Environment Canada
Canadian Wildlife Service

Environnement Canada
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Anatum Peregrine Falcon Recovery Plan

ANATUM PEREGRINE FALCON

RECOVERY PLAN

October 1988

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Published by Authority of the Minister of the Environment
Canadian Wildlife Service

Catalogue No. CW-66-97/1988E
ISBN 0-662-16544-6

Cover illustration of the Peregrine Falcon by Susan Popowich

EXECUTIVE SUMMARY

PEREGRINE FALCON RECOVERY PLAN

The Peregrine Falcon (Falco peregrinus) is a migratory raptor that formerly bred widely across Canada. The anatum, or continental, subspecies that formerly bred in the boreal forest south to the Gulf of Mexico was eliminated from most of its range in North America because of the use of persistent organochlorine pesticides, notably DDT. Of nine zones in Canada, only three have adequate numbers of the subspecies to sustain local populations.

Thanks to the pesticide controls imposed in the early 1970s there has been some reduction in the prevalence in the environment of these persistent compounds. It is now feasible to formulate a plan to bring back the anatum Peregrine Falcon to its former abundance.

The plan presented herein describes the steps required to reintroduce and/or increase the wild anatum population in all zones to the point at which it is self-sustaining and no longer endangered. This is to be done by raising birds in captivity at three Canadian breeding facilities and releasing them into the wild so that they will survive and breed successfully. The plan's objectives are:

- To establish by 1992 a minimum of 10 territorial anatum pairs in each of zones 1 to 6 shown in this plan.
- To establish by 1997 in each of five of those six zones (zones 1 to 6) a minimum of 10 territorial anatum pairs naturally fledging 15 or more young annually, measured as a five-year average commencing in 1993.

The plan identifies several problems or limiting factors and management solutions, grouped in four priorities. These are

PRIORITY I

1. Population monitoring
2. Low productivity as a result of pesticides
3. Preserving the gene pool

PRIORITY II

1. Preserving habitat
2. Releases

PRIORITY III

1. Protecting peregrines from human disturbance
2. Protection of peregrines from predation
3. Impacts of disease and other disasters

PRIORITY IV

1. Public awareness
2. Research and development of more effective management techniques

This plan will be implemented by a national recovery team and its advisors. The team will report each year to the meeting of Canadian Wildlife Directors.

The estimated annual cost of implementing this plan is from $374 000 to $456 000. This cost will be borne by the various federal, provincial, and territorial agencies involved according to their own budgetary priorities. Some non-government support is also envisaged.

DISCLAIMER

This recovery plan has been prepared to delineate reasonable actions required to protect and recover the anatum Peregrine Falcon. It does not necessarily represent all the views of all jurisdictions or participating agencies. Goals and objectives will be attained and funds expended contingent upon appropriations, priorities, and other budgetary constraints.

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INTRODUCTION

The anatum race of the Peregrine Falcon, which formerly bred widely across Canada, has in recent decades declined to the point where it has been declared an endangered species. The Western Raptor Technical Committee was requested by its parent body, the Western Wildlife Directors Committee, to develop a national Peregrine Falcon Recovery Plan. In 1986 the Western Wildlife Directors Committee presented the draft plan to the Canadian Wildlife Directors Committee, which appointed a recovery team to review it. The plan was approved in 1987. The recovery plan presented here proposes a coordinated national management effort that would over the next 10 years restore the anatum peregrine population in Canada.

This plan is concerned only with the restoration of the anatum Peregrine Falcon (Falco peregrinus anatum) in Canada. Much of the rationale for the proposed management actions reflects current knowledge, particularly that gained from programs carried out in Canada (Appendix 1). The concepts and guiding principles identified in Guidelines for Wildlife Policy in Canada were also fundamental in the development of this plan. In addition, the following precepts were recognized:

- Management of Peregrine Falcons is a provincial and territorial responsibility; however, in the national and international interest the Canada Wildlife Act provides for federal involvement in the management of endangered species.
- The anatum Peregrine Falcon is designated as endangered in Canada by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC).
- The recovery plan is national in scope and requires the full support of every governing body that has jurisdiction for peregrine management.
- In Canada, it is still possible to restore the anatum peregrine, inasmuch as there is parent stock both in the wild and in captivity.
- Wildlife agencies in Canada have a responsibility to protect the anatum population from decline.

GOAL AND OBJECTIVES

The goal is to enhance the wild anatum Peregrine Falcon population in Canada to a level at which it is no longer considered endangered or threatened by COSEWIC. This is proposed through two objectives:

1. To establish by 1992 a minimum of 10 territorial anatum pairs in each of zones 1 to 6 shown in this plan.
2. To establish by 1997 in each of five of those six zones (zones 1 to 6) a minimum of 10 territorial anatum pairs naturally fledging 15 or more young annually, measured as a five-year average commencing in 1993.

APPROACH

Certain factors were recognized in preparing this plan. Various anatum subpopulations in Canada have reacted quite independently to the effects of pesticides and the subsequent efforts to control the use of these pesticides in North America. Some subpopulations were extirpated; others persisted at reduced levels. Of these some have expanded since the use of dichlorodiphenyltrichloroethane (DDT) has been controlled, whereas others remain in a tenuous state because DDT still persists at significant levels in their life cycle and may, in fact, be a major barrier to the reintroduction of a viable anatum population. It is also necessary to recognize that anatum management is at various stages of development and intensity in the different provinces and territories. The national approach should establish biogeographical boundaries to facilitate the recovery plan. To reintroduce the anatum to areas where it is extirpated or at reduced levels, annual mass hack releases are required to enhance the probability of pair formation (Appendix 1). Past releases used relatively low numbers of young, as they were primarily designed to test techniques; reintroduction was not the only objective.

On the basis of physiographic features and behavioural differences among peregrine subpopulations, the historical range of the anatum

peregrine in Canada was divided into three regions: Eastern Seaboard and Great Lakes, Interior Plains, and Western Mountains. Each region was subdivided into two or more zones on the basis of historical population levels, habitat, political boundaries, and restoration needs of at least two disjunct populations in each region. The zones are (1) Maritime, (2) Great Lakes, (3) Prairies, (4) Mackenzie River Valley, (5) Northern Mountains, (6) Southern Mountains, (7) Eastern Mackenzie Watershed, (8) Western Canadian Shield, and (9) Eastern Canadian Shield (Figure 1).

The approach used in developing this plan was

1. To identify management problems and factors limiting recovery of the anatum population in Canada.
2. To identify management actions (strategies) required to address, counteract, or overcome the factors limiting recovery.
3. To priorize limiting factors and management actions collectively, on a scale of one (highest) to four (lowest).
4. To identify responsibilities and costs associated with the plan.

LIMITING FACTORS, PROBLEMS, AND MANAGEMENT ACTIONS

This section identifies the major limiting factors and problems in order of priority and the management actions recommended to address them.

PRIORITY I

1. Population Monitoring

   Limiting factors and problems

   - Planning of recovery efforts requires current information on the status of nesting territories within the historical range.
   - It is vital to the planning process to acquire information about occupancy, breeding success, and productivity on remnant as well as reintroduced populations, particularly for

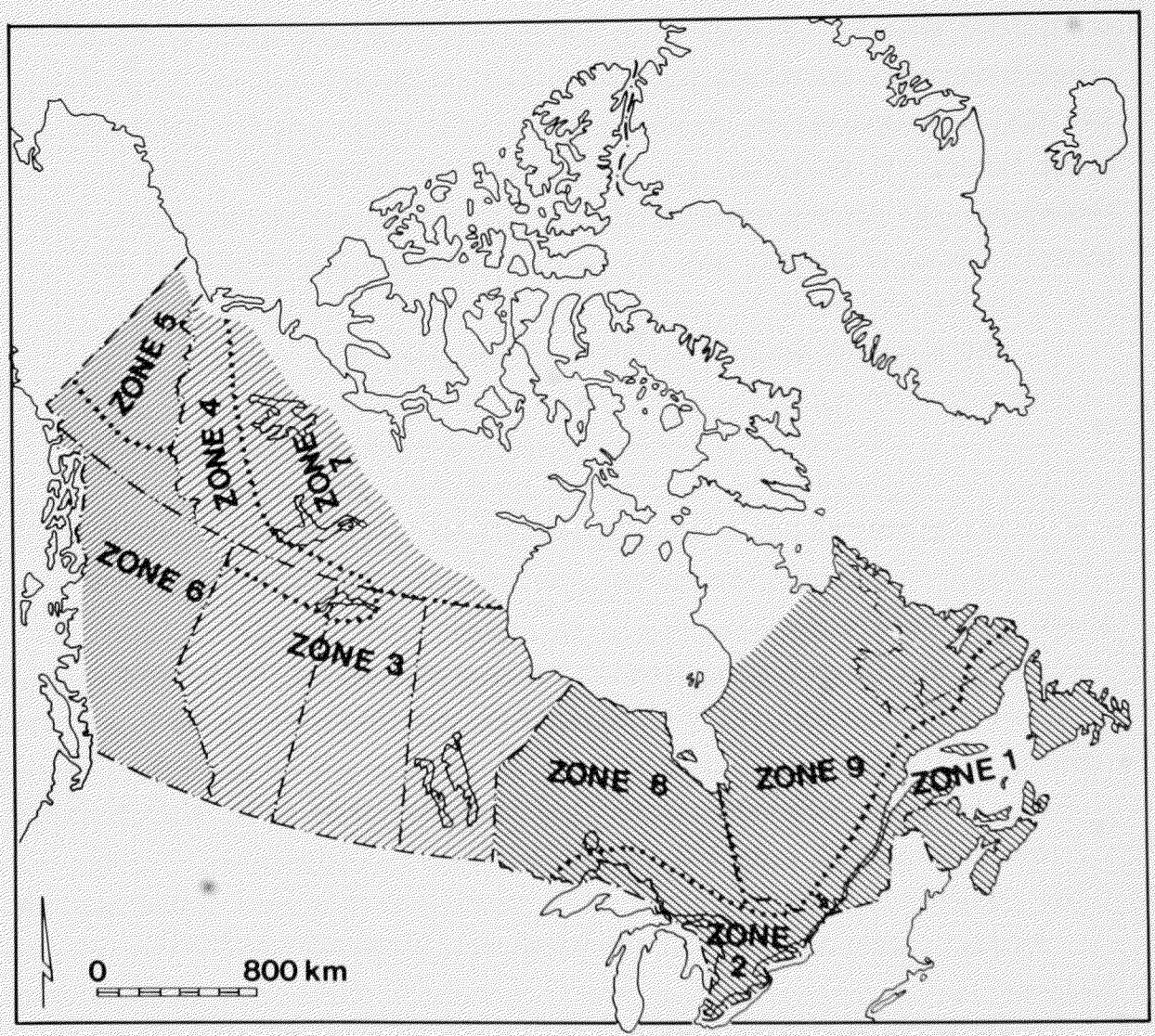

Figure 1. Proposed management regions and zones for implementation of the anatum peregrine recovery plan

identifying to what extent captive stock is required to maintain genetic diversity (see Preserving the Gene Pool, below).

Management actions

- Assess historical and potential nesting territories in Zones 1, 2, and 3 to determine present suitability for peregrine occupancy and release. This assessment should cover at least 80% of all known historic sites.
- Survey remnant as well as reintroduced populations, with emphasis on monitoring the occupancy and productivity of a baseline population. The survey should cover at least 10 territorial pairs in each zone annually (all pairs if less than 10) until 1994.
- The total population should be surveyed every five years from 1990. The Canadian Wildlife Service (CWS) should nationally coordinate the five-year survey and complete the subsequent report.

2. Low Productivity as a Result of Pesticides

Limiting factors and problems

- Residues of dichlorodiphenyldichloroethylene (DDE) persist in the peregrine population and migratory prey species at levels that may limit recovery efforts in some areas.
- Sources of residues -- in breeding grounds, during migration, and in wintering grounds -- in peregrine and prey need to be identified.
- Efforts to identify and manage subpopulations are confounded by lack of information on migration behaviour and on location of wintering grounds of peregrine and prey populations.

Management actions

- Monitor pesticide levels in wild peregrines on their breeding grounds. This requires analysis of the contents of addled eggs, their membranes, and shell thicknesses. Adults should be trapped and blood collected for analysis.
- Monitor pesticide levels in prey. To do this on the wintering grounds it will be necessary to continue and strengthen the

present Canadian-Latin American program aimed at identifying pesticide sources and cooperating with other agencies in modifying use patterns. Monitoring on breeding grounds in each zone will determine whether levels in prey are low enough at core sites to proceed with releases.

- o Areas where remnant populations exist should also be monitored.
- o Discourage the use of specified persistent pesticides. Such a program should focus on human problems (health, economic impact) arising from use of these chemicals. The public should be made more aware of the impact of chemicals that are in use.
- o Seek the support of other institutions (such as the Department of External Affairs and the Canadian International Development Agency) to enhance foreign education programs.

This plan has two recommendations:

- o It is vital that the CWS be funded to maintain and enhance its toxicological expertise and involvement. The roles required at the national level are coordinating the ongoing data collection, maintaining a central registry, performing quality assurance and analysis, and maintaining baseline data on pesticides in the environment at release sites.
- o Also vital to the implementation of the plan is support to the CWS to continue and expand a Latin American pesticide monitoring program: data collection needs standardization, and the program requires long-term funding.

3. Preserving the Gene Pool

- o The World Conservation Strategy calls for efforts to maintain genetic diversity among animals. The anatum subspecies of Peregrine Falcon is the result of thousands of years of selective pressure by the environment. The anatum peregrine has been endangered by contaminants related to man; consequently, man has the responsibility to maintain that subspecies in perpetuity.

Limiting factors or problems

- o Ensuring that a diverse gene pool of pure anatum peregrines is preserved in wild and captive stocks.

- Preventing inbreeding of pure anatum in participating captive breeding facilities.
- Ensuring that only pure anatum are released to the wild.
- Ensuring that facilities holding peregrines meet or exceed expected husbandry standards.

Management actions

- Establish a captive breeding program (i.e., enhance the genetic diversity of present programs) to hold a minimum of 50 pairs of anatum peregrines, of which at least 20 pairs are breeding.
- It is recommended that the 50 pairs be distributed among at least three breeding facilities to reduce the possibility of catastrophic losses from disease or other disaster. A further recommendation is that the captive breeding facilities currently holding anatum stock originally intended for peregrine releases (CWS Wainwright, Saskatchewan Cooperative Falcon Project, and the Macdonald Raptor Research Centre) be supported for the purpose of maintaining the gene pool.
- Establish a record of the pedigree for all anatum peregrines in those facilities producing young for release or holding stock to maintain the gene pool.
- If necessary, inject wild stock into captive breeding facilities to diversify bloodlines. Wild pairing with F^2 captive stock is recommended.
- Monitor all captive breeding facilities to ensure that pure bloodlines are maintained and that the birds are handled in a manner that meets or exceeds the standards of the Canada Council on Animal Care.
- It is assumed that a sufficient genetic pool will be achieved when wild populations comprise approximately 200 birds, distributed over five geographically distinct breeding units (populations), with a minimum of 20 pairs in four of the five units. Figure 2 shows the units and gives current population estimates (there are 132-152 pairs, but they are not distributed as required). If surveys confirm the estimates in Figure 2, the plan to maintain 50 pairs in captivity should proceed.

- It is recommended that the possibility of farming out breeding stock to the private sector to reduce costs be explored.

PRIORITY II

1. Preserving Habitat

Limiting factor or problem

- The loss of nesting habitat and associated prey habitat (primarily wetlands) is a concern, particularly in those zones where human settlement is expanding and the use of land for agriculture, forestry, mining, and hydro-electric development is a threat.

Management actions

- Prey habitats should be designated around each of the occupied nesting territories in each zone to receive suitable protection.
- Provincial and territorial governments and agencies (federal if applicable) should ensure the integrity of core site habitat and minimize disturbance using the protection mechanisms at their disposal.

2. Releases

Limiting factors and problems

- The anatum population was nearly extirpated in Zones 1, 2, and 3. There is no indication that remnant populations will expand into vacant range in the near future.
- There must be a secure source of captive-raised young peregrines for releases.

Management actions

- Action is required most in Zones 1, 2, and 3.

  The approach is as follows:

  - If, in the view of the responsible jurisdiction, residue levels in prey are sufficiently low and if historical site assessments are acceptable, large-scale mass hack releases clustered within Zones 1, 2, and 3 will be conducted for five years (1987 to 1991 inclusive) to establish wild territorial pairs.

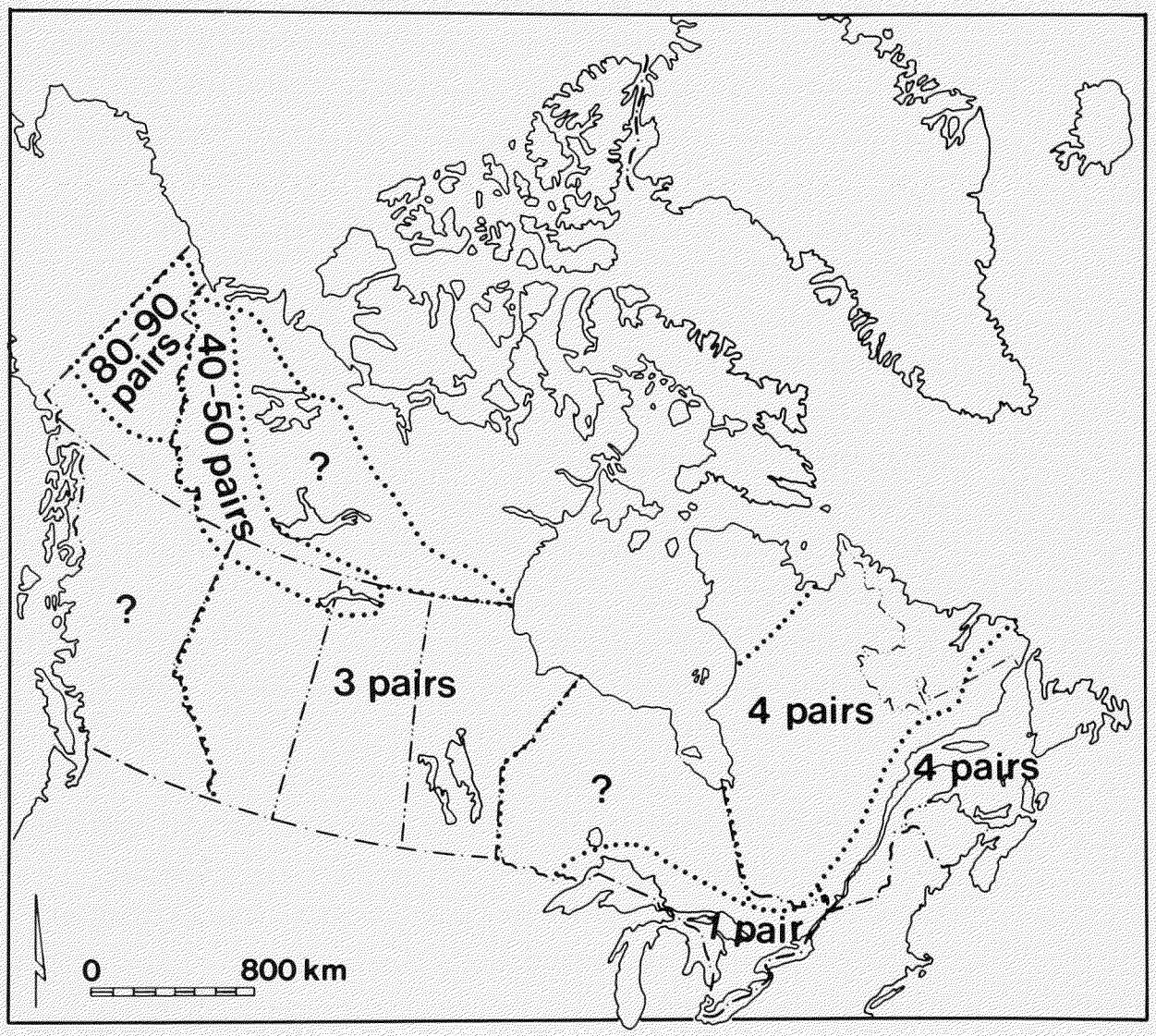

Figure 2. Current anatum population units and population estimates

- The target for releases is a yearly minimum of 30 captive-raised young in each zone (at least 10 young at each release site). See Table 1 for projections of mass hack results.
- Release sites are to be monitored annually to determine occupancy and subsequent productivity of established pairs.
- Wild production is to be supplemented by fostering captive-raised young to a maximum of four wild young plus captive young per nest. Captive-raised young used for fostering will be part of the minimum annual release of 30 young per zone.
- Captive brood stock must be established and maintained to meet the needs of mass hack releases (Table 2 shows the capabilities of the three facilities currently holding peregrines for this program). Yearly production should aim at 20% more than the minimum needs of the mass hack releases (i.e., 110 young). Each facility will be assigned a production goal.
- It is proposed that the captive breeding facilities established to preserve the gene pool (see above) also should produce the young required for releases. These facilities should function on a cost-recovery basis, charging up to $2000 a bird. Upon receiving birds, agencies or organizations would compensate the facility directly.
- Breeding guidelines are to be established to ensure that the young for release are acceptable (i.e., ages of hack-released young and wild fledgings matched).
- Guidelines are needed to ensure that proper procedures are employed during releases and follow-up monitoring.
- In conjuction with pesticide monitoring of wild pairs, it is necessary to collect addled eggs, shell fragments, blood samples, and body parts of dead peregrines for pesticide analysis.
- Hack release priorities are zone 1, 2, and 3.

Table 1. Projected numbers of wild breeding pairs produced by mass hack releases

Year	Captive-produced young released	Number of breeding age birds in wild population[1]			Successful breeding pairs in wild[2]	Young produced by wild pairs[3]
		Captive-produced	Wild-produced	Total		
1987	30	0	0	0	0	0
1988	30	0	0	0	0	0
1989	30	0	0	0	0	0
1990	30	11	0	11	3	6
1991	30	20	0	20	6	12
1992	-	28	0	28	8	16
1993	-	35	3	38	11	22
1994	-	41	7	48	14	28
1995	-	35	12	47	14	28
1996	-	30	18	48	14	28
1997	-	26	26	52	16	32

[1]Assumes a 50% first year mortality and a 15% yearly mortality thereafter.
[2]Assumes 60% of breeding age birds are nesting successfully.
[3]Assumes 2.0 young per successful pair.

Table 2. Current and estimated production capabilities at the three existing breeding facilities

Facility	1985	1986	1987	1988	1989 to 1992 (Young per year)
CWS (Wainwright)	68	69	79	94	80[1]
Macdonald Raptor Research Centre (McGill)	2	6	11	1	30[1]
Saskatchewan Cooperative Falcon Project (Saskatoon)	6(16)[2]	7(26)	13(28)	15	30[1](45)
Total	76(86)	82(101)	103(118)	110	140[1]

1. These figures are estimates.
2. The first figure is the number of young available for use in the plan; the figure in parentheses is the total number of young produced.

PRIORITY III

1. Protecting Peregrines from Human Disturbance

Limiting factors and problems

- Any human activity that elicits a response from resident peregrines, especially from April 15 to September 1, can have a negative impact on the population.
- Poaching is a concern on the breeding grounds -- eggs and small young are preferred.
- Shooting still occurs during all phases of the life cycle.

Management actions

- Against poaching: develop and implement a permanent identification system; maintain confidentiality of nesting locations where appropriate; conduct enforcement workshops to familiarize officers with the problem; implement programs to increase the awareness of the public; seek the assistance of the public in monitoring and reporting suspicious activities at nest sites; and, where necessary, use remote sensing as with TV monitors.
- Against shooting: improve public education, with local emphasis to increase awareness; increase fines; and restrict access to nesting areas or impose firearm restrictions in these areas.
- Against other human disturbance: where appropriate, establish no-disturbance areas of approximately 1 km around nest sites from April 15 to September 1; impose spatial and temporal access restrictions; use volunteers to monitor nests and report disturbances; and strongly enforce these measures.

2. Protection of Peregrines from Predation

Limiting factor or problem

- This is primarily a concern at release sites when released peregrines, lacking adult guidance and protection, are vulnerable to avian and mammalian predators.

Management actions

- These management actions apply only to release and occupied nesting territories.

- Predation could be lessened by ensuring that release sites afforded suitable escape from predators, by access to cliffs and perches. Managers must be prepared to remove avian predators from these areas as required (i.e., Great Horned Owl Bubo virginianus, Red-tailed Hawk Buteo jamaicensis, and Goshawk Accipiter gentilis).
- Manipulation of wild nest sites may be required to prevent losses. This includes rehabilitation of cliff sites and use of dummy eggs.

3. Impacts of Disease and Disaster

Limiting factor or problem

- Although major losses from disease or disasters are not likely in the wild population (including release birds), captive breeding situations are a major concern.

Management actions

- Rehabilitate sick and injured birds where possible.
- Submit dead birds to veterinary labs for necropsy and tissue analyses for pesticide residues.

PRIORITY IV

1. Public Awareness

Limiting factor or problem

- There is a need to increase public awareness of aspects of peregrine management and the use of environmental pollutants and to gain public support and financing for the Peregrine Falcon recovery program.

Management actions

- Where possible, establish high-profile media programs to enhance public awareness of the program.
- Publish and distribute the national recovery plan.
- Publish an annual progress report.

2. Research and Development of More Effective Management Techniques

Limiting factor or problem

- Generally, management techniques have been sufficiently developed to achieve the objectives stated in this plan. However, further refinement of techniques would improve efficiency. Areas requiring further investigation include satellite telemetry monitoring to locate wintering grounds, techniques of releasing falconry trained birds, short-stopping migration (see Appendix 1), and captive breeding techniques, including artificial incubation, pairing, artificial insemination, and imprinting.

Management actions

- Satellite telemetry monitoring of migration behaviour is in the embryonic stage of development in Alaska. Canadian agencies should remain cognizant of American efforts and provide input into the development of programs monitoring Peregrine Falcons.
- Improvements in release techniques will be facilitated by an evaluation of annual release reports and identification of possible improvements. Experiments with new release techniques of falconry-trained birds will be conducted as part of ongoing regional programs primarily using volunteer falconers.
- Short-stopping migration techniques require further evaluation; efforts will concentrate on establishing a program on a volunteer basis through other wildlife agencies in North America.
- Captive breeding methods (artificial incubation, pairing, artificial insemination and imprinting) will be assessed annually to improve techniques. Experimental breeding techniques should be discussed by representatives of all facilities before application.

RESPONSIBILITIES AND COSTS

In determining the responsibilities for implementing and funding this plan two principles were applied:

1. Management of the anatum peregrine is a provincial and territorial responsibility. However, the status of the anatum population is a national concern, in that this population is designated as endangered by COSEWIC. All wildlife agencies in Canada therefore share the responsibility for rehabilitation of this species.
2. Judicious use of present and ongoing resources, such as breeding facilities and management programs, is of paramount importance in minimizing recovery costs.

Table 3 summarizes management actions required and their annual costs. Funding will be provided by the respective governments and agencies according to their priorities. Non-government organizations and other interested parties will be encouraged to assist wherever possible.

The average cost for the captive production of a peregrine was estimated to be $2000 (estimated over five years, assuming facilities are already operational and producing young). Production costs of the captive breeding facilities are to be recovered as follows:

1. Each facility will be assigned a production quota based on its capacity and the minimum needs of the recovery plan, but will maximize production.
2. Facilities will be paid up to $2000 a bird (for each bird in their production quota) by the agencies receiving the birds.

The total estimated annual cost of the recovery program for the first five years (1987-1991) is $374 000 to $456 000. This total reflects only the projects for Priority I and II actions. To some degree, Priority III and IV actions are already being addressed in some provinces and territories. During year five (1991), the need for captive breeding and pesticide monitoring will be reviewed. Funding for the last five years of the program (1992-1996) will be determined following a review of the results of the recovery plan for years one to five.

For the objectives of this plan to reach fruition, a commitment to support and fund all possible aspects of the plan will be necessary.

A national peregrine recovery team will coordinate the implementation of the plan and review recovery efforts.

APPENDIX 1
BACKGROUND INFORMATION

I. PEREGRINE FALCON BIOLOGY

1. Peregrine Falcon Life History and Population Dynamics

The Peregrine Falcon formerly bred widely across Canada, from our southern borders north to the Arctic islands (Bent 1938). Three subspecies have been described, each occupying different areas. Pealei occupies the coastal islands of the Pacific and some coastal areas on the adjacent mainland extending north into Alaska through the Aleutian chain. This subspecies is larger than other subspecies of peregrines; it is generally darker with a unique plumage that is particularly resistant to moisture.

The Arctic tundra peregrine (tundrius) nests north of the treeline in suitable breeding habitat, widely dispersed throughout Arctic America. It is smaller and generally lighter coloured than the other two races (White 1968). Because it breeds much later in the season, its young barely have time to fledge before the fall migration. Based on extrapolations from populations monitored in North American peregrine surveys, it appears that tundrius may have declined to about half of its original breeding population in Canada (Fyfe et al. 1976).

The anatum, or continental, subspecies of peregrines is found from the boreal forest south to Mexico, and originally bred from the Atlantic seaboard to the west coast (Bent 1938). It is a large, dark peregrine with heavy feet, a pronounced orange cast to the breast, and heavy black malar stripes or solid black faces. Following the extirpation of this subspecies in much of its range in Canada, remnant populations are now found in the Yukon, Porcupine and Mackenzie river basins and northern Alberta, with a few pairs reported in the interior of British Columbia. These remaining Canadian anatum birds are in forest areas and feed on forest dwelling birds (White and Fyfe in prep.).

In general all three subspecies are cliff nesters; however, in a few isolated locations in the Arctic, Cade (1960) has documented nesting on the ground or on gravel ridges. Recently, pealei have been recorded using abandoned Bald Eagle nests in trees (Campbell et al. 1977). That

Table 3. Actions and costs of anatum Peregrine Falcon recovery plan.

Priority	Management action	Annual costs ($000)	Comments
I.	1. Population monitoring		
	- historical nest inventory/assessment	3-15	Zones 1, 2 and 3 only (already partially completed in most zones).
	- remnant/reintroduced pop./occupancy, productivity (to 1994)	30	All zones.
	2. Pesticide monitoring		
	- wild population (breeding)		
	- sample collection	12	Six zones, sample 10% of pop. or min. 2 birds, 1985-1989.
	- analysis and dissemination	2	Prov./terr. facilities may be used if quality control is adequate.
	- prey monitoring		
	- wintering (Latin American Program)	35	Field project and analyses costs.
	- breeding		
	- sample collection	30	All zones.
	- analyses and dissemination	8	
	- Promote non-use of specified pesticides	?	An implementation plan will be prepared by the recovery team.
	3. Preserving gene pool		
	- maintaining genetic stock	60-80	Potential for private enterprise to fund.
	- development and maintenance of national studbook	1	

Table 3 (continued)

Priority	Management Action	Annual costs ($000)	Comments
II.	1. Preserving habitat near occupied sites	-	
	2. Releases (mass hack and fostering)		Fostering considerably cheaper.
	- captive breeding, production of young for release	120-140	Cost recovery basis, with agency conducting release paying for birds ($2,000 each).
	- implementation and manpower	-	Depending on release locations (i.e., federal vs. prov./terr. lands), costs will be affected by availability of volunteer help, cost-sharing with other govt. agencies. Many costs may be incidental to other actions.
	Zone 1: 3 release sites	20-30	
	Zone 2: 3 release sites	20-30	
	Zone 3: 3 release sites	20-30	
III.	1. Protect peregrines from human disturbance		
	- identification system	Costs minimal	System at present in effect for all raptors; improvement is recommended.
	- public information programs	?	
	- protection/enforcement	?	
	2. Protect peregrines from predation (release sites)	Costs minimal	
	3. Disease and disaster	1	Necropsy costs.

Table 3 (continued)

Priority		Management Action	Annual costs ($000)	Comments
IV.	1.	Public awareness	?	
	2.	Research and development management techniques	See comments	Included in operational costs for production of birds, implementation and manpower for releases, and population monitoring.
		Administration - National Recovery Team	12	
		Total Costs	374-456	

peregrines traditionally nest in the same territory year after year is one of the characteristics of the species (Ratcliffe 1980), and because of this it is relatively easy to monitor populations and the success of individual pairs.

It is believed that normally the males arrive first and establish a territory. However, females may also maintain a territory until the male arrives (Cade 1960). When the males return, they vigorously defend their territory against other falcons and against most other raptors. The returning male remains near the nesting cliff and frequently advertises his location by rather elaborate courtship flights, carried out at high elevations, that frequently end at the nest cliff itself (R.W. Fyfe, pers. observ.). With the arrival of the female an elaborate courtship ritual takes place for about one week, following which the female remains on the nesting cliff and the male begins to do the hunting for the pair.

Peregrines mature at two to three years of age, and some evidence suggests that initially both sexes return to their natal territory before looking for other territories. However, if the natal territory is occupied, they apparently go in search of other nesting territories and other partners to establish a new breeding pair.

Depending on location and climate, the eggs may be laid from early April (in western Canada) to early June (in Arctic Canada). The first clutch normally averages four eggs. In southern Canada, if the clutch is lost in early incubation, the birds will normally renest. In the Arctic, however, "the short breeding season...prevents most birds from renesting after the loss of their first clutch of eggs...." (Hickey and Anderson 1969).

Incubation lasts 28-33 days (Ratcliffe 1980). The females do most of the incubating; however, the males also incubate for varying lengths of time during the day. The males spend the remainder of their time defending the territory or hunting for food. Average productivity in healthy populations is two or three young for each successful pair (Hickey and Anderson 1969).

Young peregrines remain in the nest for approximately five weeks, at which time they are able to leave on their own. The adults normally provide food to the young for an extended period following fledging (Nelson 1970). However, newly fledged young have been observed attempting to hunt within a few days after leaving the nest (R.W.F., pers. observ.).

Banding data suggest that between 50 and 75% of the young that fledge do not survive to the following year (Enderson 1969, Lindberg 1975). Clearly, the first autumn migration is the most critical in the life of these young birds, as they tend to be tame and extremely awkward and have as yet to develop fully their hunting skills.

The peregrines' most serious natural predators are nocturnal (when this species is relatively vulnerable) and include the Great Horned Owl, raccoon (Procyon lotor), and mink (Mustela vison) (U.S. Fish and Wildlife Service 1967). Few diurnal predators would affect the peregrine, as it is extremely aggressive toward any predator entering its nesting territory. Peregrines have been observed harassing coyotes (Canis latrans), bobcats (Lynx rufus), and even grizzly bears (Ursus arctos) (R.W.F. pers. observ.).

Normally peregrines prey on smaller birds, which they catch in flight, though mammalian prey have been found occasionally at nest sites. An incredible number of species comprise their prey, from small sparrows to waterfowl up to the size (in one observed instance) of a Greylag Goose (Anser anser), which managed to escape (Dunlop 1912). The principal prey in Britain tends to be medium-size birds, particularly doves, pigeons, and birds of flicker and blackbird size (Ratcliffe 1980). In the Arctic there is a tendency for the peregrines to feed heavily on shorebirds and small passerines such as Lapland Longspurs (Calcarius lapponicus) (Cade 1960). Birds breeding along the coast feed heavily on alcid populations, in contrast to those which breed in forested regions, which prey mostly on the larger passerines. On the wintering range peregrines are frequently observed in association with large flocks of shorebirds or other prey species. Some migrants take up residence in South American cities, where they prey heavily on bats, domestic pigeons, and wild doves (R.W.F. pers. commun.). Appendix 2 provides a comprehensive list of prey species.

The migratory habits of peregrines are extremely variable. Some populations are almost non-migratory: although they may move several hundred kilometres, they are not a truly migratory population (Hickey and Anderson 1969). However, most populations of the anatum peregrine tend to be migratory; the extent of the migration can vary considerably, depending on the breeding location. The birds that breed in the north are more migratory than those that breed farther south in warmer latitudes (Hickey and Anderson 1969). Banding data suggest that all Canadian anatum peregrines are migratory and move at least to the southern states and northwest coast of the Gulf of Mexico, and often into South America (Figure 3).

Limited banding data suggest that the tundra peregrines migrate farthest, sometimes as far as the extreme south of South America, although they may also be found wintering in Peru and Ecuador on the west and Suriname on the east (Figure 4).

2. Former and Present Population Status

In eastern North America, peregrine population inventories were done as early as the 1930s and 1940s. These results were compiled by Hickey (1942), who reported a total of 408 nesting territories occupied in the eastern United States, Canada, Labrador, and Greenland. A similar study was subsequently carried out for western North America (Bond 1946). Although Canadians provided information for these two studies, no systematic surveys of Canadian peregrine populations were carried out before the 1960s. Early information on our populations comes from the individual account of explorers, ornithologists, falconers, and interested amateurs who recorded observations of this species during their travels. This information is far from complete, but it did provide an overview that indicated the extent of the Peregrine Falcon's breeding range in this country and served as a basis for planning the intensive surveys that began in the 1960s and have continued to the present.

In Canada, the United States, and western Europe from the late 1940s into the 1960s several investigators began recording events at occupied peregrine nesting territories that could not be explained. These observations included poor reproduction resulting from egg loss, hatching failures, egg-eating by adults, desertion of the nest during

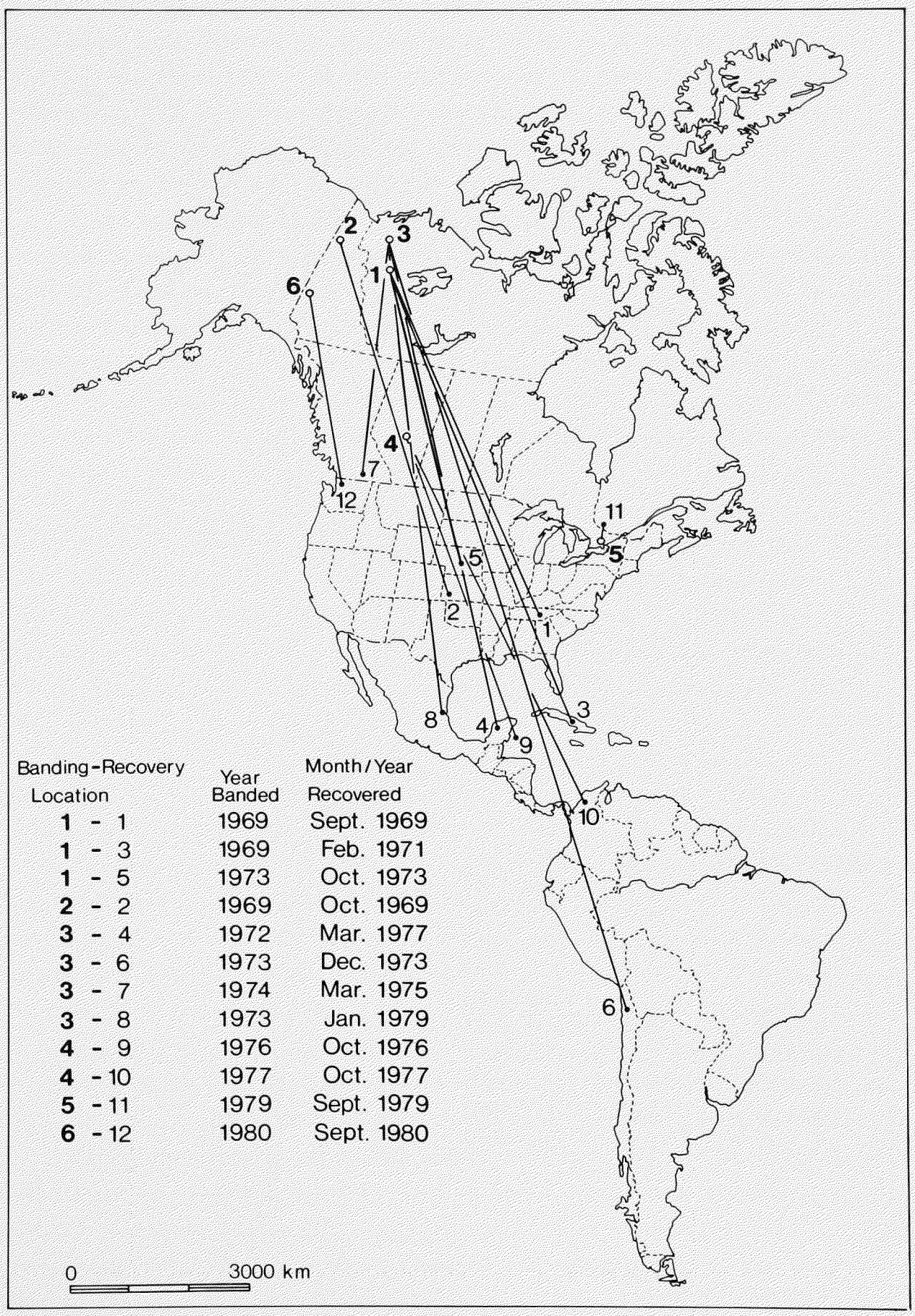

Figure 3. Band recoveries of Falco peregrinus anatum

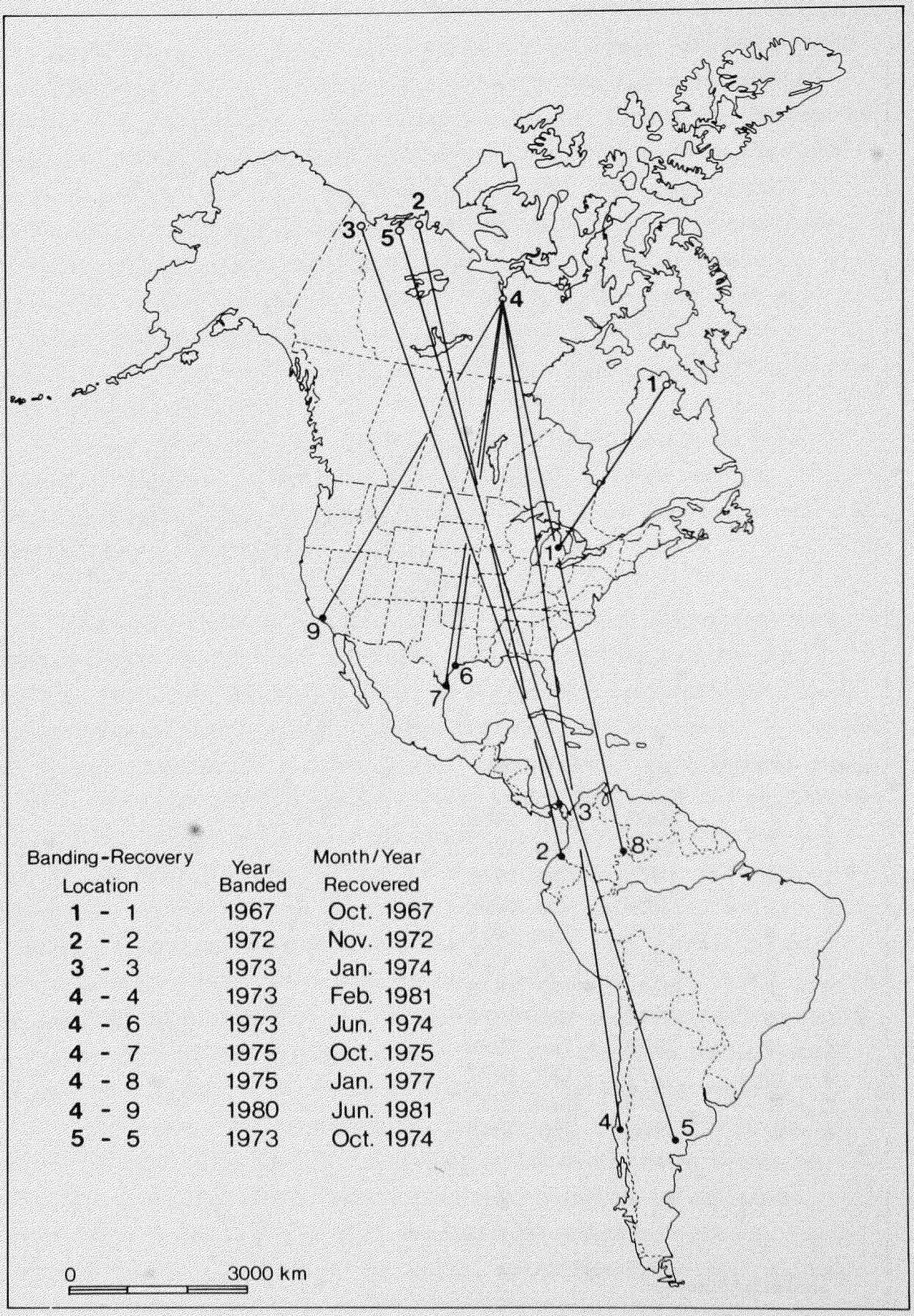

Figure 4. Band recoveries of Falco peregrinus tundrius (CWS unpubl. data)

incubation, the occupation of nesting territories by non-breeding pairs, and an increasing number of lone birds occupying nest cliffs (Hickey and Anderson 1969). Such events were observed in both eastern and western North America, the most publicized one perhaps being the egg-eating observed at the Sun Life Building in Montreal (Hall 1955).

Coincidental with these events was the documentation of a rapid decline of several peregrine populations in Europe and North America. In 1965 Dr. J. Hickey organized a conference of researchers from the United States, Canada, and Europe specifically to present data on peregrine populations (Hickey and Anderson 1969). Canadian data suggested that the anatum population in eastern Canada was in some difficulty; however, it was reported that peregrine populations elsewhere in Canada were stable and were not known to be declining (Fyfe 1969).

A second raptor research planning conference was held in November 1969, at Cornell University. The participants agreed that it was necessary to specifically monitor peregrine populations and the levels of organochlorines found in these falcons and in their prey throughout North America. It was subsequently decided that there should be continent-wide surveys of all peregrine populations every five years beginning in 1970.

The results of the 1970 survey documented the severity of the decline in North American anatum peregrine populations and suggested an initial decline in tundrius (Cade and Fyfe 1970). The second survey in 1975 further verified the decline of the remaining anatum birds and again provided data that suggested a decline in populations of F. p. tundrius (Fyfe et al. 1976). Except for three pairs in Alberta, no other anatum birds were found south of latitude 60°N and east of the Rocky Mountains. In contrast, the most recent surveys in 1980 (Table 4) indicated a recovery of anatum in the extreme northwestern segment of its range, and a few new pairs were documented in the areas of reintroduction (White and Fyfe in prep.). These data also indicated that in many areas the decline of tundrius apparently had ceased and that several population units have stabilized at or about the 1975 level. There was even a suggestion of slight increases in specific tundrius populations. However, one population unit along the north slope of the Yukon has continued to decline and now appears to be extirpated.

Table 4. Summary of Peregrine falcon survey Data in Canada in 1975[1] and 1980

Area	1975[2]				1980[2]			
	Number sites known	Number sites surveyed	Number occupied[3]	Percent occupied	Number sites known	Number sites surveyed	Number occupied[3]	Percent occupied
F. p. anatum								
Alberta, Saskatchewan	48	44	4	9	71	71	9	13
Manitoba	44	44	24	55	48	43	20	47
Mackenzie Valley	15	14	0	0	15	8	0	0
Maritime Provinces	29	8	0	0	29	29	0	0
Ontario	2	2	0	0	-	-	-	-
Southern Labrador	-	-	-	-	5	5	2	40
Southern Quebec[4]	15	12	6	50	66	62	47	76
Yukon River								
F. p. tundrius								
Anderson River[4]	-	-	-	-	8	8	4	50
Banks Island	14	14	7	50	14	1	1	100
Central Arctic Coast	26	26	12	46	27	24	10	42
Horton River	15	15	5	33	15	15	4	27
Interior Barrens	16	13	1	8	32	30	13	43
North Slope, Yukon	14	12	5	42	16	16	2	13
Rankin Inlet[4]	-	-	-	-	11	9	8	89
South Baffin Island[4]	-	-	-	-	8	6	2	33
Ungava Bay	27	25	11	44	29	21	10	48
Victoria Island[4]	-	-	-	-	10	4	4	100
Wager Bay[4]	-	-	-	-	38	22	9	41
F. p. pealei								
Queen Charlotte Islands	67	66	66	100	67	66	64	97

[1]Data from Fyfe et al. 1976.
[2]Includes all new sites found.
[3]Includes all pairs and singles.
[4]Not surveyed in 1975.

3. Reasons for the Population Decline

Throughout the breeding range the factors normally associated with Peregrine Falcon population declines included loss of nesting habitat, a decline in the prey base, predation, and human interference. In 1965 there was no evidence to suggest a major loss of nesting habitat or reduced prey populations (Hickey 1969). Nor was there any suggestion that natural predation had increased or could have induced the decline.

Hickey (1942) estimated a maximum decline of 18% up to 1940 with 45 out of 408 eyries permanently abandoned because of disease, shooting, nest robbing, or other types of human disturbance at the nest. Physical disturbance and human encroachment at the nest cliff apparently were the most important factors. Data from the 1940s to the present suggest that such factors as shooting, egg collecting, and pressure from falconers were at a minimum. There is no evidence nor any reason to believe that there was an increased incidence of disease or natural predation in the wild.

Ratcliffe (1969) suggested that the decline and the aberrant behaviour observed in Europe and North America might be linked to contamination by pesticides. The British had documented eggshell thinning, egg-eating and disappearance, and adult mortality. Equally important, they had analysed some of the eggs and carcasses and had found evidence of organochlorine contamination (Ratcliffe 1969).

The conference resulted in population and pesticide monitoring of raptors and their prey throughout Canada and the United States. By the end of the 1960s there was documented evidence of high residues of DDT, organic mercury (Hg), and cyclodienes (aldrin, dieldrin, endrin, and heptachlor) in the eggs of peregrines, other raptorial birds, and some prey species. These pesticide levels in Canadian wildlife proved to be a useful indicator of potential environmental problems (Fimreite et al. 1970, Fyfe et al. 1969) and were primarily responsible for the studies that led to the restrictions placed on DDT and mercury in Canada in 1969 and 1970.

As a result of the monitoring it was evident that toxic chemical residues in tundra peregrines and their prey were generally not as high as those recorded farther south in anatum populations (White and Fyfe in prep.). However, even low residues were unexpected in the northern population because the chemicals were not being used extensively in Arctic North America. The only explanation was that these peregrines and their prey were accumulating residues while on migration or on the wintering range and were carrying the pollutants in their tissues back to the breeding areas.

There is now considerable evidence that DDT was the principal agent responsible for eggshell thinning and therefore was the principal factor in the decline. However, it should be noted that in a depleted population the significance of each factor is magnified. It is therefore necessary to reduce the effect of each to safeguard the remaining birds and to maximize production so that the populations can increase.

II. CANADIAN CONSERVATION EFFORTS

1. Toxic Chemical Monitoring

CWS began monitoring toxic chemical residues in Canadian wildlife in the early 1960s. By 1966 CWS was looking at residue levels in birds of prey and their prey species. In 1967 CWS began long-term ecosystem monitoring of residue trends in western Canada using the Prairie Falcon (Falco mexicanus) and Richardson's Merlin (Falco columbarius richardsonii) as indicator species. Following the identification of elevated mercury residues in wildlife in 1969, CWS began working more closely with other governmental agencies monitoring pesticides and researching the potential effects of new chemicals on the environment.

In general, between 1970 and 1982, other than limited monitoring of raptor eggs and prey species, the raptor sampling by the CWS and some provincial/territorial agencies was intermittent. There was a shift in emphasis to the captive breeding of peregrines, environmental impact studies, and other areas of concern in relation to toxic chemical research.

A comparison of earlier data with recent monitoring of wild peregrine populations suggests some improvement in the current level of DDE residues in Canadian anatum peregrines (Figure 5). However, Peakall et al. (1975) indicate that a level of 15-20 ppm wet weight DDE in the eggs is sufficient to cause 18% shell thinning and, in turn, reproductive failure. It is therefore clear that some anatum peregrine populations that have been sampled are still accumulating levels of organochlorines high enough to adversely affect production. Tundrius samples from the eastern and central Canadian Arctic indicate residue levels that should not have adverse affects on reproduction (Figure 6).

It is generally accepted that the source of the residues in the peregrines must lie in the prey species consumed (Enderson et al. 1982). The prey probably pick up the residues in areas where the chemicals are either used extensively or accumulate, for example, in some river estuaries. However, it is not clear what percentage of these residues is accumulated during migration, on the wintering range, or on the breeding grounds. Nor has it been shown which prey species account for the majority of the contamination or which areas in the wintering range contribute significantly to the contamination. It has been shown that whole-body residue levels of 1 ppm DDE wet weight in prey are sufficient to allow predatory birds to accumulate levels that will affect reproduction (Enderson et al. 1982). Limited Canadian sampling from 1981 indicates that there are sufficient residue levels in the prey to be of concern from all but one of the areas sampled (Table 5).

In 1981, the Western Raptor Technical Committee recommended that the CWS continue the monitoring of residues in peregrine populations and in their principal prey species. This recommendation was put forward for several reasons. It was considered necessary to obtain current residue levels in Canadian peregrine populations in light of the low residue levels reported by Henny et al. (1982) in migrants (these data differ markedly from the most recent Canadian data, which indicate high levels in recent Canadian anatum egg samples). Moreover, it is necessary to know the levels of toxic chemicals found in the local prey species before initiating reintroductions. It is also necessary to identify which prey species might contribute significant residue levels to wild peregrines in the breeding or wintering grounds, or both. This monitoring was initiated by CWS in 1981.

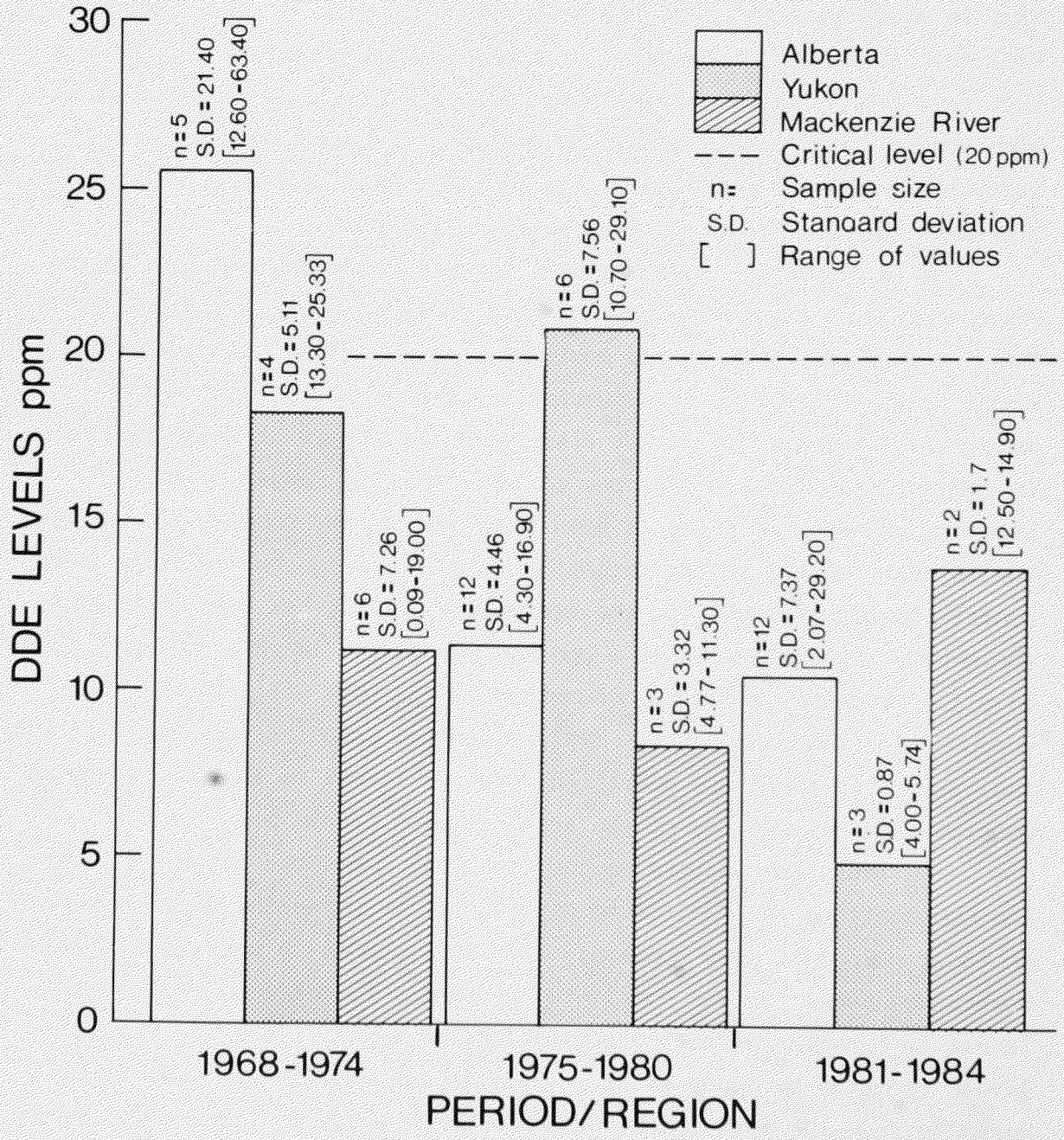

Figure 5. Anatum Peregrine Falcon DDE egg residue levels, 1968-1984, expressed as parts per million wet weight values (CWS unpubl. data)

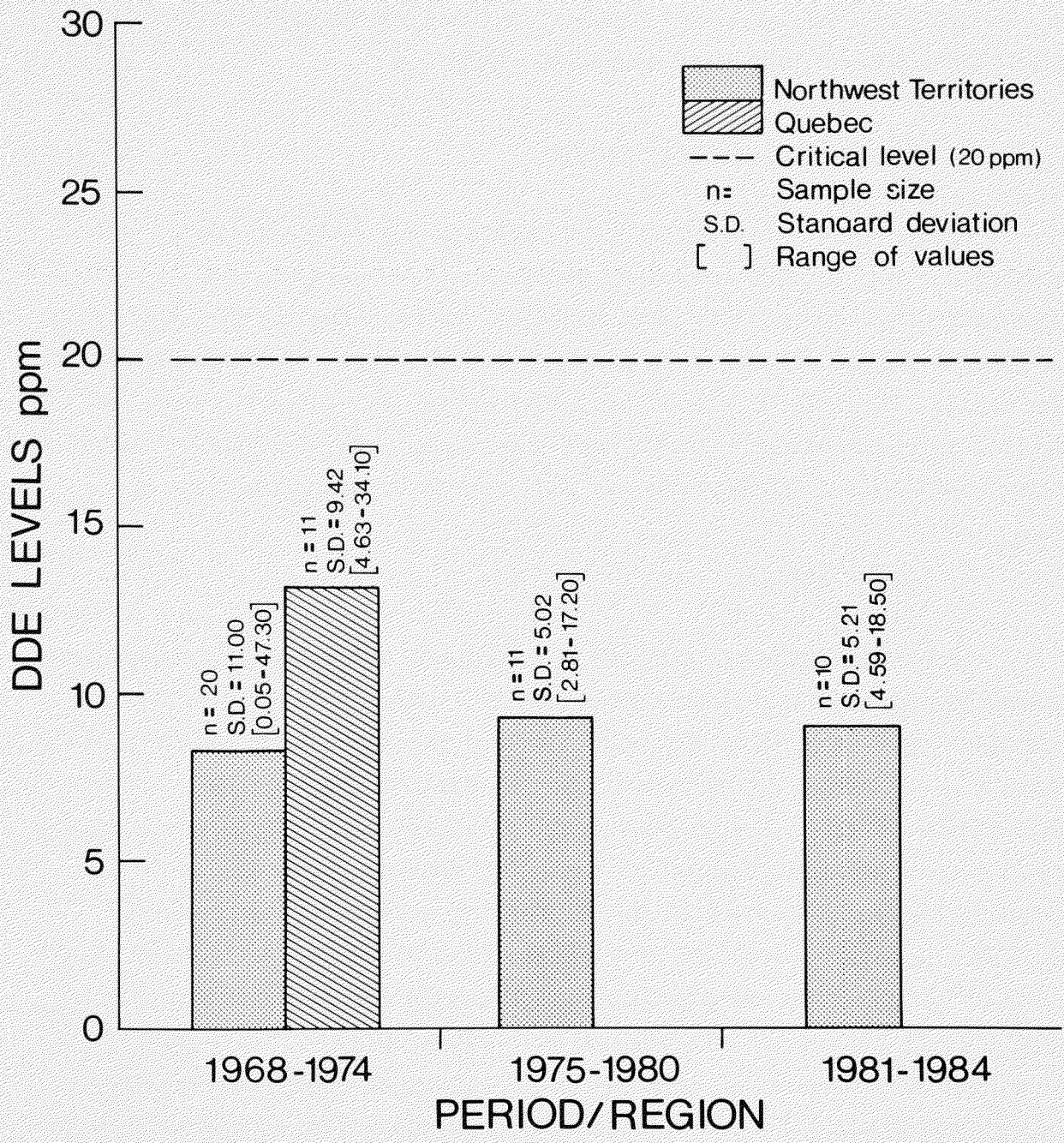

Figure 6. Tundrius Peregrine Falcon DDE egg residue levels, 1968-1984, expressed as parts per million wet weight (CWS unpubl. data)

In addition to the monitoring carried out in Canada, CWS initiated monitoring of prey in the wintering range through a cooperative project in Suriname in 1979, Peru and Ecuador in 1983, Panama and Costa Rica in 1984, Venezuela in 1986, and Mexico in 1987.

2. Toxic Chemical Legislation

Canadian and U.S. legislation controls the specific use of toxic chemicals. Regulations regarding persistent chemicals such as organochlorines and mercury have modified use patterns to the extent that in general these pollutants no longer pose a serious threat in Canada and the U.S.A. The largest use of organochlorines, DDT in particular, has shifted to the developing countries; these chemicals continue to have widespread application in tropical and subtropical regions.

3. Legal Status

In Canada birds of prey are not included under the Migratory Birds Convention Act and therefore come under provincial and territorial jurisdiction. At present all provinces and territories of Canada protect birds of prey either by including them in specific protective legislation or by excluding them from the legislation that identifies the species that may be harvested or taken for various purposes (Table 6). However, the collection of birds of prey for scientific purposes is allowed. Some provinces and territories also allow the collection of birds of prey for falconry purposes, for commercial sale, or for public display. In all instances, any use of birds of prey within a province or territory must be covered by a permit. At present there are no uniform import and export regulations among the provinces. This results in birds being taken illegally in one province and moved to another province without permit or proof of legal collection.

Table 5. DDE residue levels in prey species of the Peregrine Falcon collected in Canada during 1981 (all values in parts per million wet weight)

Species	Maritimes	Quebec	Ontario	Alberta	NWT
Tern, Black	-	-	-	0.92(9)[1]	-
Sandpiper, Semi-palmated	-	0.02(10)	-	-	0.04(7)
Killdeer	-	-	1.17(2)	0.05(2)	-
Plover, Semi-palmated	-	-	-	-	0.32(10)
Dove, Rock	-	0.02(10)	-	-	-
Flicker, Yellow-shafted	-	0.11(10)	0.10(2)	-	-
Kingbird, Eastern	-	-	0.44(8)	0.16(9)	-
Lark, Horned	-	-	-	-	0.14(10)
Bobolink	0.20(10)	0.10(10)	-	-	-
Blackbird, Red-winged	0.16(10)	0.13(10)	0.11(10)	0.02(9)	-
Blackbird, Brewer's	-	-	-	0.89(6)	-
Grackle, Common	-	-	0.18(8)	-	-
Longspur, Lapland	-	-	-	-	0.02(10)
Swallow, Barn	-	-	1.65(10)	-	-
Pipit, Water	-	-	-	-	7.61(2)
Robin	1.50(8)	0.38(10)	0.60(5)	-	-

1. Residue levels are from a pooled sample for each species. The numbers in parentheses after the residue levels indicate the sample size. Underlined DDE levels are sufficiently high to contribute significant residues to their predators (Enderson et al. 1982).

III. PROPAGATION IN CAPTIVITY AND EXPERIMENTAL RELEASES OF PEREGRINE FALCONS

1. Propagation in Captivity

The first documented successful breeding of peregrines in captivity was that by Dr. Renz Waller in Germany in 1942 and 1943 (Waller 1962). Concern for declining peregrine populations prompted serious large-scale attempts to breed them in captivity. The first attempts in Canada were carried out by Mr. Frank Beebe in the mid-1960s. Subsequent attempts were carried out by Mr. Richard Fyfe in the Maritimes and Mr. Joe Simonyi in Ontario. By the early 1970s there were several substantial successes in breeding Peregrine Falcons in captivity.

In 1970 CWS took 12 F. p. anatum nestlings into captivity upon direction from the 39th Federal-Provincial Wildlife Conference. These birds, collected from Alberta, Newfoundland, the Yukon, and the Northwest Territories, were held to maintain a gene pool and provided the initial stock for the CWS breeding project. The breeding program has been divided into four aspects: 1) research related to suitable husbandry techniques for keeping peregrines in captivity, 2) research in developing methods for pairing and propagation of these birds in captivity, 3) the development of suitable methods for reintroduction, and 4) the development of a reintroduction program to be carried out in cooperation with the provinces, territories, and private agencies.

The first problems in captive breeding were those of husbandry. Aside from manpower and housing, it was essential to establish an adequate food source. Several avenues were explored before the Alberta Fish and Wildlife Division agreed in 1976 to provide Japanese Quail (Coturnix japonica) and pheasants (Phasianus colchicus) as a food supply.

Once the peregrines could be maintained, problems related to overwintering, establishing pair bonds, egg laying, copulation, and artificial incubation had to be overcome. Many of these have been solved, but pair bonding and aspects of artificial incubation still present problems. Following the successful propagation of the birds in captivity, several of the initial progeny were held for future breeding stock, and the remainder were used for experimental releases.

Table 6. Protective provincial/territorial legislation applicable to the Peregrine Falcon in Canada (Martin 1979)

Province/Territory	Protected by wildlife or game act	Falconry with permit	Falconry without permit	Take birds from wild with permit	Export within Canada	Possession of dead birds allowed
Alberta	yes	yes[1]	no	yes[2]	yes	no
British Columbia	yes	yes[3]	no	yes	no	no
Manitoba	yes	no	no	no	no	no
New Brunswick	yes	no	yes[4]	no	no	no
Newfoundland	yes	no regulations		no	no	no
Northwest Territories	yes	no	no	yes[2]	yes	yes[5]
Nova Scotia	yes	no	yes[4]	no	no	no[6]
Ontario	yes	no	no	no	no	yes[7]
Prince Edward Island	yes	no	no	yes[2]	yes	no
Quebec	yes	no	no	yes	yes	no
Saskatchewan[8]	yes	yes	no	yes	yes	yes
Yukon[9]	yes	yes	no	yes	yes	no

1. Only anatum Peregrine Falcon allowed for falconry use.
2. Only for scientific purposes.
3. Anatum, pealei, and tundrius Peregrine Falcons allowed for falconry use.
4. Need permit to keep a bird.
5. With a permit authorized by the superintendent under special conditions; rarely if ever occurs for Peregrine Falcons.
6. Allowed with permission.
7. May be possessed if not taken contrary to the law.
8. No falconry regulations but only anatum Peregrine Falcons authorized for falconry.
9. Policy allows anatum, pealei and tundrius Peregrine Falcons for falconry use.

Beginning in 1975 initial experimental releases were made in northern Alberta. In these experiments, young raised in captivity were fostered to wild birds. The experiments were followed in subsequent years by experimental double clutching and hack releases across Canada. All the initial releases were experimental, designed to explore methods for successful release of young back to the wild.

It is hoped that the final aspect, a cooperative reintroduction program, will lead to taking F. p. anatum off the endangered list and to establishing self-sustaining populations in the wild. The facility at Wainwright is now capable of producing approximately 60 anatum peregrines per year for reintroduction by those provinces, territories, and private agencies cooperating with the peregrine program.

In addition to the CWS anatum project, there is also a breeding project to produce tundrius birds to release in the Yukon. At present this project produces 20+ birds a year, the majority of which also go into the reintroduction program in Canada.

2. Experimental Releases

Fostering

Fostering includes the placing of eggs or young under or with wild or captive adults of the same species. This technique can greatly enhance production in a remnant population that has low reproduction. The initial experimental work for fostering peregrines was carried out in Canada in 1975 with the fostering of young under wild parents in northern Alberta. This work has continued for several years and has successfully introduced young into the wild. The adults care for the young, protect them against predators, and provide them with the same basis for survival as young produced in the wild.

The fostering method, when combined with double clutching, also has potential for increasing production. In this technique, the first clutch of pairs that are producing poorly is removed. The adults are then either forced to lay again or left with dummy eggs until their own young or others bred in captivity are returned.

Fostering can also help establish newly formed pairs that have failed to lay or produce in their first nesting attempts. In this way, young bred in captivity can be fostered and fledged by these wild pairs. Normally the human involvement necessary in fostering is minimal because the wild adults take over. However, to double clutch or foster young, nest locations and breeding success must be determined beforehand.

Cross-fostering

In cross-fostering, young or eggs of one species are placed with or under the care of breeding pairs of another species. This allows the release of young peregrines under wild birds of prey in areas where remnant populations of peregrines no longer exist. Experimental work in captive breeding had indicated that raptors have a strong parental tendency and will accept and care for eggs or small young of other species. Initial field experiments were done in 1972 and 1974 in Canada with cross-fostering Prairie Falcons to buteos; in 1982 the Alberta Fish and Wildlife Division successfully cross-fostered peregrines to Prairie Falcons. These experiments clearly indicated that cross-fostering is a useful and successful technique for releasing young. However, there are no data available indicating whether any of the young released in this fashion returned to breed in the areas from which they were fledged.

Cross-fostering is useful for breeding peregrines in captivity as it allows the fostering of peregrine eggs to Gyrfalcons (Falco rusticolus) or Prairie Falcons, which breed earlier. These birds are used as foster incubators or brooders for the eggs or young of the anatum peregrines at Wainwright when the peregrines' eggs are removed sequentially to increase production.

It should be noted that cross-fostering raptor species does entail some risk. Laboratory research with two species of small falcons has indicated that behavioural modifications resulting from imprinting on the foster species can lead to aberrant mate choices. Moreover, the majority of experiments in the field have revealed significantly high mortalities among cross-fostered nestlings in a number of raptor species.

Hacking

Hacking, a falconry technique in which birds of prey are released at a site or box without the care of any adult raptor, is used where there no longer are remnant populations of wild falcons. Humans provide the young with food until the young are able to hunt for themselves. The hack box, an artificial nest box, is placed at an original nest site, an acceptable new nest site, or even at such sites as city buildings. Experimental work on hacking releases has been carried out both in the United States and Canada since about 1975. Many young falcons have been successfully released from hack boxes, and a large number of them have returned to their natal areas to nest.

Predation has been the greatest problem with hacking releases, particularly predation by Great Horned Owls and some mammalian predators. Many possible solutions have been tested, but more experimental work is required to reduce predation from hack sites. Urban releases using tall buildings as the hack site appear to be free from predation and therefore offer an advantage over releases in the wild. Most cities have a good food supply in the form of pigeons and passerine birds. Experimental city releases have proven successful, as demonstrated by the establishment of a pair in Edmonton and the identification of urban-released birds breeding in the wild in northern Alberta.

Mass Hack

"Mass hack" refers to the release of a large number of young from one release site in a particular year. There are several methods, including successive releases from the same release sites, the release of young from two release boxes in close proximity, and the release of young from several release sites within a few kilometres of one another. The objective of this technique is to release as many like-aged young as possible into a given area in order to create a reasonable probability that at least one mature male and female will return to the area during the same breeding season. It is also desirable to get as many young as possible out in the first two years of a release to avoid future conflict with older birds returning and attempting to drive the younger birds out of their territory.

Hold and Release

Holding birds for extended periods before release relies heavily on falconry techniques. The young falcons are held in captivity, trained to hunt, and kept over winter for release the following spring. This method may give the young a better chance of survival; band recovery data indicate that the majority of young falcons are lost in the wild during the first year. Holding and training them to hunt may increase their chances of survival in the wild. However, there are no data on the survival rate of birds released at one year of age, and it is not known whether they would have the same tendency to home to their release site as birds fledged in their first fall. Experimental work in Saskatchewan and Alberta has proven inconclusive, and more research is needed to determine the value of this technique.

The most promising application for this method appears to be in providing potential mates for lone birds that have returned to a suitable nesting territory. Breeding pairs would theoretically form, establish a territory, and return to the site the following year.

Experimental work has been carried out by Dr. T.J. Cade in Baltimore and by the Alberta Fish and Wildlife Division. The results are inconclusive, but it appears that the technique has potential. The manpower requirement for holding and release is higher than for any other method in that it normally requires one person to train one, or at most two, birds for release. However, there are falconers in most regions, and some may be interested in holding and flying peregrines over winter prior to release. The feasibility of enlisting some of these people in holding and releasing birds experimentally should be explored.

A second method that has been proposed is the training of a pair of birds for potential release at a nest site. In this case the falconers would train a matched pair of birds and fly them selectively at a potential nest site. The birds would be flown at the site in the fall and again just as the breeding season was beginning with the hope that the birds would then establish a territory and nest at this particular location. As with the first method described above, this technique would require considerable time; the possibility of finding volunteers could be explored.

There is considerable room for additional research into better methods of reintroduction. We need methods that will get the largest number of birds successfully released into an area and enhance the establishment of new pairs. In so doing, we must strive to maximize the number of birds and minimize the time and personnel required.

IV. MONITORING OF PEREGRINE FALCON POPULATIONS

The first Canada-wide survey of Peregrine Falcon populations was carried out in 1970[1] by government employees and volunteers as part of the more comprehensive North American Peregrine Falcon Survey (Cade and Fyfe 1970). In 1975 a second North American Peregrine Falcon Survey was conducted with considerably greater provincial and territorial involvement (Fyfe et al. 1976). Yukon Territory assumed the entire responsibility for its surveys, and most of the provinces either volunteered assistance or assisted CWS in the coordination of the surveys. The 1980 survey was possible only because of provincial and territorial involvement and a major contribution provided by World Wildlife Fund Canada (White and Fyfe in prep.). CWS involvement in 1980 was greatly reduced, being principally coordination and limited funding where necessary.

Additional population monitoring of peregrines has been carried out at every opportunity in the intervals between the five-year North American Peregrine Falcon Surveys. This has been particularly true in the Yukon and Northwest Territories, where considerable data have been collected and several populations of both *tundrius* and *anatum* have been monitored since 1975. Similarly, additional surveys and population monitoring have been carried out to varying degrees by federal and provincial wildlife agencies.

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[1]Except for British Columbia, the provinces and territories agreed to CWS carrying out the surveys. British Columbia was already monitoring its population of *F. p. pealei* on the Queen Charlotte Islands and decided to work independently.

V. PUBLIC RELATIONS

The peregrine program has had excellent support from the media, from federal and provincial public relation outlets, and also from the Canadian Nature Federation and World Wildlife Fund Canada. This has helped maintain the support necessary to carry out the program. Since the program has been one of considerable controversy, it is doubtful that it would have been initiated without good public relations. In recent years good public relations have played a major role in maintaining provincial support and the high level of support by the federal government.

VI. FINANCIAL SUPPORT

Most of the funding of peregrine research projects in Canada has come from federal and provincial wildlife agencies. In addition, World Wildlife Fund Canada contributed directly to the Alberta, Saskatchewan, and MacDonald peregrine breeding projects, provided funds for research on tundra peregrines by Macdonald College, and made a major contribution to enable full coverage in the Canadian portion of the 1980 North American Peregrine Falcon Survey. It has also paid for follow-up work resulting from the 1980 survey. In Alberta, funding was also provided by the Alberta Fish and Game Association for research into release methods.

APPENDIX 2

PREY SPECIES OF THE PEREGRINE FALCON IN NORTH AMERICA

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1. General Data (* denotes most common species)

Bent, A.C. Life histories of North American birds of prey. 1938.

- Auklets
- Blackbirds
- Bluebirds
- Bobolinks
- Catbirds
- Chimney Swifts
- Coots
- Crossbills
- Crows
- Cuckoos
- *Flickers
- Gallinules
- Grackles
- Grebes
- Grouse
- Goldfinches
- Grosbeaks
- Gulls (small)
- Herons (small)
- *Jays
- Kingbirds
- Kingfisher
- Mallards
- Marsh Hawk
- Meadowlark
- *Mourning Dove
- Murrelets
- *Night Hawk
- Nuthatches
- Orioles
- Petrels
- Pheasants
- Phoebes
- *Pigeons (domestic)
- Plovers
- Ptarmigan
- Quail
- Rails
- Robins
- Sandpipers
- Shearwaters (small)
- Snipe
- Sparrowhawk
- Starlings
- Teal
- Terns
- Thrashers
- Thrushes
- Warblers
- Whippoorwill
- Woodpeckers

Cade, T.J. Falcons of the world. 1982.

- Blue Jays
- Flickers
- Meadowlarks
- Mourning Doves
- Ptarmigan (rock and willow)
- Red-winged Blackbirds
- Shrikes
- Snipe (Common)
- Teal

2. Prey used by the anatum race (* denotes the most common species)

Beaver, L. Biology and management of Peregrine Falcons in northeastern Alberta. 1979.

Blackbird, Red-winged
Blackbird, Rusty
Blackbird, Yellow-headed
Bufflehead
*Coot
Cowbird, Brown-headed
*Flicker, Northern
Gadwall
Grackle, Common
Grebe, Horned
Grebe, Red-necked
*Gull, Bonaparte's
*Gull, Franklin's
Gull, Ring-billed
Kingfisher, Belted
Mallard
*Nighthawk, Common
Phalarope, Northern
Pintail
Plover, American Golden
Rail, Sora
Robin
Sandpipers, Spotted
Shoveler
Snipe, Common
Starling
Swallow, Cliff
Teal, Blue-winged
Teal, Green-winged
Tern, Black
Tern, Common
Thrush, Swainson's
Warbler, Yellow
Woodpecker, Downy
Yellowlegs, Greater
Yellowlegs, Lesser

NOTE: Gulls and waterfowl combined accounted for 63.9% of total biomass and 43.1% of the numbers of prey species taken.

Cade, T.J., White, C.M. and Haugh, J.R. Peregrines and pesticides in Alaska. 1968. Condor 70:170-178.

Blackbird, Rusty
Brant, Black
Canvasback
Chickadee, Black-capped
Chickadee, Boreal
Crossbill, White-winged
*Flicker, Yellow-shafted
Flycatcher
Grebes, Horned
Grebes, Red-necked
Grosbeaks, Pine
Grouse, Ruffed
Grouse, Spruce
Gull, Bonaparte's
Gull, Mew
Gull, Sabine's
Harlequin Duck
*Jay, Gray
Junco, Dark-eyed
Kestrel
Owl, Boreal
Owl, Hawk
Phalaropes, Northern
Phoebe
*Pintail
Plover, Upland
Redpoll
*Robin
Sandpiper, Pectoral
Sandpiper, Semipalmated
Sandpiper, Solitary
*Sandpiper, Spotted

Scaup	*Teal, Green-winged
Scoter, Surf	Tern, Arctic
Scoter, White-winged	*Thrushes, Varied
*Shoveler	Thrushes, Hermit
*Snipe, Common	Thrushes, Swainson's
Sparrow, Fox	Warbler, Orange-crowned
Sparrow, White	Warbler, Yellow
Solitaire, Townsend's	Waxwing, Bohemian
Swallow, Bank	Widgeon
Swallow, Cliff	Woodpecker
Teal, Blue-winged	*Yellowlegs, Lesser

NOTE: From Alaska during spring-summer.

NOTE: Birds accounted for 94.2% of prey taken. Mammals accounted for 5.8% of prey taken.

Hare, Snowshoe	Squirrel, Arctic Ground
Shrews, Dusky	Vole, Red-backed

Enderson, J.H., Craig, G.R., Burnham, W.A. and Berger, D.D. Eggshell thinning and organochlorine residues in Rocky Mountain peregrines, Falco peregrinus, and their prey. 1982. Canadian Field-Naturalist 96: 255-264.

Most frequently found prey species: * denotes most common; ** denotes common.

*Blackbird, Brewer's	Nutcracker, Clarke's
*Blackbird, Red-winged	*Robin
Bluebird, mountain	Siskin, Pine
*Dove, Mourning	*Starling
*Flicker, Northern	**Swift, White-throated
*Meadowlark, Western	Tanager, Western

Prey not frequently taken but available also.

Bluebird, Western	Phoebe, Say's
Cowbird, Brown-headed	Solitaire, Townsend's
Crossbill, Red	Swallow, Cliff
Grosbeak, Black-headed	Swallow, Tree
Jay, Pinyon	Swallow, Violet-green
Jay, Steller's	Vireo, Solitary
Killdeer	Warbler, Yellow-rumped
Kingbird Western	Wood pewee, Western
Nighthawk	

Errington, P.S. Food Habits of southern Wisconsin raptors. 1933. Condor 35(1):19-29.

*Blackbird, Red-winged
Bluebird
*Bobolink
*Chicken, Domestic
*Doves, Mourning
Doves, Rock
*Flicker, Northern
Grebe, Horned
Heron, Green
*Jay, Blue
Kestrel
Killdeer
Martin, Purple
*Meadowlark
*Nighthawk
*Pigeon
Robin
Sapsucker, Yellow-bellied
Swift, Common
Teal, Green-winged
Tern, black
Whippoorwill
Woodpecker, Red-headed

NOTE: From Wisconsin during spring-summer.

Henny, C.J. and Nelson, M.W. Decline and present status of breeding Peregrine Falcons in Oregon. 1981. The Murrelet 62:43-53.

Bluebird, Brewer's
Bluebird, Mountain
Bunting, Lazuli
Cowbird, Brown-headed
Crow, Common
Dove, Mourning
*Dove, Rock
Flicker, Northern
*Grosbeak, Evening
Gull, Bonaparte's
Jay, Gray
Jay, Steller's
Magpie, Black-headed
Meadowlark, Western
Nutcracker, Clark's
Owl, Pygymy
Pheasant, Ring-necked
Rail, Sora
Siskin, Pine
Swallow, Violet-green
Tanager, Western
Teal, Cinnamon
Turnstone, Black
Warbler, Yellow
Waxwing, Cedar
Woodpecker, Hairy
Woodpecker, Lewis

NOTE: From Oregon during spring-summer.

Hunt, G.W., Rogers, R.R. and Slowe, D.J. Migratory and foraging behavior of Peregrine Falcons on the Texas coast. 1975. Canadian Field-Naturalist 89(2):111-123.

Blackbird, Rusty
Catbird, Gray
Coot
Cowbird, Brown-headed
*Dove, Mourning
Dove, Rock
Dove, White-winged
Egret, Cattle

Egret, Snowy
Flicker, Northern
Grackle, Green-tailed
Gull, Herring
Gull, Laughing
Gull, Ring-billed
Heron, Black crowned night
Heron, Green
Kestrel
Lark, Horned
Meadowlark, Western
Plover, American Golden
Rail, King
Redhead
Scaup, Lesser
Shoveler
*Sparrows
Teal, Green-winged
Tern, royal
Willets

NOTE: From Texas during migration.

NOTE: Passerines and small land-birds composed 60% of total. Shorebirds composed 29% of total.

3. Prey used by the pealei race (* denotes the most common species)

Beebe, F.L. The marine peregrines of the northwest Pacific Coast. 1960. Condor 62(3):145-189.

Auklet, Cassin
*Murrelet, Ancient
Petrel (2 species)

White, C.M., Emison, W.B. and Williamson, F.S.L. DDE in a resident Aleutian Island peregrine population. 1973. Condor 75:306-311.

NOTE: * denotes most common according to numbers.
** denotes common according to numbers.

*Crested Auklet
*Least Auklet
**Parakeet Auklet
*Unidentified Auklets
Bunting, Snow
Finch, Gray-crowned Rosy
Goldeneye, Common
Guillemot, Pigeon
Gull, Black-headed
Harlequin, Duck
Kittiwake, Black-legged
**Longspur, Lapland
Mallard
Merganser, Red-breasted
Murrelet, Ancient
**Petrel, Fork-tailed
**Petrel, Leach's
Petrel, Scaled
Petrel, Unidentified
Phalarope, Red
Pintail
Plover, American Golden
**Ptarmigan, Rock
Puffin, Horned
Puffin, Tufted
Sandpiper, Rock
Sandpiper, Wood
Tattler, Wandering
**Teal, Common
Tern, Aleutian
**Tern, Arctic
Turnstone, Ruddy

4. Prey used by the tundrius race (* denotes the most common species)

Cade, T.J. Ecology of the peregrine and gyrfalcon populations in Alaska. 1960. University of California Publications in Zoology, Vol. 63(3):151-290.

Jaeger, Long-tailed
Jaeger, Parasitic
*Longspur, Lapland
Old Squaw
Passerines, Unidentified
Phalarope, Northern
Phalarope, Red
Pintail
Plover, Black-bellied
Plover, Golden
*Ptarmigan
Robin
Sandpiper, Pectoral
Sandpiper, Semipalmated
Sandpiper, Unidentified
Snipe, Common
Sparrow, Fox
Sparrow, Tree
Thrush, Gray-cheeked
Wagtail, Yellow
Warbler, Arctic

NOTE: Waterfowl accounted for 5.04% of total.
Ptarmigan accounted for 15.97% of total.
Shorebirds accounted for 31.92% of total.
Passerines accounted for 42.87% of total.

White, C.M. and Cade, T.J. Cliff-nesting raptors and ravens along the Colville River in arctic Alaska. 1971. Living Bird 10:107-150.

Bluethroat
Dowitcher, Long-billed
Godwit, Bar-tailed
Goose, Canada
Gull, Sabine's
Gull, Unidentified
Jaeger, Long-tailed
*Jaeger Parasitic
Jaeger, Pomarine
Jay, Gray
Loon, Arctic
*Longspur, Lapland
Merganser, Red-breasted
Owl, Short-eared
*Passerines, Unidentified
Phalarope, Northern
Phoebe, Say's
Pintail
Pipit, Water
*Plover, American Golden
Ptarmigan
Sandpiper, Pectoral
Sandpiper, Semipalmated
Sandpiper, Spotted
Scaup, Greater
Scoter
Shorebirds, Unidentified
Shrike, Northern
*Snipe, Common
*Sparrow, Fox
*Sparrow, Tree
Sparrow, White-crowned
Redpoll
*Teal, Green-winged
*Tern, Arctic
Thrush, Gray-cheeked
Wagtail, Yellow
Warbler, Arctic
Warbler, Yellow
Waterfowl, Unidentifed
Widgeon
Yellowlegs, Lesser

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