appropriate. Hunting is not allowed in the City and County of Denver therefore this method will not be an option for DPR.

Capture and Euthanize

The most efficient way to reduce the size of an urban-suburban flock of resident Canada geese is to increase mortality among adults. Hunting is the major cause of goose mortality, but geese may seldom be available to hunters in an urban or suburban environment. For the purposes of lethal control, resident geese are usually captured by hand. Resident Canada geese would

primarily be captured from June through August and would not include migratory geese. Migratory Canada geese are present in Colorado from mid-September through March. Once captured, geese would either be shipped to poultry processing locations for processing for human consumption and donated to charitable organizations or euthanized and either buried or incinerated.

The advantage of this lethal management is that it would be applied directly to the problem goose population, its effects are obvious and immediate, and carries no risk that the geese will return or move and create conflicts elsewhere. If this method were to be considered for DPR, a contractor such as USDA-Wildlife Services would be the lead role along with support and direction from CPW.

6. Methods that ARE NOT recommended

The methods listed below are often asked about but are not recommended:

Plastic Scare Devices
Plastic swans, alligators, owls, snakes and dead goose decoys, as a rule, have not proven to be effective in repelling Canada geese.

Windmills
Recently windmills have been offered for sale to use to discourage geese from using areas. These devices have been found to be poorly constructed and will not last.

Mute Swans
Live Mute swans are ineffective at preventing Canada geese from using or nesting on ponds. Additionally, swans can be aggressive towards humans and may have undesirable effects on native aquatic vegetation. The use of mute swans as a Canada geese damage management technique is ineffective and is not recommended.

Capture & Relocation
Capture and relocation of nuisance geese is commonly requested. This is not a viable solution for adult geese because the birds imprint on the area where they learn to fly, and most will return to the capture site or a similar setting.

Since giant Canada geese already occupy virtually all suitable habitats, there is limited opportunity to relocate juvenile geese without creating similar problems at release sites. Relocation is effective for young juveniles because they imprint on the release area where they learn to fly rather than returning to the area where they were captured.

Toxicants

There are no toxicants registered with the Environmental Protection Agency for controlling Canada geese in the United States.

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Code of Federal Regulations: 50CFR 13.46, 50CFR 21.41

Large Canada Geese in the Central Flyway:

Management of Depredation, Nuisance and Human Health and Safety Issues

Prepared for
The Central Flyway Council

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Executive Summary

The Central Flyway is an administrative unit for migratory game bird management. It is comprised of ten states (MT, WY, CO, NM, TX, OK, KS, NE, SD & ND), two Canadian Provinces (Saskatchewan & Alberta), the Northwest Territories and Nunavut. The Central Flyway Council, established in 1948, is an advisory body to the U.S. Fish and Wildlife Service (USFWS) and assists the Canadian Wildlife Service (CWS) in matters regarding migratory game birds.

In cooperation with the USFWS and the CWS, the Central Flyway (Flyway) manages five populations of Canada geese. Two of these (the Tall Grass Prairie and Short Grass Prairie populations) breed in the Arctic and are comprised of small races of birds and are beyond the scope of this document. They are, however, an important consideration in the management of large Canada geese. The three populations of Canada geese comprised of large races that are the primary subject of this document are the Hi-Line, the Western Prairie and the Great Plains populations. In addition, some information about the Rocky Mountain Population is included. These populations are distinguished from one another by their geographical distribution in the summer and winter as well as their racial makeup.

The Flyway has adopted management plans for each of these populations Each of these has a similar Goal: Maximum recreational opportunity consistent with the welfare of the population, international treaties, habitat constraints and the interests of all Central Flyway provinces and states." The plans contain population objectives and estimates of population size are obtained annually, most often by winter counts.

All populations of Canada geese in the Central Flyway are above objective levels. This was achieved through careful and coordinated management decisions made over many decades. At the Flyway level, the primary action that contributed to this achievement was facilitating coordinated implementation of hunting regulations geared toward keeping mortality at an appropriate level. At the state and provincial level, many activities were undertaken to increase the population size including the release of captive-reared goslings, the release of adults and the implementation of special hunting regulations. More than 120,000 geese were handled for restoration purposes between 1960-99 in the Flyway.

The 1997-99 average winter count of total Canada geese in the Central Flyway was 1.5 million birds, up from about 206,000 in the 1960's. Of the 1.5 million, about 620,000 were from the three populations of primary interest in this document. This is about 60% above objective levels.

Along with these successes comes a new set of problems. As both total and local populations of geese have grown, so has the frequency of interactions between geese and people. Some of these interactions such as the sharing of city parks, housing developments, airports and agricultural crops are not welcomed by some humans. All jurisdictions in the Flyway, including federal agencies, have been working on preventing and/or alleviating these problems for over a decade using many tools. Some of the limited number of tools provide a higher success rate than others. Some are considerably easier than others for a local jurisdiction to implement in an expeditious, effective, socially acceptable manner. Constraints have been traditionally placed on actions by state and provinces by their respective federal agencies as well as society.

As a partial response to possibly reducing some of these constraints, the US Fish and Wildlife Service, in August 1999, announced its intent to prepare an Environmental Impact Statement (EIS) on Resident Canada Geese. This document provides the necessary

background and current data about Central Flyway resident Canada geese to satisfy a request from the USFWS for assistance in the preparation of the EIS.

The Goal of the Central Flyway specified in this document is: Manage resident Canada geese in the Central Flyway to achieve maximum benefits from these birds while minimizing conflicts between geese and humans.

In preparation for discussion of objectives and associated strategies to address growing populations of resident Canada geese, a history of restoration efforts, population changes, harvest, problems caused and problem resolution activities is presented. The document is intended to be a summary but much detailed information is presented in appendices. An important section is a summary of information on a state by state or province basis.

Five objectives are identified, each with a set of strategies the Central Flyway believes will assist in meeting them. They are:

1. Ensure that the positive values associated with resident Canada geese are maximized.
2. Implement control methods directed at problem resolution and/or goose population reduction that are socially and biologically acceptable, site-specific, efficient and effective.
3. Implement public awareness campaigns and cooperative programs to maximize the effectiveness of preventative and problem resolution methods..
4. Monitor goose populations, the number and type of problems they cause, attempts to solve those problems and the social acceptance of management actions.
5. Establish mechanisms for evaluation of objectives and strategies.

An Action Matrix is provided that identifies current and potential actions that would lead to problem abatement. Each action is defined and associated with an assessment of social acceptance and effectiveness.

Finally, a philosophy about the future, a data needs section and literature references are included.

While this document is designed to address problems caused by Canada geese as they affect humans, their property and, in some cases, their safety, it is in no way intended to reduce the high value the Central Flyway places on this renewable resource. Canada geese are part of the larger natural community the Flyway seeks to conserve. Beyond that, they provide an immense and increasing amount of recreation to citizens of the Flyway, from the Queen Maude Gulf in the Northwest Territories to Brownsville, Texas. And the Central Flyway is committed to the conservation of that recreation.

This document was produced by P. Joseph Gabig, Natural Resource Consulting (www.wildlifeconsult.com), under contract with the U.S. Fish and Wildlife Service, Region 6, Denver, Colorado (Ref No. 601819Q616). It was extensively reviewed and edited by the Central Flyway Waterfowl Technical Committee.

Introduction

The Central Flyway is an administrative unit for migratory game bird management. It is comprised of ten states (MT, WY, CO, NM, TX, OK, KS, NE, SD & ND), two Canadian Provinces (Saskatchewan & Alberta), the Northwest Territories and Nunavut. The Central Flyway Council, established in 1948, is an advisory body to the US Fish and Wildlife Service (USFWS) and assists the Canadian Wildlife Service (CWS), in matters regarding migratory game birds. There is a Technical Committee that advises the Council on technical issues and provides recommendations regarding potential actions.

The Central Flyway (Flyway), in cooperation with the USFWS and the CWS, manages five populations of Canada geese (*Branta canadensis*). The Short Grass Prairie and Tall Grass Prairie populations breed in the Arctic and are comprised of small races of Canada geese (e.g. *B. c. parvipes* and *hutchinsii*) and are beyond the scope of this document. They do, however,

play an important role in management decisions and will be included in some discussions. The other three populations of Canada geese are the Hi-Line (HL), the Western Prairie (WP) and the Great Plains (GP) populations. These populations are comprised of the large races of geese (*B. c. moffitti, interior* and *maxima* and are the primary subject of this document. In addition, some western states in the Flyway deal with management issues of an expanding Rocky Mountain Population (RMP), which is largely oriented to the Pacific Flyway, and this population will also be discussed.

These populations of geese are distinguished from one another by their geographical distribution in the summer and winter as well as their racial makeup. Hi-Line birds are oriented to the western portions of the Flyway while GP and WP birds are exclusively oriented to the east tier of states and Saskatchewan with a portion of the breeding range extending into Manitoba (Appendix 9).

The focus of this document is address problems caused by resident Canada geese - those that largely or totally spend the entire year within a state or province.

The Flyway has adopted a management plan for each of these populations. A single plan was adopted in 1988 for the WP and GP because they had become impossible to separate during winter surveys that are used to index population size. However, a distinction was drawn between their respective breeding grounds. Population objectives for all populations identified in their respective plans are primarily derived from winter indices. For decades prior to the winter of 1998-99, some goose population estimates were made in December and some in January. Since then, all population objectives have been based on a coordinated January survey.

All populations of Canada geese in the Central Flyway are above objective levels. The Flyway considers this a positive response to careful and coordinated management decisions. Many strategies were developed and implemented over the decades with the objective of increasing the size of Canada goose populations.

Along with actions at the Flyway level, most states and Alberta and Saskatchewan conducted programs to increase the number and expand the range of breeding Canada geese within their jurisdictions. Restoration programs trace their origin to the early 1950's and others to the 1970's. Programs in northern areas were being terminated while those in more southern areas were just beginning. Later, this report will provide a brief review of these efforts and their outcome but for the moment, suffice it to say that these programs were successful.

Current estimates of population size are considered symbols of success. Canada geese are now accessible for viewing, hunting and other recreation to more people than ever before. The 3-year (1997-99) average winter-count of all Canada geese in the Flyway is 1.5 million, including a few thousand birds from the RMP and Eastern Prairie populations and several thousand not classified into a population.

Along with success, however, frequently comes a new set of problems. Such is the case with Canada geese in the Central Flyway. As both total and local populations of geese increased, so did interactions between people, their property and geese. Some of these interactions such as sharing city parks, airports or agricultural crops with geese are not wanted or caused safety concerns. Some problems with "too many waterfowl", such as those in southern Canada, date back to the 1960's when provinces began paying compensation to farmers for damage caused by waterfowl eating crops in the fall. States began to see their own, mostly urban problems in the early 1980's. Since then, the number of problems and the number of states which need to deal with them has steadily increased.

In many cases, states continued to expend efforts to increase the number and distribution of resident Canada geese while at the same time dealing with problems that ranged from nuisance to aircraft safety. Initial actions by states to address "too many geese"

often included trapping them and moving them to unoccupied areas. This was partially successful until there were few or no places left to put geese. In some instances, scare devices, such as those that make noise or flash in the sun were used. However, this tended to forestall larger problems or just move it to another location.

Between the early 1970's and 1990's, the Flyway and individual states maintained a conservative hold on hunting regulations. As population objectives were achieved after decades of effort, there was a concern that liberalizing regulations too quickly might cause an unwanted population decline. Ultimately, regulations were slowly liberalized, harvest increased and populations continued to grow. The Flyway, working with the USFWS and other flyways began to search for new tools to assist states in controlling local flocks of resident geese. One outcome of this effort is that all states in the Flyway can now hold early (September) and/or late (January) hunting seasons under USFWS approved guidelines. Some other tools were available but were cumbersome and required considerable federal oversight. The Migratory Bird Treaty Act and other federal regulations still constrained states from adding substantial management options to address growing populations.

In an attempt to find solutions to these problems, the USFWS announced its intent to prepare an Environmental Impact Statement (EIS) on Resident Canada Geese (USFWS 1999b). The USFWS requested that the Central Flyway assist in the preparation of the EIS and this document provides the necessary background and current data about Central Flyway Canada geese to accomplish that. Beyond that, it identifies the Flyway's viewpoint, strategies and associated justifications regarding possible changes in the federal regulations that govern what states can do to address the problem of "too many geese." It also identifies actions that will lead to improved responses by agencies to problems caused by Canada geese.

For this document, nuisance and problem Canada geese are defined as geese, goose flocks or local populations of birds that create problems for humans by fouling parks or ball fields with their droppings, eating agricultural crops intended to produce income for a farmer, eating plants used in landscaping or erosion control or threaten the safety of air travel. In most cases, these are flocks of large Canada geese that reside within a city or town but may include flocks that use some other kind of refuge from which to stage their foraging activity and regional populations in rural areas. Between fall and spring, some of these flocks include migrant geese including small Canadas from the SGP and TGP populations.

Many different types of data and data sources were used for this report. Some were tabulated from a survey of state and provincial migratory bird biologists who scoured local records for needed information. Some were obtained from existing state publications. Information from U.S. Department of Agriculture Wildlife Services (WS) was valuable. Other data were obtained from the U.S. Geological Service (USGS), Biological Resources Division Bird Banding Laboratory, the Central Flyway Harvest and Population Survey Data Book (Sharp 1999), and USFWS and USGS files . In addition, Management Plans adopted by the Central Flyway Council were used. Data were analyzed using Microsoft Access 97 and Excel 97, Statistix and custom programs written in Visual Basic. Specific methods are referenced in the various sections of this document.

While this document is designed to address problems caused by Canada geese as they affect humans, their property and their safety, it is in no way intended to reduce the high value the Central Flyway has placed on this renewable resource. Canada geese are part of the larger natural community the Flyway seeks to conserve. Beyond that, they provide an immense and increasing amount of recreation to citizens of the Flyway, from the Queen Maude Gulf in the Northwest Territories to Brownsville, Texas. And the Central Flyway is committed to the maintenance of that recreation.

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Goal and Purpose

GOAL

Manage resident Canada geese in the Central Flyway to achieve maximum benefits from these birds while minimizing conflicts between geese and humans.

PURPOSE

The Central Flyway Council has placed a high priority on Canada goose management since its inception in 1948. Management issues have included population size, inventory, habitat quality and quantity, distribution, restoration and recreational use by humans including hunting.

Canada goose populations have increased significantly in the last three decades. These populations include those that migrate through Central Flyway States and those that are resident. It is primarily these resident birds that sometimes cause "problems" for humans.

The purpose of this document is to discuss the history of resident Canada goose management in the Central Flyway and reflect on that history to identify effective strategies to address problems caused to humans, their property and safety by Canada geese.

History and Current Status of Canada Goose Management in the Central Flyway

> "40 years ago, when wild geese, and I mean Canadas at that, were as plentiful almost as the ducks ... there were many geese killed much larger than any that have been killed ... during the past quarter of a century...." Sandy Griswold, Sporting Editor, Omaha World Herald, 1927. (Nebraska Game and Parks Commission 1979).

Griswold went on to predict the "absolute extinction of the Canada geese within a period of not more than 20-25 years." According to Delacour (1954), who reported that the giant Canada goose was extinct, Griswold hit the mark. The primary reason for this was that a Canada goose was worth $0.50 on the eastern game markets in 1905 ($8.86 in 1998 dollars). Additionally, spring hunting was a common practice.

However, even before Hanson (1965) announced the rediscovery of giant Canada geese, members of the Central Flyway had begun restoration projects. Captive breeding flocks were housed at four National Wildlife Refuges (NWR) in North Dakota and South Dakota between 1938 and 1941 (Lee et al. 1984) and the first breeding flocks were established in Nebraska in 1936 (Gabig 1986). These early efforts experienced mixed success in terms of re-establishing flocks of Canada geese but much success in learning about what worked and what didn't. Over the next 40 years, captive flocks of breeding adults were established in most states and Alberta and Saskatchewan (Table 1). Goslings from these flocks were allowed either to free fly from their hatching location or, more frequently, transported to a new location with suitable breeding habitat. The nature of the bird, particularly females, to return to the area where they fledged after reaching sexual maturity allowed for nucleus breeding flocks to become established.

By 1960, attempts to establish breeding flocks were ongoing in several states, including Colorado, Kansas and Wyoming. Between 1960-62, 259 wild geese were trapped at Bowdoin NWR in Montana and transplanted to Saskatchewan. The pace quickened in the 1970's, when over 18,000 geese were released in the Flyway, including over 12,000 in the U.S. (Table 2). In the two decades that followed, over 85,000 birds were handled (Table 2). Kansas and

Oklahoma started major programs in this period while Wyoming and Alberta terminated theirs.

Canada geese and their restoration were important topics across North America during this period. Between 1968 and 1998, five symposia were held where the topic was exclusively Canada geese (Hine and Schoenfeld 1968; Canada Goose Production Workshop 1971; Kuck and Schroeder 1974; Johnson 1982; Rusch et al. 1998). All but the latter had a significant focus on restoration of populations. *Homegrown Honkers* (Dill and Lee 1970) was published in 1970. In 1984, *Rearing and Restoring Giant Canada Geese in the Dakotas* (Lee et al. 1984) was published. The 79 page book contained 414 "Selected References."

Table 1. Locations and average flock size of captive breeding adult Canada geese in the Central Flyway.

Area	Period	Flock Size
Alberta	1960-80	25
Colorado	1955-60	120
Kansas	1980-91	485
Montana	1945-66	30
Nebraska	1968-84	360
North Dakota	1965-80	230
Oklahoma	1980-90	200
Saskatchewan	1973-80	?
South Dakota	1963-71	90-250

Table 2. Number of Canada geese released either as goslings from captive flocks or as the result of trap and transport programs in the Central Flyway.

Period	AB	SA	MT	ND	SD	WY	NE	KS	CO	OK	NM	CF States	CF Total
1967-98	0		0	0	12,278	0	0	0	0	0	0	12,278	12,278
1960-69	156	1737	371	0	0	121	0	0	1,800	0	0	2,292	4,185
1970-79	2,299	4118	0	5,546	0	1,021	3,803	0	2,000	0	176	12,549	18,966
1980-89	1,265	7075	0	4,457	0	1,049	4,224	10,701	730	13,057	432	34,650	42,990
1990-99	0	9702	0	3,563	0	0	4,447	17,836	2,220	5,556	0	33,622	43,324
Total	3,720	22,632	371	13,566	12,278	2,191	12,474	28,537	6,750	18,613	0	95,391	121,743

There was a change in the focus of activity over these three decades. In the 1970's, 87% of the releases in the U.S. were goslings and 75% of these were from captive flocks held by states (Appendix 1). During the 1980's, 54% of the releases were goslings but this decreased to 43% in the 1990's. In addition, only 23% of the goslings were from captive flocks between 1980-1999. The reason for this shift in the source of birds is that they became available both from other locations within a state and from other states and/or provinces (Appendix 1). In the decade 1990-99, more than 21,000 geese were trapped and translocated within a jurisdiction and another 18,500 were moved from one jurisdiction to another (Appendix 1). The availability of Canada geese was directly related to population size (supply) and problems being caused by geese (i.e. the desire to reduce the number of geese in some places). Many adults were available. Essentially all geese translocated in the 1990's were available because they were causing problems.

As of 1999, only Colorado had an active restoration program and it is scheduled to terminate in 2000. All other states and provinces had terminated their programs though Saskatchewan, Oklahoma, Kansas, Nebraska, South Dakota and North Dakota were still moving birds from places where they were causing problems to less populated locations.

Beyond moving birds, the Central Flyway, states, provinces and federal organizations have taken a number of other actions to address problems. WS has, in particular, been working with airports in the U.S. portion of the flyway in implementing management methods designed to prevent problems from developing as well as solving current problems. Transport Canada, the federal agency that deals with commercial air safety in Canada, has an active program with the same emphasis.

Rather than wait for problems to reach crisis levels on a state by state basis, the Flyway has requested and received authorization from the USFWS for all states to be able to implement September and January hunting seasons directed at resident Canada geese. As of 1999, three states (SD, KS and ND) had used this option. In addition, the USFWS has allowed more liberal regular season hunting regulations directed at large Canada geese in the 1990's, as requested by the Flyway. Harvest has increased and may be effective at addressing the problem on a large scale.

However, these actions may not be effective at the local level (e.g. within an urban community). To address these site-specific problems, states have published information for home and golf course owners to assist in problem prevention and resolution. Some states have had discussions with urban planners and developers. The principle problems experienced and philosophies of states and provinces are discussed in Appendix 2.

Population Size and Distribution

There are two primary time periods that it is reasonable to attempt to obtain an index to population size of Canada geese - at the time of breeding when pairs and "flocks" are counted and in the winter, when birds are relatively concentrated and total counts can be obtained. There is a long history of the latter survey in the Central Flyway and the results are discussed below. First, however, surveys of breeding populations will be reviewed.

Breeding Bird Surveys

Population indices in this report are from several sources. Many are from the annual May Breeding Duck Survey (Wilkins and Cooch 1999) conducted across a broad range of northern North America. While some Canada goose data were recorded on this survey designed to estimate duck population size as early as 1955, data available from 1970 to 1999 were used in this report for HL, RM and WP populations and that portion of the GP population that occurs in Canada (Nieman et al. 2000). The May Survey data also were used to estimate goose populations in North Dakota, South Dakota and Montana. Population information was obtained from the state wildlife agencies where the May Survey is not conducted or data sets were not available. These latter data were based on state-directed surveys and, in some cases, the best professional judgement of waterfowl biologists. Projections for 2010 were made linear and exponential regression equations unless states did their own projection (Appendix 3).

All populations of Canada geese in the Central Flyway are increasing including the RMP which is largely oriented to the Pacific Flyway. The index for total large Canada geese for the three populations in the Central Flyway in 1999 was over 900,000 birds, 95% higher than in 1990 and 680% larger than in 1980 (Table 3). There is evidence that the explosive growth in population of the 1970's and 80's has slowed (Table 3). The sum of the point projections for 2010 indicates a 161

% growth from the 1999 estimate to about 2.4 million birds (Table 3).

The Breeding Bird Survey (Peterjohn 1994) supports the conclusion that Canada goose populations are growing in most parts of the Central Flyway (Table 4). Significant ($P<0.1$) positive annual trends range from 12% to 36% for the period 1980-98. Only the New Mexico data show a significant ($P<0.05$) negative trend.

State and provincial waterfowl biologists were asked to provide their judgement about the rate of increase they expected in the breeding population of Canada geese in their jurisdiction

compared to present (1995-99) rate. Five biologists (from AB, SK, NE, ND, NM) believed that the population would continue to grow at the present rate, five (CO, WY, MT, OK, KS) believed the increase would proceed at a slower rate and one (TX) believed the rate would increase. South Dakota believed that their population would stabilize.

Table 3. Indices of the number of Canada geese in the spring in the Central Flyway, potential population size in 2010 and population objectives.

	1970	1980	1990	1999	2010[1]	Objective[2]
Great Plains Population						
Canada	1,900	4,900	20,800	43,000	359,700	
North Dakota	0	3,700	26,600	104,500	516,600	60,000-100,000
South Dakota	900	3,400	46,200	111,800	100,000	50,000[3]
Nebraska	4,000	8,000	12,000	32,000	36,800	30,000-50,000
Kansas	200	200	8,000	30,000	37,500	37,500
Oklahoma	30	30	11,100	43,900	75,000	20,000-40,000
Texas		500	600	750	900	750
Total	7,030	20,730	125,300	365,950	1,126,500	
% Change		195%	504%	192%	208%	
Western Prairie Population						
Canada	22,000	35,700	145,500	247,500	618,500	
% Change		62%	308%	70%	150%	
Hi-Line Population						
Canada	17,800	21,800	111,500	212,100	456,300	
Montana	40,500	27,500	69,500	62,200	141,600	80,000
Wyoming	1,000	3,900	9,700	15,800		9,700
Colorado	3,600	7,900	10,000	14,500	18,000	12,500
New Mexico	50	75	200	1,700	3,300	5,300
Total	62,950	61,175	200,900	306,300	659,200	
% Change		-3%	228%	52%	115%	
Sub-Total - Central Flyway Large Canada Geese						
	91,980	117,605	471,700	919,750	2,404,200	
	% Change	28%	301%	95%	161%	
Rocky Mountain Population						
Canada	20,700	15,300	41,500	125,700	168,900	
Montana	8,400	8,900	28,000	41,400	64,700	45,000
Wyoming	2,000	3,600	5,500	7,900	12,500	6,000
Total	31,100	27,800	75,000	175,000	246,100	
% Change		-11%	170%	133%	41%	

1. Most estimates are based on a regression fitted exponential equation [$Y = e^{(b * year)}$] (see Appendix 3). By it's nature, this equation accounts for historical growth and there is no certainty that such growth can be susteained. An estimate of a linear nature is provided for many locations in Appendix 3.
2. The population objectives in this table are based on the best knowledge and information available. In addition, they represent state or provincial-wide objectives. As such, jurisdictions may modify population objectives and/or address the size of sub-populations as needed.
3. This estimate was provided by SD Game, Fish and Parks and represents a management objective they intend to attain.

Winter Surveys

Winter surveys have been conducted for Canada geese in the Central Flyway since the 1930's. Since the winter of 1981-82, estimates of individual populations have been made. Procedures for assigning geese to a population are contained in the Management Plans for each population (Central Flyway Council references) and include leg band recoveries and neck

collar observations. Winter surveys are used to establish population objectives that in turn identify points at which hunting regulations may be changed.

Table 4. Trends of the number of Canada geese in the Central Flyway as reported by the Breeding Bird Survey.

	* * * * * * * * 1966-1998 * * * * * * * *						* * * * 1980-98 * * * *		
Region	Trend	P	N	95% Conf. Int.		R.A.	Trend	P	N
Alberta	9.8	***	57	1.9	17.8	7.78	7.2		58
Colorado	8.8	**	17	0.5	17.2	2.63	12.5	****	18
Kansas	39.6		9	*****	218.1	0.68	34.5		8
Montana	25.7	****	27	8.4	43.1	4.35	30.6	***	26
Nebraska	15.2	**	7	2.5	27.9	2.25	9.1		6
New Mexico	-7.6	**	5	-9.9	-5.3	0.40	-9.1	***	5
North Dakota	50.6	****	31	16.0	85.2	5.62	36.6	***	31
Oklahoma	17.5	***	6	10.8	24.3	0.34	17.5	**	7
Saskatchewan	8.1		32	-4.5	20.7	10.04	12.8	***	31
South Dakota	27.1	*	11	-7.6	61.8	0.71	15.3		11
Wyoming	-4.8		25	-18.8	9.2	8.67	-3.5		25

No Canada geese were reported in Texas
Trend is estimated percent change per year
R.A: Relative abundance - birds seen per route
* P<0.2 that the trend is zero: ** P<0.1: *** P<0.05: **** P<0.01

All populations of Canada geese in the Flyway are above objective levels (Table 5) and the total Canada geese counted in the winter is continuing to increase (Table 6). The three populations of large geese (with the WP and GP populations counted as one in the winter) of most concern in this report are growing at a similar rate (P>0.9, equal slopes) (Fig 1). The three-year running averages have been increasing since data estimates were first computed for each population (Table 7). Projections of population size indicate that the total number of Canada geese in the flyway will be 1.96 million by 2010, 31% larger than in 1999. This estimate is comparable to the 28% growth rate computed from breeding population data.

Table 5. Population objective indices, current status and projected index for 2010 for Canada goose populations in the Central Flyway based on winter surveys.

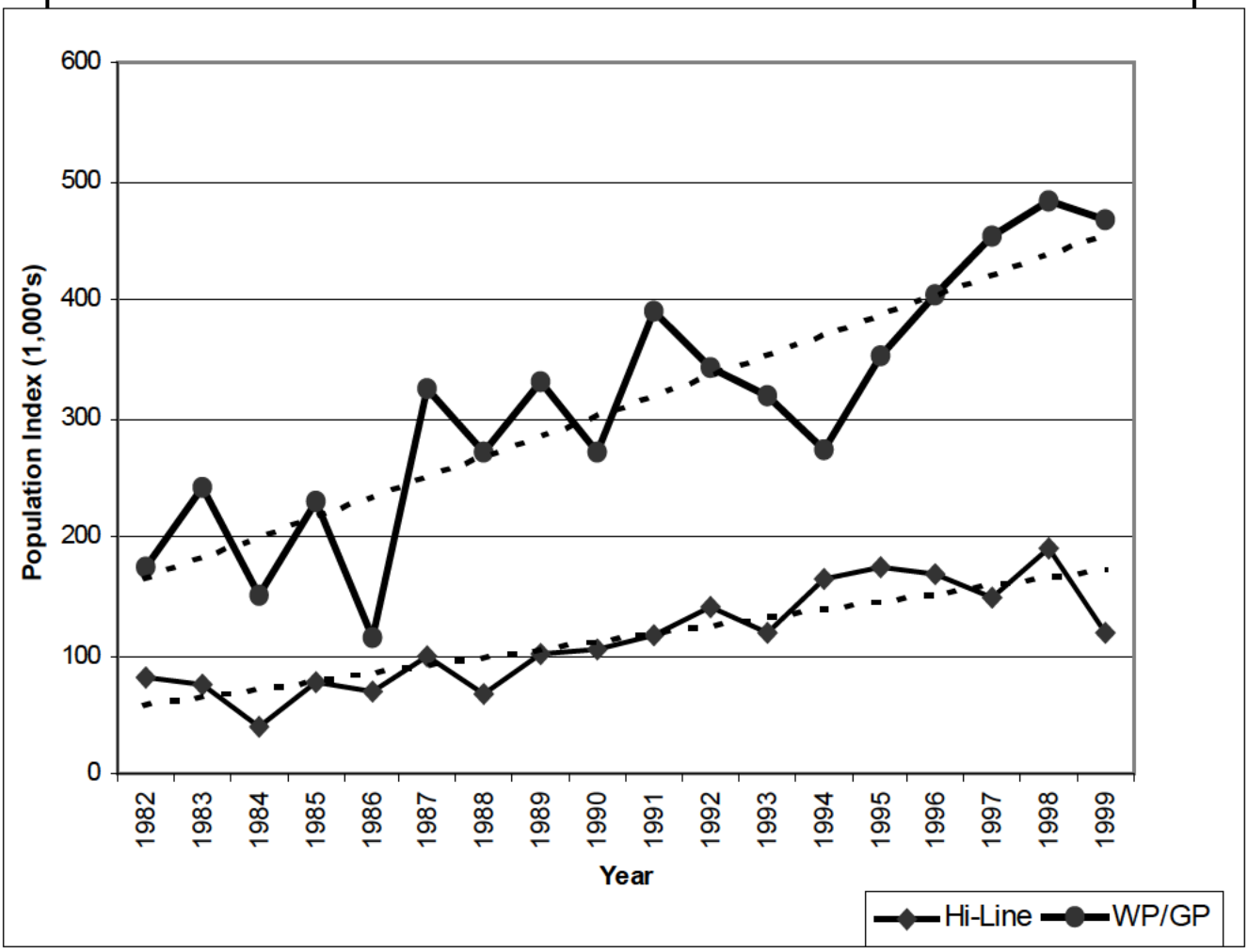
Population	Objective	Average 1997-99 Index	Amount (Percent) Above Objective	Projected Population Index - 2010 **
Tall Grass Prairie	250,000	380,961	130,961(52%)	329,000
Short Grass Prairie	150,000	434,829	284,829(189%)	852,000
Western Prairie & Great Plains	300,000	467,603	167,603(56%)	644,000
Hi-Line	80,000	152,991	72,991(91%)	247,000

** See Appendix 4 for equations used.

Table 6. Average indices of Canada geese in the Central Flyway based on winter surveys.
Percent change from the previous period is shown.

Period	Average	% Change	Period	Average	% Change
1948-59	145,505		1970-79	445,834	54%
1960-69	205,806	29%	1980-89	729,912	39%
			1990-99	1,359,837	46%

Figure 1. Population indices from winter surveys in the Central Flyway for Hi-Line and Western Prairie and Great Plains Canada goose populations.



Harvest

A common goal of Central Flyway goose management plans is "Maximum recreational opportunity consistent with the welfare of various populations, international treaties and habitat constraints" (Central Flyway references). Thus, harvest and hunting regulations play an important role in the perspective of the Flyway. Each of the management plans for the populations of Canada geese contain population objectives that are the benchmark used to restrict or liberalize hunting regulations. These regulations were restrictive during the 1970's and into the 1980's including early season closing dates, daily bag limits of one or two and time frames (or windows) within which the limit could change. As states worked to increase their resident flocks, they instituted more restrictive regulations within their boundaries. While attempts were made to maximize "recreational opportunity" for populations that could withstand higher harvest, management practices put into place to protect a sub-population often provided for reduced harvest of populations that didn't require it.

The management plans also describe the distribution of populations within the flyway, sometimes to the county level within a state, during the fall migration and winter. In addition, procedures are described to separate "small" from "large" Canada geese in the harvest by measuring tail feathers procured from hunters through the USFWS Parts Collection Survey. Using these two tools, an estimate of the harvest can be made at the population level.

Table 7. Three-year running averages and percent change for populations of Canada geese in the Central Flyway using winter survey results.

	Hi-Line		West. Pr. & Grt. Plns		Short-Grass Prairie		Tall Grass Prairie	
Winter	3 -Yr Avg.	% Change	3 -Yr Avg.	% Change	3 -Yr Avg.	% Change	3 -Yr Avg.	% Change
1983-84	65,767		189,041		157,567		231,583	
1984-85	63,933	-3%	207,504	10%	165,267	5%	207,797	-10%
1985-86	61,900	-3%	165,172	-20%	167,867	2%	215,743	4%
1986-87	81,433	32%	223,098	35%	183,667	9%	181,863	-16%
1987-88	78,233	-4%	236,985	6%	170,333	-7%	218,162	20%
1988-89	88,333	13%	308,743	30%	204,933	20%	226,080	4%
1989-90	90,933	3%	291,104	-6%	267,333	30%	221,873	-2%
1990-91	107,533	18%	330,421	14%	390,467	46%	221,533	0%
1991-92	121,000	13%	334,295	1%	502,267	29%	242,612	10%
1992-93	125,186	3%	349,976	5%	485,631	-3%	272,257	12%
1993-94	141,098	13%	310,805	-11%	460,836	-5%	245,286	-10%
1994-95	152,396	8%	314,337	1%	486,696	6%	234,839	-4%
1995-96	168,751	11%	342,767	9%	564,357	16%	244,395	4%
1996-97	163,482	-3%	403,057	18%	573,227	2%	257,283	5%
1997-98	169,012	3%	446,322	11%	487,490	-15%	286,224	11%
1998-99	152,991	-9%	467,603	5%	434,829	-11%	380,961	33%

In about 1990, as populations remained above objectives and continued to increase, the Central Flyway Council started a slow progression of liberalizing regulations (Appendix 5). These first occurred in the west tier of states (NM, CO, WY and MT and in west TX) where SGP and HL birds are harvested. Between about 1990 and 1999, there was a change in the east tier of states (TX, OK, KS, NE, SD and ND) from 72 days to hunt Canada geese with a bag limit of one to 95 days and a bag limit of three. In addition, South Dakota provided the first early September season in the Flyway in 1996 with the objective to decrease the local Canada goose population in the northeast and east-central portions of the state. In 1999, Kansas and North Dakota instituted their first September season.

During the nearly four decades between 1962 and 1998, Canada goose harvest increased more or less with the increase in population size despite a concurrent decline in the number of adult waterfowl hunters (Table 8; Fig 2). The percentage of the Flyway's total goose harvest that was Canada geese increased from about 40% prior to the mid-1980's to greater than 60% in the late-1990's. There were some minor changes in the distribution of the Canada goose harvest in the Flyway, most notably a decline in Texas (from 21% of the Flyway's total in the 1970's to 12% in the 1990's) and in North Dakota (19% to 14%). These "percentage points" of harvest were distributed across all the other states except New Mexico and Kansas which have maintained a relatively stable percentage of the Flyway's harvest.

At the same time the total harvest of Canada geese has increased, so has the proportion that are large geese (Table 9) in nearly every jurisdiction (Appendix 6) over the last two decades. Only in Colorado and Montana has this proportion been stable rather than increasing. The magnitude of the change in Central Flyway states over the period 1995-98 has been influenced by several factors, including more liberal regular season hunting regulations.

Table 8. Harvest and percent change in winter indices of Canada geese and adult waterfowl hunters in Central Flyway States.

Period	Average Harvest	% Chg. - Harvest	% Chg - Winter Pop*	% Chg. - Hunters
1962-69	115,430			
1970-79	174,227	51%	54%	51%
1980-89	229,161	32%	39%	-27%
1990-98	426,180	86%	46%	-13%

* Percent change for winter indices is calculated for whole decades (e.g. 1960-69 and 1990-99). Harvest data first became available in 1962 and the 1999 data are not available at this writing.

Figure 2. Winter count and harvest of Canada geese in Central Flyway states.

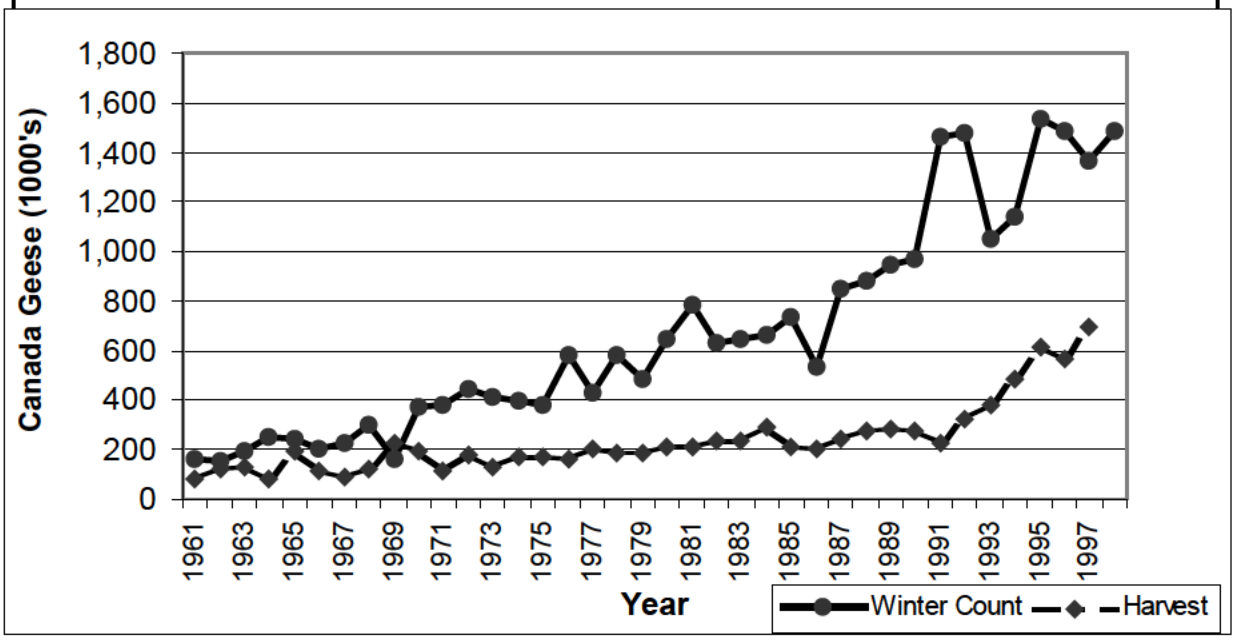


Table 9. Total and large race Canada goose (regular season) harvest in the Central Flyway.

Period	* * Central Flyway States * * Total	Large	% Lrg	* Alberta & Saskatchewan * Total	Large	% Lrg	* * * * * Total * * * * * Total	Large	% Lrg
1980-84	215,340	112,040	52%	200,395	130,305	65%	415,735	242,345	58%
1985-89	242,982	146,596	60%	204,455	135,029	66%	447,437	281,626	63%
1990-94	297,030	190,874	64%	191,392	130,618	68%	488,422	321,492	66%
1995-98	587,365	409,346	70%	228,478	167,573	73%	816,096	576,938	71%

See Appendix 6 for state and provincial details.

Problem Overview

Canada geese have proven to be adaptable and able to breed and live near and essentially within human communities. Humans often provide the right ingredients for Canada geese: a lake (water) surrounded by Kentucky bluegrass for grazing (food) with few predators and frequent handouts of desserts (bread, popcorn, etc.). (Schullery 1980; Conover et al. 1995) This has created opportunities for frequent human/goose interactions.

Besides airport safety issues discussed below, the primary problem caused by these interactions is geese leaving their droppings on golf courses, people's back yards and city parks. Secondary problems are created when geese eat vegetation, often prized landscape

plantings. In one incident in Nebraska, Canada geese destroyed a planting intended to reduce shoreline erosion on an urban lake (R. Winter, Nebraska Game and Parks Comm., pers. comm.)

Obtaining specific information about damage and problems caused by Canada geese in Central Flyway states is somewhat difficult. Wildlife Services operates in all the states in the Flyway but does not deal with Canada goose issues in each. Each state has an agency that also deals with wildlife issues and in some states there is formal agreement between the state agency and WS about who will deal with problems caused by Canada geese. In other states, WS deals with some problems (e.g. airports) while the state agency deals with other types of problems. Many state agencies consider dealing with these problems "all in a day's work" and do not have adequate reporting systems to track their occurrence. However, WS implemented a system-wide reporting system in 1994 and where they deal with Canada goose problems, the records are more complete since then.

In many cases, while problems caused by geese were being addressed, state agencies continued working toward an objective of increasing the number of geese. Many times, they would simply take advantage of "too many geese" in one place and trap and transport the nuisance birds to a place that appeared to be able to handle increased numbers. As the number and in some cases, the severity of problems increased, states gradually reduced efforts to increase the number of birds and spent more time attempting to identify solutions to the problem of "too many geese."

Many people enjoy seeing and hearing the geese - until there are "too many" (Decker 1991). According to the Oklahoma Department of Conservation (ODC), "too many" can range from a dozen to several hundred geese in an urban situation. ODC also reported problems with Canada geese involving agriculture back to 1983, but the first urban problem was reported in 1990. The number of urban incidents addressed by the ODC has increased from one to nearly 50 in 1999 (Table 10). These data are in agreement with those provided by WS for Oklahoma (Table 10). All ten states in the Central Flyway and Alberta and Saskatchewan reported incidents of resident, large Canada geese causing problems in urban situations. In the Flyway as a whole, the number of incidents of urban problems has been increasing throughout the 1990's (Table 10). Although, these types of problems seldom result in reportable, direct economic damage, WS in OK reported $44,000 in damage in 16 incidents on golf courses in 1992 and a total of $68,000 in damage in urban settings between 1992 and late-1999. WS reported over $4,000 in damage between 1993 and 1997 in Colorado. Many of these incidents occur in the summer, pointing directly to resident geese as causing them.

Another type of problem caused by Canada geese involves damage to agricultural crops. This type of problem was reported by every state in the Flyway and Alberta and Saskatchewan. Much of this damage occurs in the fall and spring in the north and winter in the south, making it difficult to attribute to resident rather than migrant birds. However, some of this damage does occur in summer months. In South Dakota, practically all of the damage to agricultural crops occurs between May and July as geese forage on soybeans and corn. In fiscal year 1999, the South Dakota Department of Game, Fish and Parks spent $148,000 on Canada goose damage management. The state estimated $397,000 in damages occurred to agricultural crops in 1999.

In Oklahoma, WS reported over $400,000 in damage to agricultural crops during the period 1992-99. Over $130,000 in damage was identified in North Dakota between 1995 and 1999. The number of incidents in the Central Flyway States is increasing (Table 10).

Human health issues have been raised as they relate to increasing resident Canada goose populations. Friend (1987) indicated that several bacterial diseases that infect waterfowl can be transmitted to humans. These include: chlamydiosis which is much more prevalent in pet birds, domestic fowl and pigeons than waterfowl and treatable with antibiotics; salmonella, which occurs at a low level in wild birds and can be prevented by good personal hygiene ; and

avian tuberculosis, which also occurs at a low level in wild migratory birds and to which humans are considered to be highly resistant. In addition, it has been shown that *Giardia* cysts and *Cryptosporidium parvum* oocysts can persist in Canada goose intestines and be found in feces (Graczyk 1998). While there is the potential for individual humans to become seriously ill from some diseases associated with Canada geese, the risk to the human population is small. As of February, 2000, no Canada geese with West Nile Virus have been identified (National Wildlife Health Center (NWHC) 2000). However, some Canada geese from New York City had anti-bodies to the disease indicating past exposure (pers. comm. Linda Glaser, NWHC). To date, all known cases of West Nile disease have occurred in NY, NJ and CT.

Table 10. Selected data on incidents of problems caused by Canada geese

	Urban[1]				Agriculture					
	Oklahoma			Central Flyway	Oklahoma			North Dakota		Central Flyway
	State[2]	Wildlife Serv.[3]			State	Wildlife Serv.		Wildlife Serv.		
Year	Inc.[4]	Inc.	$$	Inc.	Inc.	Inc.	$$	Inc.	$$	Inc.
1992	1	24	47,600	71	0	16	2,400			59
1993	6			56	4	32	17,600			84
1994	3	24		76	2	32	13,600			80
1995	8	8	2,000	294	2	24	13,600	12	31,250	176
1996	8	8		301	4	40	43,400	13	16,000	258
1997	21	8	6,000	349	3	64	110,880	4	3,915	278
1998	28	88	2,000	409	10	56	212,800	17	38,175	343
1999	49	56	10,400	170	6	56	5,000	12	4,2250	423
Totals	126	216	68,000	1,710	31	320	419,280	58	13,1590	1,701

1. Urban is all incidents that do not involve agriculture.
2. Oklahoma Department of Wildlife Conservation
3.U.S.Department of Agriculture, Wildlife Services
4. Inc. = Incident count

While there have been some anecdotal reports of people being chased and even bitten by nesting Canada geese, the primary safety issue involves interference at airports and actual bird strikes on aircraft. The impact of a large bird striking an aircraft flying at 500 knots creates nearly 1.5 million foot/pounds of energy (Transport Canada 1999). The engines on most medium size jet transport aircraft are designed to withstand bird strikes involving 1.5 pound birds, about 15% of the weight of a large Canada goose. Large flocking birds such as Canada geese and pelicans (*Pelecanus onocrotalus*) are considered to be the greatest threat to aircraft (Transport Canada 1999).

In the U.S., there have been over 2,500 bird strikes on civil aircraft annually between 1990-98 (Bird Strike Committee USA 1999). In Canada, there has been an average of 762 bird strikes annually between 1993-98. Between one and nearly three percent of these Canadian strikes were caused by Canada geese, allowing that between 30% and 45% were caused by unknown species.

The U.S. Air Force reported over 2,500 bird strikes annually between 1985-98 (Bird Strike Committee USA 1999). Between 1985 and August 1999, the cost of these strikes was over $500 million (U.S. Air Force BASH 1999). Canada geese ranked second in terms of the

cost of these strikes at over $81 million and thirty-second in terms of the number of strikes (54). Only the American white pelican caused more damage.

Between 1990 and August 1999, there have been 69 reported strikes by waterfowl on commercial aircraft in Central Flyway states (FAA 1999), at least 57 (83%) by geese. The other 12 reports listed "Ducks, geese, swans" as the species involved. Most of the entries for "Geese" do not list species but 13 show that Canada geese were involved (FAA 1999). There were an average of nearly seven strikes annually with the highest number (12) being recorded in 1998. Reported losses were over $2.2 million including $1.4 million in one incident in Colorado in 1998. Strikes have been reported in seven of the ten Central Flyway states with Nebraska and Texas accounting for a combined total of 53% of the reports. Between 1985 and 1996, in North America, 95% of the strikes on aircraft of known goose species (129) were by Canada geese, allowing that that 65% (241) of the total reports did not identify the goose species involved (Seubert 1996).

The above facts show some of the history and current extent and nature of problems caused by Canada geese. To gain some insight into the future, 12 state and provincial migratory bird managers in the Flyway were asked their professional viewpoint about projected changes in the number and/or severity of problems caused by Canada geese between 1999 and 2010. Each indicated that they expected an increase to occur as goose populations increase. The primary problems expected is an increase in urban problems in both Canada and the U.S. One biologist stated that increasing human populations would lead to increased human/goose interactions even if goose populations stabilized. A number of biologists indicated that the public's tolerance of nuisance geese was becoming lower. This was reflected in statements about the nature of people moving into new housing developments, their apparent desire for golf courses and lakes as well as the longevity of existing problems at established sites. There also was some belief that problems associated with agriculture would also increase.

Some managers believed that the severity of the problems would stay the same and others were certain this aspect would increase. Profit margins in agriculture have an effect on perceptions of severity. In addition, as more airports experience interactions with geese, the severity of problems will likely increase. Overall, there was concern by all managers about the effect of dealing with increased problems caused by Canada geese on agency staff and budgets.

Objective and Strategy Identification

The Central Flyway has had and maintains a significant interest in Canada goose management. The adoption of management plans in the 1980's was a significant step in a decades long commitment to this renewable resource and the people who use and enjoy it. The simple act of identification of populations required much data gathering and research. A six-year program in the early 1990's to re-examine the parameters of the delineation of some populations required a major commitment of resources by the Central Flyway and required a large, international and inter-flyway coordination effort. Significant efforts by states and provinces in cooperation with partners such as the USFWS, the CWS, private land owners and sportsmen, were expended to improve the status of Canada geese. These efforts have been highly successful as demonstrated by increases in population size, the broadened distribution of breeding birds and harvest estimates.

Along with this success have come some problems for humans which have become increasingly more frequent and, in some case, more severe. As outlined above, these problems include fouling of urban parks and lakes, destruction of private property at golf courses and housing developments, destruction of agricultural crops and threats to airplanes.

Members of the Flyway along with WS have been addressing these problems almost on a case by case basis. Further, they have been under some constraints from the USFWS due to

the their responsibility to manage migratory birds. In addition, record keeping associated with both problem identification and remedial actions taken has been incomplete.

To efficiently and effectively deal with resident, large Canada geese that are causing problems in the Flyway, five objectives and associated strategies are identified. They address interactions between government agencies and the public, identification and implementation of control methods, monitoring and evaluation. It is the intention of the Flyway to apply control methods as needed, at all scales of problem resolution ranging from Flyway-wide to specific locations such as a golf course or airport. However, most control actions will be implemented at local scales even though larger scale population objectives have not been met.

Objective 1. Ensure that the positive values associated with resident Canada geese are maximized.

Justification: The states and provinces in the Central Flyway have worked individually and jointly over several decades to establish resident Canada goose populations. This has been accomplished through active release programs, hunting season restrictions and by dealing with problems created by expanding human and goose populations. The Central Flyway believes that its human residents have significantly benefited from these efforts and wishes to maintain and enhance those benefits.

Strategy 1. Maintain hunting seasons that are commensurate with population size and objectives and in accord with population based Management Plans.

Strategy 2. Maintain important viewing opportunities during all times of the year.

Strategy 3. Identify and implement measures that can prevent problems associated with "too many geese" from occurring.

Strategy 4. Assure that the health of populations of migrant Canada geese is maintained by implementing respective management plans.

Strategy 5. Make certain the public is aware of the significant efforts that have been expended across the Flyway and the economic and recreational benefits derived from those efforts.

Objective 2. Implement control methods directed at problem resolution and/or goose population reduction that are socially and biologically acceptable, site-specific, efficient and effective.

Justification: The identification of effective problem control activities should assist in bringing a comprehensive list or menu from which management agencies can choose. This list should allow the selection of a particular action that is commensurate with the nature of the problem and the desired outcome. Maximizing local (state, provincial, community) input and having a broad range of tools available for control activities will also likely maximize effectiveness.

Strategy 1. Maintain and distribute a matrix of actions (Table 11) that might be taken to address problems caused by Canada geese and which identifies the social acceptability, cost and the potential of a goose population change or problem resolution.

Strategy 2. Encourage the U.S. Fish and Wildlife Service and the Canadian Wildlife Service to adopt federal regulations (e.g. depredation or conservation order) that would give states and provinces the authority to manage resident Canada geese where and when necessary.

Strategy 3. Adopt changes in framework dates for establishing regular hunting seasons in the U.S. that would allow for early September opening dates.

Table 11. An Action Matrix to address problems caused by Canada geese with measures of social acceptance, relative cost and projected effects on populations.

The assumption is made that most actions are taken on a largely local rather than flyway-wide basis. See Appendix 7 for a description of actions.

			Projected Effects On The		
Action	Social Acceptance	Relative Cost	Greater Population [1]	Local Population [2]	Problem
None	Low	Low	None to minimal increase	None to moderate increase	None to moderate increase
Provide technical advice only (e.g. terminate feeding, vegetative changes)	Moderate	Low / Moderate	None	None to minimal reduction	Small to moderate reduction
Scare hardware, chemicals, denial of access	Moderate	Moderate	None	None	Moderate reduction
Reproductive inhibitors, contraceptives, sterilization	Moderate	High	None	Unknown	Unknown
Use of other animals (falcons, dogs) as a scare device	High	Low / Moderate	None	None	Small to moderate reduction
Trap & transplant	High	High	None	Moderate reduction	Small to moderate reduction
Reducing egg hatchability	Moderate	High	Minimal reduction	Moderate reduction	Small to moderate reduction
Increased "regular season" sport hunting	High	Low	Low to moderate reduction	Moderate to high reduction	Moderate to high reduction
Special hunting seasons	High	Moderate	Low to moderate reduction	Moderate to high reduction	Moderate to high reduction
Conservation and Depredation Order	Moderate	Moderate	Low reduction	Moderate to high reduction	Moderate to high reduction
Habitat management programs	Low / High	Low / High	Minimal reduction	Minimal to high reduction	Low to moderate reduction
Trap, process and donate to charity	Moderate	High	Minimal reduction	Moderate reduction	Moderate reduction
Issue kill permits	Low / Moderate	Low	None	Minimum reduction	Low to moderate reduction

1. Effect on, for example, the size of the Great Plains Canada Goose Population.
2. Effect on a flock of birds using a lake or park, a larger sub-population using a city or a small region of a state or province.

Strategy 4. Amend the Migratory Bird Treaty to remove the 107 day constraint on hunting season length and consider other changes that would remove constraints on the management of migratory game birds.

Strategy 5. Continue and improve programs conducted by the U.S. Department of Agriculture, Animal and Plant Health Inspection Services, Wildlife Services that deal with problems caused by Canada geese in the U.S.

Objective 3. Implement public awareness campaigns and cooperative programs to maximize the effectiveness of preventative and problem resolution methods.

Justification: Identification of methods in Objective 2 by professional waterfowl management community is only the first step in implementing them. The public and other institutions need to be aware of available solutions so acceptable ones can be chosen. Beyond that, people need to know which control actions require federal and/or state permits. Actions are best taken after local decision making processes and sometimes need to be taken quickly.

Strategy 1. Develop printed guides for the general public and institutions that identify problem control methods that can be adopted by them without special permits or additional help from agencies.

Strategy 2: Develop programs with associated printed guides primarily directed at institutions and larger land owners that identify problem control methods that may need the assistance of management agencies or special permits.

Strategy 3: Encourage cooperation between federal, state and provincial agencies, including those responsible for military and commercial aircraft, so consistent information is provided to the public, record keeping is enhanced and responsibilities are clearly defined.

Strategy 4: Make information available to the public and others via agency World Wide Web sites. Consider the possibility of establishing a central location for information that applies generally across the flyway with contact lists and links to associated sites.

Objective 4. Monitor goose populations, the number and type of problems they cause, attempts to solve those problems and the social acceptance of management actions.

Justification: Canada goose populations are growing in every part of the Central Flyway. However, in many places, there is little information to identify the rate of that growth or current information being gathered can be improved. It is important to know if management actions that are directed at population control are being effective. This requires information about population size to detect both positive and negative changes. In addition, to properly plan budgets and manpower needs, it is important to develop a mechanism to document actual problems caused by Canada geese. Lastly, it is important to document what management actions were taken so managers can learn about what control methods works under what conditions. These items taken together, provide justification for managers to take or not take future actions.

Strategy 1: Obtain agreement from all agencies involved on the exact geographic locations (e.g. latitude/longitude) that describe a population. This would, for example, facilitate publication of May Breeding Bird Survey strata and transects on which birds counted would be assigned to one population or another. In addition, large Canada geese that are currently in the "unaffiliated" class in the winter survey would be better accounted for.

Strategy 2: Identify scientifically justifiable, economical and acceptable methods to obtain indices to breeding Canada geese. Encourage states, provinces and federal governments to adopt methods with as much standardization as possible.

Strategy 3. Acknowledge that these and other efforts will allow improved population objectives to be established and that provincial and state-wide objectives need not be met before actions to reduce a local population are taken.

Strategy 4: Identify a data-base system to store information associated with management of problems caused by Canada geese. This system should not duplicate existing systems but be able to interface with them so data needs are met with a total data base available. This system should be available to federal, state and provincial organizations alike. Queries and reporting should be able to be done by the user. The best "location" for such a system is on an access-controlled Internet site. This also would facilitate making these data available to the public on an "as requested" basis. At a minimum, the data base should contain: date, location (state/province, nearest town, latitude/longitude), who is reporting (agency), resource affected category, detail resource affected, size of area affected, wildlife species involved (this could be a general goose data base), number of birds involved, action taken (provide for more than one), estimate of effort for the action (man-days, equipment), estimate of dollar loss. Assure the system can capture proactive, preventive measures taken.

Strategy 5. Develop a Geographical Information System (GIS) based data set to facilitate tracking, mapping, analysis and reporting of this information.

Strategy 6. Determine the social acceptance of various management actions under various scenarios (an estimate of social acceptance has been included in the Action Matrix under Objective 2 but affirmation of these estimates is needed).

Objective 5. Establish mechanisms for evaluation of objectives and strategies

Justification: In order to learn if methods selected to address problems caused by Canada geese are effective and socially acceptable, control methods must be evaluated. This evaluation should include population modeling, measuring human and goose responses to control methods, cost and research on alternative methods of problem and population control. Ultimately, this will lead to implementation of Adaptive Resource Management as a tool to improve efficiencies and provide justification for future actions.

Strategy 1: Develop *a priori* designed, periodic analysis and reports that would be useful to managers and agencies and built from the data base established under Objective 4 and population indices. Use these data to achieve more effective and efficient responses by agencies.

Strategy 2. Describe research needs as they relate to dealing with data gathering methods, changing Canada goose populations and methods for dealing with associated problems caused by geese.

The Future

All Canada goose populations in the Central Flyway are above objective levels and continue to increase. This has lead to increased recreational use of these birds and is considered a positive effect of long-term management decisions and actions. Along with increasing numbers of Canada geese have come increasing interactions with humans. However, some of these interactions are not desirable. States, provinces and federal agencies have taken a wide array of actions to reduce the problems caused by "too many" Canada geese. In addition, they are expending increasing amounts of manpower and dollar resources to address these problems.

Many problems caused by Canada geese are site-specific to a county, a ranch or farm, a city, a lake or golf course. While many of these have similar attributes across states, each has their own characteristics that requires site-specific solutions. These characteristics include

the speed at which a solution must be found, the number of birds involved, the social acceptance of various action alternatives, the resource being affected and the landscape itself.

As goose populations and the associated problems they cause continue to increase, agencies whose responsibility it is to deal with them will need maximum flexibility in deciding how and when to use existing methods and to try new ones. Thus, the number of options available to those agencies needs to be increased.

If local or regional populations of Canada geese can be controlled or even reduced on a local basis soon, the amount of effort needed for maintenance of a population will be less than if pursuit of solutions is forestalled.

Summary of Data and Data Analysis Needs

While compiling and analyzing the information available for this report, it became apparent that much data have been collected about large Canada geese in the Central Flyway. It also became apparent that some of these data have not been used in the most effective manner. There had never been a synthesis of the restoration efforts of all states and provinces in the Flyway. Information about the types and extent of the problems caused by Canada geese was scattered across many organizations (states, provinces, and federal agencies such as the FAA, the military and WS). Even though regulations had been changed to increase the harvest of large Canada geese, the data reflecting the percent large geese in the harvest have not been updated for several years. Information about the success and failure of methods to address problems caused by Canada geese was not available in one place. Many geese had been banded (Appendix 8) but without coordination in the Flyway. And little analysis of the recoveries, including recaptures, had been done.

The following list is an attempt to identify important tasks designed to overcome some of the deficiencies in information sharing and, more importantly, to better use the information already available (and still being collected) about large Canada geese. Accomplishing these task should lead to being able to make improved science-based and better informed decisions about Canada goose management.

Banding and Recovery Data

- Determine / map recovery distribution
- Determine survival and recovery rates
- Determine if birds banded with different Status codes have similar distribution, survival and recovery rate characteristics
- Determine best approaches to use recapture information to estimate population parameters (e.g. survival, size)
- Identify future banding needs

Determine the best methods to describe population size

Determine the best methods to describe reproduction parameters

Determine the extent and effects of molt migrations on population surveys, survey timing, banding and harvest

Determine social values associated with the presence of Canada geese in urban and rural setting and regarding hunting and acceptance of problem and population control measures

Determine efficient mechanisms to track and report on problems, actions, action effectiveness

Continue research regarding problem and population control techniques

Develop population models to assist with management decisions

Determine the best approach to implementing Adaptive Resource Management for resident Canada goose management

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Appendices

Appendix 1. Number of Canada geese released in the Central Flyway

Most were released as part of restoration efforts.

		Alberta		Saskatch-ewan[2]		Montana		North Dakota		South Dakota[3]		Wyoming		Nebraska	
Year	Source[1]	Ad.	Yng.	Ad.	Yng.	Ad.	Yng.	Ad.	Yng.	Ad.	Yng.	Ad.	Yng.	Ad.	Yng.
1967-98	Within									49	934				
	External									15	280				
	Cap Flk									550	10450				
	Unknown														
1960-69	Within		156	1737									121		
	External														
	Cap Flk						371								
	Unknown														
1970-79	Within	389	1771	4118								7	459		
	External											285	50		
	Cap Flk	3	136					1217	4329					10	3793
	Unknown												220		
1980-89	Within	186	659	7075				598	3292			76	168		
	External											102	436		
	Cap Flk		420					567							4224
	Unknown												267		
1990-99	Within			9702				511	3052					589	190
	External														300
	Cap Flk														3368
	Unknown														
Totals	Within	575	2586	22632	0	0	0	1109	6344	49	934	83	748	589	190
	External	0	0	0	0	0	0	0	0	15	280	387	486	0	300
	Cap Flk	3	556	0	0	0	371	1784	4329	550	10450	0	0	10	11385
	Unknown	0	0	0	0	0	0	0	0	0	0	0	487	0	0
Grand Totals		578	3142	22632	0	0	371	2893	10673	614	11664	470	1721	599	11875

(Continued ➔)

Appendix 1 (Continued)

Number of Canada geese released in the Central Flyway, mostly as part of restoration efforts.

		Kansas		Colorado		Oklahoma[4]		New Mexico		Central Flyway States[5]			Central Flyway Total		
Year	Source	Ad.	Yng.	Ad.	Yng.	Ad.	Yng.	Ad.	Yng.	Ad.	Yng.	Total	Ad.	Yng.	Total
1967-98	Within									49	934	983	49	934	983
	External									15	280	295	15	280	295
	Cap Flk									550	10450	11000	550	10450	11000
	Unk.									0	0	0	0	0	0
1960-69	Within			125	1675					125	1796	1921	1862	1952	3814
	External									0	0	0	0	0	0
	Cap Flk									0	371	371	0	371	371
	Unk.									0	0	0	0	0	0
1970-79	Within			50	1950					57	2409	2466	4564	4180	8744
	External							90	89	375	139	514	375	139	514
	Cap Flk									1227	8122	9349	1230	8258	9488
	Unk.									0	220	220	0	220	220
1980-89	Within	67	4282	250	480					991	8222	9213	8252	8881	17133
	External	4790	1562			9374	3683		432	14266	6113	20379	14266	6113	20379
	Cap Flk									567	4224	4791	567	4644	5211
	Unk.									0	267	267	0	267	267
1990-99	Within	3548	1593	500	1720					5148	6555	11703	14850	6555	21405
	External	8864	3831			5006	550			13870	4681	18551	13870	4681	18551
	Cap Flk									0	3368	3368	0	3368	3368
	Unk.									0	0	0	0	0	0
Totals	Within	3615	5875	925	5825	0	0	0	0	6370	19916	26286	29577	22502	52079
	External	13654	5393	0	0	14380	4233	90	521	28526	11213	39739	28526	11213	39739
	Cap Flk	0	0	0	0	0	0	0	0	2344	26535	28879	2347	27091	29438
	Unk.	0	0	0	0	0	0	0	0	0	487	487	0	487	487
Grand Totals		17269	11268	925	5825	14380	4233	90	521	37240	58151	95391	60450	61293	121743

1."Within" means birds were captured within the jurisdiction; "External" means birds were obtained from another jurisdiction; "Cap Flk" means birds, mostly goslings, were obtained from production from a captive flock.

2. All Saskatchewan birds are shown as adults in the "within" category: the number of goslings included is unknown.

3. SD birds not distributed to decade.

4. OK- 1980-89 goslings includes 2853 raised from eggs between 1986-92.

5. The table does not include: 548 birds prior to 1960 from WY; 914 unknown age birds from WY; 200 unknown age birds from KS, 102 birds from CO. Texas did not release any birds.

Appendix 2. State and Provincial Summaries

The following contains a brief overview of the status of resident Canada geese in the states and provinces of the Central Flyway. Some information presented is common to all entries. Only banding data for June through August for the period 1970-98 are included in the discussion (Appendix 8). All states conduct a winter inventory of Canada geese as part of a coordinated survey so this is not listed as a "Monitoring effort" below. Regarding the "Distribution" of breeding Canada geese, it should be noted that there is a high level of variability in densities within a state or province. Reported harvests for states are from U.S Fish and Wildlife Service (USFWS) surveys to make estimates comparable across the U.S. portion of the Flyway. Harvest estimates for Alberta and Saskatchewan are derived from annual harvest surveys conducted by Environment Canada. Although private individuals held captive flocks of geese for gosling production or otherwise participated in restoration efforts, "Restoration History" sections below only discuss state, provincial or federal government efforts. Breeding Bird Survey (BBS) data were obtained from the USGS World Wide Web site (Sauer et al. 1999). Trend is defined by the BBS as the estimated percent change per year. Data on strikes on commercial aircraft by geese were provided by the FAA (Federal Aviation Administration 1999). In many cases, these data do not show the species of goose involved, only showing "Geese" in the species column. In addition, the species involved in some strike data only shows "Ducks, geese swans." "Current" population size refers to that in 1999. The population objectives below are based on the best knowledge and information available. In addition, they represent state and provincial-wide objectives. As such, jurisdictions may modify population objectives and/or address the size of sub-populations as needed. Finally, no distinction is made between the three races of large Canada geese.

Alberta

Restoration History: The range of the Rocky Mountain (RMP), Hi-Line (HLP) and Pacific (PP) populations occur in the Province. The RMP and HLP occupy contiguous habitat in the southern two-thirds of the province with the PP occurring in the northwestern portion of the province. Alberta maintained a small captive flock of Canada geese between 1969 and 1981. The goslings from the flock were released throughout the southern two-thirds of the province in the range of both the HLP and RMP. In addition, both adults and goslings were wild-trapped during the same period and moved to unoccupied areas. In total, 3,720 birds were handled. During the 1970's, the province also conducted a program directed at providing hay bales as nesting platforms for geese. There are no current efforts directed at restoration in the province.

Population

Survey Method: The May Breeding Duck survey conducted annually by the USFWS, Canadian Wildlife Service (CWS) and Alberta Environment (AENV) is used to index the total population size. Data are available back to 1955. Corrections for visibility from the aerial surveys were first applied in 1996 and all earlier data were adjusted accordingly.

Objective (Total birds in Spring): AENV is awaiting final figures from the USFWS and CWS regarding the historical and current size of the three populations (RMP, HLP and Pacific Population) of Canada geese that occur in the Province to establish population objectives.

Current size (Total birds in Spring): The 1997-99 average for southern Alberta is 151,000 and 64,700 for central Alberta (215,700 total) based on the May data.

Trend: Increasing. There are data only for the period 1989-99 for central Alberta and the annual rate of increase for those 11 years is about 20%. For southern Alberta, the annual rate of increase has been about 6% over the last 30 years. Data from the BBS for the province indicates a significant ($P<0.05$) trend of 9% between 1966-96. The trend for 1980-96 is positive but non-significant at 7%.

Distribution: RMP Canada geese nest throughout the western portion of the southern two-thirds of the province and HLP Canada geese nest throughout the eastern portion of the southern two-thirds of the province. Pacific population Canada geese nest throughout the northwest portion of the province.

Harvest: Harvest of large Canada geese increased substantially during the 1980s and has been stable or increasing slightly during the 1990s. Average harvest of HLP geese during the 1980s (22,000) increased by 139% over that of the 1970s (15,800) and harvest during the 1990s (27,000) increased by 123% over that of the 1980s. Harvest of RMP geese during the 1980s (30,900) increased by 183% over that of the 1970s (16,900) and harvest during the 1990s (34,600) increased by 112% over that of the 1980s. On average, 80% of the total Canada goose harvest is large birds (Appendix 6).

Monitoring efforts

Banding: Between 1970 and 1991, more than 38,000 Canada geese were banded in Alberta. There were very few geese banded between 1992 and 1999 (Appendix 8).

Harvest survey: The Province relies on Environment Canada for harvest estimates.

Problem identification

Typical or primary problem type: Over the decades, the primary damage caused by waterfowl has been to agriculture with ducks being the primary culprit. However, in the last decade, the damage caused by geese in the Fall has surpassed that caused by ducks in Alberta. Some of this damage is caused by migrant snow, Ross', white-fronted and small Canada geese from Arctic nesting areas but much is due to the increasing population of resident birds. Damage caused by resident birds in the Summer has been increasing and five or six cities are now experiencing problems. It is anticipated that urban problems will take on increasing importance.

Aircraft safety: Between 1991-99, there were six strikes on aircraft at Calgary International Airport by Canada geese. It is clear from Transport Canada's Web site that they believe that Canada geese are an important threat to aircraft safety. Their publication Controlling Canada Geese (Transport Canada 1999) contains many suggestions for airport management.

Frequently used responses: The Alberta Environment, in cooperation with the Government of Canada, delivers an active damage prevention program and provides compensation for crop losses for damage to agriculture caused by geese. Responses to urban situations includes providing advice about the prevention of problems and methods for their resolution.

Management Philosophy and Expectations: Urban goose population numbers and resident intolerance of high populations of Canada geese will continue to increase. While the presence of geese within urban settings provides excellent opportunities for interaction with wildlife, AENV expects that dealing with of nuisance geese and goose damage in urban centers will take on increasing importance. Increased pressure for problem resolution can be anticipated. Agricultural producer tolerance to high goose population levels is also strained. There is an expectation that the level of effort (compensation, active prevention) regarding agricultural damage will need to be maintained. Long hunting

seasons and liberal bag limits do not address urban goose conflicts and do not result in sufficient harvest to ameliorate conflicts with agricultural producers.

Colorado

Restoration History: The Colorado Division of Wildlife (CDW) maintained a small captive flock of Canada geese between 1955-60. Goslings from this flock were used to increase the breeding population along the northern Front Range. Through 1999, Colorado has released about 6,700 adults and goslings in the Central Flyway portion of the state for restoration purposes. Many of these birds were collected from areas within the state where populations were considered too large. They are presently conducting one restoration program and that is scheduled to be completed in 2000.

Population

Survey Method: Historically, local goose populations in several portions of the state have been surveyed annually, typically in April or July. All surveys are currently being reviewed and modified.

Objective (Total birds in Spring): 12,500

Current size (Total birds in Spring): 14,500

Trend: Increasing. The BBS for the state as whole indicates a significant ($P<0.2$) positive trend of 11% between 1966-96: for the period 1980-96, the trend is significant ($P<0.05$) at 19%.

Distribution: Throughout the Central Flyway portion of the state.

Harvest: Increasing. The average harvest for Central Flyway Colorado in 1995-98 (136,000) was 146% larger than the 1990-94 average and 204% larger than the 1980-89 average. Nearly 75% of this harvest is large Canada geese (Appendix 6).

Monitoring efforts

Banding: CDW maintained a banding program from at least 1970 to 1987. Several hundred goslings were banded between 1996-98 but few bands were put on between 1988-95 (Appendix 8).

Harvest survey: CDW no longer conducts a state waterfowl harvest survey, but relies on annual federal harvest estimates.

Problem identification

Typical or primary problem type: Urban problems are the primary concern in Colorado though there are some localized agricultural problems occur.

Aircraft safety: Between 1990-99, eight strikes by "geese" of commercial aircraft were reported in Colorado. Two of these records referred to "Canada geese."

Frequently used responses: Thousands of Canada geese were trapped and transported to other states by the CDW between the mid-1970's and mid-1990's. The state's philosophy is to use available sport hunting regulations to manage populations. The state is also working with developers and urban planners in an attempt to avoid future problems.

Management Philosophy and Expectations: The CDW believes that resident Canada geese provide valuable opportunities for recreational hunting and aesthetic appreciation by the public. The management goal is to manage the size and distribution of resident Canada geese to achieve an optimal balance between positive values and conflicts between humans and geese. To achieve this balance, large changes in the overall population size are probably not needed. As the human population continues to grow along the Front Range and adjacent eastern plains, some increase in the number of nuisance complaints

about Canada geese in urban areas is expected. A few nuisance situations may continue to be created by geese on agricultural areas. The CDW intends to use available options for hunting regulations to manage the size and distribution of resident geese where they are likely to be effective. The CDW desires like a broad range of control options for urban situations so that effective, publicly-acceptable control techniques can be selected on a case-by-case basis. Waterfowl managers are taking a proactive approach by providing problem-avoidance guidance to municipal planners and developers.

Kansas

Restoration History: The Kansas Department of Wildlife and Parks (KDWP) maintained a captive flock of Canada geese ranging as high as 650 birds for the production of young between 1980-91. In addition, more than 19,000 adults and goslings were obtained from other states. In total, more than 28,500 geese have been handled in restoration efforts by the KDWP since 1980. There is no formal, current restoration program in Kansas. However, some geese that are trapped to resolve problems are released in areas where there are currently few birds.

Population

Survey Method: In 1996, KDWP initiated a roadside survey of nesting Canada geese. The survey has been modified (expanded and improved) each year but is expected to stabilize with the 1999 methodology. Data from this March/April survey combined with Professional judgement associated with unsurveyed areas were used to produce estimates of the breeding population.

Objective (Total birds in Spring): 37,500

Current size (Total birds in Spring): 30,000

Trend: Increasing. The BBS for the state shows a non-significant ($P>0.1$), positive trend of 39% for the period 1966-98 and 34% for 1980-98. The BBS for the Dissected Till Plains physiographic region, that includes eastern Kansas, indicated a significant positive trend of 15% ($P<0.05$) annually for the period 1966-96 and 18% ($P<0.01$) for 1980-96.

Distribution: Statewide

Harvest: Increasing. The average 1995-98 harvest estimate of 38,000 is 185% greater than the average for 1990-94 and 193% greater than that for 1980-89. About 80% of this harvest is large Canada geese. Harvest estiamtes from the 1999 (the first) early September season are not currently available (Appendix 6).

Monitoring efforts

Banding: Between 1982 and 1998, more than 27,000 Canada geese were banded (Appendix 8).

Harvest survey: KDWP conducts an annual survey of waterfowl harvest to supplement information from the federal survey but has some concerns about the manner in which Federal Duck Stamp sales are attributed to the state. Since Duck Stamp sales are important to being able to estimate harvest, the KDWP is not processing information from some recent years until the issue is resolved.

Problem identification

Typical or primary problem type: Urban though about 12% of the 1999 complaints were related to agriculture.

Aircraft safety: There are concerns at the two major airports (Kansas City, though formally in Missouri, and Wichita). These are primarily being addressed in a preemptive

manner by USDA, Wildlife Services personnel. Between 1990 and July, 1999, seven airstrikes of "Geese" (though two incidents listed "Ducks, geese, swans) have been reported in Kansas with one being attributed to Canada geese.

Frequently used responses: deterrents, scare devices and trap / transport. USDA Wildlife Services are working with airports in an attempt to avoid problems. Kansas conducted its first early September hunting season in 1999 near Kansas City.

Management Philosophy and Expectations: The KDWP expects that complaints associated with resident Canada geese will increase proportional to increases in the goose population. It is anticipated that the distribution of problems between agriculture and urban situations will remain unchanged. The current approach is to first educate individuals and the public on how to discourage and alleviate their goose problems. If additional effort is needed, KDWP staff review the situation and prescribe techniques that they feel are most appropriate. The KDWP will evaluate the effect of their first early September hunting season (held in 1999) and determine if and how to apply this approach in the future.

Montana

Restoration History: A small captive flock was maintained in Montana at Medicine Lake National Wildlife Refuge (NWR) between 1945-66 and goslings were used to reestablish a breeding population. Bowdoin NWR collected eggs from wild birds with the resultant young being released at several locations within the state. In addition, some captive-reared and wild-caught goslings were transported to Saskatchewan, Nebraska and Colorado. There are no current restoration efforts in Montana.

Population

Survey Method: The annual May Breeding Duck survey conducted by the USFWS and CWS is used to index the size of the Canada goose breeding population in a large part of Central Flyway Montana. Both the HL and RM populations of Canada geese nest in the state. Information about the relative size of each of these was provided by the USFWS, Office of Migratory Bird Management. There are some geese breeding outside the survey area.

Objective (Total birds in Spring): RMP: 45,000; HLP: 80,000

Current size (Total birds in Spring): RMP: 41,400; HLP: 62,200 (this is a the 1996-98 average)

Trend: Increasing according to the May Survey data for the state. In addition, the BBS data show a positive, significant ($P<0.05$) trend of 26% annually between 1966-96. The trend for the 1980-96 period is also significant ($P<0.05$) at 35%.

Distribution: Throughout the Central Flyway portion of the state.

Harvest: Increasing. The average 1995-98 harvest was 33,000, 113% higher than the 1990-94 average and 377% higher than the 1980-89 average. Typically, large Canada geese make up about 90 percent of the harvest (Appendix 6).

Monitoring efforts

Banding: A relatively consistent banding program was maintained between at least 1970 and 1981. Since then, banding has been sporadic and zero in several years. Since 1970, fewer than 7,000 Canada geese have been banded. A new, multi-year banding project was begun in 1998 (Appendix 8).

Harvest survey: The state conducts an annual harvest survey to supplement federal harvest estimates.

Problem identification

Typical or primary problem type: There have been a few urban problems since 1992, principally in three cities. There have been even fewer problems caused to agriculture.

Aircraft safety: Between 1990 and July, 1999, there were five strikes of commercial aircraft by "Geese" reported. One of these was identified as being caused by a Canada goose.

Frequently used responses: Provide advice; trap and transport.

Management Philosophy and Expectations: Montana Fish, Wildlife and Parks (MFWP) believes there will be a slight increase in the number of nuisance Canada goose situations, primarily under urban conditions. The agency remains hopeful that sport harvest in Montana and other places will keep goose populations under control although urban goose complaints will likely increase. MFWP is not taking any actions that encourage an increase in urban Canada goose populations. They take an active role in nuisance situations but USDA, Wildlife Services has had the lead role even while working closely with the agency.

Nebraska

Restoration History: The first captive flock of Canada geese in Nebraska was established in 1936 at Crescent Lake NWR. Between 1970-97, the Nebraska Game and Parks Commission (NGPC) maintained a captive flock that averaged approximately 360 birds. A separate, smaller flock of about 20 birds also was maintained from 1968-84. Goslings from these flocks were released to increase the breeding population statewide with particular emphasis placed on the Sandhills, the North Platte Valley and Lancaster County. Between 1970-97, >11,000 goslings were released. There is no current restoration program being conducted by NGPC.

Population

Survey Method: Currently, there is no formal survey for breeding geese but several April and September surveys were periodically conducted. Population estimates are based on professional judgement and annual banding operations.

Objective (Total birds in Spring): 30,000-50,000

Current size (Total birds in Spring): 32,000

Trend: Increasing. The BBS shows a significant ($P<0.1$), positive annual trend of 15% for the period 1996-98 and a non-significant ($P>0.1$) trend of 9% for 1980-98.

Distribution: Statewide

Harvest: Increasing. The average annual harvest for the period 1995-98 of 82,000 is 101% above the 1990-94 average and 228% above the 1980-89 average. Harvest is typically comprised of >85% large Canada geese (Appendix 6).

Monitoring efforts

Banding: All goslings released were banded. Banding of free-flying birds occurred in 1981-1985 and each year between 1989-98. More than 26,000 Canada geese have been banded including over 15,000 goslings for the period 1970-98 (Appendix 8).

Harvest survey: The state conducts an annual survey of waterfowl hunters to supplement federal harvest estimates.

Problem identification

Typical or primary problem type: Urban. Currently, there are few problems regarding damage to agricultural crops by resident Canada geese.

Aircraft safety: There were 17 strikes of "Geese" by commercial aircraft in Nebraska between 1990 and July, 1999 (FAA 1999). Two of these strikes list the species involved as "Ducks, geese, swans" and four of the strikes specifically identified Canada geese as being involved. Aircraft strikes in Nebraska constitute 25% of the total for the Central Flyway states.

Frequently used responses: Technical assistance, scare devices, trap and transport. USDA Wildlife Services has played an active role in preventive measures at airports using a variety of techniques including habitat management and harassment.

Management Philosophy and Expectations: The NGPC anticipates that complaints about nuisance Canada geese will increase as the population of Canada geese continues to grow. It is expected that most of these complaints will come from urban centers. The agency depends on district personnel to investigate nuisance situations and determine appropriate actions. Increasing public awareness of problems caused by Canada geese and actions that can reduce their effects was identified by the Agency in their Strategic Plan completed in 1996. Also, the Agency established a position statement about restoration efforts by private citizens and/or organizations and NGPC assistance on those efforts.

New Mexico

Restoration History: There has not been a intensive restoration effort by the New Mexico Department of Game and Fish (NMDGF). In the early 1970's and again in the late-1980's, several hundred adults and goslings (600 total) from Colorado were released in the Central Flyway portion of the state.

Population

Survey Method: A combination or professional judgement and state surveys is used to estimate the size of the breeding population.

Objective (Total birds in Spring): 4,000

Current size (Total birds in Spring): 1,700

Trend: Increasing, according to NMDGF. However, the BBS shows a significant ($P<0.1$) negative annual trend of 8% for the period 1996-98 and 9% ($P<0.05$) for the period 1980-98.

Distribution: Primarily in the Rio Grande Valley.

Harvest: Decreasing. The average 1995-98 harvest was 1,600 Canada geese, 42% below the 1990-94 average and 46% below the 1980-89 average. About 64% of the total harvest is large geese (Appendix 6).

Monitoring efforts

Banding: Fewer than 1,100 Canada geese were banded in NM between 1970-98 (Appendix 8).

Harvest survey: The NMDGF conducts an annual survey of waterfowl hunters and harvest to supplement federal estimates.

Problem identification

Typical or primary problem type: Crop depredation (agriculture). In recent years, there have been problems on a golf course in the Rio Grande Valley.

Aircraft safety: The FAA did not report any strikes of commercial aircraft by geese in NM between 1990 and July, 1999. There were no other reported incidents involving airports.

Frequently used responses: Provide advise on problem prevention; scare devices.

Management Philosophy and Expectations: The NMDGF doesn't currently have many problems with resident Canada geese. However, the population in the narrow corridor of the Middle Rio Grande Valley is growing and there is an expectation that problems in urban and agricultural settings will increase. A similar situation exists along the eastern Rocky Mountains in the upper Rio Grande River valley. There remains unfilled goose habitat in the state, which provides an outlet for trap / transplant operations. NMDGF is pursuing increasing the public's awareness of what can be done to limit problems as the goose population increases.

North Dakota

Restoration History: Between 1938 and 1941, captive flocks of geese were initiated at two NWRs in North Dakota. Over the next two decades, several other small flocks were established. Between 1965-1980, a captive flock with an average of 230 birds was maintained first by the USFWS and then by the North Dakota Game and Fish Department (NDGFD). The restoration program shifted to transplanting wild-trapped birds after 1981. Between 1970 and 1999, more than 13,500 birds were handled in restoration efforts, and more than 10,000 of these were goslings. There is no formal, current restoration effort in the state.

Population

Survey Method: The May Breeding Duck survey conducted by the USFWS provides an index to total Canada geese in North Dakota during the breeding season. Since 1992, the state has conducted several ground transect surveys on which geese are counted in mid-May.

Objective (Total birds in Spring): 60,000-100,000 (Three-year average under average environmental condition)

Current size (Total birds in Spring): 104,500

Trend: Increasing. The May survey data shows that the population increased at greater than 20% annually between 1973 and 1999. The rate of growth has increased since 1994. The BBS shows a significant ($P<0.05$) positive trend of 78% between 1966-1996. For the period 1980-96, the trend is significant ($P<0.05$) at 47%.

Distribution: Statewide

Harvest: Increasing. The average harvest for the 1995-98 period was nearly 84,000 birds, 121% greater than the average 1990-94 harvest and 188% greater than the average 1980-89 harvest. Just over 40% of the total harvest is large birds (Appendix 6). Harvest during the 1999 (the first) early September season was 1,900 birds.

Monitoring efforts

Banding: A substantial number of geese were banded in North Dakota in almost all years since 1970, though the number has recently declined. During the period 1970-98, >22,000 Canada geese were banded, including >18,000 goslings (Appendix 8).

Harvest survey: The state conducts a harvest survey of hunters as it has since 1953. These data supplement that provided by the USFWS.

Problem identification

Typical or primary problem type: Crop depredation (agriculture). However, the number of incidents of urban problems is increasing.

Aircraft safety: The FAA did not report any strikes of commercial aircraft in ND between 1990 and July 1999. Four incidents involving "aircraft" were addressed by USDA Wildlife Services between 1994 and 1999 with three occurring between December and March in those same years.

Frequently used responses: Advise on problem avoidance, scare devices, trap / transport. The first early September hunting season was held in 1999.

Management Philosophy and Expectations: The NDGFD expects continued expansion of Canada goose populations, particularly if the current good wetland conditions continue. This will increase the number and severity of problems in urban and agricultural situations. The NDGFD believes that Canada geese are a very popular species and are in high demand by hunters and non-hunters alike. Maintaining a balance between this demand and nuisance situations is important. NDGFD, working closely with USDA Wildlife Services, is attempting to help landowners learn to manage these situations and is taking other, direct action to reduce the effects of nuisance situations. NDGFD is evaluating the effects of their first (in 1999) early September hunting season to determine how to apply the method in the future.

Oklahoma

Restoration History: The Oklahoma Department of Wildlife Conservation (ODWC) maintained a captive flock for gosling production between 1980-90 with an average of 200 birds in the flock. In addition, a large number of birds, mostly adults, were obtained from other states. In total, more than 18,000 geese were translocated to the state as part of restoration efforts. There is no current restoration program in the state.

Population

Survey Method: Modeling of releases, population growth and structure.

Objective (Total birds in Spring): 20,000-40,000

Current size (Total birds in Spring): 44,000

Trend: Increasing. The BBS shows a significant ($P<0.05$) positive annual trend of 17% for the period 1996-98 and 17% ($P<0.1$) for the period 1980-98.

Distribution: Statewide

Harvest: Increasing. The average harvest during 1995-98 was 18,000, 26% greater than the 1990-94 average and 91% greater than the 1980-89 average. In recent years, the percent of the total Canada goose harvest that was large birds is near 70%, a change from about 55% in the early 1990's (Appendix 6).

Monitoring efforts

Banding: Between 1982 and 1998, over 28,000 Canada geese were banded in the state, 20,000 of which were adults (Appendix 8).

Harvest survey: A state harvest survey was conducted until 1998 and indicated a similar trend in the number of Canada geese harvested as the federal survey.

Problem identification

Typical or primary problem type: Prior to the mid-1990's, the number of incidents associated with agriculture was higher than for urban problems. Since then, the opposite is true.

Aircraft safety: There are two incidents of airstrikes of commercial aircraft with geese between 1990 and July 1999, one explicitly associated with a Canada goose. Both incidents were on the same date in November in 1996. In addition, five incidents at airports were addressed by state or federal personnel.

Frequently used responses: Scare devices, provision of advice about problem avoidance or abatement and trap/transport.

Management Philosophy and Expectations: The ODWC expects that resident Canada goose populations will continue to increase. This will lead to an escalation of nuisance complaints in both number and severity in both urban and agricultural settings. The ODWC requires those with problems to be full participants in the solution by terminating feeding, disposing of domestic waterfowl that could be acting as call flocks and other actions. Trap and transport operations conducted by the ODWC also require full participation by those experiencing the problem. There is an ongoing effort to educate the public about preventing Canada geese from becoming a nuisance and actions they can take to alleviate problem situations when they occur. Implementing an early September hunting season in portions of the state is under consideration. An application for a Migratory Bird Special Canada Goose Permit to assist in managing specific nuisance resident Canada geese has been submitted to the USFWS.

Saskatchewan

Restoration History: Saskatchewan maintained a captive flock from 1973-80, using the goslings produced for restoration purposes in the southern portion of the province. Wild trapped birds were translocated from places with high populations to those with lower levels. There are three populations of Canada geese that nest in the province: Western Prairie (WPP); Great Plains (GPP) and; Hi-Line (HLP). Most releases were in the GPP range. Between 1960-99, more than 22,500 geese were handled as part of restoration efforts. Current restoration efforts are a by-product of removing geese that are causing problems from a few locations to areas in the Province with fewer geese.

Population

Survey Method: The May Breeding Duck survey conducted by the USFWS and CWS is used to index the number of Canada geese.

Objective (Total birds in Spring): None has been established by the Province. Development of objectives will require the consultation with CWS and provincial stakeholders.

Current size (Total birds in Spring): 300,000 (1997-98 average) for Southern Saskatchewan (as described in CWS/USFWS publications) which includes the range of GPP and HLP birds in the province and a portion of the WPP range. Reports from the CWS/USFWS for Northern Saskatchewan combine data from there and North Central Manitoba and no current estimates of the proportion that occurs in Saskatchewan is available.

Trend: Increasing. The populations in southern Saskatchewan have been increasing more than 7% annually since 1966. The BBS for the province shows a significant ($P<0.2$) increase of 15% annually between 1966-96 and of 22% annually ($P<0.05$) between 1980-96.

Distribution: Southern two-thirds of the province.

Harvest: Increasing. The average harvest during 1995-98 was 109,000, 27% greater than the 1990-94 average but 17% greater than the 1980-89 average. In recent years, the percent of the total Canada goose harvest that was large birds is near 67%, a slight increase from 61-63% in the 1980's and early 1990's (Appendix 6).

Monitoring efforts

Banding: Between 1970-93, Saskatchewan had a consistent banding program with over 19,000 goslings and nearly 9,000 adults banded. Since then, less than 200 birds have been banded (Appendix 8).

Harvest survey: The Province relies on Environment Canada for harvest estimates.

Problem identification

Typical or primary problem type: Crop depredation (agriculture) by a large margin. Much of this damage is caused by some combination of migrant and resident birds in the Fall but significant problems are caused in Spring and Summer by resident birds. Large Canadas that have been remaining late into Fall and suspected to be mostly resident birds are causing additional problems. Two areas (Regina and Saskatoon) in the province are experiencing urban problems.

Aircraft safety: While preliminary investigation does not show there have been any incidents of aircraft striking Canada geese in Saskatchewan, it is clear from Transport Canada's Web site that they believe that Canada geese are an important threat to aircraft safety. Their publication Controlling Canada Geese (Transport Canada 1999) contains many suggestions for airport management. There have been incidents involving Canada geese at airports in Regina and Saskatoon.

Frequently used responses: Trap/transport; compensation; lure crops; scare devices.

Management Philosophy and Expectations: The Saskatchewan Environment and Resource Management (SERM) believes that Canada goose populations will continue to increase and will lead to increases in problems the agency will need to deal with. There will be effects in urban and agricultural settings. Changes in agricultural practices such as an increase in swath grazing, may also result in increased cost to agriculture. SERM sees little opportunity to expand the hunting season in terms of length, timing or daily bag limits. It is attempting to increase sport harvest of Canada geese by increasing the number of waterfowl hunters with particular emphasis on recruiting youth. They have targeted reducing overabundant urban populations by translocating young birds. SERM is pursuing public awareness efforts about problem abatement through publications and by holding discussions with concerned landowners.

South Dakota

Restoration History: Captive flocks were established at two NWRs in South Dakota in 1939 and 1940. Several other larger flocks were in place between 1963-98 and averaged between 100 and 250 birds. Goslings from these flocks were released statewide as part of a restoration effort. A few birds were obtained from Minnesota and about 1,000 were trapped in the state and moved to other locations. Between 1967-98, more than 12,000 birds were handled during restoration efforts with nearly 11,000 of these being goslings from captive flocks. There is no current, formal restoration program in South Dakota though some nuisance geese are trapped and released in areas with fewer birds.

Population

Survey Method: The May Breeding Duck survey is used to index the number of Canada geese.

Objective (Total birds in Spring): 50,000 under average environmental conditions

Current size (Total birds in Spring): 112,000

Trend: Increasing. Data from the May survey indicate that the population has grown by greater than 12% annually between 1966-99. The BBS shows a significant ($P<0.2$)

positive annual trend of 27% for the period 1966-98 and a non-significant positive trend of 15% for the period 1980-98.

Distribution: Statewide

Harvest: Increasing. The average harvest during the period 1995-98 of 105,000 is 84% larger than for the period 1990-94 and 117% larger than for the 1980-89 period. Typically, over 80% of the harvest is large geese (Appendix 6). The harvest during the early September seasons, 1996-99, ranged from 12,000 to 17,800, according to estimates made by the state.

Monitoring efforts

Banding: Birds were banded essentially every year between 1970-98 in South Dakota though in some years few adults were banded. In total, over 12,500 goslings and 13,400 adults were banded in the period (Appendix 8).

Harvest survey: The state conducts an annual harvest survey to supplement data provided by the federal survey. A special survey was instituted by the state for the special early September season in 1996.

Problem identification

Typical or primary problem type: Crop damage (agriculture) by a large measure and the number of complaints has been increasing. There are a few urban problems areas, most notably in Sioux Falls and Watertown.

Aircraft safety: The FAA reports six strikes of commercial aircraft by "Geese" with one of these identified as being caused by Canada geese. The South Dakota Game, Fish and Parks Department (SDGFP) has dealt with several incidents involving Canada geese at the Sioux Falls airport.

Frequently used responses: Provision of advice on avoidance and abatement; scare devices; fences; food plots; habitat management including "goose-friendly" management on state and federal lands; trap/transport. SDGFP has a comprehensive program that has recently been implemented to reduce damage to crops by geese. A part of this program is an early September hunt.

Management Philosophy and Expectations: As long as soybeans continue to be a major crop in eastern South Dakota, the SDGFP expect major conflicts between producers and Canada geese, especially during May, June, and July. SDGFP implemented a Canada goose damage management program in 1996. This program is most active in northeast and east central South Dakota, the same area where early September Canada goose seasons have been held since 1996. This program continues to evolve and has grown to be a large consumer of Department manpower and expenses. In FY99, SDGFP expended approximately $148,000 on Canada goose damage management. The latter half of the 1990's provided exceptional habitat for nesting resident Canada geese with very high recruitment rates. This will not last forever and recruitment should level off. A higher harvest of resident Canada geese from the early September and regular season is needed to stabilize a growing population. SDGFP will continue to use extended hunting seasons when warranted. It is working with wildlife researchers at South Dakota State University to determine goose movements during the summer/early fall period to improve management of the early September hunting season. Except for the airport at Sioux Falls and a few golf courses, there are few urban problems in the state though the number of incidents is expected to increase. SDGFP has translocated geese that caused problems in urban settings and may continue this in the future.

Texas

Restoration History: Texas has had no formal restoration project. No captive flocks were held and there have been no releases of birds by the Texas Parks and Wildlife Department (TPWD). A few birds have been released from private flocks.

Population

Survey Method: Professional judgement and some local surveys.

Objective (Total birds in Spring): 750

Current size (Total birds in Spring): 750

Trend: Increasing. Canada geese are not present on the BBS bird list.

Distribution: Canada geese have been observed in the Summer in 28 counties scattered throughout the east central and northern portions of the state. Evidence of breeding has occurred in 16 of these counties.

Harvest: Increasing. The average annual harvest during the period 1995-98 was 62,000, an increase of 38% from the 1990-94 average and 50% from the 1980-89 average. Typically, about 8% of the total Canada goose harvest is large birds (Appendix 6).

Monitoring efforts

Banding: None

Harvest survey: The state relies on federal surveys.

Problem identification

Typical or primary problem type: There is not a large number of problems caused by Canada geese in Texas but both agriculture and urban situations exist.

Aircraft safety: The FAA reported 19 strikes of commercial aircraft striking “”Geese” or “Ducks, geese, swans”. Eight of these incidents were identified to species with two being attributed to Canada geese. The 19 strikes are 28% (the largest) of the total strikes reported in Central Flyway states.

Frequently used responses: Provision of advice about problem resolution and abatement.

Management Philosophy and Expectations: The TPWD presently relies heavily on USDA Wildlife Services personnel to handle the few problems caused by resident Canada geese. TPWD expects that urban problems will increase in the future.

Wyoming

Restoration History: The Wyoming Game and Fish Department (WGFD) did not hold a captive flock of geese. They did engage in restoration activities as early as 1953 through trapping and transporting geese from within the state and obtaining birds from other states. Between 1960-1988, over 2,000 birds were handled in restoration efforts. The range of both the Rocky Mountain (RMP) and Hi-Line (HLP) populations occur in the Central Flyway portion of the state and restoration efforts took place in both ranges.

Population

Survey Method: Since 1970, a state survey has provided an index to the size of the breeding population.

Objective (Total birds in Spring): RMP (Central Flyway) - 6,000; (Western Region) - 12,000: HLP - 9,700.

Current size (Total birds in Spring): RMP (Central Flyway) - 7,900; (Western Region) - 10,000: HLP - 15,800.

Trend: Both populations are increasing. The total RMP has been growing at about 3% annually with those in the Central Flyway growing at a slightly higher rate since 1970. The HLP has had an annual growth rate of about 8%. The BBS shows non-significant negative trends of -0.4% and -0.3% for the periods 1966-98 and 1980-98, respectively.

Distribution: Throughout the Central Flyway portion of the state

Harvest: Increasing. The average annual harvest for the 1995-98 period was 28,500, an 86% increase from the 1990-94 average and 240% above the 1980-89 average. About 90% of the Wyoming harvest is large Canada geese (Appendix 6).

Monitoring efforts

Banding: WGFD had a consistent banding program between 1970 and 1994 except that no birds were banded in 1990. A few birds were banded in 1995. During the period 1970-95, 23,000 birds were banded (Appendix 8).

Harvest survey: WGFD conducts an annual survey of hunters to supplement federal harvest estimates.

Problem identification

Typical or primary problem type: Crop depredation (agriculture). A few incidents of urban problems have recently occurred.

Aircraft safety: No airstrikes involving Canada geese were reported between 1990 and July 1999. No incidents of geese interfering with airport operations were reported.

Frequently used responses: Compensation; fencing; habitat modification.

Management Philosophy and Expectations: The WGFD does not expect the goose population in the Central Flyway portion of the state to increase significantly in the next decade. However, the farm economy and new housing developments may present situations that will increase the number of complaints received. The WGFD is currently providing information about how to deal with nuisance geese to affected landowners and paying some damage claims. There is a greater potential for an early September hunting season to be implemented in RMP range than in HLP range.

Appendix 3. Methods used to arrive at projected breeding population size in 2010.

Various data sets and sources were used to make projections of breeding population size of Canada geese in the Central Flyway. Some states (KS, OK, NE, NM and CO) made their own projections and those are included directly in Table 3 in the body of the report and are not shown below (Table A1). The estimate in Table 3 (main text body) for South Dakota (SD) was provided by the state as their projection given an aggressive campaign to reduce the population size. That below assumes, for SD and all other places, a growth patterned after historical information.

A visual examination of plots of the annual estimates available indicated a curvilinear relationship with year was evident. Therefore, an exponential equation [Population = $e^{(b * Year)}$] was fitted to the data (Table A1). Indices for 1970 were used as the beginning year in all exponential regression estimates except as noted (Table A1). Since estimates of population size was zero for "Great Plains - Canada" for 1972 & 1973, only 28 years were in the analysis.

This approach produced some very high estimates for population size in 2010 though none particularly extraordinary given the growth of populations in the last two decades. However, there is some biological question regarding if populations can continue to increase at those same high rates even if only current control methods are available. In fact, growth in the 1990's was considerably less than in the 1980's. That said, a separate population estimate was made using simple linear regression and data from 1980-1999. It was anticipated that these more recent years would better depict current patterns of population growth if a linear relationship is considered appropriate. In many case, these latter estimates are much smaller than those made using the exponential equations.

Data from an unpublished report from the USFWS were used for the HL and RM populations in Montana. Data from Nieman et al. (2000) were used for all entries for Canada. Data from parts of southern and western Manitoba are included as prescribed by population range maps in related Central Flyway Management Plans. Data from the May Breeding Duck Survey (Smith 1995) were used for the Great Plains Population in North and South Dakota. The Wyoming data was provided by the state. For all but 1998 and 1999, only "indicated" breeding pair were included in the report. In order to estimate the total number of Canada geese in the spring, Indicated Breeding Pair was multiplied by 1.56 (from the 1998-99 data) and a visibility correction factor of two was then applied.

Table A1. Some statistical properties from exponential regression equations and associated projections of breeding population size for Canada geese in 2010 (in 1,000's) for some areas of the Central Flyway. Projections from linear regression using 1980-99 data are also shown.

							Projected Pop. Size in 2010		
Population & Location	Years	R^2	F	Pr>F	Constant	Coefficient (Year)	Expon. Est.[1]	Linear Est.[2]	R^2 Lin.[3]
Great Plains									
Canada	1970-99	0.85	146	0.00	-311.67	0.1614	360	63	0.60
North Dakota	1973-99	0.86	151	0.00	-297.21	0.1544	516	112	0.74
South Dakota[4]	1973-99	0.89	220	0.00	-285.79	0.1488	642	135	0.80
Western Prairie									
Canada	1970-99	0.94	422	0.00	-166.21	0.0893	618	312	0.83
Hi-Line									
Canada	1970-99	0.85	154	0.00	-160.28	0.0862	456	261	0.89
Montana	1970-99	0.57	38	0.00	-96.88	0.0541	142	136	0.57
Wyoming	1970-99	0.89	232	0.00	-154.92	0.0823	40	16	0.67
Rocky Mountain									
Canada	1970-99	0.68	59	0.00	-108.34	0.0600	169	152	0.75
Montana	1970-99	0.64	49	0.00	-114.73	0.0626	65	49	0.60
Wyoming	1970-99	0.76	90	0.00	-77.90	0.0435	12	8	0.38

1. Projected population size for 2010 using the exponential equation reported.
2. Projected population size for 2010 using a linear regression equation for years 1980-99.
3. R^2 for the linear regression equation used.
4. The estimate shown here for SD differs from that in Table 3 - see footnote there.

Appendix 4. Methods used to arrive at projected wintering population size in 2010.

The source for the data used in this analysis was the Central Flyway "Data Book' (Sharp and Moser 1999). Simple linear regression equations were fitted to the data and estimates of the indices were made for the year 2010. The year used was the latter of winter period included (e.g. surveys in the winter of 1982-83 are shown as year 1983). This was necessary since some data prior to 1999 were collected in December of the winter period and some in the following January. While data for the total number of Canada geese are available back to 1948, only the years 1970-99 were used in the projection to more accurately reflect current conditions.

Some statistical properties from regression equations and associated predictions of wintering populations of Canada geese in 2010 for some areas of the Central Flyway. The predicted 2010 values are in 1,000's of geese.

Population	Years	R^2	F	P>F	Constant	Coefficient (Year)	2010 Prediction	SE - Predicted
Great Plains & Western Prairie	1982-99	0.74	46.41	0.00	-33741	17.1	644	75.0
Hi-Line	1982-99	0.72	40.97	0.00	-13402	6.8	247	31.7
Short Grass Prairie	1982-99	0.60	23.76	0.00	-50955	25.8	852	157.9
Tall Grass Prairie	1982-99	0.18	3.25	0.09	-8770	4.5	329	72.4
Total Canada Geese	1970-99	0.86	167.2	0.00	-86223	43.9	1,964	185.0

Appendix 5. A Summary of goose hunting regulations in the Central Flyway

Early Flyway History and East Tier States Regulations

(Information about seasons between 1918 and 1990 was available in a report by Marvin Kraft, KS Department of Wildlife and Parks. East tier states include ND, SD, NE, KS, OK and eastern TX.)

1918 through 1990

From 1918-29, the bag limit for geese was eight daily, with no possession limit. Between 1930 and 1945, the daily bag varied from two to five with a possession limit of double the daily bag. From 1946 through 1960, the daily bag limit varied from four to five geese with a possession limit of one daily bag, with 1946 (bag of 2 geese) and 1957 (bag of 6 geese) being the only exceptions.

In about 1944, the bag limit for dark geese was separated from that for "light" geese (snows and blues), being set at two dark geese. Between then and 1990, the daily bag limit for dark geese in east tier states of the Central Flyway has normally been two Canada geese, or one Canada goose and one white-fronted goose.

From 1918 through 1960 the framework dates (earliest and latest dates for hunting) for geese were the same as for ducks. Beginning in 1961, framework dates for geese were separated from ducks, usually opening earlier and continuing later. Between 1961 and 1990, framework dates for dark geese were from about October 1 to January 15-20.

Season length for geese was the same as for ducks from 1918 to 1954. Beginning in 1955, season length for geese was separated from that for ducks, being 60 days from 1955-1957 and 75 days from 1958 through 1971 (1969 with 86 days, being the only exception). Between 1972 and 1990, the season length for dark geese in the east tier states of the Central Flyway was generally 72 days.

Until 1967, goose regulations were similar for all states in the east tier of the Flyway. There had been some discussion about management of geese on a population basis, but up to this point in time no action had been taken. In that year, a lower bag limit in prescribed areas of ND, SD, OK and TX was implemented because of concern for the welfare of TGP Canada geese. These area-specific restrictions largely remained in effect until 1982.

In 1971, due to concern about the status of large "restoration" geese, KS was required change the daily bag limit of Canada geese from two to one on December 10th. In 1972, the daily bag was reduced to one east of HY 3 in ND and all of SD and after December 10 in KS and NE. Additional restrictions were added in 1973.

In 1974 termination dates for the Canada goose hunting season were enacted in ND, SD, NE, and KS. In the same year, recognition of the range of Short-Grass Prairie Canada geese occurred and two Canada geese were allowed in the bag in NE and KS prior to Nov. 24, when the bag limit changed to one.

Although there were some minor modifications (in some instance for local management purposes), the regulations enacted in 1974 remained unchanged until 1980, when the terminations dates in ND, SD, NE and KS were removed.

In 1981, major regulation changes were adopted based a combination of three motives: 1) concern for maintaining the southern migration tradition of TGP Canada geese; 2) concern for the welfare of increasing numbers of large Canada geese delaying their migration and wintering on Missouri River impoundments in SD; and 3) lingering concern for the welfare of restoration geese in the Dakotas and NE due to the harvest on

the wintering grounds. The harvest of TGP birds was reduced by changes in regulations in northern states, the harvest of late-migrating large Canadas was reduced by changes in mid-latitude states, and an unsuccessful attempt to use late-season hunting to influence geese to migrate from SD was made.

Although there were some minor changes, the regulations adopted in 1981 remained the same through 1990.

1990 through 1999

In 1990, the framework dates for Canada geese were the Saturday nearest 1 October to 20 January. In NE and KS, the season length was 72 days with two Canadas per day allowed through mid-November at which time the daily limit changed to one. The bag limit was generally two throughout the season in the remainder of the east tier states. The 1991 season brought a change in the ending framework date to 31 January. Regulations remained the same until the 1994 season when the season length was increased to 86 days and the bag limit was set at two throughout the season.

In 1995, the ending framework date was extended to the Sunday nearest 15 February (from 31 January) in the west zone of Texas. The 1997 season brought the opportunity for states to split the Canada goose season into three segments: previously, two segments had been allowed. In 1998, the ending framework was set at the Sunday nearest 15 February for all states and the season length was extended to 93 days and the bag limit increased from two to three. Texas was allowed a longer season (107 days) but needed to accept a daily bag of one to use it. In 1999, the east tier was permitted to have a 95 day season, a minor adjustment to manage split seasons better.

An early September season was first used in the Central Flyway by SD in 1996. These seasons are to be directed at reducing the number of resident Canada geese. There are a number of restrictions or conditions placed by the USFWS associated with these seasons (56 Federal Register: 49111: 26 September 1991). In 1999, new early September seasons were established by ND and KS.

Dark Geese in the West Tier States and Alberta

Since at least 1970, Canada goose hunting regulations in the Central Flyway portion of the west tier of states in the Flyway (MT, WY, CO, NM and a portion of west TX) have been more liberal and stable than in the east. Between 1970-90, between 90 and 95 days were available to hunt Canada geese and the bag limit was two with a possession limit of twice the daily bag. An exception was in MT, where, beginning in the early 1980's, the bag limit was three. In 1990, season length was increased to 100 days and to the maximum allowed under the Migratory Bird Treaty of 107 in 1991. The daily bag limit increased to three (four in MT) in 1990 and to four throughout the area in 1995. It increased to five in 1999. In 1990, the framework (outside dates) for Canada geese were The Saturday nearest 1 October to 20 January. The ending date moved to 31 January for the 1991-92 season. In 1995, hunting was allowed until the Sunday nearest 15 February in a portion of TX and this date became available to all states in the Flyway in 1998.

During the same period (1970-99), hunting regulations in Alberta, which harvests geese from the same populations that occur in the west tier of states in the flyway, were even less variable. Between 95 and 107 days were available for hunting Canada geese during the period 1970-93. During this entire period, the daily bag limit was five with a possession limit of ten. Since 1994 the season length has been 107 days. The daily bag limit was set at six in 1994 and eight in 1996.

Appendix 6. Total and large race Canada goose harvest in the Central Flyway.

	***** Alberta *****			***** Colorado *****			***** Kansas *****		
Period	Total	Large	% Lrg	Total	Large	% Lrg	Total	Large	% Lrg
1980-84	102,238	73,166	72%	39,546	29,366	74%	12,810	6,166	48%
1985-89	107,706	77,190	72%	49,746	34,381	69%	13,080	8,759	67%
1990-94	105,092	78,237	74%	55,345	40,769	74%	13,284	9,914	75%
1995-98	119,155	94,844	80%	135,895	101,423	75%	37,907	30,146	80%

	***** Montana *****			***** Nebraska *****			***** New Mexico *****		
Period	Total	Large	% Lrg	Total	Large	% Lrg	Total	Large	% Lrg
1980-84	5,905	5,419	92%	18,655	11,733	63%	2,569	1,315	51%
1985-89	7,881	7,302	93%	31,278	24,071	77%	3,507	2,046	58%
1990-94	15,427	14,127	92%	40,763	33,520	82%	2,817	1,771	63%
1995-98	32,858	30,249	92%	81,846	70,521	86%	1,637	1,043	64%

	**** North Dakota ****			***** Oklahoma *****			**** Saskatchewan ****		
Period	Total	Large	% Lrg	Total	Large	% Lrg	Total	Large	% Lrg
1980-84	32,343	8,238	25%	7,763	2,700	35%	98,157	57,139	53%
1985-89	25,993	7,896	30%	10,642	4,619	43%	96,749	57,839	60%
1990-94	37,944	15,319	40%	13,916	6,476	47%	86,300	52,381	61%
1995-98	83,927	36,279	43%	17,587	9,643	55%	109,323	72,729	67%

	**** South Dakota ****			***** Texas *****			**** Wyoming ****		
Period	Total	Large	% Lrg	Total	Large	% Lrg	Total	Large	% Lrg
1980-84	46,959	28,013	60%	42,129	1,915	5%	6,661	5,207	78%
1985-89	49,799	30,273	61%	40,928	3,365	8%	10,126	8,987	89%
1990-94	57,038	41,219	72%	45,097	4,348	10%	15,400	13,981	91%
1995-98	105,061	87,815	84%	62,324	3,875	6%	28,578	24,964	87%

Note: Percent large for west tier states for 1982 was subjectively estimated based on values for nearby years. Percent large for states was estimated from Hand-Tally information collected at the annual Wing Bee (pers. comm. Michael A. Johnson, ND). Percent large for Alberta and Saskatchewan is from CWS reports.

Appendix 7. Descriptions of actions included in the Action Matrix (Table 11)

Actions are associated with Objective 2, Strategy 1.

None: A determination is made that goose populations are not "too large" and there are not problems severe enough to require action. This could lead to an increase in local population size and problem occurrence and severity.

Provide technical advice only (e.g. terminate feeding, vegetative changes): An assumption is made that people experiencing the problem can take care of it themselves if provided information. The effect can be to move the problem elsewhere rather than solve it. Some actions such as removing nest structures and providing human access to islands can be partially effective in reducing population growth. Both the public's acceptance and cost of this action is dependent on the frequency and severity of problem occurrence. This action includes taking steps to prevent problems from occurring (e.g. meeting with developers, landscapers and airport managers). No special permits are required to implement this action.

Scare hardware, chemicals, denial of access: These actions can be provided as technical advice or by agencies but are frequently used in a cooperative effort. For example, an agency might provide flash tape but the individual being affected by geese might install it. These actions frequently only work for a short period of time requiring changing techniques or re-application. They may have different affects in different seasons. Cost and public acceptance can be moderately high though their effect is very local and often moderate at best. There is the potential to move the problem elsewhere rather than solve it. No special permit is required to implement this action.

Reproductive inhibitors, contraceptives, sterilization: These actions are currently being used almost exclusively in experimental situations. There has been no wide-scale use to date. They may have the potential to reduce the growth rate of local populations and ultimately a local population size if delivery mechanisms (procedures) prove practical and feasible on a fairly large scale (e.g. city-wide). Permits may be required for some actions.

Use of other animals (falcons, dogs) as a scare device: These actions have largely been applied by those experiencing the problem rather than agencies. They must be applied on a regular (nearly daily) basis but some successes in problem reduction have been identified. Effects are specific to a golf course, city lake or airport. There is the potential to move the problem elsewhere rather than solve it. No special permit is required to implement this action except that falconers need to hold a federal permit to own raptors. Some dogs being sold for the purpose of discouraging goose use of an area carry a substantial price tag.

Trap & transplant: This high-cost action must be considered as a "stop-gap" or temporary action. In some areas, it is taken annually. Sometimes volunteers or those directly affected by the geese assist with the work, reducing the cost. It assumes there is a viable place to where the birds can be moved. When agencies had active restoration programs, this action was viewed as taking one action to achieve two objectives: reducing a problem population at one location while increasing the population growth rate in a desirable place. However, the number of the places where more geese are desired is rapidly shrinking. It also assumes that few birds will return to the original site. Many times, this action affects mainly sub-adults (i.e. non-breeding birds), reducing the effectiveness. This action tends to treat the symptom rather than the problem (i.e. why the geese are there in the first place). A federal permit is required.

Reducing egg hatchability: This includes spraying eggs with oils or otherwise affecting the yoke's ability to develop. It eliminates renesting attempts. This is a very labor intensive action and therefore comes with a high cost. It is usually carried out by agencies and a federal permit is required. It only reduces the current year's production and therefore needs to be annually applied. It is best applied to a small area since individual nests need to be found and accessed.

Increased "regular season" sport hunting: This generally accepted, low cost action can be applied to a large area and has the potential to be effective in population control. In addition, it may increase hunter interest. It may not be able to be used in urban situations. To fully understand the effect on local, regional and more broadly based populations, data from banding, harvest and other surveys need to be available. No permits are needed.

Special hunting seasons: This action can be applied to large and small areas. Under controlled situations, it could be used where a "regular" hunts cannot. There are urban situations where this action is not likely to be available. Under some conditions, there are significant data gathering and reporting requirements by the USFWS that increase the cost of implementation. There is the potential to increase interest in goose hunting via this action. No permits are needed.

Conservation and Depredation Order: These actions are not presently available but may be considered in the current Environmental Impact Statement process. Some activities that might be permitted are presently partially available under special, site-specific federal permitting procedures. By having broader options available, federal action would pass much management control of resident Canada geese to the state or provincial agencies. This would allow rapid, tailored response to local situations. General activities under these actions would entail the taking of birds at times of the year when hunting seasons are not available, in manners not traditionally used in hunting seasons and for a variety of uses.

Habitat management programs: This action includes site-specific activities that could be used to either increase or decrease goose use of an area. Public acceptance would generally be high and the cost is variable ranging building a concrete wall to planting hedges. High cost actions may reduce social acceptance. However, there may be long-term benefits from these actions reducing the long-term cost. Unless conducted on a very large scale, there would not likely be a significant effect on goose population size. No permits are needed for implementation.

Trap, process and donate to charity: This specific action is currently provided by special permit and may be included as a component of a future Depredation Order. It can be conducted in areas where there are no viable places left to which to transport and release birds or hunting is not a viable option. The use of volunteers can reduce the high cost of this action. Benefits include not having to transport live geese and the provision of nutrition to people in need. Many times, this action affects mainly sub-adults (i.e. non-breeding birds), reducing the effectiveness as a long-term solution - it may need to be carried out annually.

Issue kill permits: These special permits are issued on a case-by-case basis by the USFWS. They allow killing a specific, usually low number of geese that cannot be utilized for any purpose. The effect is very local and they are used for the most severe problems (e.g. airports). Killing a few Canada geese on a small area can be an effective deterrent to other birds using the area.

Appendix 8. Canada goose bandings in the Central Flyway in June through August, 1970-98

Band Year	Alberta		Colorado		Kansas		Montana		North Dakota		Nebraska		New Mexico		Oklahoma		South Dakota		Saskatch-ewan		Wyoming		Central Flyway[1]		
	Yng	Ad	Yng	Ad	Yng	Ad	Yng	Ad	Yng	Ad	Yng	Ad	Yng	Ad	Yng	Ad	Yng	Ad	Yng	Ad	Yng	Ad	Yng	Ad	Total
1970	440	89	469	5	86	28	178	42	262	34	122	8	64	30	13	0	105	150	405	4	124	1148	2268	1538	3806
1971	338	73	525	73	35	1	452	127	214	25	171	17	38	266	23	0	109	197	449	11	190	581	2544	1371	3915
1972	844	256	409	9	0	0	525	137	1130	53	304	21	20	27	18	4	56	191	684	117	273	841	4263	1656	5919
1973	1130	169	408	8	0	0	279	31	1231	58	448	24	0	0	0	0	244	518	650	127	365	619	4755	1554	6309
1974	2054	652	525	754	5	0	362	78	1094	126	497	30	0	0	0	0	479	694	636	147	390	516	6042	2997	9039
1975	2111	460	265	418	0	0	337	50	1016	286	449	25	0	0	0	0	269	429	857	308	310	777	5614	2753	8367
1976	2362	438	716	410	0	0	602	104	702	139	568	5	0	0	0	0	779	641	354	479	339	585	6422	2801	9223
1977	1892	499	400	288	0	0	337	75	257	90	593	28	0	0	0	0	469	469	1195	445	473	1059	5616	2953	8569
1978	3391	735	515	319	3	0	390	54	503	131	380	19	0	0	0	0	736	143	1914	1074	257	760	8089	3235	11324
1979	2470	359	218	16	0	0	336	76	434	165	385	45	0	0	0	0	587	1	1849	904	519	917	6798	2483	9281
1980	1575	324	347	304	0	0	481	165	227	325	73	18	0	0	0	0	874	108	2491	1457	621	900	6689	3601	10290
1981	2766	244	450	388	0	0	131	65	428	217	346	240	0	0	7	0	772	5	830	225	480	771	6210	2155	8365
1982	1613	152	350	246	186	74	58	31	578	152	406	159	0	0	124	559	799	3	533	407	529	678	5176	2461	7637
1983	1930	202	414	298	685	160	23	22	586	134	340	222	0	0	34	609	651	0	357	326	579	1184	5599	3157	8756
1984	1733	135	327	157	639	409	10	4	700	178	683	191	43	12	462	622	650	10	859	414	188	556	6294	2688	8982
1985	1630	219	300	105	808	411	197	192	866	206	663	287	69	0	172	1545	279	5	723	303	135	247	5842	3520	9362
1986	1606	156	368	196	643	532	104	82	711	211	652	2	0	32	554	310	197	18	774	199	95	110	5704	1848	7552
1987	1402	195	280	479	1065	715	0	0	964	185	615	4	302	0	964	695	756	2207	714	308	421	286	7483	5074	12557
1988	171	44	0	70	864	1086	91	16	936	222	533	1	130	0	565	1646	671	979	699	357	307	100	4967	4521	9488
1989	244	88	30	37	874	556	109	20	718	192	599	82	0	0	931	1960	397	2602	276	157	100	1463	4278	7157	11435
1990	395	69	6	20	694	119	32	4	861	110	796	609	0	0	859	2752	318	886	740	418	229	48	4930	5035	9965
1991	195	182	17	40	643	368	0	0	471	135	1215	1900	18	0	1115	1996	212	2064	538	241	0	0	4424	6926	11350
1992	3	0	0	35	1163	1047	0	0	993	223	852	740	12	6	682	1527	419	447	666	181	229	768	5019	4974	9993
1993	1	0	18	20	1117	2108	0	0	825	192	1164	968	0	0	359	695	136	53	607	346	122	445	4349	4827	9176
1994	0	0	0	0	834	1934	0	0	821	160	704	700	0	0	336	850	341	93	0	0	226	199	3262	3936	7198
1995	84	0	61	34	1796	2825	0	0	222	33	629	1652	0	0	307	1058	421	158	80	13	75	63	3675	5836	9511
1996	36	0	468	50	498	227	7	3	239	66	429	611	0	0	231	1635	679	298	27	0	0	0	2614	2890	5504
1997	63	0	285	0	667	499	19	0	83	8	379	340	0	0	459	1234	163	18	15	1	0	0	2133	2100	4233
1998	2	0	464	2	554	412	361	83	147	54	632	1719	0	0	163	605	98	37	38	6	0	0	2459	2918	5377
Total																									
Adult		5740		4781		13511		1461		4110		10667		373		20302		13424		8975		15621		98965	
Yng	32481		8635		13859		5421		18219		15627		696		8378		12666		19960		7576		143518		242483

1. There are no bandings in Texas.

Appendix 9. Range maps of populations of Canada geese that occur in the Central Flyway.

Rocky Mountain Population

Hi-Line Population

Western Prairie Population

Great Plains Population

Appendix 9 (continued). Ranges of Populations of Canada that occur in the Central Flyway

Short Grass Prairie Population

Tall Grass Prairie Population

Eastern Prairie Population

COLORADO RESIDENT CANADA GOOSE MANAGEMENT PLAN
COLORADO PARKS AND WILDLIFE
March 2019

INTRODUCTION

Canada geese (*Branta canadensis*) are federally protected in the United States by the Migratory Bird Treaty Act. The U.S. Fish and Wildlife Service (USFWS) defines resident Canada geese as Canada geese that nest and/or reside predominantly within the coterminous United States (U.S. Fish and Wildlife Service 2005). Resident Canada goose populations have grown dramatically across the United States over the past several decades (Schmidt 2004). While resident Canada geese provide a valuable resource for waterfowl hunters and wildlife viewers, conflicts between people and geese occur.

Breeding resident Canada geese occur throughout Colorado (Boyle 2016). Much larger numbers of Canada geese and cackling geese (*B. hutchinsii*) that nest in states north of Colorado and in Canada also are present in Colorado from fall through spring (Central Flyway Waterfowl Technical Committee 1965, Colorado Division of Wildlife 1989, Kraft and Funk 1990). Colorado Parks and Wildlife (CPW) manages wildlife populations in Colorado, and in cooperation with the USFWS manages resident and migrant Canada and cackling goose populations in the state. Recreational hunting is the primary tool used by CPW to manage Canada and cackling goose populations, in coordination with the USFWS and other states and provinces in the Central and Pacific Flyways. However, hunting cannot effectively address some human-goose conflicts.

Under federal regulations, non-lethal control activities for Canada geese, such as hazing and harassment, habitat management, and repellants, can be used without a permit at any time. Local ordinances may prohibit some control activities. All control activities that involve direct contact with geese and can result in harm to geese, goslings, eggs, or nests require a federal permit issued by the USFWS, or must be taken under a depredation order. The USFWS issues permits to alleviate resident Canada goose depredations in coordination CPW and the Wildlife Services program of the U.S. Department of Agriculture's Animal Plant Health Inspection Service (Wildlife Services-Colorado). Wildlife Services-Colorado is the federal agency with lead responsibility for dealing with wildlife damage complaints. Where human health and safety is a concern, Wildlife Services-Colorado has primary responsibility for conducting damage management activities, and these situations are not addressed in this plan. However, most conflicts between people and geese in Colorado involve nuisance and property damage issues. To address these conflicts, permitted lethal control activities for resident Canada geese are currently available from March 11 through August 31 each year.

This plan defines CPW's goal, objectives, and strategies for management of resident Canada geese in Colorado. The plan 1) provides a reference for coordination and communication on statewide activities related to resident Canada geese within CPW, 2) facilitates required state-federal coordination on management of resident Canada geese,

and 3) provides a means to communicate with the public about management goals, objectives, and actions for resident Canada geese in Colorado.

GOAL

The CPW management goal for resident Canada geese in Colorado is to maximize recreational opportunity consistent with the welfare of the population, habitat constraints, and landowner/public tolerances.

OBJECTIVE 1. Maintain a stable statewide population trend and current county-level distribution of breeding Canada geese in Colorado.

Strategy 1.1. CPW will monitor statewide breeding population trends using annually updated results from the North American Breeding Bird Survey (BBS).

Strategy 1.2. CPW will monitor the statewide distribution of breeding Canada geese using the number of counties with eBird observations of geese reported during April and May as an annual index of breeding distribution.

Rationale

Maintaining a healthy statewide population of resident Canada geese is consistent with the goal of this plan. There are no historic or current statewide population surveys conducted for resident Canada geese in Colorado, and rigorous population estimates are not available (see Background Information below). CPW currently conducts annual aerial cruise surveys to provide a rough population index for breeding Canada geese in parts of western Colorado as part of rangewide, cooperative monitoring of Rocky Mountain Population Canada geese (Pacific Flyway Subcommittee on Rocky Mountain Population Canada Geese 2000). CPW also conducts an annual Mid-winter Waterfowl Survey during the first week of January that provides an index to Canada goose numbers in eastern Colorado and the San Luis Valley, but observers cannot distinguish between resident and migrant Canada geese during this count.

A specific statewide abundance objective is not useful in relation to the management goal. The number of resident Canada geese that achieves a balance between providing recreational opportunity and meeting landowner tolerances varies locally throughout the state and is likely to change over time. However, we used results from an intensive statewide banding program to provide a benchmark of approximately 17,400-26,100 resident Canada goose statewide following the breeding season during the 2000s (see Background Information below). We caution that this is at best a crude index to the true population.

For future management decisions and communications purposes, it is useful to track indices for the overall population trend and distribution of resident Canada geese across Colorado. Although not designed well for species like Canada geese, the BBS provides a long-term, on-going source for bird population trends at a state scale. BBS results for

Colorado are imprecise, but indicate an increasing trend (7.21% average annual increase, 0.17-15.19% credible interval) in the breeding population of Canada geese from 2005 through 2015 (Sauer et al. 2017). CPW will annually monitor the updated interval BBS trend estimate. If the BBS trend credible interval indicates a declining statewide resident Canada goose breeding population, CPW will consider conducting intensive population monitoring in areas where we suspect undesirable declines have occurred, and review potential management actions.

Observations posted on eBird (https://ebird.org/home, The Cornell Lab of Ornithology) from March through May 2018 show that resident Canada geese occurred in every county in Colorado except Cheyenne County. This citizen science source provides a convenient, large-scale index to resident Canada goose distribution in Colorado. CPW will annually review eBird records of Canada geese during the breeding season across the state. If records are lacking from a county for at least two years, CPW will consider conducting detailed investigations to determine if habitat changes or management actions explain the change in distribution.

CPW will augment information on the statewide breeding population of resident Canada geese from BBS and eBird with local information from field personnel. Where there are concerns about changes in local populations, or the need to have more detailed demographic estimates in specific areas of the state, CPW will conduct statistically rigorous population surveys (see Strategy 4.1).

OBJECTIVE 2. Provide and promote opportunities for hunting and viewing resident Canada geese in Colorado.

Strategy 2.1. Provide annual legal hunting opportunity that promotes the harvest of resident Canada geese.

- 2.1.1 In the Pacific Flyway portion of Colorado, CPW will consider maintaining a special September Canada goose season, and early-season (late September and October) hunting opportunity during the regular Canada goose season.
- 2.1.2 In the Central Flyway portion of Colorado, CPW will consider maintaining goose hunting zones in the mountain parks (North Park, South Park, the San Luis Valley) and the Northern Front Range, where early-season hunting opportunity is provided in late September and October.
- 2.1.3 In the Northern Front Range goose hunting zone, CPW will also consider extending the hunting season as late as federal frameworks allow, to provide late-season hunting opportunity when resident Canada geese are more vulnerable to harvest in this hunting zone.
- 2.1.4 CPW will work with the Pacific and Central flyways and USFWS to maintain regulations (e.g., season length, bag limit) that maximize legal hunting opportunity for Canada geese in Colorado. This includes effective, coordinated management of migrant Canada goose and cackling goose populations.

2.1.5 CPW managers will work with landowners and local governments to promote the use of managed, local hunting opportunities for Canada geese in and near municipalities where permitted by local ordinances, and support changes in local ordinances that permit greater opportunity for Canada goose harvest.

Strategy 2.2. Promote legal hunting and viewing of Canada geese in Colorado.

2.2.1 As resources permit, CPW will use Canada goose hunting opportunities to recruit hunters by offering skills training workshop and mentored hunts for youth, women, veterans, etc.

2.2.2 CPW will work with partners to provide information to the public on the biology and distribution of Canada geese in Colorado.

2.2.3 CPW will work with partners to communicate the aesthetic values of Canada geese to the public.

2.2.4 CPW will develop and post natural history information about the multiple Canada goose populations living in Colorado on its website.

2.2.5 CPW will add information to its wildlife viewing program about locations and times of the year to view Canada geese.

Rationale

The primary motivation for establishing local breeding populations of Canada geese in Colorado was to provide additional legal hunting opportunity, as well as viewing opportunities. Hunting and viewing Canada geese adds much to the quality of life for residents living in Colorado and visitors exploring the state. CPW has a statutory responsibility to provide wildlife-related recreational opportunity:

> **33-1-101. Legislative declaration**
> (1) It is the policy of the state of Colorado that the wildlife and their environment are to be protected, preserved, enhanced, and managed for the use, benefit, and enjoyment of the people of this state and its visitors. It is further declared to be the policy of this state that there shall be provided a comprehensive program designed to offer the greatest possible variety of wildlife-related recreational opportunity to the people of this state and its visitors and that, to carry out such program and policy, there shall be a continuous operation of planning, acquisition, and development of wildlife habitats and facilities for wildlife-related opportunities.
> (4) The state shall utilize hunting, trapping, and fishing as the primary methods of effecting necessary wildlife harvests.

Regulated hunting harvest is an accepted method to manage wildlife populations. Legal hunting is the most effective way to reduce the Canada goose population growth rate, by reducing survival of adult Canada geese (Balkcom 2010). Hunting activity can also influence the distribution of Canada geese at local scales.

CPW sets annual hunting regulations for Canada geese within frameworks established by the USFWS for season dates, season length, bag limits, and methods of take. Federal hunting frameworks for regular hunting seasons are based primarily on the status of migratory populations of Canada and cackling geese. In 2002, CPW established a

September Canada goose season (currently September 1-9) in the Pacific Flyway portion of Colorado. In addition to providing general recreational hunting opportunity, this season provides a mechanism for individual landowners to address site-specific conflicts (primarily crop depredation issues). In the Central Flyway portion of Colorado, CPW established special goose hunting zones in North Park, South Park, the San Luis Valley, and the northern Front Range. Hunting seasons in these zones begin in late September or early October, before resident Canada geese migrate from the mountain parks, and before large numbers of migrant Canada and cackling geese arrive along the northern Front Range. Band recovery information indicates that substantial harvest of resident Canada geese along the Front Range occurs early and late in the hunting season; thus, late season (February) hunting opportunity can also be an effective tool for managing resident Canada geese in the northern Front Range area (Gammonley 2010).

Because many resident Canada geese in Colorado live near municipalities, they can provide convenient hunting opportunities. In addition, even limited hunting activity can be effective in redistributing geese around local areas. Local governments and property owners can address some human-goose conflicts with carefully managed hunts in and near municipal areas.

Resident Canada geese provide highly accessible opportunities for the public to view and interact with this species. Because of their adaptability to human-modified habitats and living in close proximity to humans, viewing opportunities for Canada geese are abundant throughout much of Colorado without active management to provide viewing opportunities. Resident Canada geese provide a convenient means for CPW and partners to educate and inform the public about wildlife biology and management issues.

OBJECTIVE 3. Reduce and manage local-scale conflicts and damage attributed to nuisance and/or depredating resident Canada geese.

Strategy 3.1. Provide property owners and managers with information on non-lethal and lethal methods for addressing site-specific human-goose conflicts.

- 3.1.1 CPW will provide information on using non-lethal and lethal methods to address conflicts with resident Canada geese (and migrant Canada and cackling geese) on its public website, at CPW offices, in land use comments, and when requested by the public.
- 3.1.2 CPW will coordinate with USFWS and Wildlife Services-Colorado on providing information on site-specific resident Canada goose management to the public.

Strategy 3.2. Encourage the use of regulated hunting to address local resident Canada goose conflicts wherever possible (see Strategy 1.1.4).

- 3.2.1 In rural and exurban areas where regulated hunting is permitted, hunting should be used as a primary tool for addressing site-specific conflicts with geese.

3.2.2 CPW will support the use of managed, local hunting opportunities for Canada geese in and near municipalities, where permitted by local ordinances.

Strategy 3.3. Manage non-hunting, lethal control of resident Canada geese by property owners, primarily in municipalities.

3.3.1 CPW, USFWS, and Wildlife Services-Colorado will coordinate on damage management activities.

3.3.2 For statewide egg oiling activities, CPW will direct individual property owners to the USFWS Resident Canada Goose Nest and Egg Registration Site (https://epermits.fws.gov/eRCGR/).

3.3.3 In the Denver metropolitan area and within the incorporated boundaries of other municipalities along the I-25 Front Range corridor in Larimer, Weld, Boulder, Broomfield, Denver, Jefferson, Adams, Arapahoe, Douglas, El Paso, and Pueblo counties, property owners will coordinate culling resident Canada geese with USFWS and Wildlife Services-Colorado. Wildlife Services-Colorado will be the primary contact for assistance with lethal control in these areas.

3.3.4 CPW will maintain a USFWS Special Canada Goose permit that allows CPW and individual subpermittees to conduct lethal control activities for resident Canada geese. CPW will use this permit in limited situations where property owners cannot effectively use non-lethal control, hunting, and egg oiling to address site-specific human-goose conflicts with resident Canada geese.

Rationale

CPW's primary role is managing resident Canada geese at a population level, rather than managing site-specific conflicts. Most human-goose conflicts in Colorado are local in scale. Although some isolated conflicts occur outside of hunting seasons in rural and unincorporated areas, the vast majority of conflicts between humans and resident Canada geese occur in municipalities, and most of these conflicts occur in the Denver metropolitan area and other Front Range municipalities. Conflicts in Front Range municipalities primarily involve damage and costs to public and private property (e.g., the cost of cleaning up goose waste at parks and golf courses).

CPW provides individual property owners with information on methods to address conflicts, and conducts some activities to address site-specific issues with resident Canada geese. From the 1970s through the 1990s, CPW routinely trapped adult geese and goslings from Front Range municipalities and translocated them to more rural areas in Colorado and other states; USFWS granted CPW a permit to conduct these trap and transplant operations. Importantly, this activity was for many years associated with efforts to establish new local populations of resident Canada geese. However, by the mid-1990s there were no suitable areas remaining to establish new local populations. Furthermore, trap and transplant has proven to be a costly and ineffective method to address site-specific human-goose conflicts. Consequently, by the late 1990s CPW suspended routine trap and transplant efforts.

In 2001, CPW obtained a new Special Canada Goose permit from the USFWS, which permits state wildlife agencies to conduct lethal damage management activities. Although CPW personnel have directly conducted some damage management activities, subpermittees (i.e., property owners or managers) authorized by CPW have conducted the vast majority of activities under this permit. Furthermore, almost all of the lethal damage management activity conducted under this permit has been egg oiling, and virtually all of the egg oiling activity occurs in Front Range municipalities. Since 2002, CPW personnel and over 50 subpermittees have treated over 6,000 nests in Colorado. The USFWS now has an online registration system where individuals can obtain a permit for egg and nest control, and report their activities directly to the USFWS. Beginning in 2019, CPW will direct individual property owners to use the online USFWS registration system for egg and nest control.

The USFWS Special Canada Goose permit also allows CPW to cull adult resident geese and goslings. However, although CPW has allowed a few individual subpermittees in rural areas to conduct limited culling of adult geese, primarily in association with agricultural damage (<10 subpermittees have killed about 300 geese since 2008), CPW has expressly avoided implementing widespread and large-scale culling operations under its Special Canada Goose permit. Recently, there is increased interest in culling from public and private property owners in the Denver metropolitan area and other Front Range municipalities. While CPW is not opposed to this method and is not concerned about population-level impacts of these activities, we lack the financial and staff resources to conduct or oversee these activities. Individuals or coalitions of individuals in Front Range municipalities can most effectively work directly with federal agencies (USFWS and Wildlife Services-Colorado) to implement culling.

If individuals register directly for egg oiling activities, and Front Range municipalities work directly with federal agencies on culling activities, CPW expects damage management actions conducted under the Special Canada Goose permit will be very limited. Examples include 1) limited culling of geese causing crop damage in rural areas, and 2) assisting property owners with first-time, time-sensitive removal of nests where aggressive pairs of geese are regularly in contact with people (e.g., near the entrance to a business or school). CPW, USFWS, and Wildlife Services-Colorado will regularly coordinate and communicate on control activities (see Strategy 4.3).

OBJECTIVE 4. Improve monitoring of and communication about resident Canada goose populations, harvest and hunting activities, conflict-related control activities, and public attitudes toward resident Canada geese in Colorado.

Strategy 4.1. Develop and implement a periodic spring population survey for resident Canada geese along the I-25 urban corridor from Fort Collins to Pueblo (Front Range corridor).

4.1.1 CPW will design a survey to obtain reliable estimates of spring abundance and distribution of resident Canada geese along the Front Range corridor.

4.1.2 CPW will coordinate with partners to conduct the survey in a cost-effective way, and communicate results of the survey.

Strategy 4.2. Monitor Canada goose harvest and hunter activity in Colorado.

4.2.1 USFWS annually conducts waterfowl harvest surveys that include estimates of Canada goose harvest, and the temporal and spatial (county-level) distribution of harvest in Colorado. CPW will track and communicate results of this survey as related to resident Canada geese (e.g., early season goose harvest).

4.2.2 CPW will consider periodically conducting intensive monitoring studies of resident Canada geese (e.g., banding) to obtain and update information on survival and harvest rates, and spatial and temporal distribution of resident Canada goose harvest.

Strategy 4.3. Track statewide damage management activities for resident Canada geese in Colorado.

4.3.1 CPW, USFWS and Wildlife Services-Colorado will meet annually to share and review information on non-lethal and lethal control efforts.

4.3.2 CPW, USFWS, and Wildlife Services-Colorado will update approaches and procedures as needed.

Strategy 4.4. CPW, in coordination with partners, will periodically conduct public surveys on attitudes and perceptions toward resident Canada geese, and incorporate these results into communications efforts and goose management actions.

Strategy 4.5. CPW, in coordination with partners, will periodically (at least every five years) review and update the objectives, strategies, and background information in this plan as needed.

Rationale

As the human and resident Canada goose populations in Colorado continue to grow and interact, we expect an increased need to share information on management activities with management partners and the public.

CPW does not currently conduct extensive, rigorous population surveys for resident Canada geese along the Front Range corridor. A periodic ground-based survey conducted during spring can provide precise abundance estimates and information on distribution of resident Canada geese along the Front Range corridor, where most conflicts occur and property managers conduct most site-specific control activities. This information would be useful for communicating about changes in local populations and the effectiveness of control actions.

Similarly, tracking harvest of Canada geese and control activities conducted throughout Colorado will help facilitate communication about the status of resident Canada geese in Colorado. Perceptions and attitudes toward resident Canada geese and management activities is likely to vary among different segments of the public, geographically, and

over time. Understanding these perceptions and concerns will assist local, state, and federal managers in communicating with the public about resident Canada geese and their management.

BACKGROUND INFORMATION

Canada Goose Populations in Colorado

In North America, Canada geese are managed at a population level based on relatively distinct breeding area affinities. During migration and winter, different breeding populations of geese often mix together. Large numbers of Canada geese that breed outside Colorado migrate through and winter in Colorado. While many Canada geese that breed in Colorado also winter in the state, often moving short distances or to lower elevations, some resident breeding geese in Colorado migrate out of the state during winter (primarily to New Mexico). Thus, while resident Canada geese in Colorado are the focus of this plan, it is necessary to consider resident geese in the context of the overall Canada goose populations that occur in Colorado.

Three continental populations of Canada geese occur in Colorado:

Hi-Line Population (HLP)

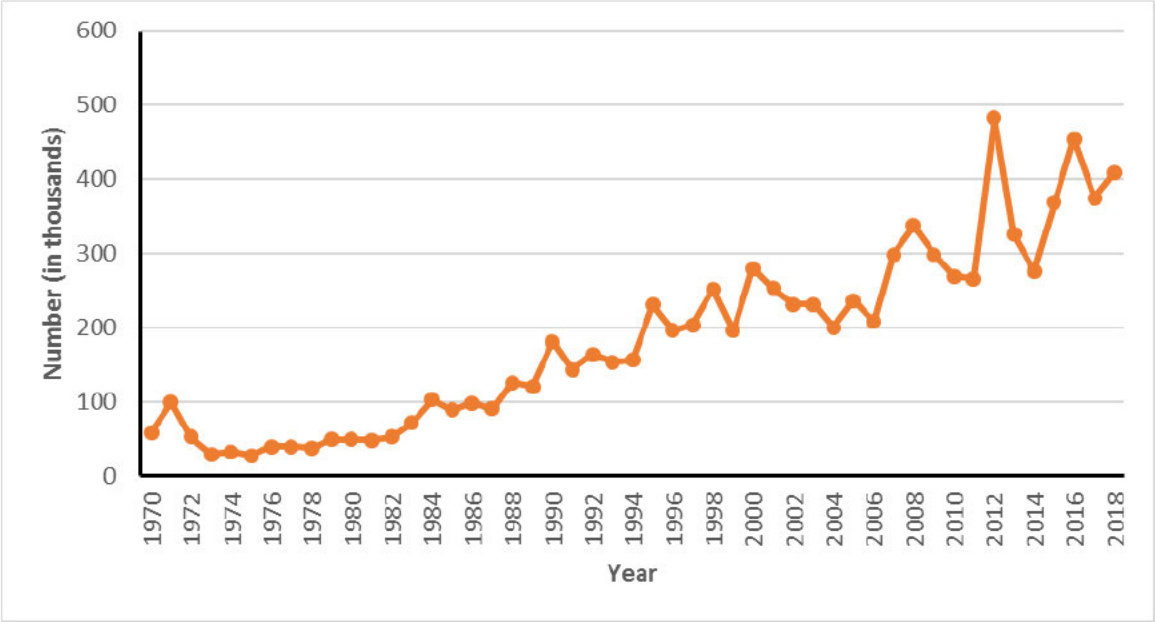
HLP Canada geese nest in southeastern Alberta, southwestern Saskatchewan, and eastern Montana, Wyoming, and Colorado; this population winters primarily in these states and New Mexico (Central Flyway Council 2010). Resident Canada geese that breed in Colorado east of the Continental Divide are part of the HLP. In Colorado, concentrations of breeding, nonbreeding, and molting HLP Canada geese occur during the spring and summer in North Park (Jackson County), South Park (Park County), the San Luis Valley (Alamosa, Conejos, Costilla, and Rio Grande counties, and portions of Hinsdale, Mineral, and Saguache counties), and the Northern Front Range (Adams, Arapahoe, Boulder, Broomfield, Denver, Jefferson, Larimer, and Weld counties). Smaller, local concentrations of HLP Canada geese occur during spring and summer in El Paso and Pueblo counties, and additional breeding HLP Canada geese are scattered at low densities throughout eastern Colorado.

Although it does not include the Colorado and Wyoming portions of the HLP breeding range, the Waterfowl Breeding Population and Habitat Survey (WBPHS) conducted annually by the USFWS does include Canada and Montana and provides an index to the breeding population of HLP Canada geese (U.S. Fish and Wildlife Service 2018). Results of this survey show an approximate seven-fold increase in the HLP from the 1970s to the present (Fig. 1). The 2018 WBPHS estimate for HLP geese was 409,200 (343,700–474,800). There was no significant trend in these indices during 2009–2018 ($P = 0.084$) (U.S. Fish and Wildlife Service 2018).

Eastern Colorado is a primary wintering area for HLP Canada geese from throughout their breeding range. As the overall HLP breeding population has grown, the numbers of HLP in Colorado during fall migration, winter, and spring migration has increased. HLP Canada geese present in Colorado during the breeding period primarily spend the fall and

winter in Colorado and New Mexico (Gammonley 2010, Sanders and Dooley 2014, CPW unpublished data).

Figure 1. Estimates of Hi-Line Population Canada geese from the U.S. Fish and Wildlife Service Waterfowl Breeding Population and Habitat Survey in Alberta, Saskatchewan, and Montana (U.S. Fish and Wildlife Service 2018).



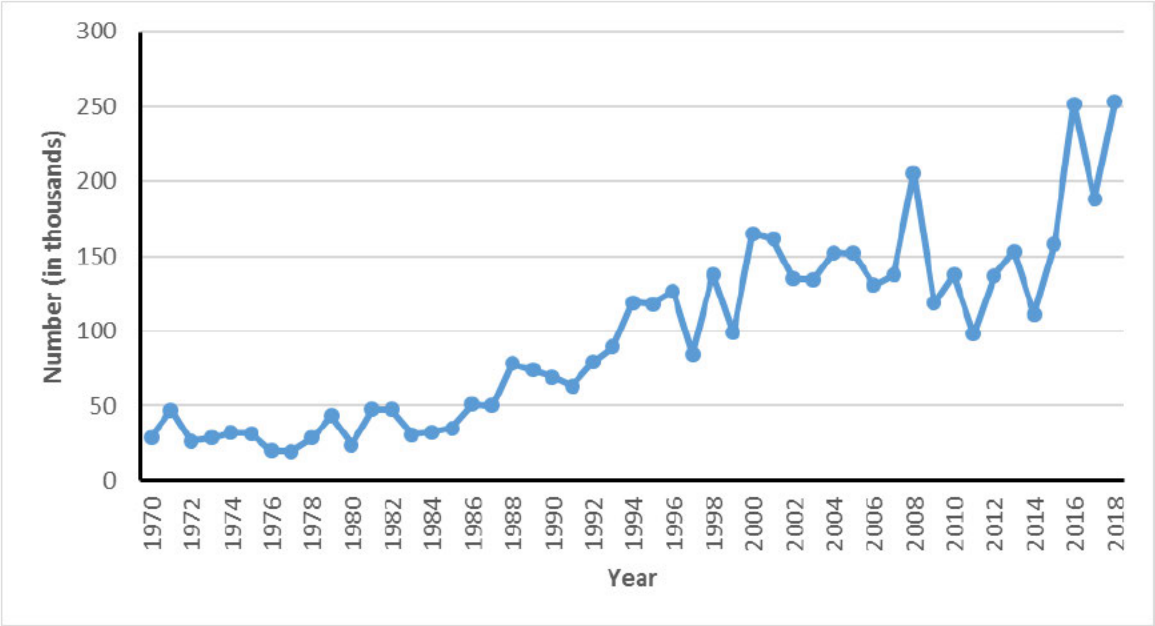
Rocky Mountain Population (RMP)

RMP Canada geese nest in southern Alberta, western Montana, Wyoming, and Colorado, and the intermountain regions of Utah, Idaho, and eastern Nevada (Pacific Flyway Council 2000). This population winters mainly in central and southern California, Arizona, Nevada, Utah, Idaho, Colorado, Wyoming, and Montana. Resident Canada geese that breed in Colorado west of the Continental Divide are part of the RMP. Local concentrations of breeding, nonbreeding, and molting HLP Canada geese occur during the spring and summer in Middle Park (Grand County) and throughout the river valleys of western Colorado.

WBPHS estimates from portions of Alberta and Montana provide an index of the breeding population size of RMP Canada geese (U.S. Fish and Wildlife Service 2018). In 2018, the WBPHS estimate for RMP geese was 252,700 (188,600–316,800). The WBPHS estimates for RMP geese have shown an approximate nine-fold increase from 1970 to the present (Fig. 2), and have increased 8% per year during the past ten years ($P = 0.007$).

Although western Colorado is not a primary wintering area for the overall RMP, the number of Canada geese wintering in western Colorado has increased as the local breeding population and overall numbers of RMP Canada geese have increased. RMP Canada geese present in Colorado during the breeding period primarily spend the fall and winter in Colorado and New Mexico (Sanders and Dooley 2014).

Figure 2. Estimates of Rocky Mountain Population Canada geese from the U.S. Fish and Wildlife Service Waterfowl Breeding Population and Habitat Survey in Alberta and Montana (U.S. Fish and Wildlife Service 2018).



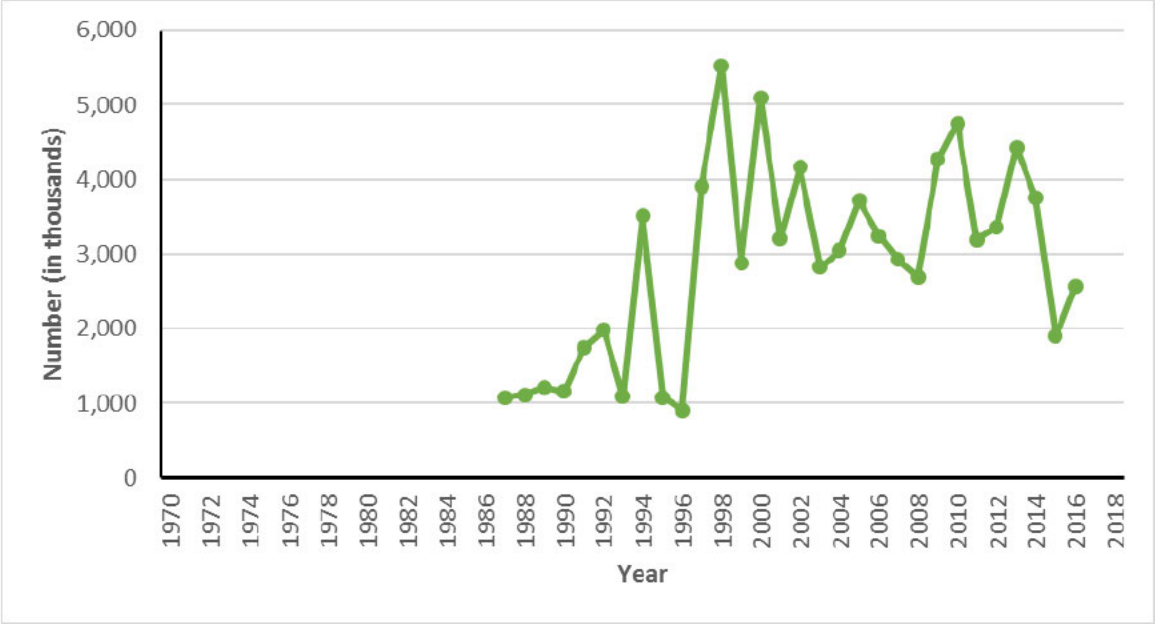
Central Flyway Arctic-Nesting Canada and cackling geese (CFAN)

CFAN geese are comprised primarily of cackling geese that nest north of the tree line in the Canadian arctic, but also includes some portions of smaller subspecies of Canada geese that nest near the tree line. Consequently, CFAN geese are not resident Canada geese as defined by USFWS. CFAN geese were previously managed separately as the Short Grass Prairie and Tall Grass Prairie populations of Canada geese, which are now referred to as West-tier and East-tier CFAN, respectively (Central and Mississippi Flyway Councils 2013). West-tier CFAN nest in Canada on Victoria and Jenny Lind Islands and on the mainland from the Queen Maud Gulf west and south to the Mackenzie River. East-tier CFAN nest on Baffin, Southampton, and King William Islands; north of the Maguse and McConnell Rivers on the Hudson Bay coast; and in the eastern Queen Maud Gulf region. West-tier CFAN geese winter in eastern Colorado, northeastern New Mexico, and the Oklahoma and Texas panhandles, and East-tier CFAN winter mainly in Oklahoma, Texas, and northeastern Mexico; considerable overlap in use of wintering areas can occur. Eastern Colorado is a primary wintering and spring migration area for West-tier CFAN geese, where they mix with HLP Canada geese.

Lincoln estimates of the adult cohort of CFAN geese are the primary management indices for this population (U.S. Fish and Wildlife Service 2018). Lincoln estimates are derived from annual estimates of total harvest and harvest rate and represent an indirect measure of abundance. Due to the methodology, Lincoln estimates are typically not available from the most recent years. The 2016 adult Lincoln estimate was 2,562,400 (1,565,400–

3,559,300). The CFAN population increased from the late 1980s to the late 1990s and has since remained relatively stable (Fig. 3), and during the past 10 years, there was no significant trend in these estimates ($P = 0.424$). A portion of the West-tier CFAN breeding range is covered by the WBPHS in the Northwest Territories. In 2018, the WBPHS estimate was 165,400 (119,500–211,300). There was no significant trend in these estimates from 2009 to 2018 (P = 0.979) (U.S. Fish and Wildlife Service 2018).

Figure 3. Estimates of adult Central Flyway Arctic Nesting Canada and cackling geese (U.S. Fish and Wildlife Service 2018).



Establishment of Local Breeding Populations in Colorado

Although historical records are sparse, it is likely that many locally breeding Canada geese in Colorado were eliminated as the state was settled (Szymczak 1975). By the 1950s, locally breeding RMP Canada geese were concentrated in northwestern Colorado along the Yampa, Green, and Little Snake rivers; very low numbers of breeding Canada geese were scattered through eastern Colorado; and a few non-migratory Canada geese resided in the Denver area, which originated from captive decoy flocks liberated in the 1930s (Rutherford 1967, Szymczak 1975). HLP Canada geese migrated through Colorado mainly along the eastern side of the Rocky Mountains between primary wintering and breeding areas, and the primary winter concentration area of CFAN geese in Colorado was located in the lower Arkansas River Valley in southeastern Colorado (Szymczak 1975, Colorado Division of Wildlife 1989).

During the 1950s, many state wildlife agencies across the coterminous United States began efforts to establish or re-establish local breeding populations of Canada geese. After the completion of a statewide habitat suitability study, Canada goose (primarily juveniles translocated during June and July) were first released in the San Luis Valley, North Park, and north-central Front Range foothills areas north of Denver during 1956–1957 (Szymczak 1975). A concerted effort was made in 1957–1967 to build the breeding

population in north central Colorado (Fort Collins area), which would supply stock for transplants into other areas in Colorado east of the Continental Divide beginning in 1967. Geese transplanted from outside Colorado were obtained from other United States breeding populations in the Central Flyway and likely represented 3 races of large Canada geese including western (*B. c. moffitti*), giant (*B. c. maxima*), and interior (*B. c. interior*). Canada geese were translocated to local areas west of the Continental Divide from native stocks in northwest Colorado beginning in 1967. The state completed major efforts to translocate geese to local breeding areas in Colorado in 1974 east of the Continental Divide and 1988 west of the Divide. In the early 1990s, managers translocated geese from the Denver and northern Front Range area to supplement a small local breeding population in Pueblo County. These efforts successfully established local populations of breeding Canada geese throughout the western valleys, the mountain parks, and the Front Range corridor in Colorado.

Current Abundance of Resident Canada Geese in Colorado

There are no statewide, rigorous breeding population surveys of Canada geese conducted by CPW or USFWS in Colorado. To obtain a rough index for contemporary numbers of resident Canada geese in Colorado, we used information from recent banding studies (Table 1). During 2000-2006, CPW conducted a large-scale project to legband resident RMP and HLP Canada geese during the summer wing-molt period at concentration areas in the mountain parks and western valleys of Colorado (Sanders and Dooley 2014). During 2003-2008, CPW conducted a separate project to legband resident Canada geese during the summer wing-molt period at sites along the I-25 Front Range corridor (Gammonley 2010). The population of geese present during the summer banding period includes local breeders, local nonbreeders, molt migrants from surrounding states, and young produced that year. Combining results from these two banding projects, CPW captured about 8,700 geese annually during the period when the studies overlapped

Table 1. Resident Canada geese captured suring large-scale banding operations in Colorado (Gammonley 2010, Sanders and Dooley 2014).

Banding area	Years	Geese banded/year	Banded geese recaptured/year	Total geese captured/year
RMP range		1,537	440	1,977
Northwest	2002-2006	84	12	96
West central	2002-2006	958	292	1,250
Southwest	2003-2006	283	68	351
Middle Park	2000-2006	212	68	280
HLP range		4,053	2,678	6,731
North Park	2002-2006	1,195	739	1,934
South Park	2003-2006	719	323	1,042
San Luis Valley	2002-2006	393	292	685
Front Range	2003-2008	1,746	1,324	3,070
Statewide total		5,590	3,118	8,708

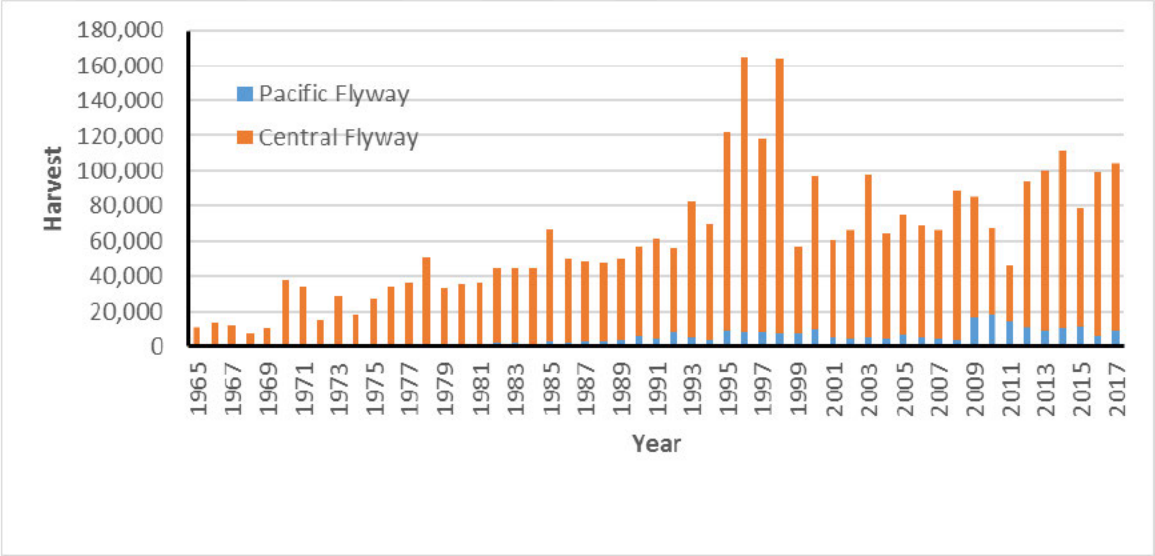
(2003-2006). Although these studies included many of the sites where concentrations of resident Canada geese occur during summer, CPW did not capture every goose at some sites, and did not capture geese at numerous other sites where resident geese occur around the state. We roughly estimate there were 2-3 times as many resident geese in Colorado than CPW captured during these studies, indicating a potential summer statewide population of 17,400-26,100 during the mid-2000s.

Canada Goose Harvest in Colorado

Recreational hunting harvest is the primary method used to manage Canada goose populations in North America. Prior to the 1960s, Canada goose hunting regulations were very restrictive. Hunting was initially prohibited or very restricted in areas where managers were trying to establish local breeding populations (Szymczak et al. 1981). As local resident populations and the overall populations of HLP, RMP, and CFAN geese increased, managers liberalized hunting regulations throughout Colorado. Currently, federal regulation frameworks permit CPW to provide 107-day hunting seasons (the maximum allowed under the Migratory Bird Treaty Act), with daily bag limits of four in the Pacific Flyway and five in the Central Flyway portions of Colorado.

Canada goose harvest in Colorado has increased as local and migrant populations have increased and regulations have become more liberal (Fig. 4). Since the 1990s Canada and cackling goose harvest in Colorado has averaged about 87,000 per year. From 1999-2017, an average of 14,044 hunters in Colorado spent an average of 5.86 days/hunter hunting geese, and the average seasonal harvest was 6.3 geese/hunter (Dubovsky 2018).

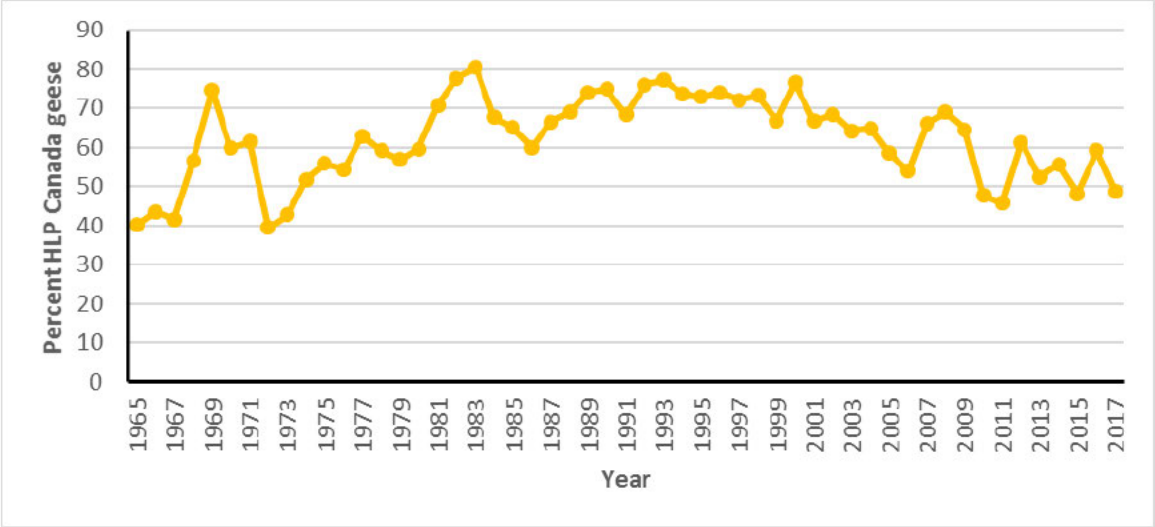
Figure 4. Estimates of annual harvests of Canada and cackling geese in the Pacific Flyway and Central Flyway portions of Colorado (U.S. Fish and Wildlife Service 2018).



In the Central Flyway portion of Colorado the annual Canada goose harvest is a mix of resident HLP Canada geese, HLP geese migrating to Colorado from breeding areas outside Colorado, and CFAN geese migrating to Colorado from their arctic and subarctic

breeding areas. Both the HLP and CFAN populations have increased over time, and the proportion of HLP Canada geese in the total Canada/cackling goose harvest in Central Flyway Colorado has fluctuated around an average of about 60% since the 1960s (Fig. 5).

Figure 5. Annual estimates of the percentage of Canada and cackling geese harvested in the Central Flyway portion of Colorado that are HLP Canada geese (including resident geese), versus CFAN geese.



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Focus

Zoonotic Transmission of *Cryptosporidium parvum*: Implications for Water-borne Cryptosporidiosis

T.K. Graczyk, R. Fayer and M.R. Cranfield

The emergence of Cryptosporidium parvum*-associated cryptosporidiosis as a worldwide zoonosis has stimulated interest in the modes of pathogen transmission. Here, Thaddeus Graczyk, Ronald Fayer and Michael Cranfield discuss the complex epidemiology of* C. parvum*, emphasizing the crosstransmission potential of the pathogen, mechanical vectors involved in water-borne transmission of the oocysts, and factors contributing to contamination of pristine waters with* Cryptosporidium*. They also outline the public health importance of proper interpretation of positive detection of* Cryptosporidium *oocysts at water-treatment facilities and identify means by which watersheds can be protected from* Cryptosporidium *contamination.*

Parasites of the genus *Cryptosporidium* are cyst-forming protozoons with a monogenous life cycle that inhabit epithelial cells of the gastrointestinal or respiratory tracts[1]. Of eight valid species infecting all vertebrate groups – *Cryptosporidium nasorum* (fish), *C. serpentis* (reptiles), *C. baileyi* and *C. meleagridis* (birds), and *C. felis*, *C. wrairi*, *C. muris* and *C. parvum* (mammals) – only one, *C. parvum*, represents a global public health problem due to its zoonotic potential[2]. The pathogen infects 79 species of mammals, is highly prevalent in ruminants, and is crosstransmissible to humans[1]. The only exogenous stage, the oocyst, is long-lived and resistant to standard water disinfection[3]. As a result, *Cryptosporidium* has caused massive epidemics and has become recognized as the most important water contaminant in the USA[4] (Table 1). Water-borne transmission is facilitated by the small size of the oocyst (3.5–5.0 μm), suboptimal processing at water-treatment facilities, and long-lasting infectivity of the oocysts in the environment[3].

Approximately one week after ingestion of oocysts by humans, severe chronic or self-limiting diarrheal disease may result, depending on immune status[5]. As few as 30 oocysts initiated infection in a dose–response study in immunocompetent humans[6]. Over one billion oocysts can be excreted daily in diarrheal stools (up to 30 bowel motions, totaling three liters per day) by an immunodeficient person[7,8]. Persons at greatest risk from *Cryptosporidium* are young children, and immunocompromised and immunosuppressed

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Table 1. Outbreaks of water-borne cryptosporidiosis in the USA

Year	Location	Population infected (per 10^3)	Attack rate (%)	Suspected cause(s)
1984	Braun Station, TX	2.00	–	Sewage-contaminated well
1987	Carrolton, GA	12.96	–	Water-treatment deficiencies
1988	Los Angeles, CA[a]	–	73	Inoperative swimming-pool filters
1991	Pennsylvania	0.55	–	Water-treatment deficiencies
1992	Jackson County, CO	15.00	–	Water-treatment deficiencies
1992	Lane County, OR[a]	–	37	Oocysts in filter washback water
1993	Madison, WI[a]	–	55	Fecal accident in swimming pool
1993	Milwaukee, WI	403.00	–	Snow melt, flood, water-treatment deficiencies
1994	Clark County, NV[a]	0.08	–	Fecal accident in swimming pool

[a] Due to drinking and recreational waters.

individuals[8]. The pathogen contributes significantly to mortality of AIDS patients due to lack of effective prophylactic or therapeutic medications; extra-intestinal infections in the pancreas, gall bladder, bile ducts, and even the lungs have been observed in immunocompromised patients[8].

The importance of detection

Cryptosporidium oocysts are continuously (as distinct from intermittently) prevalent in surface waters[9]. The prevalence of positive samples in these waters varies from 6% to 100%, with oocyst concentrations of 0.003 to 5800 per liter, respectively[3,10]. Adverse weather conditions such as heavy rains, snow melts, and floods wash oocysts from land areas into surface waters, elevate turbidity, cause sewage overflow and increase urban and agricultural run-off, resulting in water contamination[3]. When the water-borne oocysts are recovered at a water-treatment facility, it would be ideal to be able to determine their concentration, species and infectivity for humans. If oocysts are from any of the seven medically unimportant species of *Cryptosporidium*, their high concentrations (even if the oocysts are viable) should not trigger public health officials to alert water consumers.

Immunofluorescent monoclonal antibodies (IFAs), which can be used according to the existing regulations for oocyst detection[4], have been commercially designed as test kits: *Hydrofluor-Combo* (indirect IFA assay) and *MERIFLUOR*™ (direct IFA assay). Other test kits include the enzyme immunoassay (EIA) *Prospect*™ Rapid Assay. Although the tests were known to be highly sensitive to *C. parvum*, their specificity to the medically unimportant *Cryptosporidium* species was not clear until a recent study of crossreactivity. When examined for reactivity against *Cryptosporidium* species (25 oocyst isolates) of low risk to public health, the tests showed crossreactivity of 76% (both IFA assays) and 24% (the EIA)[11]. The level of crossreactivity for each test kit was incorporated into a modeled mathematical simulation with a pool of 300 oocyst isolates representing medically important and unimportant species of the pathogen[11]. The pool components were constructed according to the probability of a positive reaction of each test, with equalized numbers of *C. parvum* oocyst isolates and the oocyst isolates of other species[11]. In the model, 93 and 43 samples for IFA and EIA testing, respectively, were randomly drawn from the pool of 300 oocyst isolates, subjected separately to IFA and EIA testing and returned to the pool[11]. The procedure was repeated 30 times[11]. The results showed that the probability of obtaining a positive reaction due to medically unimportant species of *Cryptosporidium* was 0.38 with both IFA tests, and 0.12 for the EIA test[11]. More importantly, testing of randomly drawn samples demonstrated that up to 35% of the samples reacting positively with both IFA tests, and up to 12% reacting positively with the EIA test, represented *Cryptosporidium* of low risk to public health[11]. Since the quantitative environmental composition of *Cryptosporidium* species (which may reflect the composition of water-recovered oocysts) is currently unknown[12], it remains undetermined how applicable these findings are to the water-treatment plant situation. Modeling may appear to be an academic exercise, but it is expected to provide useful advice to the water-treatment facility managers on how to interpret positive results when these or similar test kits are used. The US Environmental Protection Agency recently issued the Information Collection Rule (ICR), indicating that a water-treatment plant that serves more that 10000 people must monitor source and drinking water for *Cryptosporidium* oocysts[13]. It is possible that test kits recommended in current regulations[4] and specifically designed for water testing (eg. the *Hydrofluor-Combo* test) may detect *Cryptosporidium* species[11] that are not infectious to humans and needlessly exacerbate health concern by erroneously reporting *C. parvum* contamination.

Although molecular techniques have demonstrated differences among *Cryptosporidium* species[12], no methods to speciate water-borne oocysts at a water-treatment facility have been adopted[12]. Assessment of infectivity of oocysts recovered from treated drinking water would be invaluable in providing accurate information, facilitating communication of health officials with water-plant managers. Recently, the efficiency of oocyst recovery from drinking water was greatly improved by a technique in which an entire filter membrane that had entrapped particulate matter from a large volume of water[14] was dissolved, leaving behind *C. parvum* oocysts. Most importantly, this method does not alter the infectivity of *C. parvum* oocysts[15], offering the advantage that the recovered transmissive stages of the pathogen can be subsequently subjected to the infectivity bioassay[15].

Zoonotic potential of *Cryptosporidium parvum*

Cryptosporidium was known to parasitologists long before human cryptosporidiosis emerged as a global

problem. The zoonotic potential of *C. parvum* raised early concerns that large concentrations of domestic animals, particularly at dairy farms and cattle grazing lands and pastures, were possible sources of water-borne oocysts[3]. Concern about environmental contamination by cattle feces increased when cider from fallen apples collected in a pasture caused an outbreak of cryptosporidiosis[16]. Sewage waste and discharges, and agricultural and urban run-off have become recognized as potential sources of water contamination[3]. Consequently, current watershed protection programs include elimination of human activity from the area of water catchment[3]. Surprisingly, waters from the protected watersheds have been found to be contaminated at similar levels to waters from unprotected or industrially impacted areas[17], raising the concern that environmental factors contributing to the contamination may not be fully recognized[3]. Wildlife, particularly large game animals, was postulated as a potential factor contributing to water contamination[9], and it has been demonstrated that white-tailed deer are susceptible hosts for this human pathogen[18]. Because oocyst excretion by domesticated animals could result in contamination of the aquatic environment[19], a recent report that *C. parvum* was experimentally transmitted to aquatic lower vertebrates (fish, amphibia and reptiles) and then back to mammals exacerbated the concerns of agencies responsible for provision of drinking water safe from water-borne diseases[20]. If aquatic vertebrates could serve as reservoirs for a human pathogen transmitted via water, current watershed-management practices would have to be modified. However, a series of crosstransmission experiments undertaken shortly after this report did not substantiate transmission of *C. parvum* to fish, amphibia or reptiles[21]. Nevertheless, lower vertebrates may disseminate *C. parvum* oocysts acquired by ingestion, ie. via infected prey[21]. The developmental stages of *Cryptosporidium* in the study suggesting transmission to aquatic lower vertebrates[20] most likely originated from pre-existing subclinical *Cryptosporidium* infection(s).

The results of early transmission experiments showed a lack of host-species specificity in *Cryptosporidium* within mammalian groups[8]. However, the theory of a monotypic genus for *Cryptosporidium* was misleading and was erected because only mammal isolates were transmitted to mammals[8]. Numerous experimental crosstransmission studies have established that species of *Cryptosporidium* are specific to reptiles, avians and mammals[8,21–23]. Some species, such as *C. wrairi* and *C. felis*, are even more specific, infecting only guinea-pigs and cats, respectively[2]. The discovery that a *C. parvum*-refractory host can excrete intact ingested oocysts raised the issue that if oocyst infectivity is retained after passage through the intestine, that host could act as a mechanical vector and disseminate the pathogen in the environment. What if that vector were an aquatic migratory bird? Indeed, *C. parvum* did not establish intestinal or respiratory infection in oocyst-inoculated Peking ducks or Canada geese (*Branta canadensis*), but passed through the intestinal tract and was infectious for mice in a bioassay[24,25]. During spring and fall migrations, thousands of waterfowl use pastures and cattle grazing lands along the eastern shore of the USA for feeding and resting and, until recently, waterfowl have not received epidemiological attention as a vector for water-borne oocysts. Much of the daily activity of these birds involves grazing on land and shallow water[24,25]. A flock of Canada geese wandering around a protected water reservoir represents a wildlife conservation goal of the watershed protection program and state and federal environmental law; however, the event may have epidemiological implications[25]. If such water became contaminated, waterborne oocysts could be filtered out and concentrated by mollusks (oysters), which efficiently filter approximately ten liters of water per hour. The results of a recent experiment indicate that oysters do remove *C. parvum* from water and could, if eaten raw, serve as a source of human infection[26,27].

Cryptosporidiosis as a global health problem

The facts provided here are not intended to imply that the means to protect surface water from contamination with oocysts are not effective, but rather to recognize factors contributing to such contamination. The first species of *Cryptosporidium* was described in 1907 (Ref. 1) and the first human case of cryptosporidiosis in 1976 (Ref. 2); however, there is no doubt that the oocysts were present in the environment before they were recognized. The emergence and explosive spread of HIV around the world, together with the consequences of AIDS, greatly enhance the life-threatening manifestation of cryptosporidiosis as a global health problem. Prevention of *Cryptosporidium* infection, by blocking transmission via water to which exposure cannot be avoided, constitutes another challenge that humans have to face in the developing and developed world.

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Hemoglobin: Food for Thought in Vectors and Parasites

R. Charlab and E.S. Garcia

Several reports indicate that hemoglobin can serve as a source of peptides involved in regulatory functions in mammals, including humans. Here, Rosane Charlab and Elói Garcia discuss the potential role of hemoglobin-derived peptides as regulatory molecules in blood-sucking vectors and protozoan parasites.

Hemoglobin is the major blood protein, present at a concentration of about 14 g per 100 ml. In addition to its essential role as an oxygen carrier, hemoglobin may be relevant as a source of potentially active peptides[1,2].

Like the formation of the 'classical' endorphins from inactive prohormones, partial enzymatic cleavage of hemoglobin, *in vitro*, generates peptides with opioid activity, which are called hemorphines. Their opioid activity was determined by the use of electrically stimulated myenteric plexus/longitudinal muscle preparations of the guinea-pig ileum[1,3]. Similar opioid peptides have also been isolated from various mammalian sources, suggesting they possess a biological function[4–7].

Apart from hemorphin-containing fragments, which correspond to a region of the hemoglobin β-chain[3], endogenous peptides carrying mainly α-globin sequences have been identified *in vivo*. Distinct immunomodulatory, analgesic, cardiotropic and hematopoietic regulatory activities have been attributed to these molecules (for review, see Ref. 2). It is possible, therefore, that fragments generated during physiological or physiopathological processes as a result of limited proteolysis of globin (or a globin-like protein), or even released in the intestinal tract from foods containing blood, may be involved in mammalian signaling processes[1–3,7,8].

A number of studies now suggest that the release of peptides from hemoglobin may represent a general phenomenon, affecting not only mammals but also blood-sucking insects and their parasites.

Hemoglobin and blood-sucking triatomines

The importance of hemoglobin as a dietary supply of amino acids to blood-sucking insects is well established[9]. Some reports suggest that, in addition to its nutritional role, hemoglobin modulates several processes in these insects[10,11]. Peptides released by proteolytic cleavage of hemoglobin may also be operational in hematophagous insects. A few examples (below) support this view, particularly for the *Trypanosoma cruzi*–triatomine interaction.

Rhodnius prolixus, an obligatory hematophagous triatomine insect, requires bloodmeals for complete development of five instar stages and for reproduction of the imaginal stage. Hemoglobin is important indirectly for starting this insect's bloodfeeding; it carries the 2,3-diphosphoglycerate molecule, which is a key phagostimulant for blood-sucking insects[12]. The insect feeds quickly, at infrequent intervals, taking very large meals of blood: in the pre-adult stages each meal can be up to 10–12 times as large as the insect itself[13]. During a full engorging of the fifth-instar larva of *R. prolixus*, approximately 250 µl of blood are sucked, ie. about 35 mg of hemoglobin are ingested and stored in the dilated anterior midgut. After feeding, most erythrocytes are lysed by a lytic peptide, rendering the hemoglobin accessible to protease attack in the posterior midgut[14]. Only two endoproteases are found in

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Can Hunting of Translocated Nuisance Canada Geese Reduce Local Conflicts?

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Abstract

*Resident Canada geese (*Branta canadensis*) nest or reside in the temperate latitudes of North America. In past years, translocation the capture and subsequent release of geese at distant locations has been used to establish resident goose populations and to reduce nuisance problems. However, with new special hunting seasons designed to target resident Canada geese, we can now evaluate translocation as a management tool when hunting is allowed at release sites. We selected 2 study sites, representative of urban and suburban locations with nuisance resident geese, in central and western New York, USA. In June 2003, we translocated 80 neck banded adult geese, 14 radiomarked adult females, and 83 juveniles 150 km east and southwest from urban and suburban problem sites in western New York to state owned Wildlife Management Areas. At these same capture sites, we used 151 neck banded adult geese, 12 radiomarked females, and 100 juveniles as controls to compare dispersal movements and harvest vulnerability to translocated geese. All observations (*n = 45*) of translocated radiomarked geese were <20 km from release sites, in areas where hunting was permitted. Only 25 of 538 observations (4.6%) of radiomarked geese at control sites were in areas open to hunting. The remainder of observations occurred at nonhunting locations within 10 km of control sites. More translocated adult geese (23.8%) were harvested than control geese (6.6%; $\chi^2 = 12.98$, P = 0.0009). More translocated juvenile geese were harvested (22.9%) than juvenile controls (5.0%; $\chi^2 = 12.30$, P = 0.0005). Only 7 (8.8%) translocated adult geese returned to the original capture sites during Canada goose hunting seasons. Translocation of adult and juvenile geese in family groups may alleviate nuisance problems at conflict sites through increased harvest, reducing the number of birds returning in subsequent years.* (WILDLIFE SOCIETY BULLETIN 34(3):845 849; 2006)

Key words

Branta canadensis*, Canada geese, harvest, hunting, nuisance, translocation.*

During 1953–1965, 20,734 migrant Canada geese were captured at wintering locations in the Mississippi and Atlantic Flyways and transplanted to 9 national wildlife refuges in 4 southeastern states (Hankla 1968). The primary intent was to 1) restore wintering flocks in the south to their historic high levels, and 2) establish additional wintering flocks in new areas with suitable habitat. Transplants consisted of 1) fully-winged birds, 2) birds with primary feathers removed prior to release, and 3) immature birds held for 2 years at the release sites. This attempt to redistribute wintering geese was unsuccessful, but the practice of trapping and moving geese was initiated.

In the 1960s and 1970s, new emphasis was placed on transplanting geese to both restore and introduce the giant Canada goose (*Branta canadensis maxima*; Hanson 1965) and its western counterpart, *B. c. moffitti* (Palmer 1976). Transplanting consisted of moving flightless molting adults and goslings to new areas. This method proved highly successful in establishing locally breeding flocks throughout much of the United States and southern Canada (Lee et al. 1984). These flocks increased dramatically and in succeeding decades caused nuisance problems, especially in urban and suburban areas (Conover and Chasko 1985). Trapping and relocation of geese continued but primarily to help control local population growth (Hindman and Ferrigno 1990). Presently, there is little interest in transplanting geese.

Temperate-nesting geese in the Atlantic Flyway, referred to as "resident" geese, now total ~1 million birds, while "giant" geese in the Mississippi Flyway number ~1.5 million (U.S. Fish and Wildlife Service 2004). Harvest of these geese has increased sharply as populations have grown and hunting regulations were modified to target local flocks (Lawrence et al. 1998, Atlantic Flyway Council 1999). In the late 1980s, the U.S. Fish and Wildlife Service endorsed the implementation of special hunting seasons, outside the regular Canada goose hunting season framework, to help control temperate-nesting geese (Heussmann et al. 1998). These seasons involved hunting in September and late winter when subarctic nesting populations would not be affected. While effective in many rural areas, geese in many cities and suburbs receive little exposure to hunter harvest because hunting is prohibited (Smith et al. 1999).

We transplanted nuisance geese from urban and suburban sites where hunting was prohibited to rural areas where hunting was allowed. Our objective was to determine the conditions under which the hunting of transplanted geese would lessen their negative impact on the local community. We know that translocation of adult geese, by themselves, often is ineffective, because of their eventual return to the original capture site (Cooper 1978, 1987; Cooper and Keefe 1997). However, translocated goslings often remain at release sites (Surrendi 1970, Martz et al. 1983, Cooper 1987, Smith 1996). By releasing molting adults with flightless young into rural areas with similarly flightless adults and young, we hypothesized that formation of creches would delay the return of transplanted birds to the capture site and increase their exposure to the early September and autumn harvest seasons.

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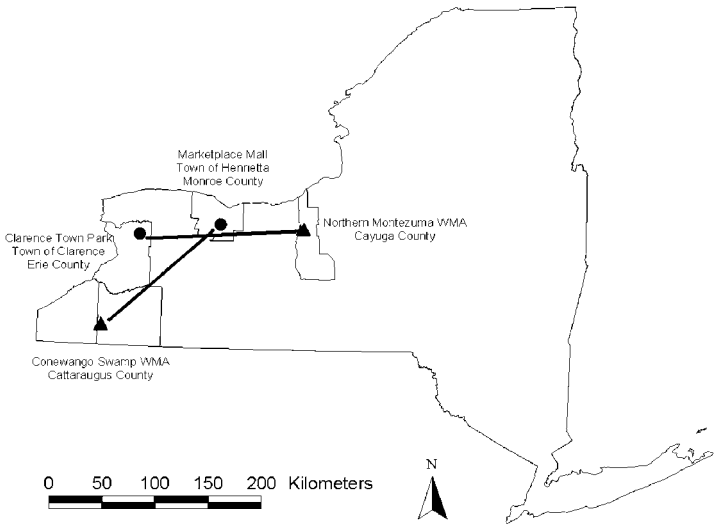

Figure 1. Capture sites (circles) and release sites (triangles) for Canada geese translocated in Jun 2003 from the towns of Henrietta and Clarence, in western New York, USA, to Wildlife Management Areas owned by the New York State Department of Environmental Conservation.

Study Area

We selected 2 towns with a history of nuisance goose problems as control sites in western New York state. The town of Henrietta, located 4 km south of Rochester in Monroe County, is a highly developed urban location with shopping malls, corporate complexes, and residential areas (Fig. 1). The town of Clarence, approximately 32 km northeast of downtown Buffalo in Erie County, is a suburban site with residential subdivisions, drainage ponds, and town parks surrounded by agricultural lands. In both towns, hunting was prohibited due to ordinances and safety concerns, and nonlethal hazing techniques were used to frighten nuisance geese at problem sites.

We released translocated geese at Wildlife Management Areas (WMA) owned by the New York State Department of Environmental Conservation (NYSDEC). We translocated geese captured in Henrietta 150 km southwest to Conewango Swamp WMA, located in the town of Conewango, Cattaraugus County (Fig. 1). This 364-ha wetland was approximately 1.5 km north of the village of Randolph and surrounded by agricultural lands. We translocated geese captured in Clarence 157 km east to Northern Montezuma WMA in the town of Savannah, Cayuga County (Fig. 1). This 2,550-ha parcel of upland and wetland habitat was part of the 14,569-ha Montezuma Wetlands Complex, which included Montezuma National Wildlife Refuge and lands owned by conservation groups and individuals. Hunting was allowed at both release areas.

Methods

In June 2003, we captured flightless adult and young Canada geese by herding them into portable funnel traps at several locations within control sites. We aged, sexed, and marked geese with standard aluminum United States Fish and Wildlife Service leg bands (Table 1). We also marked adult geese with plastic neckbands inscribed with unique alpha-numeric codes. We fitted a subsample of adult female geese, exhibiting brood patches, with either a neck-band radiotransmitter manufactured by Advanced Telemetry Systems (ATS) in Isanti, Minnesota (Model A3880, 57 g) or backpack-style transmitter (ATS, Model A1560, 48 g) attached with an elastic harness (mention of trade names or commercial products does not constitute endorsement or recommendation for use by the U.S. government). For comparison, we either released groups of adult and young geese on site to serve as the control or translocated them to WMAs (Table 1).

Table 1. Number of Canada geese leg banded (neck banded, radiomarked in parentheses) at control sites and released on site or translocated 150 km to state Wildlife Management Areas (WMA) in western New York, USA, Jun 2003.

	Age and sex classes[a]					
Location	AHY-M	AHY-F	AHY total	HY-M	HY-F	HY total
Control sites						
Henrietta	55 (55)	70 (63, 7)	125 (118, 7)	7	5	12
Clarence	19 (19)	19 (14, 5)	38 (33, 5)	51	37	88
Total	74 (74)	89 (77, 12)	163 (151, 12)	58	42	100
Translocation sites (WMA)						
Conewango Swamp	25 (25)	29 (22, 7)	54 (47, 7)	21	24	45
Northern Montezuma	21 (21)	19 (12, 7)	40 (33, 7)	20	18	38
Total	46 (46)	48 (34, 14)	94 (80, 14)	41	42	83

[a] AHY After Hatch Year, HY Hatch Year, M Male, F Female.

We tracked radiomarked and neck-banded geese at control and release sites weekly from the date of release through 1 September 2003, and bimonthly thereafter through December 2003 to determine dispersal. When visual sightings were possible, we recorded date, time, location, number of geese, and neck-band codes. When birds were not seen but located using triangulation of the radio signal, we recorded the date, time, location, and radio frequency. If geese were not located near the release location, we monitored the original capture sites weekly to determine if and when geese returned.

We calculated dispersal distances of radiomarked and neck-banded geese from locations plotted in ArcView GIS v. 3.3 (Environmental Systems Research Institute, Redlands, California). We calculated percentages of neck-banded geese observed returning to original capture sites and documented dates of return. We also compared proportions of radiomarked and neck-banded geese observed in areas open to hunting at control and release sites.

We obtained band recoveries of birds shot or found dead from September 2003 to March 2004 from the U.S. Geological Survey's Bird Banding Laboratory (Laurel, Maryland). We used only direct band recoveries, defined as recoveries during the first hunting season after banding, to evaluate the vulnerability of geese to harvest. We used chi-squared tests and program CONTRAST (Hines and Sauer 1989; Sauer and Williams 1989) to compare mortality rates between translocated and control groups for adult and juvenile age classes.

Results

Translocated Geese

Between 1 September and 5 December, we saw 41 (51.3%) of 80 translocated neck-banded geese <20 km from their release sites.

Table 2. Direct recovery rates (f) and corresponding standard errors of translocated and control Canada geese during Sep and regular Canada goose hunting seasons in New York, USA, 2003 2004.

Hunting season	Age[a]	Classification	n[b]	Recovered (%)	f	SE
September	AHY	Translocated	80	19 (23.8)	0.238	0.048
1 Sep 15 Sep		Control	151	10 (6.6)	0.066	0.020
	HY	Translocated	83	19 (22.9)	0.229	0.046
		Control	100	5 (5.0)	0.050	0.022
Regular	AHY	Translocated	80	4 (5.0)	0.050	0.024
26 Oct 17 Jan		Control	151	5 (3.3)	0.033	0.015
	HY	Translocated	83	1 (1.2)	0.012	0.012
		Control	100	1 (1.1)	0.010	0.010

[a] AHY After Hatch Year, HY Hatch Year.
[b] Number of adult geese neck-banded and juvenile geese leg-banded.

Flock sizes ranged from 10 to >2,000 birds, indicating some neck-banded geese separated from the translocated groups and others merged with local flocks and migrating geese. We observed geese in wetlands, agricultural fields, horse pastures, and rural lawns near ponds. No complaints of nuisance problems caused by translocated geese were reported near the release locations. Thirty-nine neck-banded geese were never observed after translocation.

We tracked 11 of 14 translocated radiomarked geese between 1 September and 5 December 2003. We excluded 3 geese from analyses; 1 died of an unknown cause, 1 experienced widespread interference with the radio frequency, and 1 transmitter failed. All observations ($n = 45$) of radiomarked geese were <20 km from release sites. One radiomarked female, with 5 neck-banded geese, flew 75 km west of the Northern Montezuma release area by 1 September 2003, but returned to the release site by 10 October 2003. We observed this female 2 km north of the release site in April 2004; it was the only radiomarked goose located near a release site >10 months after translocation.

Control Geese

Between 1 September and 30 December, we observed 122 of 151 (80.8%) neck-banded geese at control areas <10 km from the capture sites. The remaining 29 neck-banded geese were never observed. We observed only 21 neck-banded geese (13.9%) at least once on properties open to hunting. Almost all of the 1,600 observations (96.0%) of neck-banded geese were in areas where hunting was not allowed.

We did not track 3 of 12 geese radiomarked at control sites; 1 lost its transmitter, 1 was hit by a car, and 1 died of a wing injury. We consistently observed 8 of the remaining 9 birds near control sites between 1 September and 30 December. We did not observe one bird near the control site after 6 September, but it returned by 12 December. Some geese may have been exposed to hazing programs at conflict areas within control sites, but remained close to those sites despite disturbance. Only 25 of 538 (4.6%) observations of our radiomarked geese were in areas open to hunting. We made the remaining 95.4% of observations at nonhunting locations within 10 km of the control sites.

Mortality

Five of 11 (45.5%) translocated radiomarked geese were shot <20 km from release sites during the September hunting season. Another bird was harvested in December, during the regular season, 35.2 km from the release site. No radiomarked control geese ($n = 9$) were harvested during hunting seasons in New York, USA. However, one was harvested in Virginia, USA, during February 2004.

During the September hunting season, the direct recovery rate of translocated adult geese (23.8%) was higher than the direct recovery rate of adult geese at control sites (6.6%; $\chi^2 = 12.98$, $P \leq 0.001$). Translocated juvenile geese also were harvested at a higher rate (22.9%) than juvenile controls (5.0%; $\chi^2 = 12.30$, $P \leq 0.001$; Table 2). All harvest reports of translocated ($n = 38$) and control ($n = 15$) geese during September were <35 km from the translocated and control sites.

During the regular hunting season, 5.0% of translocated adults were harvested versus 3.3% of control adults. Only 1.2% of translocated juveniles and 1.0% of control juveniles were harvested during this period (Table 2). Six geese were recovered <50 km from the release and control sites, and 5 were recovered out-of-state. The small number of direct recoveries reported during the regular hunting season prohibited further comparisons.

Return to Original Capture Sites

Seven of 80 (8.8%) translocated adult geese returned to the original capture sites during the regular Canada goose hunting season. They were first observed in October ($n = 3$), November ($n = 3$), and December ($n = 1$), <5 months after release. Upon return, these geese were located in areas where hunting was not permitted. We observed no radiomarked geese at the original capture sites during open hunting seasons.

After hunting seasons, 13 additional neck-banded geese (16.3%) were detected at capture sites between March and April 2004. Six of these were seen in Virginia, USA, in January, before they returned to western New York, USA. Three returning adult females were observed on nests. Two of 11 translocated radiomarked geese also returned to the capture sites. One returned in April 2004 and was observed nesting approximately 0.25 km from the original capture site. The other was detected at the original capture site in June 2004.

Discussion

Translocation studies of resident Canada geese have focused mainly on establishment of flocks at new locations or measuring control of nuisance flocks based on failure of translocated birds to return to their original capture sites in subsequent years. Our study investigated translocation as a seasonal mechanism to reduce return rates by exposing local geese to hunter harvest. We detected over half (51.3%, $n = 80$) of our translocated radiomarked geese within 20 km of the release site during open hunting seasons. They also were in areas open to hunting every time we observed them. Direct recoveries of bands indicated that translocated geese were harvested <35 km from the release site during the September Canada goose season and <50 km during the regular goose season. In contrast, 80.8% ($n = 151$) of neck-banded adults from our control areas remained <10 km from the site of capture and in areas closed to hunting.

Smith et al. (1999) noted that relocating geese to public hunting areas can result in some harvest of geese near the release site. In this study, translocated adults were harvested at significantly

higher rates (23.8%) during the September Canada goose season than adults from control areas (6.6%). Six of 11 translocated radiomarked geese were also reported harvested during the autumn hunting season versus no radiomarked control birds ($n = 9$).

Our translocated juveniles were also harvested at a higher rate (22.9%) than control juveniles (5.0%) during the September season. Smith (1996) found that juveniles translocated from urban areas to WMAs within Michigan and Ohio from 1988 to 1993 had less than half the probability of survival than juveniles that remained in urban locations. Because juveniles are known to stay with adults through the first year (Hanson 1962), translocating juveniles and adults in family groups may increase the likelihood that adult birds will remain in areas open to hunting, rather than return immediately to original capture sites where hunting is not allowed. Also, because translocated geese dispersed up to 50 km from release sites, hunting pressure in and around release sites is an important consideration for this method to be successful.

Return rates of adult translocated geese to the original capture sites were similar to a previous study in New York in 1997 and 1998 in which 19% ($n = 41$) of adult geese translocated 100 km east or 300 km northwest returned to the capture site more than 8 months after release (B. L. Swift, New York State Department of Environmental Conservation, unpublished report). In our study, 25% ($n = 80$) of translocated geese returned to capture sites <10 months after release. Only 8.8% of these adult geese returned during the hunting season.

We could not account for approximately 50% of translocated adults at the end of this 1-year study. Possible explanations are nonreporting of bands and nonrecovery of geese by hunters. In addition, translocated geese may have dispersed long distances with resident or migrant geese, and auxiliary markers were not detected. If geese were not harvested, they could return to the original capture site over time or be exposed to hunting mortality in subsequent years near release sites. Future long-term translocation studies are needed to assess the impacts of translocation in reducing survival of Canada geese at nuisance sites, especially during years with special Canada goose hunting seasons and liberal bag limits.

Management Implications

Translocation of adult and juvenile geese in family groups may alleviate nuisance problems at conflict sites. Harvest of geese near the release sites limits the number of geese that return to the original capture site in subsequent years. Translocation may be most beneficial and cost effective when geese are translocated >150 km from the capture site to areas with high hunting pressure. Translocation may be more effective if conducted in consecutive years, and the long-term effectiveness of this technique requires further evaluation.

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2008

Evaluation of an Integrated Non-Lethal Canada Goose Management Program in New York (2004 - 2006)

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ABSTRACT: New York State has an estimated population of 249,702 resident Canada geese. Human-goose conflicts are increasing, including unacceptable accumulation of goose feces in public parks, overgrazing of landscaped lawns, noise, and aggressive behavior of individual geese. An integrated Canada goose management program was conducted and evaluated at 8 sites in Orange County, New York from 2004 to 2006. The program, conducted from March through November each year, consisted of egg oiling (300-470 eggs oiled a year), hazing to reduce local goose populations using multiple techniques, public outreach/education, and program monitoring. The monitoring component included goose movement and population surveys using neck-collared geese and standardized fecal counts, at both managed and unmanaged sites. We monitored 3 unmanaged ("control") sites to provide a comparison. We conducted fecal surveys, as an indirect method for potentially estimating site-specific goose populations and associated reduction in damage. The number of droppings counted, when standardized to droppings per foot per day, decreased at treated sites (2004, 0.16; 2005, 0.12; 2006, 0.05) but did not differ at unmanaged sites, indicating a sustained population reduction on site during the project. In addition, the mean number of geese observed at treated sites decreased each year (2004, 77; 2005, 19; 2006, 11) while the mean number at unmanaged sites did not differ. The alternate location of the majority of dispersed geese is unknown, although monitoring of marked birds indicates that many birds moved only short distances (<2 km). The implementation of an integrated non-lethal goose damage management program over 3 years reduced the number of Canada geese at specific locations and minimized local conflicts. The widespread adoption of this type of program could reduce human-Canada goose conflicts across a larger landscape but will require extensive coordination of local projects, a public involvement process, and an intensive, long-term commitment of resources.

KEY WORDS: border collie, *Branta canadensis*, Canada geese, damage management, egg oiling, feces, hazing, New York, nuisance geese

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INTRODUCTION

In the Atlantic Flyway, there are currently 1.1 million resident Canada geese (*Branta canadensis*) (USFWS 2007). Geese are considered resident geese if they nest or reside in the areas of Southern Quebec and the Maritime Provinces of Canada, southward through the states along the Atlantic coast (Nelson and Oetting 1998, Sheaffer and Malecki 1998, Johnson and Castelli 1998). Resident goose populations have experienced significant increases in recent years, with populations growing at a rate of 7.9% per year (Sauer et al. 2006). The population of resident geese has grown so rapidly that they now meet or exceed the number of geese in all 4 flyways (USFWS 2002). With these population increases have come an increased number of conflicts associated with resident geese, particularly in urban and suburban areas (Fairaizl 1992, Forbes 1993, Cooper and Keefe 1997, Lowney et al. 1997, Holevinski et al. 2007).

Resident geese have several biological advantages over migratory geese: they breed at a younger age, have larger clutch sizes, and have higher nest success rates and higher survival rates then migratory geese (Smith et al. 1999). Canada geese, primarily resident populations, have caused conflicts in at least 37 states at both feeding and loafing areas (Forbes 1993). These conflicts include overgrazing and excessive droppings on lawns, golf courses, pastures, athletic fields, public parks and beaches, playgrounds, cemeteries, and residential areas. Urban geese create traffic hazards and are aggressive towards people during the breeding season. Urban and suburban areas have experienced an increase in goose conflicts, as geese target areas with water bodies adjacent to mowed lawns, which provide ideal habitat. Desired qualities include short grass, open space for flight clearance, and water, which provides a safe refuge from predators (Holevinski et al. 2007, Conover and Kania 1991, Converse 1985, Cooper and Keefe 1997). Costs related to replanting and reseeding overgrazed lawns and cleaning up goose droppings is estimated to exceed $60 per goose (Allan et al. 1995).

Large flocks of geese can also be a potential source of disease for both humans and other waterfowl. Urban geese often come into contact with exotic, domestic, or hand-reared waterfowl, which can be a source of duck virus enteritis (USDI 2003). This virus is a highly contagious disease of waterfowl caused by the herpes virus and kills many infected birds (Baldassarre and Bolen 2006). Urban geese often mingle with waterfowl outside urban areas and may spread diseases into the migrating population. Urban geese can create human health and safety concerns. Public beaches have been closed due to excessive fecal coliform levels that been attributed to

geese (Woodruff et al. 2004). Goose feces have been found to contain *Salmonella*, *Listeria*, and *Campylobacter*, which can be carried into drinking water supplies (Graczyk et al. 1998, Clark 2004). Heavy concentrations of goose droppings can cause eutrophication of lakes and reservoirs, as well as excessive algae growth; this, in turn, lowers water quality for other aquatic life (Clark 2004).

Populations of geese near airports create hazards, and Canada geese are ranked as the third-most-hazardous species involving collisions with aircraft (Dolbeer et al. 2000). From 1990-2005, geese were involved in 1,279 strikes with civil aircraft and caused $395 million in damage (Cleary et al. 2006). Eschenfelder (2000) stated that currently there are no civil aircraft engines in existence that are certified to tolerate an impact with a bird the size of an adult Canada goose and continue operating.

Management of Canada geese is best accomplished using a variety of tools and techniques. Killing geese is often viewed as unacceptable in many urban communities; therefore, some communities look to non-lethal techniques, which can be more socially acceptable to the public. However, some non-lethal techniques have little or no effect. These include the use of dead goose decoys (Seamans and Bernhardt 2004), plastic alligator heads, coyote effigies, scary-eye balloons, swans, and distress calls (Mott and Timbrook 1988, Aguilera et al. 1991). Some techniques do work to alleviate problems for several weeks or months, including chemical repellents (Cummings et al. 1992, 1995; Dolbeer et al. 1998), gridwires, propane cannons, and mylar tape (Smith et. al. 1999). Natural and artificial barriers can reduce access to certain areas by geese and limit geese numbers in defined areas during the molt (Gosser et al. 1997). Recently, an integrated hazing approach using pyrotechnics, dogs, and lasers has become a popular method of deterring geese from a site (Castelli and Sleggs 2000, Swift 2000, York et al. 2000, Holevinski et al. 2007). Hazing involves continuously harassing geese until they leave the site, using one or more scare tactics. Translocation (capture and transfer programs) was popular in the past, but very few states remain willing to accept more geese. Many states including New York now prohibit translocation, due to concerns associated with the spread of avian diseases. Avian contraceptives are being developed, but results have varied (Bynum et al. 2005, VerCauteren and Marks 2003). One long-term management approach to reduce goose populations and the associated damage is egg oiling. This technique is often endorsed as a non-lethal form of control, when in fact it is a form of lethal control. Other population management techniques to reduce local goose populations include capture-and-euthanize programs, most often conducted during the goose molting period, and implementation of hunting seasons that target resident geese. These lethal approaches, in conjunction with habitat modification, may lower local populations (Gosser et al. 1997, Cooper 1998).

There are an estimated 249,702 resident geese in New York state (USFWS 2007). From 1 Jan. 2004 to 31 Jan. 2006, there were 206 newspaper articles covering urban goose issues in 30 newspapers throughout NY. In 1996, there were 30 Canada goose depredation permits issued by the U.S. Fish and Wildlife Service in New York; by 2006 that number had increased to 337 (USFWS 2008).

We examined the efficacy of an integrated goose management program that included egg oiling and the use of border collies, remote-controlled boats, kayaks, and pyrotechnics to chase resident Canada geese from parks in Orange County, New York communities that did not want to conduct "roundups" (capture-and-euthanize programs) or were unable or unwilling to implement limited shooting programs. To monitor and document reduction in damage, we conducted a standard fecal count survey of goose droppings at managed and unmanaged sites to determine if the program was reducing the number of droppings and associated conflicts. Our goals were: 1) to test a resident Canada goose management program that could be recommended to communities to reduce goose population to a more acceptable level, and 2) to determine if the implementation of a standardized droppings count could provide a suitable index to on site goose populations and damage reduction.

Study Area

This study was conducted at 11 locations in Orange County, NY. Orange County is located in the lower Hudson Valley of New York on the west side of the Hudson River and is 80 km north of New York City. Orange County borders both Pennsylvania and New Jersey and measures 211,343 ha, with more than 35,000 ha of parkland. Eighteen percent of county land is in agriculture. The landscape is primarily suburban-residential, interspersed with areas devoted to agricultural production. The human population is estimated at 359,089, with people living primarily in several densely populated urban centers bordering large tracts of undeveloped lands. Orange County has a history of urban goose conflicts, and in 2005 the Orange County Parks and Recreation Department had begun making inquiries to various wildlife management agencies about establishing a county-wide program to manage geese at locations that were had documented goose complaints on both public and private properties.

We identified 11 sites as high human-goose conflict areas, based on conversations with the Commissioner of Parks, town officials, and on records of public complaints. The high priority sites included 1) Mill Pond, located in Monroe, NY (a village park and a 3.2-ha pond with a bike path); 2) Twin Lakes, located just outside the town of Monroe (10.66 ha in size, used as a water-ski school); 3) Thomas Bull Memorial Park, just outside of Middletown (has an 18-hole golf course with approximately 28 ha of day-use area, including 2 ball fields and extensive lawns; it has a 2.4-ha fishing pond as well as 4 smaller ponds on the golf course, and it borders the Walkill River); 4) Silver Lake (a 13.7-ha lake, with a condominium complex on the south side and an assisted living center on the west side); 5) Alder Pond (a18-ha floral supply distribution center, with a 0.2-ha pond0; 6) Algonquin Park, located in the City of Newburgh (a 17-ha park with a 0.4-ha pond and a large picnic area) 7) Mary Harriman Park (a small urban park located in the

town of Woodbury, containing a 2.4-ha pond surrounded by 2 baseball fields and a roller hockey rink); 8) Union Hall, located at the Laborers International Union in Newburgh (has 40 ha of woods and large lawns, with 0.7-ha and 0.2-ha ponds); 9) Washington Lake (a 61-ha lake that is reservoir for the City of Newburgh; it has a picnic area and is considered a trophy bass management area for veterans and people with disabilities); 10) Northeast Business Center–Grainger Building (a large, 85-ha distribution center, located adjacent to Stewart International Airport, with 3 retention ponds of 0.4, 0.3, and 1.5 ha in size); and 11) Newburgh Auto Park (a car dealership located on Route 17K in Newburgh, with 69 ha of lawns as well as two 0.4-ha retention ponds).

METHODS

Egg Oiling

Egg oiling was conducted to stabilize goose populations on all managed study sites that had nesting geese. Oiling eggs also facilitates summer and fall hazing programs by reducing the number of goslings present, which otherwise promote a stronger site fidelity for breeding adults and result in a larger number of geese producing droppings. In 2004, 2005, and 2006, trained volunteers assisted with egg oiling programs. Volunteers and county and town park employees attended a 2-hour training session that provided them with a background on goose biology, how to properly oil nests, and how to safely interact with nesting geese. During 2004, 29 people were trained, and in 2005 18 people were trained. No additional training sessions were held in 2006. Nest searches began in late March and two person teams searched an area once per week for 3 weeks. Nests were flagged and the eggs were marked with a permanent black marker, coated with corn oil, and returned to the nest. After a 1-week period, nests were treated again to ensure that the entire clutch had been oiled and that the adults were continuing incubation. Nests were visited a third time to remove treated eggs and checked to ensure that no renesting had occurred. Egg oiling took place from 6 April to 25 April 2004, 15 April to 2 May 2005, and 4 April to 20 April 2006.

Capture and Banding

In late June and early July 2004 and 2005, we used drive traps to capture a total of 174 adult geese and 38 juvenile geese during the summer molt. All geese were sexed, aged, and fitted with standard aluminum U.S. Fish and Wildlife Service leg bands. Yellow alpha-numeric auxiliary neck bands were also placed on 88 adult geese. The location of collared geese was recorded, as well as associated flock size at study sites or other locations within the study area.

Nuisance Abatement

A border collie was obtained through a trainer who specialized in training dogs to herd geese. From 24 May to 10 November 2004, 25 May to 24 October 2005, and 16 May to 3 November 2006, Monday through Friday, trained border collies were used to scare geese out of Union Hall, Mill Pond, Algonquin Pond, Thomas Bull Park, and Mary Harriman Park. Harassment sessions lasted until the geese had left the site, and they occurred at random times throughout the day. Sites were visited multiple times per day. Geese were harassed throughout the molt period to ensure that flighted geese were not loafing with molted geese, and geese searching for molting sites from points further south did not use these locations. The dog stalked geese on land until they flew away or entered the water. The dog was then sent into the water and further stalked geese until they flew away. In some cases, geese were herded off high-impact/high-conflict properties to areas considered to have low-impact/low-conflict potential. Washington Lake, Newburgh Auto Park, and Grainger were identified as experimental control sites, where no harassment or other management was conducted.

In conjunction with the trained border collie, we used 2 electric remote-controlled model boats (Aquacraft Hammer, and Traxxas Villian) powered by 7.2-volt 6-cell rechargeable batteries to harass the geese that flew into the water. The Aquacraft Hammer was dark blue in color 24 inches long, and had an average speed of 20 mph. The Traxxas Villian was white, 31 inches long, and had an average speed of about 25 mph. Both boats had a run time of approximately 15 minutes before batteries needed recharging. The range on the boats was about 250 yards from the remote-control unit.

In larger bodies of water, a 1-person kayak was used to assist the border collie. The kayak was used to chase geese, block swimming routes, or to pose as a threatening presence. Pyrotechnics were used in areas where it was difficult for the dog and remote-controlled boats to penetrate dense aquatic vegetation. Lasers were also used at dawn and dusk at 2 treatment sites to haze geese from roosting sites.

Program Monitoring

Standardized fecal counts were conducted at 5 treatment and 3 control sites. At each site, one 100 × 2-meter transect was set up and delineated with spray paint. Within each transect, goose droppings ≥1.3 cm were counted, and then the area was raked clean. Counts were conducted on Monday and Thursday of each week, from 27 May to 10 November 2004, 23 May to 10 October 2005, and 19 May to 2 November 2006. Total fecal counts were standardized to droppings per day per m, using the number of preceding days since the last count.

The number of droppings counted per day per m was compared between years within treatments using Kruskal-Wallace one-way analysis of variance, because data did not meet the assumption for normality (Zar 1984). Then number of geese observed was compared between years within treatments using Kruskal-Wallace one-way analysis of variance. Treated and control sites were not compared, because the sites could not be considered as independent sites because of documented interchange of geese among sites.

RESULTS

Nuisance Abatement

During 2004, we hazed geese on 73 days in Orange County, from 24 May to 10 November, and made 364 site visits ($\bar{x}$ = 1.2 visit/day), hazing an average 175 geese

/day. The border collie and remote-controlled boat combination was used in 70% of 189 events and removed all geese on site 72% of the time. The border collie alone was used in 11% of 189 events and removed all geese on site 70% of the time. We documented 12,800 goose flights (sum of geese in all flocks chased) out of parks. No geese were present at a treatment site on 22 visits.

During 2005, geese were hazed on 86 days, from 19 May to 29 October 2005, with an average of 109 geese hazed/day (-37% compared to 2004). The border collie/ remote-controlled boat combination was used on 28% of 239 events and removed all geese 62 % of the time. The border collie alone was used on 53% of 239 events and removed all geese on site 68% of the time. Sites were visited 516 times, and we documented 9,432 goose flights out of parks. No geese were present at a treatment sites on 130 visits.

During 2006, geese were hazed on 106 days, from 11 May to 3 November, with an average of 78 geese hazed/day (-28% compared to 2005). We visited parks 786 times ($\bar{x}$ = 2.5 visits/day). The collie and remote-controlled boat combination was used in 31% of 271 events and removed all geese on site 92% of the time. The border collie alone was used in 25% of 271 events and removed all geese on site 79% of the time. We documented 8,297 goose flights out of the parks. No geese were present at a treatment site on 475 visits.

Population Stabilization

Nest searches were conducted and eggs oiled for all 3 years of the project. Nest searches took anywhere from 2 to 8 hours to complete depending on the size of the location. During each visit, all eggs located were oiled, even if they had already been oiled on previous site visits. For each year, only the highest number of nests and eggs are reported. On 6 April, 15 April, and 26 April 2004, a total of 299 eggs from 65 nests were oiled during 3 visits to Orange County. Eggs were treated at control sites and adjacent wetlands only. Sites were monitored from May to June 2004, and 160 goslings were observed at treatment sites. During the following year, at the request of the county, all locations were searched for nests as well as adjacent wetlands. From 15 April to 2 May 2005, 404 eggs from 72 nests were oiled. Monitoring of all oiled sites found 35 goslings. A total of 473 eggs from 92 nests were oiled from 4 April to 20 April 2006. A total of 24 goslings were observed at oiled sites. Only the highest number of goslings observed at each site was recorded. There were no goslings observed on Mill Pond or Thomas Bull in 2006**.**

Harassment

The mean number of geese observed at managed sites was documented on days when fecal counts were conducted. The mean number of Canada geese observed at managed sites decreased (T = 357.9, P < 0.01) each year of the study. The mean number of geese at unmanaged sites remained stable (T = 3.35, P = 0.18) during the study period.

During 2004, we found that geese responded to being chased by the border collie by flying into the water. The dog was subsequently sent into the water to continue the chase. In some instances, it took up to 45 minutes for the geese to leave the water and the site. Using the remote-controlled boat without the dog resulted in geese leaving the water and running up on shore, but did not result in them flying away from the site. The combination of border collie and remote-controlled boat together was the most effective combination used. With this combination, all geese were removed from a site during 72% of 189 events in 2004. After the molt, the same combination removed all the geese in 95% of 111 events. Use of the border collie and remote-controlled boat reduced the goose population at the managed sites by 71% during the first month of use. The average amount of time required to clear a site of geese was 33 minutes.

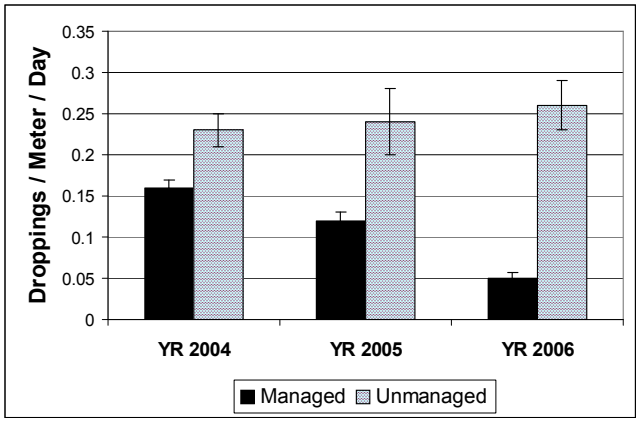

Figure 1. The mean number of Canada goose droppings counted along 100-meter transects at managed and unmanaged sites in Orange County, NY.

Fecal Counts

The mean number of Canada goose droppings at managed sites decreased (T = 56.6, P < 0.01) each year while unmanaged site counts remained stable (T = 0.23, P = 0.89) (Figure 1).

Marked Geese

While no standardized route was driven to document collared geese, collared geese observations were made while driving and working throughout the study area on a daily basis. Only 2 geese were observed from those collared at Chadwick Lake (n = 10) during the 3-year study. Also, geese collared at Twin Lakes were seldom observed during the study. Band return data showed that many of these geese were likely molt migrants from Long Island and Pennsylvania. In 2004, collar observations were made from 28 June to 10 November; during that period, collared geese from Algonquin Park were observed on 298 occasions at managed sites where they were chased away 5-13 times each (mean = 9.25, n = 21). The same geese were observed 159 times at unmanaged sites.

During 2005, collar observations were made from 18 May to 28 October. An additional 30 geese were collared at Washington Lake on 8 July 2005. Collared geese were observed on 137 occasions at managed locations, and 231 times at unmanaged sites. Collared

geese from Algonquin Park were chased away 1-16 times each (mean = 5.2, n = 24). Six collars from Washington Lake appeared at Algonquin Park, a distance of 3.9 km, and were chased away once and not observed at Algonquin Park for the remainder of the year.

In 2006, collar observations were made from 11 May to 30 November. Collared geese were observed on 66 occasions at managed sites, and 250 times at unmanaged sites. Collared geese from Algonquin were chased away 1-10 times each (mean = 2.7, n = 16). Over the 3 years, there was a 78% reduction in the number of collared geese observed at managed sites, and a corresponding 57% increase in collared geese at unmanaged sites.

Collared geese were observed on the airfield of Stewart International Airport on 3 occasions and were associated with flocks of up to 20 geese. Collared geese were frequently observed at unmanaged locations around Newburgh. The furthest movement recorded by geese within the study area was 3.9 km and was made by geese moving from Washington Lake to Grainger. The furthest movement outside the study was of a goose banded in Newburgh and hunter harvested 632 km away near Quebec City, Canada, in 2005.

During the course of this study, 7.5% of the banded geese were hunter harvested, with band returns coming from New York (8), Pennsylvania (4), Maryland (2), and Delaware (1).

Program Costs

Funds for the 3 years of this study were provided through a Congressional directive. Material costs were $7,500, which included the purchase of a trained border collie, 2 remote-controlled boats and batteries, a battery charger, kayak, life vests, and miscellaneous items. The salary for one person to harass geese from the 5 locations, visiting each site 3 times per day, 5 days per week for 8 months, was $32,000.

DISCUSSION

Management of nuisance geese on private and public land has spawned a new industry that uses border collies as a management tool. The success of these companies suggests that few people and communities are willing to use lethal methods to control Canada goose populations. Unfortunately, the same property owners and communities are surprised at the amount of effort involved; typically, multiple visits are required per day several days a week, and our research showed that the same flock of geese may have to be chased away up to 21 times during the season. Some locations required up to 5 hours of harassment per visit, as the geese would fly from one extreme end of the park to the other. The goal is to get the geese to leave the site entirely, and in these situations, moving geese is physically demanding work, as a person constantly had to stay with them and keep them moving to encourage them to leave.

Several of the locations we worked with did not have the funds necessary to hire a staff member to chase geese, or they were concerned about purchasing and housing a dog and acquiring all the materials necessary to perform the work. Our research showed that the collared geese would return to the parks in the spring after ice-off, and the whole process would start again. That is why a multi-year budget is needed to accomplish management objectives.

A key element to successfully hazing geese from specific locations can be attributed to the reduction of goslings from the site, because adult geese defend their goslings and rarely abandoning them when threatened. Nest searches and egg oiling, which reduced the number of goslings, was enhanced by the participation of the local communities. The addition of 8 town employees and 18 park staff as well as the observations of the volunteers who attended the egg oiling training sessions allowed for more efficient and complete coverage of the areas.

As an example of the difficulty involved in moving adult geese with goslings, we highlight work done in July 2006 at Thomas Bull Park. We located a group of geese consisting of 6 adults, 22 goslings, and 1 domestic goose. The group was initially harassed for 65 minutes using a kayak and remote-controlled boat. The harassment was repeated the following day for the same duration. By the third day, this group had left the site and was not observed again that year. Pressuring flocks of geese in this manner caused the goslings to emit distress calls, which further distressed the adults. We believe this caused the adults to relocate broods to safer brood-rearing locations. The combination of egg oiling with harassment is an example of a successful integrated program, where one technique (oiling) reduced the necessity for another (harassment).

Holevinski et al. (2007) found that a remote-controlled boat and border collie combination removed greater then 90% of geese. Results would likely have been similar in this study had we not chosen to harass geese through the molt in 2004 and 2006. This was done because pressuring molted geese caused several of them to relocate to lower-impact areas within or near treatment sites. Castelli and Sleggs (2000) found that border collies successfully reduced geese at a corporate complex in New Jersey. At a nuisance/suburban site located in Rockland County, New York, Swift and Felegy (2000) experienced a >50% reduction of geese while conducting a similar study. During 2005 and 2006, the remote-controlled boat and border collie combination was used on 28% of all events. We believe this decreased in number of intervention was attributed to geese associating the dog with the remote-controlled boat and not attempting to land in water (53% of 239 events).

The collared goose data showed that geese did not move far from areas in which they were being hazed. For example, 16 geese collared at Algonquin in 2004 were hazed from the park 48 times in 2006. This shows a high site fidelity to an area from which they had been harassed for the past 3 years. Twelve of the 59 geese banded at Algonquin were observed at an unmanaged location 1.2 km away on 161 occasions in 2004. This is similar to findings by Holevinski et al. (2007) of hazed radio-marked geese moving an average of 1.18 km, at an urban site in Brighton, NY. Collared geese hazed in a Rockland County, NY study were observed <2 km from the hazing site (B. L. Swift, NYDEC, unpubl. data). While the number of geese utilizing the managed locations de-

creased, there was a corresponding increase in geese at unmanaged areas within 3 km of the managed locations. Hazing geese does not remove the problem flocks from the general area, but instead simply moves the targeted population to a nearby area, usually <2 km from the treatment sites. In some instances, those are low-impact areas, but often they are not.

Although geese were observed at all managed sites, fecal counts showed a gradual decrease in number of droppings over time, indicating that geese were spending less time loafing and foraging at those sites. The primary complaint of most communities experiencing goose damage is the accumulation of droppings. Using a combination of border collies and remote-controlled boats, we were able to significantly reduce the fecal load at management sites.

More than half of the geese collared in 2004 were still observed in 2006. This shows a high site fidelity to historic nesting and molting areas. Collared geese were readily observed throughout all management periods. A total of 57% of all collar observations occurred at the Newburgh Autopark, a site that was not managed and that was considered a low-impact site because it consisted of a large field and pond that was only used during car shows and sales events. This suggests that geese were learning to avoid the treatment sites during the day. Based on the decrease in the number of droppings documented during fecal counts, this avoidance likely continued throughout times when we were not on site harassing the geese.

Management Implications

It is unlikely that any park, town, community, or golf course will completely eliminate geese, even seasonally. However, adhering to and budgeting for a multi-year management plan will markedly reduce the conflicts created by Canada geese over time. The findings of this study were similar to previous research examining the use of border collies, remote-controlled boats, and lasers as tools to disperse geese from a location (Holevinski et al. 2007). This study documented the effectiveness and advantages associated with implementation of an integrated Canada goose management program using remote-controlled boats, dogs, kayaks and pyrotechnics in reducing the problem of site-specific goose overabundance and droppings. The disadvantages of this type of program are that it may be too costly or not cost-effective for some communities, and many times it moves the geese only short distances. The relocated geese may cause similar conflicts on nearby properties or can cause human health and safety issues at airports or freshwater reservoirs. Harassment programs of any type are not recommended in areas within 3 miles of an airport, due to the safety concerns of repeatedly forcing geese into the air in the vicinity of airplane approach routes (Baxter and Robinson 2007). Holevinski et al. (2007) found that hazing alone is unlikely to reduce nuisance goose populations in a community. Programs conducting egg oiling and hazing techniques are becoming more common as the nuisance goose problem increases. However, in order to stabilize the resident Canada goose populations in the 4 flyways at the current population level, 787,000 nests would have to be removed (or treated to prevent hatching) annually for the next 10 years (Federal Register 2006).

Private landowners and communities should consider managing their nuisance geese through population reduction and organized hunting programs where practical. Reducing the adult goose population could bring overall goose numbers to more manageable levels and states in the Atlantic Flyway are shifting hunting seasons to specifically target resident goose populations. In urban and suburban areas, harassment programs or round-ups may be the only management options available, with harassment programs the least cost effective management option because of the duration of time and labor required to keep the geese away for any period of time. Communities should also recognize that by allowing nuisance populations to grow, migratory populations of geese are negatively impacted at breeding locations in northern Canada, as a result of competition for food resources. Nuisance geese that have a failed nesting often undertake molt migrations into Canada. The influx of those molt migrant geese results in lower gosling survival and lower body weights in migratory geese (Ankney 1996). Our study showed that fecal counts could be used as an index to measure success of a harassment program, and that harassing geese with remote-controlled boats and border collies was an effective method to reduce populations of nuisance geese on individual sites.

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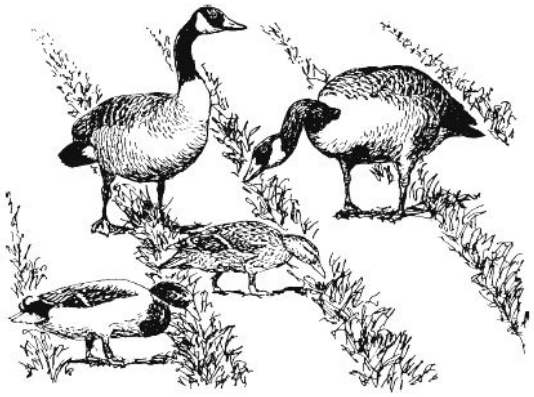

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Population Ecology

Demographics of Canada Geese Introduced in Western Colorado

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ABSTRACT Breeding populations of Canada geese (*Branta canadensis*) were established throughout western Colorado during 1955–1988 using geese transplanted from other areas. Subsequently, there has been no assessment of demographics and winter distributions on these local populations. Managers need this information to effectively manage breeding populations of Canada geese to provide publics with recreational opportunities and to reduce human-goose conflicts in western Colorado, particularly for segments of internationally recognized populations with cooperative management plans. We conducted a band recovery study during 2000–2006 to assess demographics and winter distributions of Canada geese breeding in 7 subareas of western Colorado. Cooperators banded 19,189 geese during June and early July. We recaptured 5,185 of these geese 1–4 times during banding operations in subsequent years and most (97%) were recaptured in the subarea of banding the year after banding. We obtained 2,921 useable band recoveries through May 2007, and most (98%) recoveries were a result of either being shot or found dead during hunting season. Direct band recoveries (<1 year after banding) were recovered almost exclusively in Colorado (87%) and New Mexico (12%), and indirect band recoveries (≥1 year after banding) showed similar distribution (73% in Colorado and 16% in New Mexico). Geese in subareas of western Colorado had different recovery distributions, and contributed to 4 wintering concentrations of Canada geese in western and central Colorado and New Mexico. Annual survival probability for adult geese was 0.864 ± 0.012. The survival probability for juvenile geese was 0.503 ± 0.026, but we did find evidence that this estimate may be biased low. We used the band reporting probability of 0.525 ± 0.071 to derive harvest rates from band recovery rates. Harvest rate was 0.128 ± 0.018 for adult geese and 0.169 ± 0.024 for juvenile geese. Survival probability was lesser and harvest rate greater for the 3 western subareas (Western Plateau) compared to the 4 eastern subareas (Rocky Mountains). Our results suggest that Canada geese that breed and molt in western Colorado have high survival probability and are largely non-migratory with some movement in winter from high to low elevation areas primarily in Colorado. To effectively manage the growing resident goose population in western Colorado, managers may need to increase harvest rates for these geese. © 2014 The Wildlife Society.

KEY WORDS band, band recovery, *Branta canadensis moffitti*, Canada goose, Hi-line population, introduced, Rocky Mountain population, survival, transplant, western Canada goose, western Colorado.

Significant changes in the number and distribution of Canada geese (*Branta canadensis*) have occurred in Colorado since the Colorado Division of Parks and Wildlife (CDPW) initiated a transplant program in 1953. Canada geese historically nested, and in some cases wintered, in the intermountain basins or parks and possibly on the plains east of the Rocky Mountains in Colorado, but were extirpated at an early date after settlement by Europeans (Szymczak 1975). In the 1950s, Colorado had 1 native breeding population of Canada geese located in the northwest corner of the state along the Yampa, Green, and Little Snake rivers and 1 winter concentration located in the southeast corner of the state primarily in the Arkansas Valley (Colorado Game, Fish, and Parks Department 1967, Szymczak 1975, Colorado Division of Wildlife 1989). Another group migrated through Colorado along the eastern side of the Rocky Mountains between wintering and breeding ranges. A few non-migratory Canada geese existed in the Denver area, which originated from captive decoy flocks liberated in the 1930s (Rutherford 1967).

After the completion of a statewide habitat suitability study (Szymczak 1975), the first Canada goose transplants (primarily juveniles during Jun and Jul) were released in the San Luis Valley, North Park, and north central Colorado during 1956–1957, all east of the Continental Divide. A concerted effort was made in 1957–1967 to build the breeding population in north central Colorado (Fort Collins area), which would supply stock for transplants into other areas in western and central Colorado east of the Continental Divide beginning in 1967. Geese transplanted from outside Colorado were obtained from other United States breeding

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populations in the Central Flyway and likely represented 3 races of large Canada geese including western (*B. c. moffitti*), giant (*B. c. maxima*), and interior (*B. c. interior*). Canada geese were transplanted west of the Continental Divide from native stocks in northwest Colorado beginning in 1967. The last geese to be transplanted in Colorado were in 1974 east of the Continental Divide and 1988 west of the Divide.

The Colorado transplant program resulted in the successful establishment of breeding Canada geese throughout western and north central Colorado. The CDPW implemented various area closures, limited permit hunting seasons, and special area limited goose seasons to restrict goose harvest while populations were being established. By the mid 1990s, increasing numbers of Canada geese inspired elimination of some harvest restrictions. The CDPW eliminated the last limited permit hunting season in 1997 and the last special area goose season in 2000, which resulted in a single uniform goose season on each side of the Continental Divide. Thus, the season length was 107 days, the maximum allowed by the United States Migratory Bird Treaty Act, and in 2002 the daily bag limit was increased from 2 to 3 geese for all of western Colorado, the maximum allowed by federal frameworks.

United States resident Canada goose populations (geese that nest or reside predominately within the conterminous United States during Mar–Aug) have become overabundant in some locations in Colorado and throughout the United States (U.S. Fish and Wildlife Service 2005). The United States Fish and Wildlife Service authorized special hunting seasons in September to specifically target overabundant resident Canada geese. The first September goose season in Colorado was in Middle Park during 2002 and was expanded to include the entire Pacific Flyway portion of Colorado in 2003. Also in 2002, CDPW implemented the use of a federal permit to ameliorate problems caused by breeding Canada geese. This allowed for the treating of goose eggs, through oiling or addling, at sites where nesting geese cause nuisance problems or are otherwise undesirable (e.g., golf courses, city parks, back yards). The United States Fish and Wildlife Service completed an environmental impact statement in November 2005 that identified additional options for state wildlife management agencies to help control populations of resident Canada geese (U.S. Fish and Wildlife Service 2005).

Harvest management of Canada geese in western Colorado is especially challenging because these geese are part of 2 internationally recognized populations that occur in both the Pacific and Central flyways. Canada geese breeding or migrating through western Colorado are segments of the Rocky Mountain Population (RMP) west of the Continental Divide and Hi-line Population (HP) east of the Continental Divide (Bellrose 1980, Krohn and Bizeau 1980, Central Flyway Council 1998, Pacific Flyway Council 2001). The RMP ranges from central Alberta south to southern California, Arizona, and northwest New Mexico. The HP ranges from central-west Saskatchewan and central-east Alberta south across central Montana, Wyoming, and Colorado into central New Mexico. Both populations comprise the large western race, but the HP also includes birds with characteristics similar to the giant race. The RMP is considered migratory, whereas the HP is considered to include both migratory and non-migratory segments. The Pacific and Central flyway management plans for the RMP and HP guide federal and state harvest management regulations based on the status of these continental populations on a flyway basis, although consideration is given to specific reference areas (Pacific Flyway Council 2001). Both management plans identify the need for additional information to better delineate continental populations and segments and to better assess distribution, derivation of harvest, harvest rates, and survival rates.

Little demographic information is available to inform management decisions as breeding populations of Canada geese in western Colorado have only recently become well established. Managers need demographic and winter distribution information to effectively manage Canada geese breeding and molting in western Colorado to provide publics with recreational opportunities and to reduce human-goose conflicts. Canada goose demographic information is also critical to gain support among managers in adjacent states and the Pacific and Central flyway Councils because Colorado management actions affect the status of continental populations and resulting harvest regulations specified in management plans. Furthermore, Canada goose demographic information is necessary to justify management options afforded under the United States Fish and Wildlife Service environmental impact statement for control of resident geese.

Our objectives were to determine band recovery distributions, recovery rates, harvest rates, and survival rates of Canada geese breeding in 7 subareas of western Colorado. We were particularly interested in determining the extent that harvest regulations can be applied to these geese locally while minimizing impacts to other areas in western Colorado and elsewhere. Thus, our focus was on spatial rather than temporal variation in demographics as harvest regulations were mostly unchanged in western Colorado for this study.

STUDY AREA

The study area consisted of that portion of Colorado west of the Rocky Mountain Front Range (herein referred to as western Colorado; Fig. 1). The Front Range separates the Southern Rocky Mountains and Western Plateau geomorphic regions from the eastern High Plains (Erickson and Smith 1985). Elevation of the study area ranged from 1,350 m to 4,350 m. Average annual precipitation in the study area ranged from $\leq$25 cm to $\geq$127 cm, and ambient temperatures averaged -16° C to 0° C in January and 7° C to 27° C in July. Vegetation types include park grasslands and sagebrush, desert shrubland, desert brushland, plateau sagebrush, plateau and foothills oakbrush, lower mountain woodlands, plateau and southern mountain woodlands, high mountain forests, and alpine meadows and grasslands (Erickson and Smith 1985).

We divided western Colorado into 7 contiguous subareas along county lines and the Continental Divide to separate the 4 mountain parks in the Southern Rocky Mountains

Figure 1. Canada goose banding locations within 7 subareas of western Colorado during 2000 2006.

region and the 3 major watersheds west of the mountain parks in the Western Plateau region (Fig. 1). The mountain park subareas were North Park, Middle Park, South Park, and the San Luis Valley. The western subareas were Northwest, West Central, and Southwest. Each subarea approximated boundaries of major watersheds. Middle Park, Northwest, West Central, and Southwest subareas were west of the Continental Divide (Pacific Flyway), whereas North Park, South Park, and San Luis Valley subareas were east of the Continental Divide (Central Flyway).

Trap sites within each subarea were wetlands where nesting and molting Canada geese were known to be most abundant as determined from annual observations of CDPW biologists and officers. Trap sites primarily included rivers and associated wetlands and natural and man-made reservoirs, lakes, and ponds. Lakes and reservoirs were primarily inhabited by molting geese, whereas ponds, rivers, and river-associated wetlands were primarily inhabited by brood rearing geese.

During 2000–2006, the Canada goose hunting season in western Colorado was generally consistent, except that in 2002 the daily bag and limit increased from 2 birds to 3 and in the Pacific Flyway portion of Colorado the season length increased 5 days to 107 to match the Central Flyway portion. Also, for the Pacific Flyway portion of Colorado, 9 days were shifted from the regular season and applied to a special early September season in 2002 (the special season applied only to Middle Park in 2002 and all of western Colorado beginning in 2003).

METHODS

Band and Recapture

We captured and banded Canada geese annually in June and early July during 2000–2006 in western Colorado. We banded geese only in the Middle Park subarea during 2000 and 2001, and then expanded banding to include all subareas during 2002–2006, with the exception that we did not band geese in South Park and Southwest subareas in 2002 because of forest fires. We trapped areas with significant numbers of geese ($\geq$ about 12 birds). We trapped Canada geese using a drive trap at 1–6 sites each day during 1–7 days in each of the 7 subareas, depending on annual abundance and distribution of nesting and molting Canada geese. The drive trap consisted of 2 plastic-netting fence lines arranged in a funnel shape with a holding pen at the end. Teams of pedestrians and kayakers herded molting, brood rearing, and juvenile geese into drive traps. We determined age class (local [hatching-year bird not yet capable of flight, hereafter HY] or after hatching year [AHY]) and sex for all geese captured

or recaptured by plumage and cloacal examination (Hanson 1962). We banded each goose on the right leg with an aluminum leg band (with a toll-free telephone number for reporting) following the protocol and techniques recommended by the Bird Banding Laboratory of the United States Geological Survey. We recorded each goose already banded as a recapture if it was banded prior to the current year. We recorded a bird recaptured more than once per year only on the initial recapture. We released all geese at the place of capture immediately after processing.

We cooperated in a national band reporting probability study for geese in 2005, where we banded 1,100 Canada geese according to the national study protocol. Half of the geese received a standard band (control) on the right leg, and the other half received a standard band on the right leg and a reward band on the left leg. The values of reward bands were $10, $20, $30, $50, and $100, and were used in equal number (110 bands each). We determined band retention rates in 2006 from reward-banded geese. We used a computer in the field to record recapture data; a program interactively checked each band number to determine validity and whether the bird should have a second band. We checked for band retention on all birds that should have had a second band.

Data Analysis

We obtained band recovery data from the United States Geological Survey's Bird Banding Laboratory (BBL) in spring 2013. We used band data from 2000 to 2006 and recoveries of these birds through May 2007. The band and recovery year was June through May spanning 2 calendar years and hereafter is referenced by the earlier year. We excluded any recoveries as a result of injury during banding operations and associated banding data. We coded recoveries as either direct (<1 year after banding) or indirect (≥1 year after banding). We used standard, control, and reward bands for analysis of apparent recapture rates and recovery distributions.

We used Burnham's model (both live-dead; Burnham 1993) in Program MARK (White and Burnham 1999) to estimate survival probability and other demographic parameters from band recapture and recovery data. We restricted data to 2002–2006 and excluded reward-banded geese from our analysis of survival probability because we banded only in 1 subarea prior to 2002 and reward bands are reported with different probability than standard bands (Nichols et al. 1991, Zimmerman et al. 2009*a*). Model parameters were

S_i = probability that a goose alive at the time of banding in year i is alive at the time of banding in year $i+1$ (survival probability);

p_i = probability that a goose present in the banding area at the time of banding in year i is recaptured at the time of banding in year $i+1$ (conditional recapture probability);

r_i = probability that a goose that dies during year i is found dead and its band reported to the BBL (Seber [1970] parameterization; reporting probability); and

F_i = probability that a goose present in the banding area at the time of banding in year i is also present in the banding area at the time of banding in year $i+1$, given that it is alive in year $i+1$ (conditional fidelity probability).

We constructed models to test our a priori hypotheses about population demographics considering age class, year, and subarea main effects in S_i, r_i, and F_i and year and subarea main effects in p_i. We pooled age classes for p_i because geese banded as HY birds were AHY birds at the first opportunity for recapture. We combined males and females after preliminary analyses revealed no difference between sexes and because this is a commonly recognized pattern in geese (Francis and Cooke 1992). We constructed models with 2 age classes (age2; HY and AHY), consistent with age classes recognized at time of banding, and models with 3 age classes (age3; HY, second year [SY], and after second year [ASY]), typically recognized for geese (Baldassarre and Bolen 1994:356). The 3-age-class model resulted in 4 age groups because only 2 age classes were recognized during banding (age3; HY, AHY, SY, and ASY). The SY geese were HY-banded geese 1 year after banding. The ASY geese were AHY-banded geese ≥1 year after banding and HY geese ≥2 years after banding. The AHY geese at banding were an unknown mix of SY and ASY adult geese. We also constructed models with 3 age classes, but where we combined SY and ASY classes (age3′; HY, AHY, SY = ASY) to test for a year of marking effect on survival probabilities. The AHY geese were adult geese the year of marking, whereas SY and ASY geese were adult geese ≥1 year post marking. Our most general model was S (age3, year, subarea), p (year, subarea), r (age3, year, subarea), and F (age3, year, subarea). Preliminary analyses revealed that fidelity probability was not estimable in many cases for models when age and year effects were included in fidelity probability. Thus, we were constrained to model fidelity probability without age class and year effects (i.e., only subarea effects). Consequently, our most general model was reduced to S (age3, year, subarea), p (year, subarea), r (age3, year, subarea), and F (subarea). We were primarily interested in estimating S; therefore, we constructed alternative models with all combinations of age class, year, and subarea main effects in S while retaining the general model structure for p, r, and F ($n = 8$). We expanded this model subset by considering all combinations of the 3 age classifications (age2, age3, and age3′) in S and r. We then took the best fitting model from this set and constructed additional models by eliminating ≥1 main effect from p, r, and F, although we expected these parameters would be age class-, year-, and subarea-specific.

We assessed model fit of our most general model quantitatively by estimating the variance inflation factor ($\hat{c}$) for extra binomial variation in the data using the median $\hat{c}$ estimator (White et al. 2001) in Program MARK, and qualitatively by adjusting $\hat{c}$ to determine the point at which model selection was influenced. We applied the quantitative estimate of $\hat{c}$ to adjust the variance of subsequent model estimates and model selection statistics. We based model selection on model fit and parsimony using Akaike's Information Criterion corrected for small sample size

(AIC_c; Burnham and Anderson 2002) and adjusted for overdispersion ($QAIC_c$).

We estimated the conditional band reporting probability (λ) by comparing the direct recovery rate of reward bands with that from control and standard bands deployed at the same banding location and time in 2005 (Sanders and Otis 2012). Information on band reporting probability was necessary to convert annual band recovery rates to harvest rates. We restricted the analysis to direct recoveries of AHY-banded geese shot or found dead during the hunting season. We note that λ is different than r in the Burnham model because r includes the probabilities of annual mortality, band recovery, and reporting, whereas λ is conditional on a banded goose being shot and retrieved (i.e., the probability of a person reporting the band once it is in hand). We estimated λ as

$$\lambda = \frac{f_{\text{Control}}}{f_{\text{Reward}}} \quad (1)$$

with variance

$$\text{Var}(\lambda) = \frac{\text{Var}(f_{\text{Control}})}{f^2_{\text{Reward}}} + \frac{f^2_{\text{Control}}\text{Var}(f_{\text{Reward}})}{f^4_{\text{Reward}}} \quad (2)$$

where

$$f_b = \frac{m_b}{R_b}, \quad (3)$$

$$\text{Var}(f_b) = \frac{f_b(1 \quad f_b)}{R_b}, \quad (4)$$

f_b is the direct band recovery rate of band type b, m_b is the number of direct recoveries of band type b, and R_b is the number of birds released of band type b. We expected reporting rates to be 100% for reward bands with $\geq$\$50 value (Nichols et al. 1991, Royle and Garretson 2005, Zimmerman et al. 2009*a*). We calculated direct recovery rates for reward bands with $\geq$\$50 value separately from those with $\leq$\$30 value to determine if band reporting probability decreased with reward band value.

We estimated the mean annual harvest rate (h) for each age class and subarea from the direct recovery rates (f, Equations 3 and 4) of geese banded with control and standard bands during 2000–2006 and shot or found dead during the hunting season divided by the conditional band reporting probability (λ). We derived the approximate variance of h (Var(h)) using Equation 2 with substitutions as appropriate, that is, $\lambda \rightarrow h$, $f_{\text{Reward}} \rightarrow \lambda$, $f_{\text{Control}} \rightarrow f$, $\text{Var}(f_{\text{Reward}}) \rightarrow \text{Var}(\lambda)$, and $\text{Var}(f_{\text{Control}}) \rightarrow \text{Var}(f)$.

RESULTS

Bandings

Cooperators banded 19,189 (18,639 with a standard or control band) Canada geese in June and early July in western Colorado during 2000–2006 (Table 1). Composition of the sample was 20% HY birds and 80% AHY birds, with 50% each of males and females. In 2005, 1,100 of these birds were banded in cooperation with a national reward band study: 550 received a control band and 550 received a reward and standard band. Reward and control bands were deployed in North Park ($n = 121$ of each type), South Park ($n = 166$), San Luis Valley ($n = 63$), and West Central ($n = 200$) subareas. By 2006, the percentage of AHY Canada geese captured that were previously banded during this study totaled 48% but varied among subarea from 35% to 75%.

We trapped opportunistically depending on goose distribution at 102 different wetland trap sites during the 7-year study. Of the 102 trap sites, 35 were considered molting areas where $\geq$89% of the birds trapped at each site were AHY birds, and 67 were considered brood rearing areas where $\leq$80% of the birds trapped at each site were AHY birds. In total, 14,483 geese (4% HY, 96% AHY) were trapped at molt trap sites and 4,706 geese (69% HY, 31% AHY) were trapped at brood rearing trap sites.

Recaptures

We recaptured 5,185 geese banded in western Colorado in 2000–2005, 1–4 times each for a total of 7,089 (6,922 with a standard or control band) recaptures during banding operations in 2001–2006 (Table 1). Of the unique recaptured geese, 97% of the recaptured geese were recaptured in the subarea of banding 1 year after banding and 94% were recaptured in the subarea of banding >1 year after banding. Unique recaptured HY geese were only somewhat less likely to be recaptured than AHY geese in the subarea of banding 1 year after banding (HY = 88%, AHY = 98%), but this disparity increased >1 year after banding (HY = 79%, AHY = 97%). Although recaptured HY and AHY geese had high apparent fidelity rates to subareas of banding, few (34%) were recaptured. We recaptured only 17% of the HY-banded geese compared to 38% for AHY-banded geese. These recapture rates dropped to 10% for HY geese and 28%

Table 1. Summary of band, recapture, and recovery information for hatching year (HY) and after hatching year (AHY) Canada geese leg banded with a standard or control band in June and early July in western Colorado during 2000 2006 and recovered through May 2007 by banding subarea. The sample occasion was 1 June through 31 May, referenced by the earlier calendar year.

Subarea	Years	Occasions	Banded	Recaptured	Recovered
Northwest	2002 2006	5	421	49	108
West central	2002 2006	5	4,791	1,168	993
Southwest	2003 2006	4	1,130	205	196
North Park	2002 2006	5	5,974	2,954	792
Middle Park	2000 2006	7	1,483	407	224
South Park	2003 2006	4	2,876	970	293
San Luis Valley	2002 2006	5	1,964	1,169	221
Total	2000 2006	7	18,639	6,922	2,827

for AHY geese considering recaptures only the first year after banding. This suggests that HY geese were less likely to be recaptured than AHY birds, possibly because of differences in distribution the year after banding or low survival probability. An additional 86 Canada geese were recaptured that were not banded as part of our study: 57 from western Colorado (banded 1981–1996), 10 from Utah (banded 1995–2004), 10 from the Front Range in central Colorado (banded in 2003–2005), 7 from Wyoming (banded 1989–2005), 1 from Massachusetts (banded 2000), and 1 from Quebec, Canada (banded 2003).

In 2006, we recaptured 167 (30%) of the Canada geese fit with both a reward and standard band in 2005. Additionally, we recaptured 2 reward-banded birds banded in Wyoming and learned of 1 reward-banded goose from our study that was recaptured in central Colorado. Of these 170 double-banded birds, 4 had lost their reward band representing a 1-year retention rate of 97.6%, whereas none of the birds had lost their standard band (1-year retention = 100%).

Recoveries

We obtained 2,921 (2,827 with a standard or control band) useable (5 were unusable because of unknown month of recovery) band recoveries from Canada geese banded in June and early July in western Colorado during 2000–2006 (Table 1). Most (98%) recoveries were a result of geese either shot (2,838) or found dead (36) during hunting season. However, some (47, 2%) recoveries occurred outside the hunting season and were a result of being found (31), motor vehicle strike (5), wire or tower strike (3), or unreported cause of mortality (8). Only 8 of the 31 found dead recoveries occurred during June–August, either during or immediately after banding operations, but all were HY birds. Thus, there was little evidence of mortality immediately after banding operations.

The direct hunter recovery rate of reward-banded geese (AHY) was 0.118 ± 0.014 (mean $\pm$ SE) based on 550 geese banded and 65 recovered. Band recovery rates did not decrease with decreasing reward value; the recovery rate for reward values $\geq$\$50 was 0.114 ± 0.021, whereas the recovery rate for reward values $\leq$\$30 was 0.121 ± 0.018. The direct hunter recovery rate of control- and standard-banded geese (AHY) marked at the same banding locations and times as reward-banded geese was 0.062 ± 0.004 based on 3,303 geese banded and 205 recovered. Thus, band reporting probability was 0.525 ± 0.071 for control and standard bands.

The mean annual direct recovery rate in western Colorado was greater for HY geese than for AHY geese; however, the HY recovery rate was less than the AHY recovery rate in 4 of 7 subareas (Table 2). Harvest rates were 0.169 ± 0.024 for HY geese and 0.128 ± 0.018 for AHY geese. Harvest rates varied by subarea, and were greater in the 3 western subareas (Western Plateau) compared to in the 4 eastern subareas (Rocky Mountains) for HY (0.215 ± 0.031 vs. 0.094 ± 0.017) and AHY (0.190 ± 0.027 vs. 0.105 ± 0.015) geese (Fig. 2).

Recovery Distributions

Direct and indirect recovery distributions were similar for both HY- and AHY-banded geese (Fig. 3). Ninety-nine percent of direct band recoveries were recovered in Colorado (87%) and New Mexico (12%; Table 3). Similarly, 89% of indirect band recoveries were recovered in Colorado (73%) and New Mexico (16%; Table 4). Only 7.7% of the direct and 15.6% of the indirect Colorado recoveries were east of western Colorado and all of those were in central Colorado along the east side of the Rocky Mountain Front Range. New Mexico recoveries were in the northwestern corner of the state associated with the San Juan River near Farmington and in the central part of the state along the eastern side of the Front Range and included Bosque del Apache National Wildlife Refuge near Socorro and Bitter Lake National Wildlife Refuge near Roswell.

Band recovery distributions from each banding subarea were primarily in the subarea of banding or immediately south in 1 of 3 concentration areas in western Colorado: West Central, Southwest, and San Luis Valley subareas (Fig. 4). Geese banded in the 3 westernmost subareas, all west of the Continental Divide, were primarily recovered in the West Central and Southwest subareas. Geese banded in the 4 mountain park subareas, mostly east of the Continental Divide, were primarily recovered in the San Luis Valley subarea. Some geese from the mountain parks were recovered in a known wintering area along the Front Range in central Colorado and New Mexico.

Geese banded in the mountain park subareas, particularly North Park, had the widest band recovery distributions including both sides of the Continental Divide (Fig. 4). Canada geese banded in North Park, South Park, and San

Table 2. Direct hunter recovery rates (f) for hatching year (HY) and after hatching year (AHY) Canada geese leg banded with a standard or control band in June and early July in western Colorado during 2000 2006 by banding subarea (NW Northwest, WC West Central, SW Southwest, NP North Park, MP Middle Park, SP South Park, and SLV San Luis Valley).

	HY				AHY			
Subarea	Banded	Recovered	f	SE (f)	Banded	Recovered	f	SE (f)
NW	312	35	0.112	0.018	109	15	0.138	0.033
WC	1,570	203	0.129	0.008	3,221	325	0.101	0.005
SW	557	37	0.066	0.011	573	49	0.086	0.012
NP	447	29	0.065	0.012	5,527	322	0.058	0.003
MP	475	18	0.038	0.009	1,008	74	0.073	0.008
SP	119	3	0.025	0.014	2,757	147	0.053	0.004
SLV	423	22	0.052	0.011	1,541	55	0.036	0.005
All	3,903	347	0.089	0.005	14,736	987	0.067	0.002

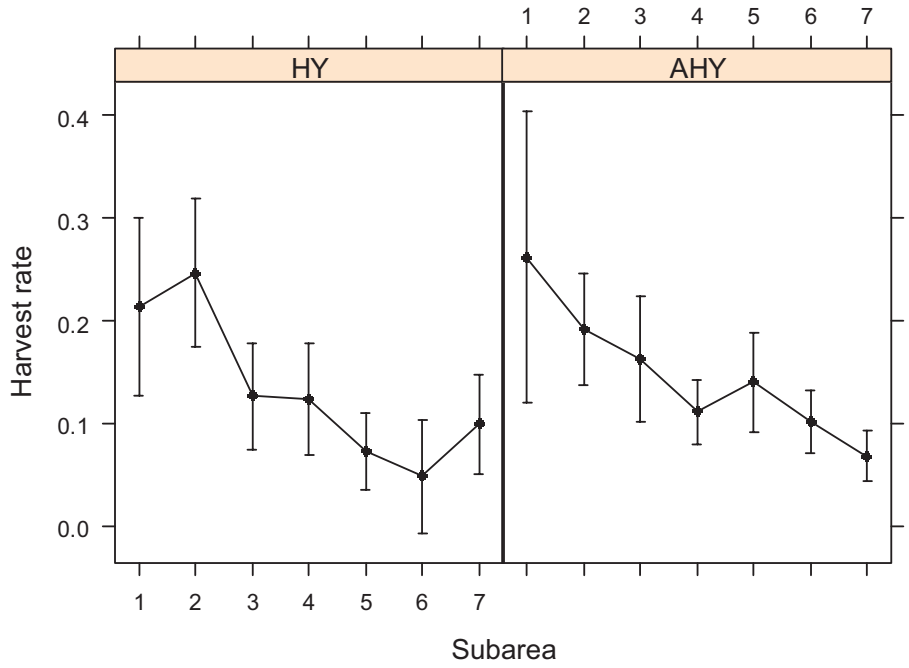

Figure 2. Annual harvest rate for hatching year (HY) and after hatching year (AHY) Canada geese leg banded in June and early July in western Colorado during 2002 2006 by banding subarea (1 Northwest, 2 West Central, 3 Southwest, 4 North Park, 5 Middle Park, 6 South Park, and 7 San Luis Valley).

Luis Valley subareas were mostly (95%, 97%, and 87%, respectively) AHY geese in molting concentration areas compared to other subareas that had only 34–75% AHY geese.

Demographic Parameters

Goodness-of-fit test statistics indicated a lack of fit of our most general model in that data were overdispersed. The estimated variance inflation factor was 2.17. We included this value in our model selection procedure and note that values from 1 through 5 made no difference in the model most supported by the data. The best fitting (top) model had 71% of the $QAIC_c$ weight and was similar to our general model except that SY and ASY age classes were combined in survival probability (Table 5). The general model had 29% of the $QAIC_c$ weight and parameter

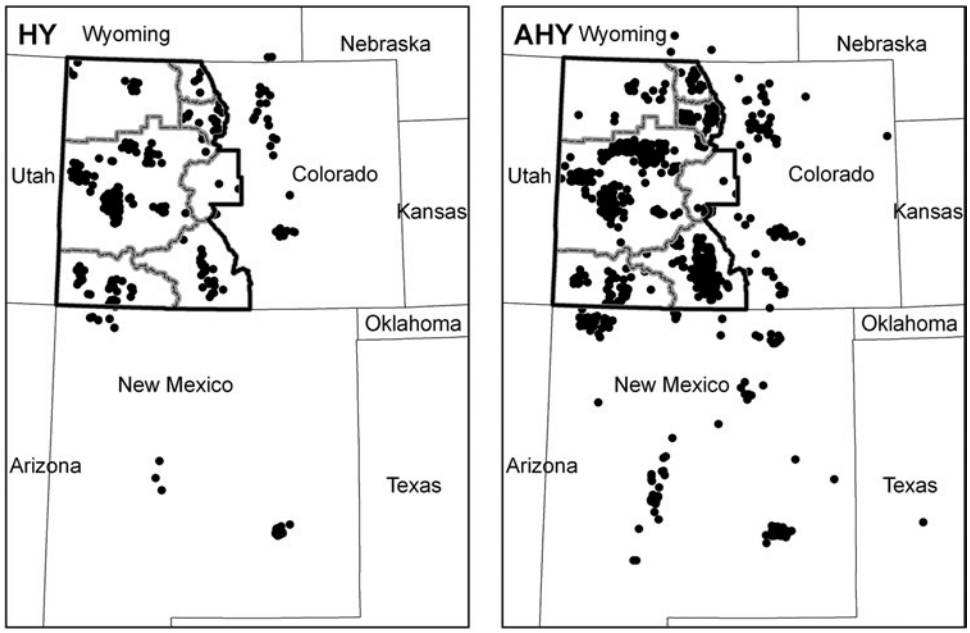

Figure 3. Direct band recoveries (black dots) for hatching year (HY) and after hatching year (AHY) Canada geese leg banded in June and early July in western Colorado during 2000 2006.

Table 3. Distribution (by percentage) of direct band recoveries from Canada geese leg banded in June and early July in western Colorado during 2000 2006 and recovered through May 2007 by recovery state and banding subarea (NW Northwest, WC West Central, SW Southwest, NP North Park, MP Middle Park, SP South Park, SLV San Luis Valley, and EC Eastern Colorado).

	Banding subarea							
Recovery location	**NW**	**WC**	**SW**	**NP**	**MP**	**SP**	**SLV**	**Total**
Arizona				1.1				0.3
Colorado	94.0	99.0	78.0	71.2	87.5	92.4	59.5	86.7
NW	53.2			3.5				2.8
WC	46.8	92.0		21.7	16.7	2.5	2.1	50.4
SW		0.2	100.0	3.9		0.6	4.3	6.9
NP				10.6				2.2
MP		1.2		9.4	59.5			6.6
SP		0.3		1.6	4.8	7.5		1.8
SLV		2.1		25.2	16.7	84.3	93.6	21.7
EC		4.2		24.0	2.4	5.0		7.7
Minnesota				0.3				0.1
New Mexico	6.0	1.0	22.0	25.1	12.5	5.8	39.2	12.1
New York						0.6		0.1
Pennsylvania						0.6	1.3	0.1
South Dakota				0.3				0.1
Texas				0.3				0.1
Utah				0.3				0.1
Wyoming				1.4				0.4
Ontario						0.6		0.1

estimates were nearly identical to the top model except in SY and ASY survival probability, which differed minimally. No other model had any $QAIC_c$ weight including all models with 2 age classes. We obtained demographic parameter estimates from our best-fitting model, which provided survival probability estimates for HY, AHY, and SY-ASY age classes by subarea and year. We dropped year or subarea effects in survival probability from our

Table 4. Distribution (by percentage) of indirect band recoveries from Canada geese leg banded in June and early July in western Colorado during 2000 2006 and recovered through May 2007 by recovery state and banding subarea (NW Northwest, WC West Central, SW Southwest, NP North Park, MP Middle Park, SP South Park, SLV San Luis Valley, and EC Eastern Colorado).

	Banding subarea							
Recovery location	**NW**	**WC**	**SW**	**NP**	**MP**	**SP**	**SLV**	**Total**
Arizona	1.7		1.0	0.4				0.3
California		0.4		0.4				0.3
Colorado	72.4	89.8	56.2	62.0	71.1	87.8	49.3	72.7
NW	50.0	0.2	3.4	3.6		0.8		3.2
WC	38.1	87.1	13.6	18.6	6.6	1.6	6.8	41.6
SW	2.4	1.2	64.4	2.2	1.1	3.1	1.4	5.1
NP				14.7				3.8
MP		1.2		8.6	48.4			6.7
SP		0.2		0.7	2.2	9.3	2.7	1.7
SL		0.5	1.7	24.4	28.6	71.3	74.0	22.2
EC	9.5	9.5	16.9	27.2	13.2	14.0	15.1	15.6
Idaho	5.2	0.9	1.9	0.4		1.4	2.0	1.1
Iowa				0.2				0.1
Minnesota				0.2		0.7		0.1
Montana		0.9	1.0	0.2				0.4
Nebraska		0.9	4.8	0.7		0.7	2.0	1.1
New Mexico	5.2	1.5	12.4	30.2	23.4	1.4	36.5	16.3
North Dakota		0.6	3.8	0.2		0.7		0.6
Oklahoma						2.0		0.2
South Carolina		0.2						0.1
South Dakota		0.4	1.0					0.2
Texas		0.2					0.7	0.1
Utah		0.6	2.9	0.9	0.8	1.4		0.9
Wisconsin						0.7		0.1
Wyoming	1.7	0.4	1.9	1.1	2.3		0.7	0.9
Alberta	8.6	1.1	1.0	0.7		0.7	1.4	1.1
Manitoba							0.7	0.1
Ontario		0.2					0.7	0.1
Saskatchewan	5.2	1.9	12.4	2.0	2.3	2.7	6.1	3.3
Mexico				0.2				0.1

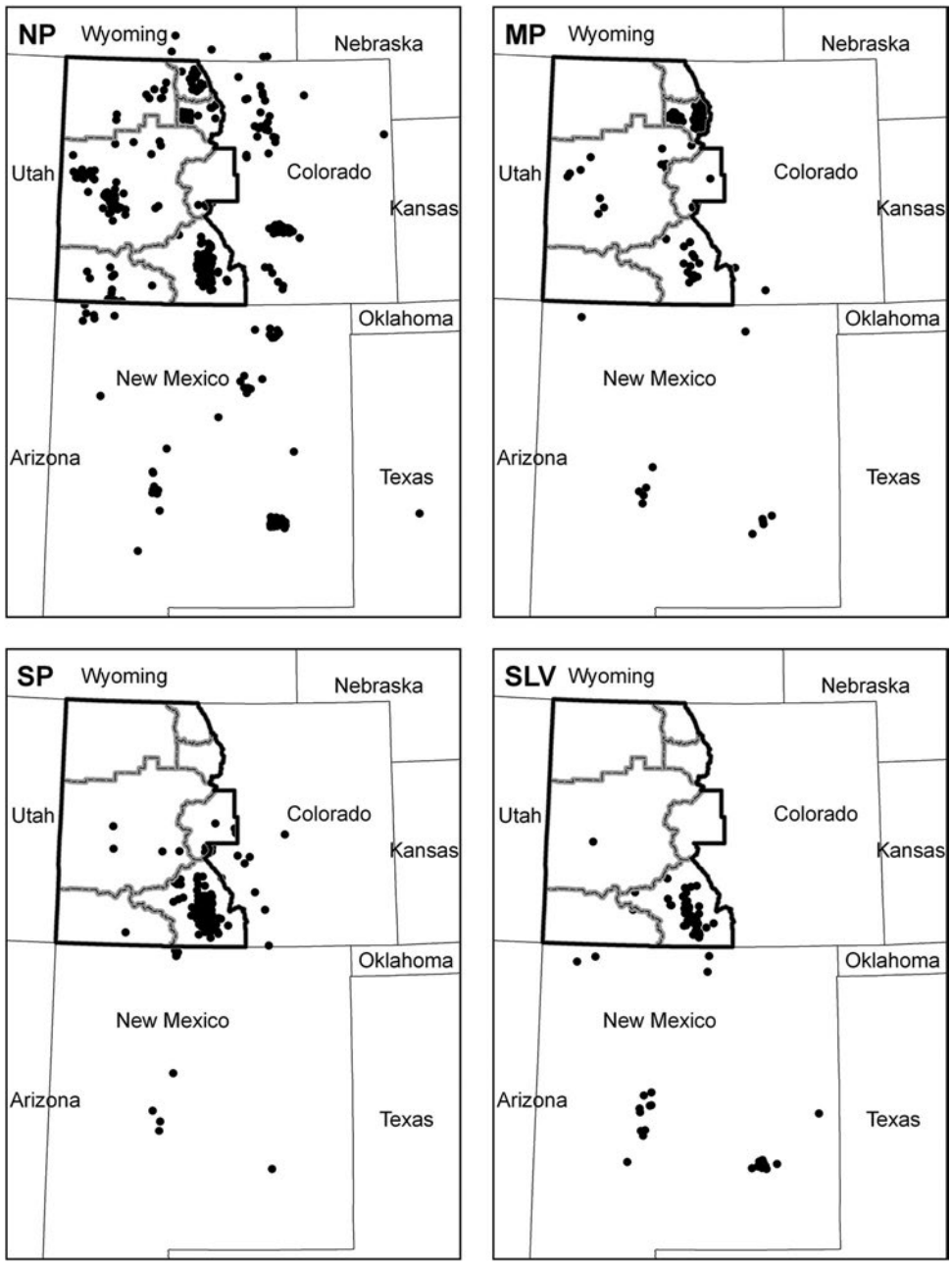

Figure 4. Direct band recoveries (black dots) for Canada geese leg banded in June and early July in western Colorado during 2000 2006 by banding subarea (NP North Park, MP Middle Park, SP South Park, SLV San Luis Valley, NW Northwest, WC West Central, and SW Southwest).

best-fitting model to derive survival probability estimates averaged over year and subarea.

Survival probability was greatest for SY-ASY geese (0.864 $\pm$ 0.012), intermediate for AHY geese (0.758 $\pm$ 0.019), and least for HY geese (0.503 $\pm$ 0.026) in western Colorado. These results suggest a reduced survival probability for adult geese the first year after banding. The AHY age class was a mix of SY and ASY geese that were not differentiated at the time of banding, but these geese were all known ASY birds the year after banding. Similarly, HY-banded geese were known SY birds the year after banding and ASY birds in subsequent years. However, the best model provided that SY and ASY geese had the same survival probability. Therefore, the difference between adult groups was effectively time since banding: either first year after banding or >1 year after banding. The difference in survival probability estimates between AHY and SY-ASY groups of adult geese (about 0.106) is the apparent difference in survival probability associated with the first year after banding. No comparative data was available to determine the first-year-after-banding effect for HY geese because age and year-of-banding effects are confounded. Survival probability estimates for HY geese may be biased low if the first-year-after-banding effect for adults applied to juvenile geese too.

Survival probabilities varied little over years considering the precision of the annual estimates (Fig. 5) but varied more by

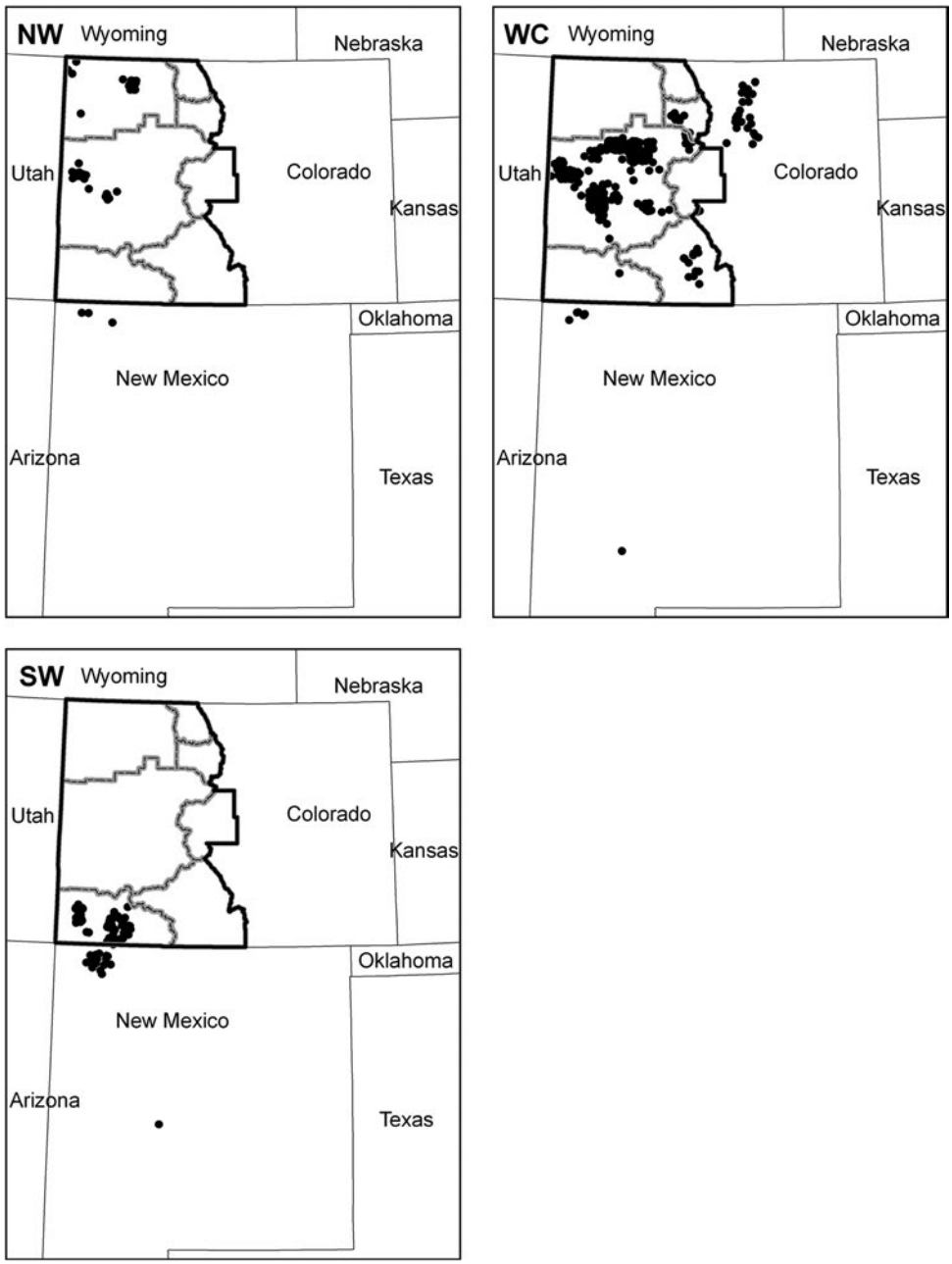

Figure 4. (*Continued*)

subarea (Fig. 6). Survival probability was lesser in the 3 western subareas (Western Plateau) compared to in the 4 eastern subareas (Rocky Mountains) for HY (0.395 ± 0.029 vs. 0.576 ± 0.033), AHY (0.685 ± 0.029 vs. 0.819 ± 0.025), and SY-ASY (0.802 ± 0.022 vs. 0.894 ± 0.012) geese (Fig. 6), and was consistent with the inverse of harvest rates (Fig. 2).

Recapture probability was 0.468 ± 0.012 for western Colorado and ranged from 0.294 ± 0.111 to 0.575 ± 0.027 among subareas excluding North Park subarea. North Park subarea had lower recapture probability, 0.131 ± 0.016, which was consistent with the wide distribution of geese from this subarea compared to other subareas (Fig. 4). Also, North Park subarea had more large reservoirs that attracted molting geese than any other subarea ($\geq$8 in total), and we were unable to capture more than about 50% of the molting geese on these reservoirs in any 1 year. Reporting probability for western Colorado was 0.544 ± 0.048 for ASY geese, 0.309 ± 0.027 for AHY geese, 0.179 ± 0.015 for HY geese, and was not estimable for SY geese. Fidelity probability was 0.792 ± 0.015 for western Colorado indicating that geese had high fidelity to subareas.

DISCUSSION

Our data (i.e., recapture rates, recovery distributions, and estimated fidelity rates) indicate that juvenile and adult geese exhibit high fidelity to 7 subareas in western Colorado in June and early July. Canada geese breeding and molting in western

Table 5. Model selection results using Akaike's Information Criterion corrected for small sample size and overdispersion ($QAIC_c$) for Burnhams's tag recapture and recovery model (Burnham 1993) for Canada geese leg banded in June and early July in western Colorado, 2000 2006. We modeled survival probability (S) and reporting probability (r; Seber [1970] parameterization) as a function of age class[a], year, and banding subarea (Northwest, West Central, Southwest, North Park, Middle Park, South Park, San Luis Valley, and Eastern Colorado). We modeled recapture probability (p) as a function of year and subarea; we pooled age classes because geese banded as hatch year (HY) birds were after hatch year (AHY) birds at the first opportunity for recapture. We were constrained to model fidelity probability (F) without age class and year effects (i.e., only subarea effects) otherwise F was not estimable in many cases. We found no support for models with 2 age classes; therefore, we show only the most general model with 2 age classes.

	AIC_c					
Model	**$QAIC_c$**	**$\Delta QAIC_c$[b]**	**Weight**	**Likelihood**	**K[c]**	**QDeviance**
{S(age3′ + year + subarea) p(year + subarea), r(age3 + year + subarea) F(subarea)}	22311.9	0.0	0.71	1.00	43	1000.1
{S(age3 + year + subarea) p(year + subarea) r(age3 + year + subarea) F(subarea)} (General)	22313.7	1.8	0.29	0.41	44	999.9
{S(age3 + year + subarea) p(year + subarea) r(age3′ + year + subarea) F(subarea)}	22326.8	14.8	0.00	0.00	43	1014.9
{S(age3′ + year + subarea) p(year + subarea) r(age3 + year + subarea) F(.)}	22336.2	24.3	0.00	0.00	38	1034.4
{S(age3′ + year + subarea) p(year + subarea) r(age3′ + year + subarea) F(subarea)}	22347.0	35.0	0.00	0.00	42	1037.2
{S(age3′ + year + subarea) p(year + subarea) r(age3 + subarea) F(subarea)}	22350.3	38.4	0.00	0.00	38	1048.5
{S(age3′ + year + subarea) p(year + subarea) r(age3) F(subarea)}	22355.3	43.4	0.00	0.00	32	1065.6
{S(age3′ + year + subarea) p(year + subarea) r(age3 + year) F(subarea)}	22360.3	48.4	0.00	0.00	36	1062.5
{S(age3′ + subarea) p(year + subarea) r(age3 + year + subarea) F(subarea)}	22363.8	51.9	0.00	0.00	38	1062.0
{S(age3 + subarea) p(year + subarea) r(age3 + year + subarea) F(subarea)}	22364 3	52.3	0.00	0.00	39	1060.5
{S(age2 + year + subarea) p(year + subarea) r(age2 + year + subarea) F(subarea)}	22366.8	54.9	0.00	0.00	40	1061.0
{S(age3 + year) p(year + subarea) r(age3 + year + subarea) F(subarea)}	22368.8	56.9	0.00	0.00	38	1067.0
{S(age3′ + year) p(year + subarea) r(age3 + year + subarea) F(subarea)}	22369.6	57.6	0.00	0.00	37	1069.8
{S(age3 + year) p(year + subarea) r(age3′ + year + subarea) F(subarea)}	22371.0	59.0	0.00	0.00	37	1071.2
{S(age3 + subarea) p(year + subarea) r(age3′ + year + subarea) F(subarea)}	22371.5	59.5	0.00	0.00	39	1067.7
{S(age3′) p(year + subarea) r(age3 + year + subarea) F(subarea)}	22380.8	68.9	0.00	0.00	32	1091.1
{S(age3) p(year + subarea) r(age3 + year + subarea) F(subarea)}	22383.2	71.3	0.00	0.00	34	1089.4
{S(age3) p(year + subarea) r(age3′ + year + subarea) F(subarea)}	22388.6	76.6	0.00	0.00	33	1096.8
{S(age3′ + year) p(year + subarea) r(age3′ + year + subarea) F(subarea)}	22398.4	86.5	0.00	0.00	36	1100.6
{S(age3′ + subarea) p(year + subarea) r(age3′ + year + subarea) F(subarea)}	22402.9	90.9	0.00	0.00	38	1101.1
{S(age3′) p(year + subarea) r(age3′ + year + subarea) F(subarea)}	22415.6	103.6	0.00	0.00	32	1125.8
{S(age3′ + year + subarea) p(subarea) r(age3 + year + subarea) F(subarea)}	22423.3	111.4	0.00	0.00	39	1119.5
{S(year + subarea) p(year + subarea) r(age3 + year + subarea) F(subarea)}	22461.6	149.6	0.00	0.00	40	1155.8
{S(year + subarea) p(year + subarea) r(age3′ + year + subarea) F(subarea)}	22462.8	150.8	0.00	0.00	39	1159.0
{S(age3′ + year + subarea) p(year) r(age3 + year + subarea) F(subarea)}	22468.1	156.1	0.00	0.00	38	1166.3
{S(year) p(year + subarea) r(age3 + year + subarea) F(subarea)}	22493.7	181.8	0.00	0.00	35	1198.0
{S(year) p(year + subarea) r(age3′ + year + subarea) F(subarea)}	22494.5	182.5	0.00	0.00	34	1200.7
{S(subarea) p(year + subarea) r(age3 + year + subarea) F(subarea)}	22513.0	201.1	0.00	0.00	36	1215.3
{S(subarea) p(year + subarea) r(age3′ + year + subarea) F(subarea)}	22514.3	202.4	0.00	0.00	35	1218.5
{S(.) p(year + subarea) r(age3 + year + subarea) F(subarea)}	22526 3	214.3	0.00	0.00	31	1238.5
{S(.) p(year + subarea) r(age3′ + year + subarea) F(subarea)}	22528 2	216.3	0.00	0.00	30	1242.5
{S(age3′ + year + subarea) p(.) r(age3 + year + subarea) F(subarea)}	22542.0	230.0	0.00	0.00	34	1248.2

[a] Age classes: age2 HY, AHY; age3 HY, AHY, second year (SY), after second year (ASY), age3′ HY, AHY, SY ASY.
[b] Difference in $QAIC_c$ values between current model and model with lowest $QAIC_c$ value.
[c] Number of parameters.

Colorado are largely non-migratory (99%) with some movement in winter from high to low elevation areas in Colorado (87%) and New Mexico (12%). Canada geese vacate the high elevation areas including Northwest, North Park, Middle Park, and South Park subareas typically in early to late November in association with freeze up (CDPW biologists, personal communication). Primary wintering areas for these geese include low elevation portions of the West Central, Southwest, and San Luis Valley subareas in western Colorado but also central Colorado and New Mexico along the eastside of the Rocky Mountain Front Range.

Canada geese inhabiting subareas of western Colorado during spring and summer have affinity for different wintering areas. Geese from the Northwest and West Central subareas winter primarily in the West Central subarea. The exception is that some geese along the eastern portion of the West Central subarea (i.e., Silverthorne, Silt, and Gunnison) winter in the San Luis Valley subarea or along the east side of the Rocky Mountain Front Range in north central Colorado. Geese from the Southwest subarea winter almost exclusively in the Southwest subarea and just across the Colorado–New Mexico boarder along the San Juan River near Farmington. Geese from Middle Park, South Park, and San Luis Valley winter primarily in the San Luis Valley subarea, but some winter along the east side of the Front Range in central Colorado and New Mexico. Geese from North Park subarea are the anomaly in that some winter in all 4 wintering areas. Consequently, neither the Continental Divide nor the Rocky Mountain Front Range provided clear separation between RMP and HP Canada goose populations in Colorado. Geese inhabiting the Western Plateau geomorphic province (RMP) perhaps have better separation compared to the Rocky Mountain province, which is an apparent mix of geese from both the RMP and HP. However, most banded geese were recovered on the side of the Continental Divide where they were banded with the exception of Middle Park and North Park, which were inhabited by a large number of molting geese.

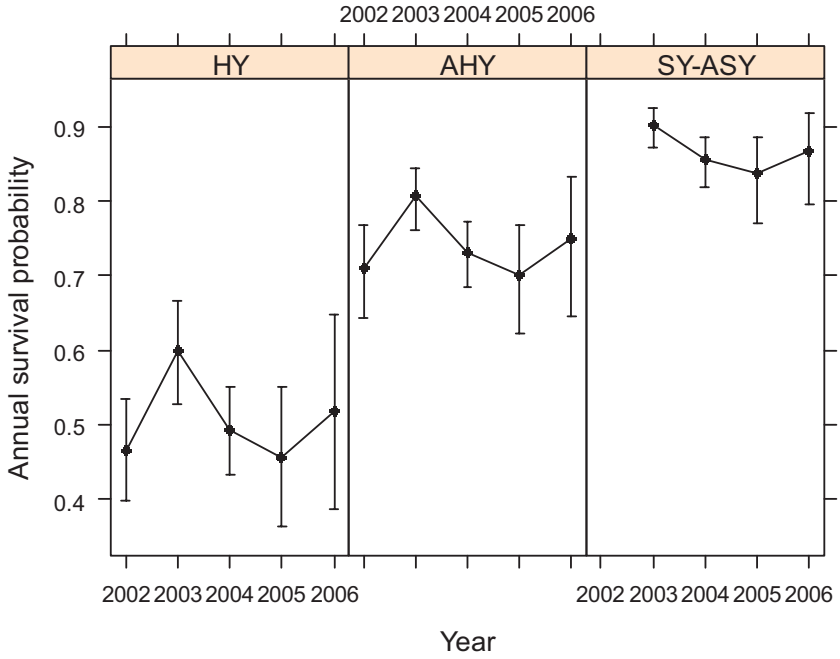

Figure 5. Annual survival probability of Canada geese leg banded in June and early July in western Colorado during 2002 2006 by age class (HY hatching year [juvenile geese the year of banding], AHY after hatching year [adult geese the year of banding], and SY ASY second year [juvenile banded geese 1 year after the banding year] and after second year [adult banded geese ≥1 year after the banding year and juvenile banded geese ≥2 years after the banding year]) and year. Error bars are 95% confidence intervals.

Most of the large reservoirs in western Colorado are in the mountain parks. These waterbodies attract non brood-rearing geese from all subareas in western Colorado, and probably the Front Range in central Colorado, when molting flight feathers in late spring and early summer (Jun and early Jul). Most of the geese banded in the mountain parks were adult non brood-rearing geese. We found no evidence of geese migrating to traditional molting locations of the RMP

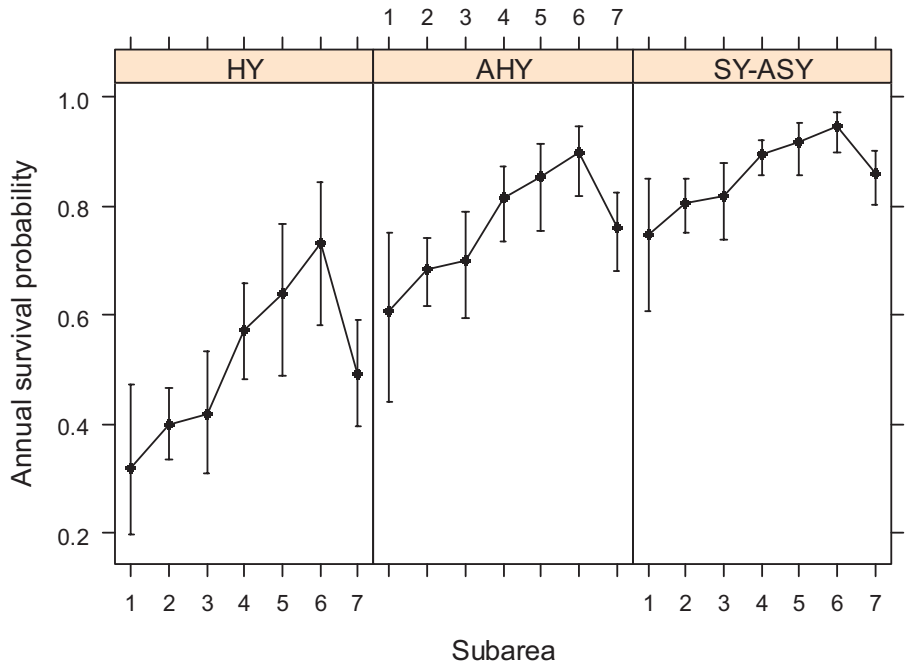

Figure 6. Annual survival probability for Canada geese leg banded in June and early July in western Colorado during 2002 2006 by age class (HY hatching year [juvenile geese the year of banding], AHY after hatching year [adult geese the year of banding], and SY ASY second year [juvenile banded geese 1 year after the banding year] and after second year [adult banded geese ≥1 year after the banding year and juvenile banded geese ≥2 years after the banding year]) and banding subarea (1 Northwest, 2 West Central, 3 Southwest, 4 North Park, 5 Middle Park, 6 South Park, and 7 San Luis Valley). Error bars are 95% confidence intervals.

and HP in the Northwest Territories and southern Alberta or anywhere outside of Colorado; although, a few Colorado banded birds from this study were recaptured on reservoirs in Wyoming (J. Bohne, Wyoming Department of Fish and Game, personal communication). Instead, the few band recoveries outside of Colorado and New Mexico (1% the first year after banding and 11% >1 year after banding) show a broad east-west distribution, especially in the eastern states, and this east-west movement of geese was evident from geese we recaptured from other studies. Thus, some, albeit small, interchange occurs among other breeding populations within and beyond the range of the RMP and HP.

Canada geese breeding in western Colorado largely lack the migratory patterns of the continental populations from which they were established. This is especially true west of the Continental Divide within the range of the RMP where populations were established from native, migratory birds. Canada geese breeding in northwestern Colorado were previously found to winter along the Colorado River in the Imperial Valley of California, characteristic of the RMP (Colorado Game, Fish, and Parks Department 1967). These geese also were known to molt in Canada or Wyoming (Pathfinder Reservoir within Pathfinder Bird Refuge near Laramie and Ocean Lake near Lander).

The survival probability (0.864 ± 0.012) of adult resident Canada geese in western Colorado was greater than that found for other migratory (0.68 ± 0.03; Eichholz and Seddinger 2007) and resident (0.52 ± 0.03 to 0.69 ± 0.02; Powell et al. 2004, Balkcom 2010, Dieter et al. 2010) populations of Canada geese. Unlike adult geese, however, the juvenile survival probability (0.503 ± 0.026) was less than that found for most other migratory (0.49 ± 0.05; Eichholz and Seddinger 2007) and resident (0.61 ± 0.03 to 0.68 ± 0.06; Powell et al. 2004, Dieter et al. 2010) populations of Canada geese and less than expected in comparison to the high survival probability for adult geese. We found evidence that our juvenile survival probability may be biased low because of either increased mortality from banding operations or band loss the first year after banding. An estimate of band loss or mortality from banding operations for juvenile geese was not possible from our data, but the annual survival rate for adult geese was 0.106 lower the first year after banding compared to other years (Fig. 5). This effect could apply to or be more pronounced for juvenile geese.

Juvenile geese had a low probability (10%) of being recaptured the first year after banding, especially compared to adult (28%) geese, consistent with low survival probability. Low survival probability could not be explained by hunter harvest. Most (98%) band recoveries in our study were a result of hunter harvest and juvenile geese are generally more vulnerable to harvest than adult geese (Eichholz and Seddinger 2007). However, the harvest rate of juvenile geese (0.169 ± 0.024) was only slightly greater than that for adult geese (0.128 ± 0.018) in western Colorado and was less than the adult harvest rate in 4 of 7 subareas. Juvenile and adult geese had the same fall and winter harvest distributions, mostly in western Colorado (HY = 85% and AHY = 78% for direct band recoveries and HY = 54% and AHY = 64% for indirect recoveries) but also central Colorado and New Mexico. The low apparent harvest rate for juvenile geese indicates that juvenile geese or their bands may have been lost after banding, but before the hunting season (i.e., bands assumed available for hunter recovery but are not), especially in some subareas. Most natural predation of juvenile geese is known to occur before fledging (Sargeant and Raveling 1992). We found no consistent pattern among the subareas (Western Plateau vs. Rocky Mountain) or within subareas over years to explain the apparent lower survival probability for geese the first year after banding. Reporting probabilities also indicate possible bird or band loss after banding and before the hunting season as estimates were lowest for geese the first year after marking, particularly for juvenile geese. Recovery rates would be expected to be similar for adult geese irrespective of time since marking (assuming similar distributions and harvest vulnerability) and greater for juvenile geese.

Band loss and mortality of geese were not observed during or immediately after banding operations by participants. We found little evidence of mortality from banding operations based on band recoveries (geese found dead) during June–August (8 geese during the 7-year study). The few geese recovered, however, were all juvenile. Most of the juvenile geese were banded at brood-rearing trap sites where 69% of the birds trapped were juvenile. Trapping at brood-rearing sites generally involved short drives, small groups of birds, quick processing times, and release of juvenile and adult geese together. We found that the 1-year band retention rate was 100% for adult geese, and probably the same for juvenile geese if they retained their band in the first few weeks after banding. We did not band juvenile geese that we thought could slip their band. Most adult geese were trapped at molting sites in large groups (up to about 1,000 geese), but were divided into several holding pens, processed efficiently with 4–5 experienced banders and a large support crew, and each goose was released after banding and all within a few hours. We found no apparent sign of systematic adult goose trampling or exhaustion during or after banding operations. Thus, we are unable to explain the apparent decreased adult survival and recovery rates the first year after banding, especially considering our care and attention to details during banding operations and an earlier study by Menu and Gauthier (2001) that indicates banding has no effect on adult geese and negligible effect on juvenile geese post-banding survival under conditions similar to ours. Possibly geese are more vulnerable to mortality and predation post banding because of taxation and disruption to family groups and diurnal activities unobservable at the time of banding (Williams et al. 1993). Reduced survival and recovery rates of adult geese the year after banding also could be explained by unreported illegal harvest of geese for their bands post banding by individuals knowledgeable on banding locations, which is known to have occurred in central Colorado (see USA vs. J. Foiles indictment 2010) and in Utah (T. W. Aldrich, Utah Division of Wildlife, personal communication) during our study.

Unobserved adult goose loss caused by banding operations could bias adult survival estimates in subsequent years because of differential frailty (i.e., heterogeneity in survival probability). Possibly, the less fit adult geese die sooner, so survivors show greater subsequent survival probabilities (Burnham and Rexstad 1993); therefore, our estimate of adult survival probability may be biased high for the unmarked adult geese we wish to make inference to. However, our apparent recapture rate for adult banded geese was 38%, so nearly half of the geese that survived the first few months post banding and subsequent hunting season were captured again. Subsequent capture events may result in additional mortality, in which case our estimate of survival probability for adult geese may be biased low relative to the unmarked population. We suspect that the potential for bias in either direction is minimal for adult geese, and that the most likely scenario is that the potential sources of bias cancel each other.

Direct recovery rates of reward-banded adult geese did not increase with increasing reward value; they were the same whether we used only \$100 reward values or all values from \$10 to \$100, except that precision improved with increasing sample size. Therefore, we used all reward bands regardless of value in determining recovery rates and believe that reward band recoveries were reported with 100% probability. Recovery rates typically do increase with increasing reward value, and approach 100% with a reward value from \$40 to \$100 (Nichols et al. 1991, Royle and Garretson 2005, Zimmerman et al. 2009*a*). We believe that differences in reward band values to achieve 100% reporting probability in our study reflects local economies and culture compared to these national studies.

Our estimated conditional band reporting probability determined from direct band recoveries of adult geese could be biased high if there was differential band loss or mortality between band types. The 1-year band retention rates during this study were 98% for reward bands and 100% for standard bands, and were consistent with apparent band retention rates on a national scale during the same time (Zimmerman et al. 2009*b*). We found no pattern in the value of reward bands lost, but all of them were less than \$100 in value. Adjusting the effective band sample size to account for 2% reward band loss increased the estimated reward band recovery rate from 0.118 ± 0.014 to 0.121 ± 0.014 and decreased the reporting probability from 0.525 ± 0.071 to 0.515 ± 0.069. The potential bias from reward band loss is probably less than our estimate considering the short time span (about 8 months) over which we estimated band reporting probabilities relative to band retention rates (about 12 months). Any unknown loss of geese caused by banding operations should not bias band reporting probability if losses occurred equally to both reward- and control- or standard-banded geese, which we believe was the case.

Our band reporting probability was less than the mean reported for geese (0.73 ± 0.02; Zimmerman et al. 2009*a*) and ducks (0.72 ± 0.03; Royle and Garretson 2005) in North America. Zimmerman et al. (2009*a*) did, however, report a reporting probability of 0.515 ± 0.148 specific to the HP (0.823 ± 0.131 for the RMP) but lacked estimate precision to demonstrate differences in reporting probabilities among populations and spatial units (our reward and control band data was included in this national study). We were able to estimate local band reporting probability with greater precision than Zimmerman et al. (2009*a*) for our study area because we had additional data from standard bands deployed in the same areas and times as control bands, which were not considered in the national study. Use of standard bands with control bands in our study increased the band sample size from 550 to 3,303 and the recoveries from 40 to 205 compared to use of control bands alone.

We found that harvest rate estimates were about double in the 3 westernmost subareas (Western Plateau) compared to the 4 easternmost subareas (Rocky Mountains) for both adult (0.190 ± 0.027 vs. 0.105 ± 0.015) and juvenile (0.215 ± 0.031 vs. 0.094 ± 0.017) geese, but variances were high. We also found that survival probability was lower in the 3 westernmost subareas compared to the 4 easternmost subareas for both adult (0.802 ± 0.022 vs. 0.894 ± 0.012) and juvenile geese (0.395 ± 0.029 vs. 0.576 ± 0.033). Differences in Canada goose survival and harvest rates between the Western Plateau and Rocky Mountain provinces in western Colorado may be related to the fact that the Western Plateau is more densely populated by people compared to the Rocky Mountain province and possibly has greater hunter participation season-long considering weather differences. Also, of the wintering areas in these 2 provinces, only the Rocky Mountain province has a federal wildlife refuge (Alamosa-Monte Vista National Wildlife Refuge in the San Luis Valley subarea), but private-owned and state park lands provide refuge for geese in the Western Plateau province.

Harvest rate estimates were consistent with annual survival probability estimates, and indicated that most of the mortality in these geese was related to harvest. Also, 98% of the recoveries of geese banded in western Colorado were a result of hunter harvest, but band reporting rates may be different for non-hunters. Hunting mortality generally comprises the bulk of mortality in geese (Menu et al. 2002). Hunter recovery rates and subsequent harvest rate estimates may be biased low if mortality was caused by banding operations or if band loss occurred during the first year after banding when we estimated recovery rates; however, adult recovery rates were similar for the first year and >1 year after banding based on reporting probabilities from our demographic model for estimating survival probabilities. Adjusting the effective band sample size for adult geese to account for possible post-banding mortality (0.106) increased the western Colorado harvest rate estimate to 0.143 ± 0.020 and made no difference in the relative comparison of harvest rate estimates among subareas.

Restoration or establishment of resident Canada goose populations in the United States is considered a success story of the 20th century (Schmidt 2004). However, increased abundance of geese has resulted in increasing wildlife-human conflicts in urban environments (Conover and Chasko 1985, Ankney 1996). Resident Canada geese in western Colorado exhibited similar small-scale movement patterns and high

fidelity to localized areas compared to other resident goose populations in the United States (Groepper et al. 2008, Balkcom 2010, Dieter et al. 2010). Harvest can be used as a management tool to reduce or stabilize population growth. Heusmann (1999) found that harvesting 25% of the resident goose population in Massachusetts was insufficient to reduce the size of the population. Hestbeck (1994) found that the population of Canada geese in the Atlantic Flyway increased with a harvest rate of 0.23 but decreased with a harvest rate of 0.32. Our estimated adult Canada goose harvest rate was less than that necessary to stabilize population growth in other resident populations; therefore, increasing harvest rates with consideration of different wintering and breeding subareas may be necessary to stabilize the apparently growing resident Canada goose population in western Colorado.

MANAGEMENT IMPLICATIONS

A breeding Canada goose population in western Colorado is well established and has apparently increased in abundance, resulting in increased human-wildlife conflicts. Geese that breed and molt in western Colorado are largely non-migratory with high, annual survival probability and potential for continued growth. Most mortality in this population is a result of hunter harvest, especially for adult geese. In geese, hunting mortality is largely additive to natural mortality (Gauthier et al. 2001) and should have a direct influence on population growth (Menu et al. 2002). Reducing adult survival probability generally has a much greater effect on population growth than any other demographic parameter (Rockwell et al. 1997, Schmutz et al. 1997, Coluccy et al. 2004). Increasing harvest rates with consideration of different wintering and breeding subareas in western Colorado may be necessary to effectively manage this growing resident Canada goose population. Liberalizing harvest regulations for Canada geese in western Colorado during early fall, prior to arrival of migratory Canada geese, may be an effective way to reduce survival rates of geese breeding in western Colorado and minimize impacts to other Canada goose breeding populations. This information also can be used to improve management of the RMP and HP Canada goose populations within the Pacific and Central flyways.

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Observations of neck-collared Canada geese near John F. Kennedy International Airport, New York City

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Abstract: Canada geese (*Branta canadensis*) often cause significant damage when they strike aircraft. They are responsible for a reported minimum of $2.6 million in damage per year to civil aviation in the United States. Knowledge of goose movements in relation to airports would allow wildlife managers to allocate time and funds to manage those populations that pose the greatest threat to aircraft. We placed alpha-numeric neck collars on 300 Canada geese within 8 km of both John F. Kennedy International Airport (JFKIA) and LaGuardia Airport in New York, New York. We conducted weekly observations for 2 years within a 12-km radius of JFKIA at locations used by the geese. At the conclusion of the study, 45% of the collared geese remained within an 8-km radius of JFKIA, and four were killed at JFKIA during wildlife control operations. We observed birds at their original banding sites 75% of the time, and within 5 km of the banding location 95% of the time. Geese that remained in the study area were re-sighted at a mean straight-line distance of 3.6 (±3.1) km from their original banding location. We note that 78% of the re-sighting locations used by geese were within 8 km of JFKIA and that movements of these geese could take them over or onto JFKI. Oiling goose eggs to kill the embryos, rounding up of flightless birds within 8 km of the airport, and bird-control activities at JFKIA and nearby areas all should be continued to reduce the probability of a catastrophic bird strike between aircraft using JFKIA and local Canada geese.

Key words: airport, bird–aircraft collision, *Branta canadensis*, Canada goose, home range, human–wildlife conflicts, movements, neck collars

Aircraft collisions with bats (Peurach et al. 2009), deer (DeVault 2008, VerCauteren et al. 2009), and birds (Bernhardt et al. 2009, Dale 2009, Dolbeer and Wright 2009, Dove et al. 2009, Linnell et al. 2009) in the United States cost civil aviation an estimated $628 million per year. Canada geese (*Branta canadensis*) alone cause a minimum of $2.6 million of damage per year (Dolbeer and Wright 2008). From 1990 to 2007, Canada geese caused 14 accidents with civil aircraft that resulted in human injuries (Dolbeer and Wright 2008, Dove et al. 2009). In 1995, Canada geese caused a U.S. Air Force (USAF) AWACS aircraft to crash on takeoff, resulting in the death of all 24 crew members and the complete loss of the $190-million aircraft (Wright 1997). Canada goose strikes to USAF aircraft cost, on average, $710,000 per strike (USAF 2008). In a ranking of wildlife hazardous to aviation, geese (primarily Canada geese) were ranked third out of 21 species groups (Dolbeer et al. 2000). With the possible exception of the empennage, no part of an aircraft can sustain a goose strike without suffering some level of damage (Dolbeer and Eschenfelder 2002).

In the northeastern United States, population trends from North American Breeding Bird Survey data show that Canada goose populations have increased from 1966 to 2007 by 12.6% per year (Sauer et al. 2008). In New York State, the resident population of Canada geese is estimated to be 200,000 (N.Y. State 2009). Knowledge of goose movements in areas associated with airports is critical for safe airport operations, given the year-round ubiquity of Canada geese throughout most of the continental United States (Groepper et al. 2008, Washburn et al. 2007). For example, Cooper (1991) identified individual Canada geese that routinely traveled into airspace at the Minneapolis-St. Paul International Airport and suggested that managers could select the individual birds that should be removed to reduce bird-strike hazards while maintaining

a local goose population. York et al. (2000) found that at least 20% of harassed geese returned multiple times to harassment sites located on an Alaskan airfield. Organizations that promote goose harassment make claims of clearing specific areas of geese, but have not documented where or how far harassed geese travel (GeecePeace 2009). In contrast, Holevinski et al. (2007) determined that Canada geese moved only about 1.2 km after harassment and showed a strong affinity to their original location. Documenting movements of harassed and nonharassed geese throughout an entire year would be enlightening because movements may vary by season and by population status (whether birds are migrants or residents). Such knowledge of goose movements will allow airport biologists to make more efficient use of time and money to control those specific individuals or populations that present hazardous conditions to aircraft. Also, by understanding goose movement patterns, biologists can avoid harassing geese in a manner that creates, rather than removes, a safety hazard.

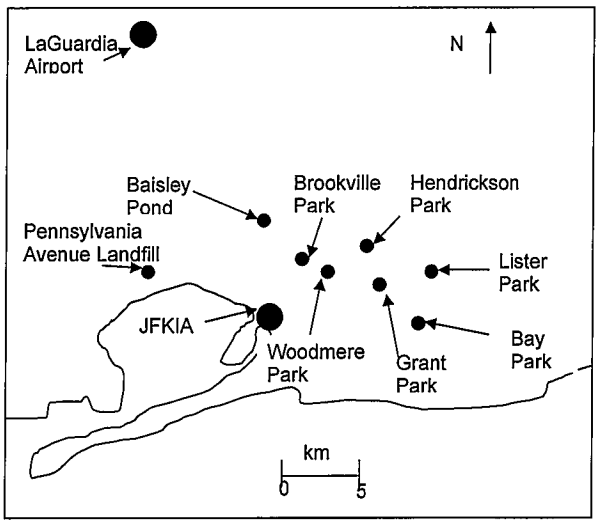

Figure 1. Nine Canada goose-banding locations in relation to John F. Kennedy International Airport and LaGuardia Airport, New York, New York.

The Federal Aviation Administration (FAA) has established a distance of 8 km around airports in which hazardous wildlife attractants should be avoided (FAA 2004). Therefore, the purpose of this study was to document movements of Canada geese originating within about an 8-km radius of the John F. Kennedy International Airport (JFKIA) to determine which geese pose a threat to aircraft there.

Methods

United States Department of Agriculture/ Wildlife Services (WS), the Town of Hempstead, New York City Department of Environmental Protection, Port Authority of New York and New Jersey, New York State Department of Environmental Conservation, New York City Parks and Recreation, and the WS National Wildlife Research Center collaborated to capture and neck-collar resident Canada geese within Nassau and Queens counties on Long Island during June 2006. Healthy birds at 9 locations <9 km from either JFKIA or LaGuardia Airport (LGA; Figure 1) were captured, aged, sexed, banded with a standard aluminum U.S. Fish and Wildlife Service (FWS) leg band, fitted with a yellow alpha-numeric auxiliary neck collar, and released at the capture site. Additional Canada geese at the Pennsylvania Avenue Landfill were banded only with FWS leg bands.

Once per week, from August 2006 to July 2008, we observed collared and non-collared geese at the 9 original banding sites by using binoculars and spotting scopes. We drove or walked throughout each location at random times of the day to locate the geese, then counted them and record our observations on a standardized data sheet. Additionally, we weekly searched up to 10 additional parks within a 12-km radius of JFKIA for collared geese, as time and resources allowed. We gathered reported public sightings and hunter harvest data from the U.S. Geological Survey Bird Banding Laboratory.

We compiled and separated recorded observations for each individual collared goose into 3 categories: weekly observations at the original banding site, weekly observations at additional locations, and weekly observations in which the individual was not located. Also, we used Google Earth™ and converted recorded observations into straight line movements from the original banding location to points where the birds were observed.

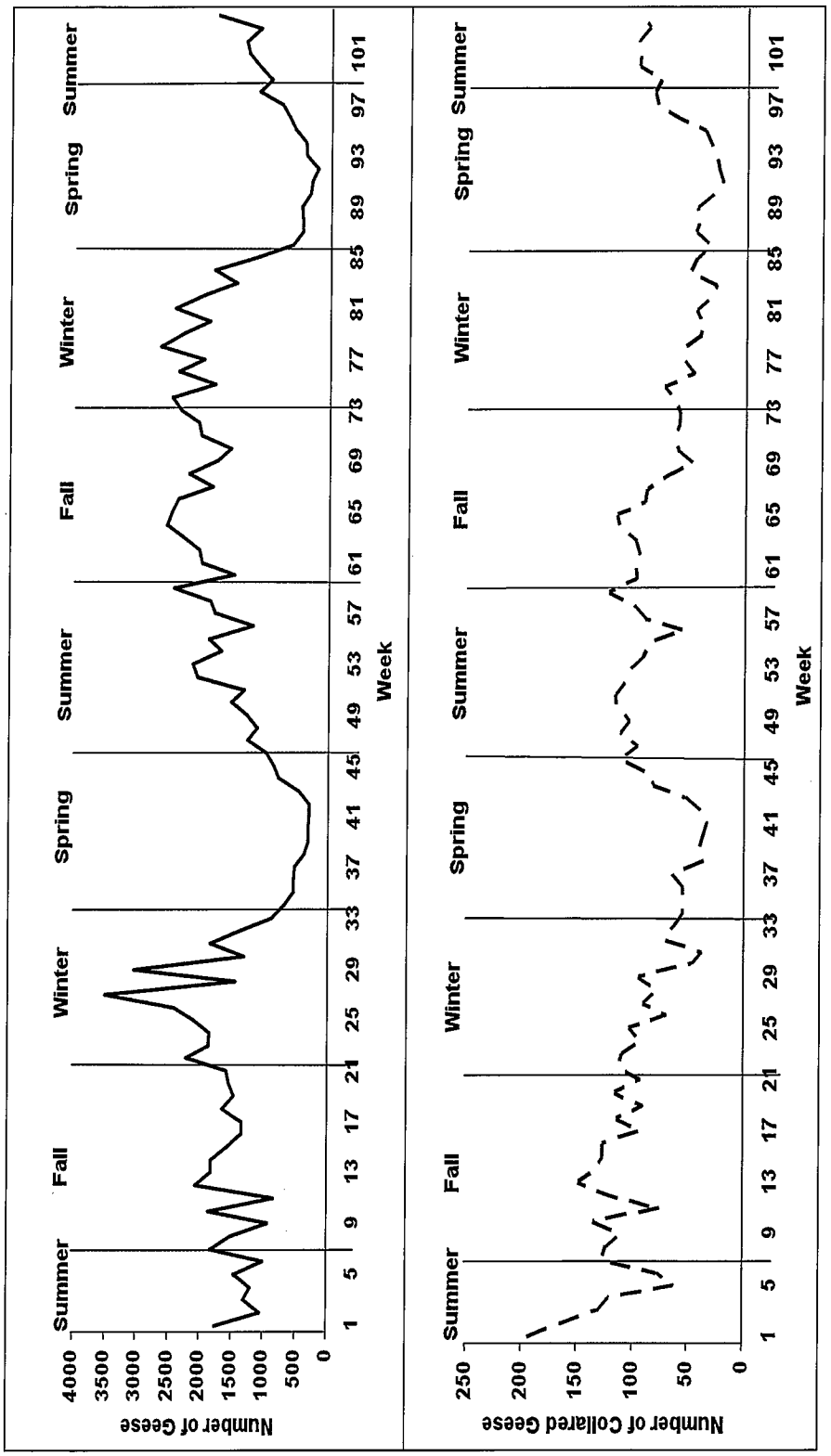

Figure 2. Weekly[1] totals of all Canada geese and Canada geese with study collars observed at 17 parks and 1 reclaimed landfill located within a12-km radius of John F. Kennedy International Airport, NY, from August 2006 to July 2008.

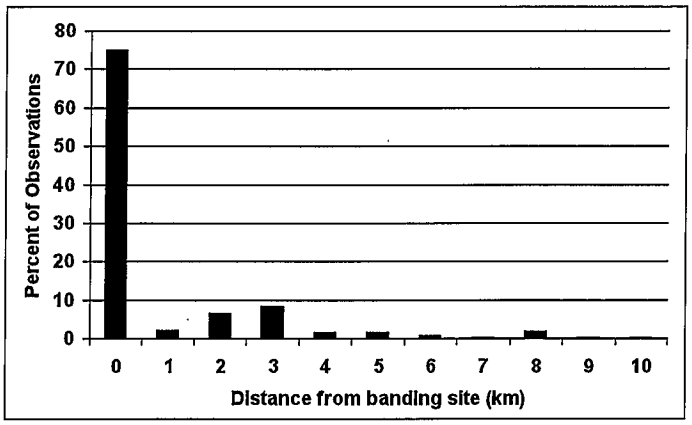

Figure 3. The percentage of observations of collared geese based on the distance (km) of re-sighting from the original banding location of 8 New York City parks and 1 reclaimed landfill within 12 km of John F. Kennedy Interational Airport, New York, New York, from August 2006 to May 2008.

Table 1. Number of Canada geese, by sex and age, banded and collared at 8 New York City Parks and one reclaimed landfill in June 2006.

	Sex			Age		Total
Location	Male	Female	Unknown	After Hatch Year	Hatch Year	
Baisley Pond Park	14	19	2	34	1	35
Bay Park	5	20	0	24	1	25
Brookville Park	16	17	0	28	5	33
Flushing Meadows Park	18	17	0	35	0	35
Grant Park	19	18	0	37	0	37
Hendrickson Park	15	23	0	38	0	38
Lister Park	18	9	0	27	0	27
Pennsylvania Ave. Landfill	15	20	0	35	0	35
Woodmere Park	18	17	0	35	0	35
Total	138	160	2	293	7	300

Results

In June 2006, we captured and collared 300 flightless Canada geese (Table 1) within 8.7 km of JFKIA and LGA at 9 locations (8 parks, and 1 reclaimed landfill; Figure 1). Additionally, we placed USFWS leg bands on 32 Canada geese at the Pennsylvania Avenue landfill site. This banded goose population represented approximately 1.5% of the estimated total population in the New York City and Long Island area (B. Swift, N.Y. State Department of Environmental Conservation, personal communication).

We conducted observations during 104 weeks, visited a mean (± standard deviation) of 17 (± 2) parks each week and observed the following

Table 2. The percentage of observations in which a banded goose was observed at the original banding location and the number of additional locations geese from a banding location were observed from August 2006 to May 2008, within 12-km of John F. Kennedy International Airport, New York.[1]

Banding location	% of times observed at banding location	Additional locations where geese observed
Baisley Pond Park	25	10
Bay Park	32	5
Brookville Park	34	10
Flushing Meadows Park	58	7
Grant Park	43	7
Hendrickson Park[1]	7	10
Lister Park	39	14
Pennsylvania Ave. Landfill	27	14
Woodmere Park	18	12

[1]164% of total banded geese were molt migrants that left the area when flight feathers grew in.

each week: 1,451 (± 706) Canada geese, 80 (± 34) study collars (5.5% of the population), and 4 (± 3) nonstudy collars (Figure 2). At the conclusion of the study, 45% of the original 300 collared geese remained within an 8-km radius of JFKIA. One hundred six geese (35%) were not observed for the last quarter of the project, 14 geese (5%) were never observed after being collared, and 45 (15%) geese were killed. Three of the killed geese (one each from Brookville Park, Baisley Pond Park and Woodmere Park) were shot at JFKIA during wildlife control operations. Additionally, one of 32 geese leg-banded at the Pennsylvania Avenue Landfill was shot at JFKIA. Over this same time period, 323 additional Canada geese were shot at JFKIA during wildlife control operations.

For the birds reported to the Bird Banding Laboratory as killed, 84% were shot, and the mean distance from the original banding locations was about 107 km (3–1,162 km minimum–maximum distance). Only 14 birds were reported to the Bird Banding Laboratory as observed and these were a mean distance of about 90 km (7–550 km minimum–maximum) from the original banding location.

For individual sites, the percentage of weekly counts in which geese were observed at their original banding location varied from 7 to 58% (Table 2). Individual geese were found at 5 to 14 locations, in addition to their original banding location (Table 2). We observed birds at their original banding sites 75% of the time, and within 5 km of the banding location 95% of the time (Figure 3). Geese that remained in the study area were re-sighted a mean straight-line distance from their original banding location of 3.6 (±3.1) km (Table 3).

Discussion

Our study objective was to determine whether Canada geese originating within an 8-km radius (as established by FAA Advisory Circular 150/5200-33A) of JFKIA could pose a threat to aircraft using the airport. We found that most of our recoveries within the 12-km radius of JFKIA that we searched occurred within 5 km of the original banding location with 75% of the observations at the original banding location. Based on a mean straight-line distance from banding locations, geese from 3 of the 9 sites would have routinely traveled far enough to reach JFKIA. Using the maximum straight-line distance traveled, birds from 7 of the 9 sites had the potential to reach JFKIA. Therefore, 78% of the locations used by geese within 8 km of JFKIA could support geese that would travel onto or over JFKIA. The 4 banded geese that were shot at JFKIA all came from within a 5-km radius of the airport. Additionally, during LGA airport bird surveys, we observed 2 neck-collared geese that moved 6.5 km from Flushing

Table 3. The mean straight-line distance that included Canada geese were observed away from their original banding location during observations conducted from August 2006 to May 2008.

Banding location	Distance of banding site (km) from JFKIA[1]	Mean (SD) distance (km) from banding site
Baisley Pond Park	2.4	4.1 (3.0)
Bay Park	8.0	4.0 (1.2)
Brookville Park	1.9	1.8 (0.7)
Flushing Meadows Park[2]	9.7	11.0 (3.3)
Grant Park	6.0	2.8 (0.3)
Hendrickson Park	5.6	3.5 (2.5)
Lister Park	8.7	6.2 (3.8)
Pennsylvania Ave. Landfill	4.8	2.6 (3.6)
Woodmere Park	1.6	5.2 (4.0)
Mean	5.4	3.6 (3.1)

[1]John F. Kennedy International Airport
[2]Flushing Meadows Park is 5.5 km from LaGuardia Airport.

Meadows, past LGA, to Rikers Island.

Approximately 1.2% of the geese shot at JFKIA during wildlife control operations were our banded geese. If our assumption of banding 1.5% of the local goose population is correct, then it is also possible that, due to the similar percentage of banded birds being shot at JFKIA, the geese shot at JFKIA were originating mostly from the New York City or Long Island areas. However, hunters preferentially select geese with neckbands (Craven 1979, Alisauskas et al. 2006). Based upon comments from personnel conducting bird control at JFKIA, shooters were selectively targeting collared geese out of flocks. This selection would bias the data and give a false impression of bird movement. Also, during the study, migratory geese came into the JFKIA area and would have been subject to control activities. Therefore, the total number of birds subject to control was actually higher than the local population, and the percentage of banded birds compared to the total population would have been <1.5%. That 1.2% of the birds shot were banded supports the proposal of the selection of banded over unbanded birds during control activities at JFKIA. Based upon our re-sighting data showing local movements (5 km), then, it is more likely that the majority of birds shot at JFKIA are originating from within the 8-km radius of the airport.

At the conclusion of the study, 55% of the banded geese appeared to be absent from the study area. We know the fate of 15% of the birds, as they were killed and their collars were reported. Approximately 5% were reported alive, but they were outside of the study area. The fate of the remaining 35% of the geese was unknown. Studies have indicated that neck collars can reduce survival of geese, although the exact cause for this reduction is unknown (Castelli and Trost 1996, Schmutz and Morse 2000). Additionally, neck collar retention is variable (average retention of 28 to 90%) over the life of the collar (Samuel et al. 1990, Campbell and Becker 1991, Wiebe et al. 2000, Samuel et al. 2001). It is possible that poor collar retention may explain some of the missing birds, although we found no lost collar, and none were reported found during the study.

The 2 counties included in the study area, Nassau and Queens, have a combined human population of 3.5 million, or about 2,000 people per km^2 when the total area is considered; however, when only land area is computed, the density is about 5,000 people per km^2 (U.S. Census Bureau 2008). With such a dense human population, potential feeding and loafing locations for resident Canada geese are limited, and most sites are likely subject to human disturbance. Open areas, such as Jamaica Bay and the Gateway National Recreation Area, likely would provide alternative foraging and

roosting locations for geese displaced from the parks around JFKIA. However, JFKIA lies between most of the parks and Jamaica Bay; thus, the geese would likely cross the airport to reach the open spaces and therefore increase the risk of a bird strikes at the airport.

Although this study did not focus on geese at LGA, Canada geese also pose a threat to aircraft using that airport. In an effort to reduce the hazard posed by Canada geese at LGA, from 2004 to 2007 Wildlife Services conducted a goose-removal program of all geese observed at Rikers Island, which is adjacent to LGA. The number of Canada geese removed from Rikers Island decreased yearly (2004, n = 518; 2005, n = 288; 2006, n = 200; 2007, n = 166) and the number of goose strikes at LGA likewise decreased by 80% (A. Gosser, USDA/WS, unpublished data). This removal is an example of management efforts necessary to reduce the risk of bird strikes posed by resident Canada geese. However, strikes that occur away from the immediate airport environment, such as the incident in which U.S. Airways Flight 1549 struck multiple Canada geese at approximately 1,000 m above ground level (AGL) in January 2009, will not necessarily be reduced by such local control. Measures to make aircraft more visible or noticeable to birds may reduce such strikes and should be investigated.

We documented Canada goose movements within an 8-km radius of JFKIA, but we did not determine how high above ground the birds fly when moving between sites. We do know that, in general, an aircraft approaching JFKIA on a 3° glide slope would be about 152 m AGL when it is 3 km from the runway (Flight Safety Foundation 2000). Because 74% of all bird strikes occur ≤150 m AGL (Dolbeer 2006), it is critical to manage hazardous bird species within this volume of air space, as they pose the greatest immediate threat to aircraft. Three of the sites in this study were less than 3 km from JFKIA; therefore, geese using those sites should be monitored and managed appropriately.

Based on this study, most of the resident Canada geese in Nassau and Queens counties remain ≤5km from their primary foraging and loafing areas. Therefore, Canada geese within 5 km of JFKIA pose the greatest hazard. However, marked geese within 8 km of JFKIA likely crossed JFKIA airspace when travelling to areas where they were observed in this study. Therefore, goose management efforts (oiling goose eggs to kill the embryos and rounding up of flightless birds) within 8 km of the airport and bird-control activities at JFKIA and nearby areas should be continued to reduce the probability of a catastrophic bird strike with aircraft using JFKIA.

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