COSEWIC
Assessment and Update Status Report

on the

Peregrine Falcon
Falco peregrinus

pealei subspecies - *Falco peregrinus pealei*
anatum/tundrius - *Falco peregrinus anatum/tundrius*

in Canada

pealei subspecies – SPECIAL CONCERN
anatum/tundrius – SPECIAL CONCERN
2007

COSEWIC
COMMITTEE ON THE STATUS OF
ENDANGERED WILDLIFE
IN CANADA

COSEPAC
COMITÉ SUR LA SITUATION
DES ESPÈCES EN PÉRIL
AU CANADA

COSEWIC status reports are working documents used in assigning the status of wildlife species suspected of being at risk. This report may be cited as follows:

COSEWIC 2007. COSEWIC assessment and update status report on the Peregrine Falcon *Falco peregrinus* (*pealei* subspecies - *Falco peregrinus* and *pealei anatum/tundrius* - *Falco peregrinus anatum/tundrius*) in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vii + 45 pp. (www.sararegistry.gc.ca/status/status_e.cfm).

Previous reports:

COSEWIC 2001. COSEWIC assessment and update status report on the Peregrine Falcon *pealei* subspecies *Falco peregrinus pealei* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vii + 21 pp. (www.sararegistry.gc.ca/status/status_e.cfm).

COSEWIC 2000. COSEWIC assessment and update status report on the Peregrine Falcon *anatum* subspecies *Falco peregrinus anatum* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vii + 45 pp.

Kirk, D.A., and R.W. Nelson. 1999. COSEWIC update status report on the Peregrine Falcon *pealei* subspecies *Falco peregrinus pealei* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. 1-21 pp.

Jonhstone, R.M. 1999. COSEWIC update status report on the Peregrine Falcon *anatum* subspecies *Falco peregrinus anatum* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. 1-45 pp.

Martin, M. 1978. COSEWIC status report on the Peregrine Falcon *anatum* subspecies *Falco peregrinus* (*anatum, tundrius and pealei*) in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. 1-48 pp. The 1992 assessment was based on 1978 report.

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COSEWIC would like to acknowledge John M. Cooper and Suzanne M. Beauchesne for writing the update status report on the Peregrine Falcon *Falco peregrinus* (*pealei* subspecies - *Falco peregrinus pealei* and *anatum/tundrius* - *Falco peregrinus anatum/tundrius*) in Canada, prepared under contract with Environment Canada, overseen and edited by Dr. Marty L. Leonard, Co-chair, COSEWIC Birds Species Specialist Subcommittee.

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Peregrine Falcon — Photo by Guy Monty.

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COSEWIC
Assessment Summary

Assessment Summary – April 2007

Common name
Peregrine Falcon - *pealei* subspecies

Scientific name
Falco peregrinus pealei

Status
Special Concern

Reason for designation
This subspecies occurs in small numbers along most of the coastal area of British Columbia, where it breeds mostly in protected areas. Its population has shown ongoing increases in size over the last 35 years. Immigration from the United States, where numbers are stable, is likely.

Occurrence
British Columbia

Status history
The Peregrine Falcon in Canada was originally evaluated by COSEWIC as three separate subspecies: *anatum* subspecies (Endangered in April 1978, Threatened in April 1999 and in May 2000), *tundrius* subspecies (Threatened in April 1978 and Special Concern in April 1992) and *pealei* subspecies (Special Concern in April 1978, April 1999 and November 2001). In April 2007, the Peregrine Falcon in Canada was assessed as two separate units: *pealei* subspecies and *anatum/tundrius*. The Peregrine Falcon *pealei* subspecies was designated Special Concern in April 2007. Last assessment based on an update status report.

Assessment Summary – April 2007

Common name
Peregrine Falcon - *anatum/tundrius*

Scientific name
Falco peregrinus anatum/tundrius

Status
Special Concern

Reason for designation
Continental populations of this species have shown continuing increases in population size since the 1970s up to near historical numbers. Population thresholds for downlisting have been achieved for both the *tundrius* and *anatum* subspecies. This recovery has been the result of reintroductions across much of southern Canada, and natural increases in productivity following the ban in Canada of organochlorine pesticides (e.g. DDT). These compounds were the primary factor responsible for the historic decline. These pesticides continue to be used on the wintering grounds, and continue to be found in peregrine tissues, albeit at levels that do not significantly affect reproductive success. The unknown effects of new pesticides regularly licensed for use in Canada are also a concern.

Occurrence
Yukon, Northwest Territories, Nunavut, British Columbia, Alberta, Saskatchewan, Manitoba, Ontario, Quebec, New Brunswick, Nova Scotia, Newfoundland

Status history
The Peregrine Falcon in Canada was originally evaluated by COSEWIC as three separate subspecies: *anatum* subspecies (Endangered in April 1978, Threatened in April 1999 and in May 2000), *tundrius* subspecies (Threatened in April 1978 and Special Concern in April 1992) and *pealei* subspecies (Special Concern in April 1978, April 1999 and November 2001). In April 2007, the Peregrine Falcon in Canada was assessed as two separate units: *pealei* subspecies and *anatum/tundrius*. Peregrine Falcon *anatum/tundrius* was designated Special Concern in April 2007. Last assessment based on an update status report.

COSEWIC
Executive Summary

Peregrine Falcon
Falco peregrinus

pealei subspecies - *Falco peregrinus pealei*
anatum/tundrius - *Falco peregrinus anatum/tundrius*

Species information

The Peregrine Falcon is a crow-sized, medium to large falcon with long, pointed wings. Plumage and morphological differences exist between the three subspecies, *Falco peregrinus anatum*, *F. p. tundrius* and *F. p. pealei* that occur in Canada. Differences are, however, generally clinal, with paler birds occurring in dry areas and darker birds in wetter areas, and smaller birds in the north and larger birds in the south and west.

Recent genetic evidence suggests that the Pealei Peregrine Falcon is genetically distinct from the other two subspecies, but that historically the Anatum and Tundrius subspecies could not be distinguished genetically. Further, current differences between these two subspecies are weak and likely due to the limited gene pool associated with the introductions and introgression from non-Anatum birds from the USA. This report will consider Anatum and Tundrius Peregrine Falcons as a single designatable unit and Pealei Peregrine Falcons as a separate unit. Information on all three subspecies will, however, be included in the report because much of the available evidence is reported by subspecies.

Distribution

The Peregrine Falcon is nearly cosmopolitan in distribution breeding in Eurasia, Africa, Australia, North America and South America. The Anatum Peregrine Falcon breeds from the interior of Alaska, across northern Canada to southern Greenland, then south through continental North America to northern Mexico. In Canada, Anatums breed in all Canadian provinces and territories except Prince Edward Island, Nunavut, and insular Newfoundland. The Tundrius Peregrine Falcon breeds from Alaska, across northern Canada to Greenland. In Canada, the Tundrius Peregrine breeds from the northern Yukon east across the low Arctic islands, northern Northwest Territories and northern Nunavut to Baffin Island, Hudson Bay, Ungava and northern Labrador. The Pealei Peregrine Falcon is restricted to Pacific coastal areas and breeds from the Aleutian Islands and other coastal Alaskan islands south to Oregon. In Canada, the

Pealei Peregrine Falcon breeds on the Queen Charlotte Islands, Triangle Island off the northern tip of Vancouver Island, the north and central BC coast, northern and western Vancouver Island, and eastern Vancouver Island and Gulf Islands south to Nanaimo.

Habitat

The Peregrine Falcon inhabits a wide range of habitats from Arctic tundra, sea coasts, and prairies to urban centres. Most Peregrine Falcons nest on cliff ledges or crevices, but some will also use tall buildings and bridges near good foraging areas. At the landscape level, suitable nest sites are patchily distributed, but can be common locally in some areas. Extensive areas of Canada, where Peregrine Falcons are absent, appear to lack suitable nest sites and/or sufficient prey. Natural nesting habitat has not changed significantly since populations crashed and is still largely available, as are additional sites on human-made structures and in urban areas.

Biology

Peregrine Falcons prey primarily on birds. Burrow-nesting and cliff-nesting colonial seabirds, shorebirds, waterfowl, pigeons and songbirds are important prey for all subspecies. Peregrine Falcons are solitary breeders. Nests are scraped in substrate on cliff ledges. Nestlings leave the nest after about 40 days. Young are fed by adults and may remain in the vicinity of the nest site for three to six weeks after fledging.

Adult Peregrine Falcons demonstrate a high degree of breeding site fidelity and are known to reuse the same nest site for decades. Most juveniles disperse widely from natal areas. Peregrine Falcons are largely migratory although some coastal pairs and northern pairs are resident and may remain at nest sites through winter if food supplies are adequate. This is especially true for Pealei Peregrine Falcons and for urban-dwelling Anatum Peregrine Falcons in eastern Canada. In the fall, most Peregrine Falcons migrate south to the USA, Mexico and Central and South America.

Population sizes and trends

National surveys to examine population trends of breeding Peregrine Falcons have been conducted in Canada every five years between 1970 and 2005. The surveys show substantial increases in Anatum and Tundrius Peregrine numbers since 1970, with notable increases between 2000 and 2005 survey periods. Although Pealei Peregrine Falcons escaped the large declines experienced by the two other subspecies, they did show declines associated with declines in prey. Their numbers have remained relatively stable, but lower than previously measured over this time period. Although these surveys are not designed to determine abundance, they can provide an estimate of minimum population size. Based on this information, the minimum population size in 2005 for Anatum Peregrine Falcons was 969 mature individuals and for Tundrius Peregrine Falcons 199. Together, a minimum population size for Anatum/Tundrius Peregrine Falcons in Canada is 1168 mature individuals. National survey information for Pealei Peregrine Falcons shows a minimum of 176 adult birds. Many additional

breeding pairs of all subspecies exist, especially Tundrius Peregrine Falcons that breed in a vast, relatively uninhabited Arctic landscape.

Limiting factors and threats

The primary factor causing the decline of Peregrine Falcon populations was reproductive failure following exposure to organochlorine pesticides, particularly DDT. Declining trends of organochlorine levels in Peregrine Falcon tissues are encouraging and are linked with improved reproductive success. However, pesticide loads in some birds still exceed safe thresholds and organochlorine pesticides continue to be used in parts of the wintering range of Anatum and Tundrius Peregrine Falcons. A potential new threat from polybrominated diphenyl ethers has also been recently identified. These compounds bio-magnify in natural systems and are present in high concentrations in some Peregrine Falcons. Their effects are unknown.

Pealei Peregrine Falcon populations on Langara Island, British Columbia are known to fluctuate in response to changes in their seabird prey populations, declining as prey declines. Seabirds face threats from introduced mammalian predators at some sites and the Pealei Peregrine Falcons at those sites could decline if seabirds decline; the same may be true for marine coastal nesting Anatum and Tundrius Peregrine Falcons.

Other limiting factors include human disturbance at nest sites, potential for increased legal harvesting for falconry, and illegal harvest of eggs and nestlings for falconry.

Special significance of the species

The Peregrine Falcon has become an icon of the environmental movement in North America and elsewhere. The collapse of Peregrine Falcon populations in southern Canada and the USA helped galvanize a shift in widespread public attitude toward better environmental stewardship.

Existing protection

The Peregrine Falcon is protected under the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), which restricts the import and export of birds and eggs in signatory countries. Like other raptors, Peregrine Falcons are not protected by the federal *Migratory Birds Convention Act*, but they are protected under provincial and territorial wildlife and endangered species acts. COSEWIC has assessed, in 2000, Anatum as Threatened (Schedule 1 of SARA), while Pealei was assessed as Special Concern in 2001 (Schedule 1) and Tundrius was assessed as Special Concern in 1992 (Schedule 3). Species on Schedule 1 are provided protection by the federal government under the *Species at Risk Act*.

COSEWIC HISTORY

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) was created in 1977 as a result of a recommendation at the Federal-Provincial Wildlife Conference held in 1976. It arose from the need for a single, official, scientifically sound, national listing of wildlife species at risk. In 1978, COSEWIC designated its first species and produced its first list of Canadian species at risk. Species designated at meetings of the full committee are added to the list. On June 5, 2003, the *Species at Risk Act* (SARA) was proclaimed. SARA establishes COSEWIC as an advisory body ensuring that species will continue to be assessed under a rigorous and independent scientific process.

COSEWIC MANDATE

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) assesses the national status of wild species, subspecies, varieties, or other designatable units that are considered to be at risk in Canada. Designations are made on native species for the following taxonomic groups: mammals, birds, reptiles, amphibians, fishes, arthropods, molluscs, vascular plants, mosses, and lichens.

COSEWIC MEMBERSHIP

COSEWIC comprises members from each provincial and territorial government wildlife agency, four federal entities (Canadian Wildlife Service, Parks Canada Agency, Department of Fisheries and Oceans, and the Federal Biodiversity Information Partnership, chaired by the Canadian Museum of Nature), three non-government science members and the co-chairs of the species specialist subcommittees and the Aboriginal Traditional Knowledge subcommittee. The Committee meets to consider status reports on candidate species.

DEFINITIONS

Wildlife Species	A species, subspecies, variety, or geographically or genetically distinct population of animal, plant or other organism, other than a bacterium or virus, that is wild by nature and is either native to Canada or has extended its range into Canada without human intervention and has been present in Canada for at least 50 years.
Extinct (X)	A wildlife species that no longer exists.
Extirpated (XT)	A wildlife species no longer existing in the wild in Canada, but occurring elsewhere.
Endangered (E)	A wildlife species facing imminent extirpation or extinction.
Threatened (T)	A wildlife species likely to become endangered if limiting factors are not reversed.
Special Concern (SC)*	A wildlife species that may become a threatened or an endangered species because of a combination of biological characteristics and identified threats.
Not at Risk (NAR)**	A wildlife species that has been evaluated and found to be not at risk of extinction given the current circumstances.
Data Deficient (DD)***	A category that applies when the available information is insufficient (a) to resolve a species' eligibility for assessment or (b) to permit an assessment of the species' risk of extinction.

* Formerly described as "Vulnerable" from 1990 to 1999, or "Rare" prior to 1990.

** Formerly described as "Not In Any Category", or "No Designation Required."

*** Formerly described as "Indeterminate" from 1994 to 1999 or "ISIBD" (insufficient scientific information on which to base a designation) prior to 1994. Definition of the (DD) category revised in 2006.

Environment Canada / Environnement Canada
Canadian Wildlife Service / Service canadien de la faune
Canada

The Canadian Wildlife Service, Environment Canada, provides full administrative and financial support to the COSEWIC Secretariat.

Update
COSEWIC Status Report

on the

Peregrine Falcon
Falco peregrinus

in Canada

pealei subspecies - *Falco peregrinus pealei*
anatum/tundrius - *Falco peregrinus anatum/tundrius*

2007

TABLE OF CONTENTS

List of figures

List of tables

List of appendices

SPECIES INFORMATION

Name and classification

Scientific name: *Falco peregrinus* Tunstall 1771
English name: Peregrine Falcon
French name: Faucon pèlerin
Classification: Class – Aves
Order – Falconiformes
Family – Falconidae
Genus – *Falco*
Species – *peregrinus*

Current classification follows the American Ornithologists' Union (AOU 2006). The species was first described in Europe by Tunstall in 1771. Globally, 19 subspecies of Peregrine Falcon are recognized (Hayes and Buchanan 2002; White *et al*. 2002), three of which are found in North America (Godfrey 1986). They include *F. p. anatum* (Bonaparte 1838), *F. p. tundrius* (White 1968a) and *F. p. pealei* (Ridgway 1871).

Throughout the status report, the three subspecies will be referred to as: Anatum Peregrine Falcon, Tundrius Peregrine Falcon and Pealei Peregrine Falcon.

A recent genetic study shows that Pealei Peregrine Falcons are genetically distinct from Anatum and Tundrius Peregrine Falcons, but that historically (pre-DDT decline) these two subspecies were not genetically distinguishable (Brown *et al*. 2007). The study also found only weak contemporary differences between Anatum and Tundrius, likely due to anthropogenic causes such as the limited gene pool used in reintroductions (Brown *et al*. 2007). For this reason, and because Anatum and Tundrius subspecies show a clear continuum in terms of distribution and plumage (see below), the two subpsecies will be considered as a single designatable unit. Pealei Peregrine Falcon will be a separate designatable unit. Most available information is reported by subspecies, so we will include information for all three subspecies in the report, combining Anatum and Tundrius information where appropriate (e.g. extent of occurrence, population size).

Morphological description

The Peregrine Falcon is a crow-sized, medium to large falcon with long, pointed wings. Males range in length from 36-49 cm and weigh 650 g on average and females range from 45-58 cm and weigh about 950 g. Sexes are best distinguished by size, with females being 15–20% larger and 40–50% heavier than males. There is little size overlap between sexes within a given subspecies (White 1968b, White *et al*. 2002).

Adults have bluish-grey or darker upperparts, a variable-width blackish facial stripe extending from the eye across the malar, and paler underparts that are whitish, greyish, or buffy with variable amounts of blackish spotting and barring. Immatures are similar but upperparts vary from pale to slate or chocolate brown and underparts are buffy with blackish streaks. Plumage and morphological differences exist between subspecies.

Differences are clinal, however, with paler birds occurring in dry areas and darker birds in wetter areas, and smaller birds in the north and larger birds in the south and west. Tundrius Peregrine Falcons tend to be paler and smaller (White 1968b); Anatum Peregrine Falcons have orange or brownish tinges to underparts; Pealei Peregrine Falcons are darker overall and are the largest peregrines, on average, in North America (White *et al*. 2002). Plumage variation within local geographic areas can also be large (e.g. northern Hudson Bay; Court *et al*. 1988a), obscuring differences between subspecies, especially *anatum* and *tundrius*.

Genetic description

Genetic diversity and population structure

A comparison of the historical (pre-DDT decline) and current genetics of Peregrine Falcons in Canada is now complete (Brown *et al*. 2007). The study assessed the level and distribution of neutral genetic variation within and between Canadian populations of the three North American subspecies before and after the DDT-induced population declines. The study addressed the consequences of the population decline and subsequent reintroductions on i) levels of genetic diversity, ii) the validity of the current taxonomy, and iii) genetic structuring across the bottleneck. Contemporary and historical (museum) specimens were genotyped for 11 nuclear microsatellite loci and a 405 nucleotide fragment of the mitochondrial control region. Genetic diversity was low for all populations in both time periods. Neither significant declines in genetic diversity nor consistent bottleneck signatures were found for any subspecies. Contemporary levels of diversity were generally higher than historical levels. The lack of a bottleneck signature was apparently related to the promptness of the recovery and the possible introgression of alleles from non-native individuals (Brown *et al*. 2007).

In terms of population genetic structuring, only two diagnosable genetic groups were identified in historical samples of Peregrine Falcons in Canada: *pealei*, and all other individuals (Table 1). Brown *et al*. (2007) state: “Both mtDNA and microsatellite data show that *F. p. anatum* and *F. p. tundrius* were genetically indistinguishable historically and that contemporary samples are weakly, but significantly differentiated.” Microsatellite analyses suggest that the changes in genetic structure between Anatum and Tundrius are largely due to changes within Anatum alone (Table 1) and that this change is localized to northern Ontario and Québec, where reintroduced Anatum individuals, their descendents and possibly also birds from the USA occur. The change in genetic structure of Anatum in this area is most likely due to the limited gene pool associated with the introductions and introgression from non-Anatum birds from the USA (Brown *et al*. 2007; see below). Breeding Peregrine Falcons of mixed subspecific pedigree, originating from the USA, have been documented in both provinces.

Some individuals from the Strait of Georgia and all samples from the lower Fraser River valley of coastal British Columbia appear to belong to *anatum*, whereas all samples from the outer British Columbia coast belong to *pealei*. However, both subspecies apparently occur on at least some of the same Gulf Islands in the Strait of Georgia (J. Brown pers. comm. 2004).

Table 1. Pairwise estimates of population differentiation derived from mtDNA (ΦST; above diagonal) and microsatellite (FST; below diagonal) data between *F. p. anatum*, *F. p. tundrius* and *F. p. pealei*. Numbers in bold are significantly greater than zero at α = 0.05. (Table modified from Brown *et al*. 2007 with permission of the author).

	Historical populations			Contemporary populations		
Population	anatum (n = 24)	tundrius (n = 49)	pealei (n = 15)	anatum (n = 109)	tundrius (n = 46)	pealei (n = 24)
Historical						
anatum	-	0.019	0.083	0.016	**0.113**	0.134
tundrius	0.003	-	**0.176**	**0.134**	0.021	**0.216**
pealei	**0.077**	**0.080**	-	0.005	**0.256**	0
Contemporary						
anatum	**0.012**	**0.015**	**0.048**	-	**0.251**	0.023
tundrius	0.007	0.001	**0.076**	0.013	-	**0.299**
pealei	**0.087**	**0.091**	0.020	0.047	0.081	-

Reintroductions and genetic integrity

Captive-bred Peregrine Falcons were reintroduced into Canada and the USA following the collapse of North American populations in the 1950s and 1960s. In Canada, about 1,500 pure Anatum Peregrine Falcons were released during the reintroduction program (G. Holroyd pers. comm. 2006). In the USA, 2500 Peregrine Falcons of seven subspecies, including *anatum, tundrius, pealei* and four exotics were released in 13 states including several (e.g. New York, North Dakota, Minnesota, Michigan, Wisconsin, Ohio) adjacent to Canada (Tordoff and Redig 2003). The introduction of subspecies from outside North America into the USA raised concerns about the genetic integrity of Anatum Peregrine Falcons breeding in Canada. Although the origin of breeding birds in the recovering populations of Peregrine Falcons in Canada have not been determined absolutely, there are several reasons to expect that the USA introductions have had relatively little influence on the genetic makeup of the re-established populations in Canada. First, Anatum Peregrine Falcons comprise nearly 40% of the gene pool of birds released in the eastern USA, with Tundrius peregrines contributing a further 23% (Tordoff and Redig 2003). If, as the recent genetic evidence suggests, Anatum and Tundrius were not genetically distinguishable historically (see above), then over 60% of the USA gene pool is of native stock. Secondly, the populations most likely to be affected by introgression with non-native birds (i.e. Peregrine Falcons in southern Ontario, Quebec) are a very small portion of the total Canadian breeding population of Anatum. Finally, some pure Anatum birds released in Canada have bred in the USA, further diluting the impact of non-native birds.

Additional genetic information

Peregrine Falcons are capable of hybridization with Prairie Falcons (*F. mexicanus*) (Oliphant 1991) and Gyrfalcons (*F. rusticolus*), although this is probably extremely rare in the wild. Modern falconry, however, frequently involves the cross-breeding of full species (Peregrine Falcon crosses with Gyrfalcon, Prairie Falcon, and Merlin (*F. columbarius*) to produce falconry stock, and some portion of these hybrids are known to be fertile. Such birds are thought to be "sterilized" by imprinting on humans, but falconry hybrid escapees have paired and produced young in the wild. Although the contribution to the genome of the native Peregrine Falcon population from such sources is believed to be insignificant (White *et al*. 2002), it has not been quantified.

Designatable units

The three subspecies of Peregrine Falcon in Canada have traditionally been assessed separately and treated as three designatable units. For the purposes of this assessment, however, we will consider Anatum and Tundrius as a single designatable unit and Pealei Peregrine Falcon as a separate designatable unit. The rationale for combining the first two subspecies is based on recent genetic evidence showing that historically Anatum and Tundrius Peregrines were not genetically distinguishable and that the weak contemporary differences are likely due to anthropogenic causes, such as the limited gene pool used in reintroductions (Brown *et al*. 2007). Additionally, Anatum and Tundrius subspecies show a clear continuum in terms of distribution and plumage. Because most available information is reported by subspecies, we will include information for all three subspecies in the report, combining Anatum and Tundrius information where appropriate (e.g. extent of occurrence, population size).

DISTRIBUTION

Global range

The Peregrine Falcon is nearly cosmopolitan in distribution, breeding in Eurasia, Africa, Australia, North America (Figure 1) and South America. It is absent only from Antarctica, New Zealand, Iceland and islands of the eastern Pacific Ocean (White *et al*. 2002).

The Anatum Peregrine Falcon breeds from the interior of Alaska, across northern Canada to southern Greenland, then south through continental North America to northern Mexico, except for the coastal Pacific Northwest from Washington north (White *et al*. 2002; but see Canadian Range). It may also nest in coastal Washington and Oregon (Hayes and Buchanan 2002). The Anatum Peregrine winters from southern Canada south through the USA (White *et al*. 2002) to northern South America.

The Tundrius Peregrine Falcon breeds from Alaska, across northern Canada to Greenland. There is overlap with the Anatum Peregrine Falcon south of the treeline in some areas. It winters from northern Mexico, as far south as Chile and Argentina.

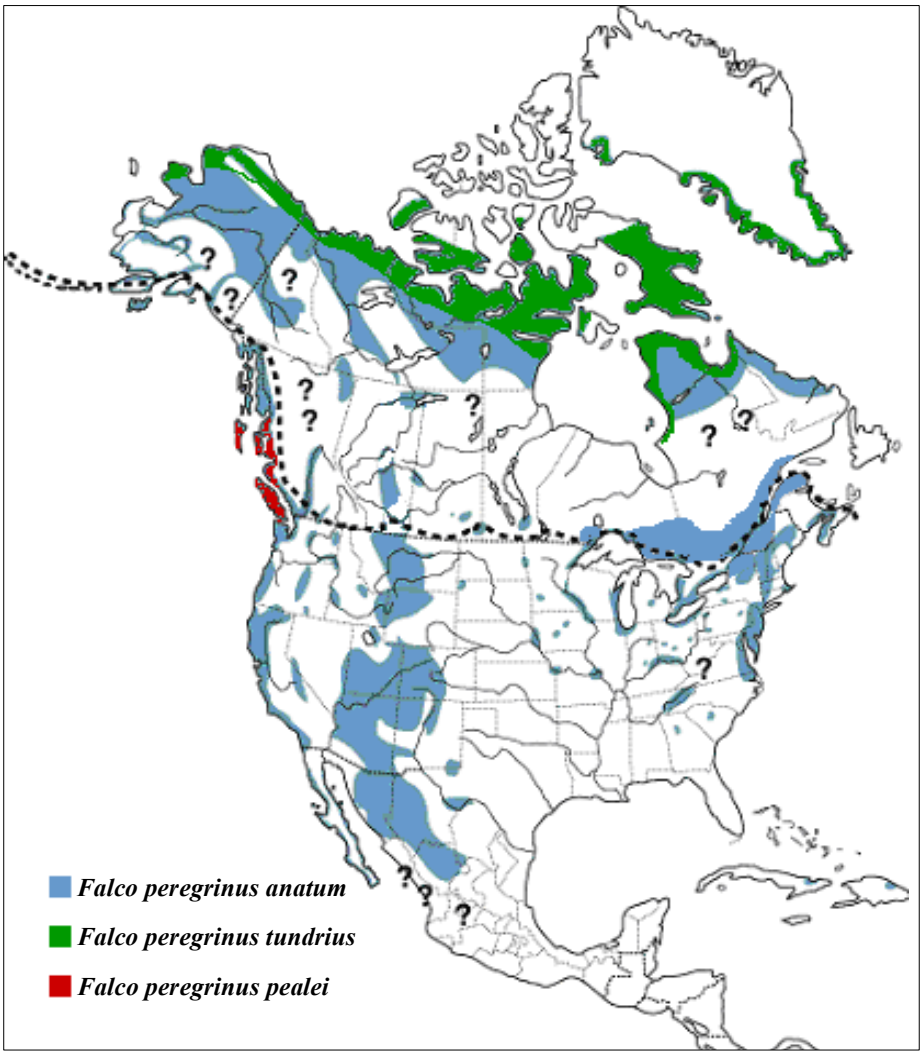

Figure 1. Breeding distribution of the Peregrine Falcon in North America. (Map: © Modified from Birds of North America Inc.). Birds typically winter south of the dashed line.

The Pealei Peregrine Falcon is restricted to Pacific coastal areas and breeds from the Aleutian Islands and other coastal Alaska islands south to Oregon (Hayes and Buchanan 2002). Some Peale's remain as residents in most years. However, other birds disperse to the south, wintering in coastal Washington, Oregon and California, and rarely northern Mexico (Campbell *et al*. 1990; Hayes and Buchanan 2002).

Canadian range

Anatum Peregrine Falcons breed in all Canadian provinces and territories except Prince Edward Island, Nunavut (Rowell 2002) and insular Newfoundland (J. Brazil pers. comm. 2007). They are now known to breed on the southwest coast of British Columbia (southeastern Vancouver Island, the Gulf Islands, and in the lower Fraser River valley (Cooper and Beauchesne 2004; Brown *et al*. 2007; Figure 2).

Tundrius Peregrine Falcons breed from the north slope of the Yukon east across the low Arctic islands and Nunavut north to Baffin Island, Hudson Bay, Ungava and northernmost Labrador (Figure 1; White and Boyce 1988). The Tundrius subspecies migrates through southern Canada during migration.

Pealei Peregrine Falcons breed on the Queen Charlotte Islands (AOU 1957), Triangle Island off the northern tip of Vancouver Island (Kirk and Nelson 1999), the central coast and northern and western Vancouver Island (Campbell *et al*. 1990; Figures 1, 2), and on the east coast of Vancouver Island as far south as at least Gabriola Island (Cooper 2006).

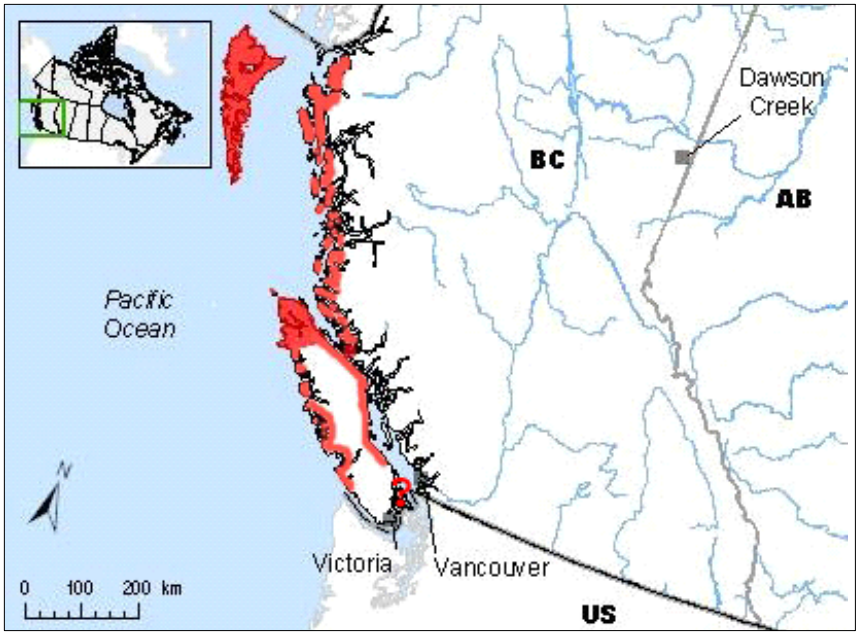

Figure 2. Distribution of the Pealei Peregrine Falcon in Canada (British Columbia). Map source: Cooper 2006 (adapted from CWS website).

Geographic boundaries between the three currently recognized subspecies are not precisely defined. For example, the Pealei Peregrine Falcon breeds on the outer west coast of British Columbia, including the west and north coasts of Vancouver Island (Cooper and Beauchesne 2004; Cooper 2006). However, Peregrine Falcons that have established (probably in the 1970s) breeding territories on southeastern Vancouver Island and the Gulf Islands were thought to be Anatums (D. Doyle pers. comm. 2004) but genetic evidence found traits of both subspecies (Brown *et al*. 2007). Birds fitting morphological descriptions of both Anatum and Tundrius have also been observed throughout Labrador (J. Brazil pers. comm. 2006).

The extent of occurrence (EO) for Anatum is 7 million km^2, Tundrius is 2 million km^2, for a combined EO of 9 million km^2 for Anatum/Tundrius Peregrines. The EO for the Pealei Peregrine Falcon is 47,000 km^2. EO estimates for Anatum and

Tundrius were made by estimating the percentage of Canada's 9.97 million km^2 land mass occupied by Anatum and Tundrius Peregrines (including areas with gaps in known distribution). The EO estimate for the Pealei Peregrine Falcon was made by taking British Columbia's area (9.5% of Canada's land mass) and multiplying by the estimated area of BC (5%) where Peale's occur. Anatum/Tundrius Peregrine Falcons occupy most (>90%) of Canada, whereas Pealei occupy about 0.5%.

The area of occupancy (AO) for Anatum is estimated at 252,500 km^2, for Tundrius at 24,000 km^2, for a combined Anatum/Tundrius AO of 276,500 km^2. The AO for Peale's is estimated at 8,500 km^2. The AO for Anatum was calculated by multiplying the estimated average home range (500 km^2, White *et al*. (2002)) by the number of occupied sites (505) in 2005. The AO for Tundrius was calculated by multiplying the estimated average home range of 500 km^2 by the number of occupied territories (48) in 2005. The AO is much larger than this estimate, however, particularly for Tundrius, as many nest sites remain undiscovered. The AO for Peale's was calculated by multiplying a home range of 78 km^2 (calculated from an estimated 5 km foraging radius reported in Nelson 1990) by the number of occupied sites (109) in 2005.

HABITAT

Habitat requirements

The Peregrine Falcon occurs in a wide range of habitats, from Arctic tundra to coastal islands, desert canyons and major metropolitan centres (Cade 1982). Although its diet is flexible (White *et al*. 2002), it breeds only in habitats with access to sufficient food supplies. In all areas, suitable nest sites are patchily distributed on the landscape level, but can be locally common. Extensive areas of Canada, where Peregrine Falcons are absent, appear to lack suitable nest sites or, if nest sites are present, lack sufficient prey (e.g. Labrador, J. Brazil pers. comm. 2006).

Nest-site characteristics

Most Peregrine Falcons nest on cliff ledges or crevices near good foraging areas. Cliffs ranging from 50–200 m high are preferred (Cade 1960; White and Cade 1971). Other nest sites include: tops of pingos in tundra, cuts for roadbeds, Common Raven *(Corvus corax*) nests on electric-transmission towers, stone quarries, open-pit mines, a variety of buildings, churches, and bridges in metropolitan centres, usually aided by an artificial nest box (Frank 1994; Bell *et al*. 1996; Cade *et al*. 1996) and towers such as power generating stations in rural areas (G. Holroyd pers. comm. 2007).

In British Columbia, Anatum nests typically are on cliffs along lake shores, rivers, or at confluences of major valleys which provide easy access to prey (e.g. Cannings *et al*. 1987). In Alberta, Peregrine Falcon breeding sites are widespread. In southern Alberta most nests are on human-made structures, elsewhere most are natural nest sites confined to the banks of rivers throughout the province, or on cliffs overlooking

lakes in the Canadian Shield region (Alberta Peregrine Falcon Recovery Team 2004). In Ontario, most nest sites are on cliffs or buildings in urban areas (Peck and James 1993). In Labrador, all nest sites are on cliffs (J. Brazil pers. comm. 2006).

Tundrius Peregrine Falcons in Rankin Inlet nest in south- or southwest-facing vertical coastal cliffs (Court *et al*. 1988a), or in rocky bluffs in inland tundra areas (Court *et al*. 1988b).

Pealei Peregrine Falcons typically nest in small cliffs tucked under overhanging Sitka spruce (*Picea sitchensis*) roots on hillsides, but nest cliffs can reach up to 366 m. Pealei Peregrine Falcons also occasionally nest in abandoned tree nests (as low as 12 m) of Bald Eagles (*Haliaeetus leucocephalus*) or cormorants (*Phalacrocorax* spp.) or in natural tree cavities (Campbell *et al*. 1977, 1990).

Habitat trends

Natural nesting habitat appears not to have changed significantly since populations crashed and is still available for reoccupancy (Rowell 2002). Many pairs in southern Canada also nest on human-made structures. Some foraging areas have been markedly impacted by urbanization and other land uses, but alternative areas are available and Peregrine Falcons are usually able to prey on a variety of taxa.

Habitat protection/ownership

Ownership of nesting and foraging habitat is a mix of private and public lands (Rowell 2002). In Ontario, for instance, a substantial number of cliff sites occur on private land (e.g. western Lake Superior, A. Dextrase pers. comm. 2006), and many of the coastal Anatums in British Columbia often nest on private property (D. Doyle pers. comm. 2004). In Quebec, Anatum Peregrines nest on federal lands at Cap Tourmente National Wildlife Reserve and Gros Cacouna. Much of the Mackenzie Valley population and other northern populations are within areas subject to present or future management by Aboriginal governments.

In Nunavut, Tundrius Peregrine Falcon nest sites are widely distributed across Crown Land, national parks and Aboriginal Lands (Table 2, M. Setterington pers. comm. 2006). Peregrine Falcon nest sites in the Northwest Territories are also distributed across a range of Crown, park and Aboriginal land (Table 3, S. Carrière pers. comm. 2007). In Labrador, 10% of nest sites are on federal land and 31% are on Inuit land (J. Brazil pers. comm. 2007).

Most Pealei nest sites are within BC provincial parks and ecological reserves, or Canadian National Park Reserves (Fraser *et al*. 1999). For Pealei Peregrine Falcons, prey is generally protected because most BC seabird colonies are protected in one form or another (Hipfner *et al*. 2002). However, seabirds themselves are facing numerous threats (see Limiting Factors).

Table 2. Habitat jurisdiction of 447 known Tundrius Peregrine Falcon nest sites in Nunavut, based on nests reported in the NWT/NU raptor nest database (GNWT/GNDoE unpublished data, accessed 21 August 2006; Table courtesy of M. Setterington).

Jurisdiction	Nests	% total
Municipal	2	0.4
Inuit Owned Land (IOL)	200	44.7
Conservation Lands*	66	14.8
IOL in Conservation Lands**	23	5.1
Federal Lands	156	34.9
Total Peregrine Nest Sites	**447**	**100.0**

Notes: *Includes National Parks, Migratory Bird Sanctuaries, National Wildlife Areas, Caribou Protection Areas, Wildlife Sanctuaries, etc.; ** Under the Nunavut Land Claims Agreement, some IOLs were located within designated Conservation Areas. The future management status of these lands is unknown, and may be withdrawn from the conservation areas. All raptor nest sites are protected under Nunavut's *Wildlife Act* regardless of land ownership. Includes only sites for which precise Lat and Long coordinate information was available.

Table 3. Habitat jurisdiction of 243 known Peregrine Falcon (includes Anatum and Tundrius) nest sites in Northwest Territories, based on nests reported in the NWT/NU raptor nest database (GNWT/GNDoE unpublished data, accessed 19 December 2006; Table courtesy of S. Carrière).

Jurisdiction	Nests	% total
Municipal & Commisionner Land (GNWT)	14	5.8
Inuvialuit Owned Land (Private)	36	14.8
Gwich'in Owned Land (Private)	33	13.6
Private Land in the Sahtu Settlement Area (Private)	26	10.7
Protected Areas e.g. National Parks, Migratory Bird Sanctuary (GC)	34	14
Crown Land in Land Settlement Areas & Regions (GC)	96	39.5
Crown Land outside Land Settlement Areas & Regions (GC)	4	1.6
Total Peregrine Nest Sites	**243**	**100.0**

Notes: Commissioner's land (GNWT or GNU) usually is part of a community or Territorial Park created for recreational purposes, and some restrictions exist on land use. Beneficiaries of a land claim agreement own surface rights, and in some areas, subsurface rights, to private lands. For these, everybody (individuals and companies) needs permission to access and permits for land use, and some restrictions apply. In protected areas, there are some restrictions on access, all need a permit for land use, and some restrictions apply. On Crown land (all federal), there are co-management instruments of land use application; some limited restrictions apply. Note that Boards administer all land uses in the NT and NU with some co-management principles (consultation). All raptors' nests are protected under both the NU and the NWT wildlife acts (territorial legislations). Also note that Crown land in the territories is considered 'Federal' land under SARA as it relates to critical habitat provisions, but not as it relates to automatic prohibitions. Includes only sites for which precise Lat and Long coordinate information exists.

BIOLOGY

Nest-building

Nests are simple scrapes in substrates that range from 17-22 cm in diameter and 3-5 cm deep. No nest material is added, but debris may accumulate around the scrape. Nests may be placed on bare ridges, ledges on cliffs or buildings, caves, or stick nests of other birds (White *et al*. 2002). Scraping in the substrate begins early in courtship and continues until egg-laying, the timing of which varies with latitude (Nelson 1977).

Number of broods annually

One brood is raised annually, although re-nesting may occur if the nest fails early in the incubation period (Beebe 1974). Some pairs may renest up to three times if eggs are lost early in incubation (Bent 1938).

Clutch size

Clutch sizes show a clinal trend ranging from a mean of 2.9 in Arctic regions to 3.7 in mid-latitudes (Hickey 1969; Palmer 1988), although Court *et al*. (1988a) reported a mean clutch size of 3.62 (*n* = 84 clutches) for Rankin Inlet. In British Columbia, clutch sizes for Peale's and Anatum Peregrine Falcons ranged from 1-5, with 3-4 being most common (Campbell *et al*. 1990). In Alberta, mean clutch sizes for Anatum Peregrines were 3.6 for southern Alberta (Stepnisky 1998) and 3.7 for northern Alberta (Moore 1995). In Ontario, mean clutch size from various areas was 3.4 eggs (*n* = 35, range 2-5; Peck and James 1993). On Banks Island, NT, Tundrius Peregrine Falcons laid an average of 2.9 eggs (*n* = 9, range 2-4) in 2000 (Anonymous undated).

Incubation and fledging

The female does almost all of the incubating while the male feeds her, although experienced males may share a significant portion of the incubation duties (Endersen *et al*. 1972). Incubation begins with the penultimate egg and lasts between 32 and 35 days (Campbell *et al*. 1990; Baicich and Harrison 1997). In the Arctic, however, cold temperatures require that incubation begin with the first egg resulting in asynchronous hatching, with as many as six days between oldest and youngest nestlings (Court *et al*. 1988b). The female does most of the brooding, which is nearly continuous for the first ten days. Nestlings leave the nest after about 40 days, with males typically fledging three to five days earlier than their female siblings. Young are fed by adults and may remain in the vicinity of the nest site for three to six weeks after fledging (Beebe 1974).

Age of first breeding

Peregrine Falcons typically begin breeding at two years of age, although there are records of breeding in one year old birds. Age of first breeding often varies depending on territory availability, with earlier breeding in areas with abundant unoccupied habitat.

Females tend to breed a year earlier than males (Cade and Fyfe 1978; Ratcliffe 1993). In Rankin Inlet, Nunavut, mean recruitment age in a Tundrius population was four years (range 2–8) for males and three years (range 3–5) for females (Johnstone 1998).

Productivity

Productivity (number of fledged young/territorial pair) for Anatum Peregrine Falcons varied greatly from region to region and year to year between the 1970s and 1990s as populations recovered from the effects of pesticides on reproduction. Before the 1980s, declining populations generally suffered depressed annual productivity rates of <1.0 to <0.5 fledglings/territorial pair (Cade *et al*. 1989; Ratcliffe 1993), but after 1984, in association with reintroductions, annual productivity generally increased (Mesta 1999).

Most studies report 1-2 young fledged/territory (White *et al*. 2002), but there are frequent exceptions. For example, in some "good" years, about three young Pealei Peregrine Falcons/territory are produced on Langara Island, British Columbia (Nelson 2001). Productivity for coastal Anatum Peregrine Falcons in British Columbia is also relatively high, as 2-4 fledglings are the norm in recent years for most pairs (D. Doyle pers. comm. 2004). In southern Ontario, many successful Anatum Peregrine nests fledge three young (T. Armstrong pers. comm. 2006). For Tundrius Peregrine Falcons in Rankin Inlet the 25-year average number of young produced per productive pair is 2.5 ± 0.4 (GNDOE unpublished data, 2006; M. Setterington pers. comm. 2006).

Factors influencing annual productivity include: (1) egg and chick mortality from cold, wet, and late spring weather (White and Cade 1971; Court *et al*. 1988b; Mearns and Newton 1988; Ratcliffe 1993; Bradley *et al*. 1997); (2) local yearly variation in prey abundance (Court *et al*. 1988b; Bradley and Oliphant 1991); (3) regional differences in overall prey availability (Ratcliffe 1993) and (4) predation/disease: not quantified for any population but can be locally significant (Cade *et al*. 1989; Tordoff and Redig 1997).

Differences in productivity at individual territories within local populations is an important aspect of Peregrine Falcon ecology. For example, for Tundrius Peregrine Falcons at Rankin Inlet, Nunavut, at regularly occupied (high-quality) sites, productivity over 14 years averaged 1.4 young; at infrequently occupied (poor quality) sites, the average was 0.8 young/pair (Johnstone 1998). At Langara Island, British Columbia, half of all nestlings were produced by 21% of nesting pairs, one-quarter of nestlings were produced by just 9% (Nelson 1990).

Data from the 2000 survey of Peregrine Falcons in Canada found that productivity ranged from 0.6-2.5 young/territorial pair and 1.2-4.0 young/successful pair (successful defined as a pair that produces at least one fledgling; Tables 4-6). Anatum Peregrine Falcons had higher productivity than Tundrius Peregrine Falcons, which had higher productivity than Pealei Peregrine Falcons. The 2005 data indicate that productivity/ territorial pair ranged from 0–2.8 young and from 0–4.0 young/successful pair. As in 2000, Anatum populations exhibited the highest productivity/successful pair while Pealei populations exhibited the highest productivity/territorial pair (U. Banasch pers. comm.).

Table 4. Productivity of Anatum Peregrine Falcons in Canada in 2000 (Rowell *et al*. 2003).

Area	Territorial Pairs	Successful Pairs	Total Young	Average Young/ Territorial Pair	Average Young/ Successful Pair
Labrador, Newfoundland	15	10	24	1.6	2.4
Bay of Fundy (NS,NB)	11	10	20	1.8	2.0
Southern Quebec	25	17	39	1.6	2.3
Southern Ontario	42	26	68	1.6	2.6
Southern Manitoba	2	1	4	2	4.0
Southern Saskatchewan	3	1	4	1.7	2.5
Alberta south of 58	23	19	57	2.5	3.0
South Interior BC	1	nd	nd	nd	nd
Lower Mainland BC	5	nd	nd	nd	nd
Gulf Islands/se Vancouver Island, BC	9	nd	nd	nd	nd
Alberta North of 58	29	8	21	0.7	2.6
Porcupine River, Yukon	35	21	44	1.3	2.1
Peel River, Yukon	22	12	14	0.6	1.2
Yukon River, Yukon	46	22	68	1.5	3.1
Southern Lakes, Yukon	nd	nd	nd	nd	nd
Mackenzie Valley, NT	80	36	80	1.0	2.2
Total/average	348	184	444	1.5	2.5

nd = no data

Table 5. Productivity of Tundrius Peregrine Falcons in Canada in 2000 (Rowell *et al*. 2003).

Area	Territorial Pairs	Successful Pairs	Total Young	Average Young/ Territorial Pair	Average Young/ Successful Pair
Ungava Bay, Quebec	nd	nd	nd	nd	nd
North Slope, Yukon	7	7	15	2.1	2.1
Rankin Inlet, Nunavut	22	16	37	1.7	2.3
Tuktut Nogait NP, NT	18	10[1]	18	1	2.6[2]
Total/average	47	33	70	1.6	2.3

[1]six additional pairs not included as nests not observed

[2]calculated from 7 pairs that produced 18 young. Other 3 pairs had 1-2 young

nd = no data

Table 6. Productivity of Pealei Peregrine Falcons in Canada in 2000 (Rowell *et al*. 2003).

Area	Territorial Pairs	Successful Pairs	Total Young	Average Young/ Territorial Pair	Average Young/ Successful Pair
Langara Island	7	5	9	1.3	1.8
Queen Charlotte Islands	44	nd	nd	nd	nd
N. Vancouver Island/Scott Islands	12[3]	nd	nd	nd	nd
Triangle Island	6	nd	nd	nd	nd
Total/average	69	5	9	1.3	1.8

[3]Productivity only observed at 2 nests for a total of 3 young; nd = no data

The unweighted average for Anatum Peregrine Falcon productivity over the eight national surveys through to 2005 is 2.2 fledglings/successful pair (Rowell *et al*. 2003; U. Banasch pers. comm.; Table 7). Productivity for Anatum Peregrine Falcons in 2005 (2.2 young fledged/successful pair and 1.3 young fledged/territorial pair) was at the lower end of the range from 1970-2005 (Table 7). It is difficult, however, to make meaningful comparisons on productivity across sites and years using unweighted data because of differences in survey methods and effort (e.g. surveys can vary from complete coverage of core zones to checks on known nest sites).

Table 7. Productivity of Peregrine Falcons in Canada from 1970-2005 (Rowell *et al*. 2003; 2005 data from U. Banasch pers. comm.). Numbers are average young fledged/successful pair; ( ) average young fledged/territorial pair.

Area	1970	1975	1980	1985	1990	1995	2000	2005
Anatum								
Labrador, Newfoundland	2.0(2.0)	0	nd	3.0(1.5)	3.3(2.6)	2.2(1.0)	2.4(1.6)	2.2(1.0)
Bay of Fundy (NS,NB)	0	0	0	0	2.0(1.2)	2.4(2.0)	2.0(1.8)	1.3(0.9)
Southern Quebec	0	nd	2.0(2.0)	0	1.9(1.4)	2.6(2.0)	2.3(1.6)	2.3(1.6)
Southern Ontario	0	0	0	0	2.0(1.3)	1.5(1.1)	2.6(1.6)	2.7(2.3)
Southern Manitoba	nd	nd	0	0	2.0(1.0)	3.0(1.5)	4.0(2.0)	3.5(2.3)
Southern Saskatchewan	0	nd	0	0	1.0(0.5)	1.5(1.5)	2.5(1.7)	0(0)
Alberta south of 58	3.0(1.5)	0	0	2.0(2.0)	1.5(1.0)	3.0(0.8)	3.0(2.5)	2.7(2.1)
South Interior BC						nd	nd	2.5 (2.0)
Lower Mainland BC						nd	nd	4.0 (0.6)
Gulf Islands/se Vancouver Island, BC							nd	2.0 (0.8)
Alberta North of 58	0	0	3.2(2.1)	0	2.6(1.4)	2.8(2.2)	2.6(0.7)	0.9(0.9)
Porcupine River, Yukon	nd	nd	1.7(1.2)	2.6(2.0)	2.8(1.7)	2.3(1.3)	2.1(1.3)	2.1(0.9)
Peel River, Yukon	nd	nd	0	2.3(1.9)	3.2(2.4)	2.1(0.9)	1.2(0.6)	1.2(0.6)
Yukon River, Yukon	2.0(2.0)	1.0(0.4)	2.2(1.3)	2.8(2.2)	2.4(1.7)	2.7(1.6)	3.1(1.5)	1.4(1.0)
Southern Lakes, Yukon						3.0(3.0)	nd	nd
Mackenzie Valley, NT	2.3(1.4)	1.3(0.9)	2.0(1.5)	2.1(1.7)	2.6(2.1)	2.6(1.8)	2.2(1.0)	2.4(1.6)
Total/average	**2.3(1.7)**	**1.2(0.7)**	**2.2(1.6)**	**2.5(1.9)**	**2.3(1.5)**	**2.4(1.6)**	**2.5(1.5)**	**2.2(1.3)**
Survey average							**2.2(1.5)**	
Tundrius								
Ungava Bay, Quebec	1.7(1.3)	1.8(1.8)	2.7(2.7)	3.2(2.7)	3.1(2.9)	nd	nd	nd
North Slope, Yukon	nd	nd	0	0	0	2.3(1.8)	2.1(1.7)	2.6(1.8)
Rankin Inlet, Nunavut	nd	nd	3.3(2.9)	1.8(0.6)	2.5(0.8)	2.1(0.7)	2.3(1.7)	?(0.1)
Tuktut Nogait NP, NT	nd	nd	nd	nd	nd	nd	2.6(1.0)	nd
Total/average	**1.7(1.3)**	**1.8(1.8)**	**3.0(2.8)**	**2.5(1.7)**	**2.8(1.9)**	**2.2(1.3)**	**2.3(1.6)**	**2.6 (1.0)**
Survey average					**2.4(1.7)**	**2.3(1.8)**		
Pealei								
Langara Island	2.2(2.2)	2.4(2.0)	2.2(2.2)	2.0(1.6)	2.8(2.0)	2.0(1.7)	1.8(1.3)	2.8(2.8)
Queen Charlotte Islands	2.5(nd)	3.2(nd)	2.5(2.1)	nd	nd	nd	nd	nd
N. Vancouver Island/Scott Islands	nd	nd	nd	nd	nd	nd	nd	nd
Triangle Island						nd	nd	nd
Vancouver/Gulf Islands							nd	2.2(1.0)
Total/average	**2.4(2.2)**	**2.8(2.0)**	**2.4(2.2)**	**2.0(1.6)**	**2.8(2.0)**	**2.0(1.7)**	**1.8(1.3)**	**2.5(1.4)**
Survey average							**2.3(1.9)**	

nd = no data

Models predicting population trends for northern and southern Alberta in the early 1990s required >1.7 fledglings/territorial pair for population growth (Court 1994; Stepnisky 1998). The national average has remained at 1.5 fledglings/territorial pair (i.e. lower than required by the models) for the last decade. Rowell *et al*. (2003) suggest a slower rate of increase for southern populations through to 2005 because fostering of new birds was discontinued.

Long-term productivity

Long-term reproductive success has been reported for Peregrine Falcons at some Canadian locations. At Langara Island, BC, a male Pealei Peregrine Falcon raised 22 young in 7 years and one female raised 18 young in 8 years. At Rankin Inlet, Tundrius Peregrine Falcons at frequently occupied nest sites had mean breeding life spans of 2.7 years for males and 2.9 years for females, with mean lifetime production of 4.7 young (Johnstone 1998). A more recent example of long-term productivity is of a female Anatum Peregrine from Wisconsin that fledged 41 young over 15 years (Septon 2004).

Life span and survivorship

Maximum longevity records for banded birds range from 16 to 20 years. In captivity, few live beyond 20 years, although a maximum of 25 years has been reported (White *et al*. 2002). Banded Peregrine Falcons in Alberta are known to return for at least 11-12 years (Rowell and Stepnisky 1997). First-year survival is not well known but is generally assumed to be 40–50% (see Ratcliffe 1993 for higher estimates in Britain). Tordoff and Redig (1997) estimated a minimum of 23% fledgling survival in Anatum Peregrine Falcons in midwest USA. Beebe (1960) proposed that survival among yearling Pealei Peregrine Falcons was low due to their harsh maritime environment. A minimum of 63% of breeding female and 74% of breeding male Peale's Peregrines are estimated to survive annually (Nelson 1988, 1990). In Rankin Inlet, survivorship estimates of adult Peregrine Falcons ranges from 0.71 to 0.85 for males and 0.69 to 0.81 for females, depending on the analytical technique used and cumulative data availability (Court *et al*. 1989 using Turnover; Johnstone 1998 using Turnover and Cormack-Jolly-Seber and Franke *et al*. 2005 using Cormack-Jolly-Seber). Court (1994) estimated the average annual mortality of adult Anatum Peregrine Falcons in northern Alberta to be 16.4 %, and Stepnisky (1998) estimated 14% annual mortality for adult Anatum Peregrine Falcons in southern Alberta.

Known population growth rates in recent years and well-known productivity rates indicate true adult survival rates of 80–85% for migrant and 85–90% for resident Peregrine Falcons (White *et al*. 2002).

Diet

Peregrine Falcons prey primarily on birds (Sherrod 1983) ranging in size from hummingbirds to geese (White *et al*. 2002). Birds are typically caught in flight so Peregrine Falcons require an ample supply of suitable prey species in areas that permit

aerial hunting (Beebe 1974). Burrow-nesting and cliff-nesting colonial seabirds, shorebirds, waterfowl, other waterbirds, pigeons and songbirds are important prey for all subspecies. Other prey may include bats, rodents, other mammals and, rarely, insects and fish (White *et al*. 2002).

Peregrine Falcons that nest on tundra can take ptarmigan (*Lagopus spp*), shorebirds, small songbirds such as longspurs and Snow Buntings (*Plectrophenax nivalis*) and ducks. Small mammals, particularly lemmings and juvenile arctic ground squirrels (*Spermophilus parryii*), can comprise a major portion of the diet in some parts of the range (Court *et al*. 1988a, Bradley and Oliphant 1991). In Labrador, for instance, male peregrines have been observed delivering small mammals such as lemmings and deer mice to the nest (J. Brazil pers. comm. 2007). In taiga areas, they take shorebirds, woodpeckers, jays, and thrushes. Anatum Peregrine Falcons in the interior of North America tend to take doves, pigeons, waterfowl, rails, gulls (G. Holroyd pers. comm. 2006) and songbirds. In Labrador, coastal nesting female Peregrine Falcons appear to favour Black Guillemots (*Cepphus grille*, D. Amirault, J. Brazil pers. comm. 2006). Shorebirds are the favoured food in the Bay of Fundy where nest sites are close to shorebird migration habitat (D. Amirault pers. comm. 2006) and in the Fraser River estuary, British Columbia, where predation on sandpipers by increasing Peregrine Falcon populations has apparently caused a shift in sandpiper migratory behaviours (Ydenberg *et al*. 2004).

In the Strait of Georgia region of British Columbia, European Starlings (*Sturnus vulgaris*) account for a large proportion of Anatum Peregrine's diet (R.W. Campbell pers. comm. 2006). Pealei Peregrine Falcons usually nest near a seabird colony and seabirds comprise a high percentage of their diet. These peregrines most frequently take auklets, murrelets, and storm-petrels, with the Ancient Murrelet (*Synthliboramphus antiquus*) being the most important prey species (Nelson and Myres 1976). Peregrine Falcons show great flexibility in prey use and some researchers believe it is impossible to link declines in prey with declines in Peregrine Falcons (Ratcliffe 1993). However, a decline of Pealei Peregrine Falcons on Langara Island, BC, is considered by some researchers to be linked to corresponding declines in preferred seabird prey abundance (Nelson and Myres 1976), even though seabirds remain relatively abundant and available compared to bird prey in other peregrine habitats.

Peregrine Falcons are thought to eat carrion only rarely (Holland 1989). On Triangle Island, BC, however, an island with very high seabird populations, Pealei Peregrine Falcons have been observed foraging on dead seabirds that perished due to mid-air collisions (L. Savard pers. comm. 2004). Similarly, in Rankin Inlet in 2006, a Tundrius Peregrine Falcon was trapped in a gill net while feeding on dead char (M. Setterington pers. comm. 2006).

Predation and mortality

Predation is not an important limiting factor for Peregrine Falcons. Of 455 peregrine fatalities in the mid-west USA, only 15 were known to be caused by

predators. The majority of deaths where the cause was known were due to collisions with buildings (17%), collisions with vehicles (11%), other accidents (7%), disease (6%) and by other Peregrine Falcons (4%; Tordoff *et al*. 2000). Great Horned Owl (*Bubo virginianus*), Northern Goshawk (*Accipiter gentilis*) and red fox (*Vulpes vulpes*) are the main known predators of wild Peregrine Falcons (Rowell 2002). Hacked young falcons have also been taken by Golden Eagle (*Aquila chrysaetos*), cougar (*Puma concolor*), and American marten (*Martes americana*), although these predators probably do not often take wild-reared young (Hayes and Buchanan 2002).

In Alberta, mortality of young results primarily from climatic factors (cold, wet weather), predation by red foxes, Golden Eagles and Great Horned Owls or collisions with man-made structures and vehicles when young birds first fledge (Sherrod 1983; Stepnisky 1996). In Ontario, non-breeding females have been observed to kill resident females and young in the nest (A. Dextrase pers. comm. 2006).

Physiology

Peregrine Falcons proved highly susceptible to chemical contamination, as evidenced by the widespread reproductive failure, particularly in Anatum Peregrine Falcons from uptake of organochlorine pesticides.

Dispersal/migration

Peregrine Falcons are largely migratory although Pacific coastal pairs and some southern interior pairs are resident and may remain at nest sites through winter if food supplies are adequate (White *et al*. 2002). This is especially true for Pealei Peregrine Falcons and for urban-dwelling Anatum Peregrine Falcons across southern Canada, east of Manitoba. Migration occurs across broad fronts but there are some general routes where Peregrine Falcon movements concentrate (Cade *et al*. 1988). In Canada, one noticeable movement is along the eastern front of the Rocky Mountains. Another is the fall migration of Tundrius Peregrine Falcons from western Greenland west across Davis Strait, then south through Canada to the US east coast (White *et al*. 2002).

In the fall, Peregrine Falcons typically migrate south to the southern USA, Central America and South America. Continental populations migrate in a “leap-frog” fashion, with northernmost birds tending to migrate the furthest south and mid-latitude birds migrating to a lesser extent (Schmutz *et al*. 1991; McGrady *et al*. 2002), but this is not entirely consistent. Individuals on wintering grounds in coastal Mexico and Central America with satellite transmitters were found breeding in the Canadian Arctic and Greenland (McGrady *et al*. 2002). One Peregrine Falcon nestling banded in the Thelon River area, NT, was recovered 14,500 km south in India Muerta, Argentina, 4 months after fledging (Kuyt 1967). Peregrine nestlings banded in Labrador have been recovered in Brazil, Peru, and the eastern and Texas coasts of the USA (J. Brazil pers. comm. 2007). Three satellite-tagged birds from Rankin Inlet migrated to coastal southern Brazil in 1994. Bands have also been returned from Peru (2), Uruguay (1) and Argentina (1; Court *et al*. 1988a; Seegar *et al*. 1997; M. Setterington pers. comm. 2007). A male

Anatum Peregrine from Toronto, Ontario was tracked for three successive years to his winter area in Cartagena, Columbia (McGill University 2002).

For Pealei Peregrine Falcons on the Queen Charlotte Islands, it appears that all immatures migrate south and spend the winter between the Fraser River estuary (near Vancouver, BC) and California, whereas adults remain near nests (W. Nelson pers. comm. 2006). However, two radio-tracked adult Pealei from extreme northern Vancouver Island, BC, wintered in Oregon. Three radio-tracked adult Anatums in south coastal British Columbia remained close to their nest sites all year, except for one bird, which went to Washington for about two months before returning (D. Doyle pers. comm. 2006).

Adult Peregrine Falcons demonstrate a high degree of breeding site fidelity (Ambrose and Riddle 1988 in Hayes and Buchanan 2002) and are often known to reuse the same nest site for several successive seasons (Beebe 1974; Court *et al*. 1989; Ratcliffe 1993). Established pairs may also use alternate nest sites within their breeding territory, either on the same cliff or on alternate cliffs, over successive seasons (White *et al*. 2002). In recovery efforts, Anatum Peregrine Falcons often re-occupy traditional nest sites that have been vacant for many years (Ratcliffe 1993). Many nest sites are occupied continuously through successive generations and at least one nest site in Labrador has been occupied (not necessarily continuously) for up to 145 years (J. Brazil pers. comm. 2006).

Young birds are known to disperse widely to new breeding areas. A wild-reared Anatum Peregrine chick from the Bay of Fundy nested as an adult in Buffalo, New York, a distance of about 1,200 km (D. Amirault pers. comm. 2006). In the southern prairies, immature captive-raised and released Anatum Peregrine Falcons returned an average distance of 130 km from their natal site; females returned an average of 263 km and males an average of 52 km (Holroyd and Banasch 1990). On Langara Island, BC only 6 of 140 banded Pealei Peregrine Falcon nestlings have returned to breed, with others known to have settled up to 300 km away (R.W. Nelson pers. comm. 2001). At Rankin Inlet, 37 (5.5%) of 668 nestling Tundrius Peregrine Falcons banded from 1981 through to 2003 have returned to the study area to breed, but none have been found breeding elsewhere (GNDoE, unpublished data, M. Setterington pers. comm. 2006).

Gregariousness

Peregrine Falcons are solitary breeders and are highly territorial towards other peregrines, although relatively high densities may occur. For example, several pairs of Peale's Peregrines nested as close as 400 m apart on Langara Island (6 km x 10 km), BC (Beebe 1960; Nelson 1977).

Interspecific interactions

Populations of Pealei Peregrine Falcons on the Queen Charlotte Islands were thought to be larger in the past and may have declined due to reduced seabird prey, as

seabird numbers declined in response to changing oceanographic conditions and reduced availability of fish prey (Nelson and Myres 1976).

Peregrine Falcons may come into conflict with other cliff-nesting birds. Cliff-nesting Great Horned Owls are known to harass and kill Peregrine Falcons at some sites (Tordoff and Redig 1997; Tordoff *et al*. 2000), but at other sites both species nest in close proximity. Peregrine Falcons do not nest on the same cliff in the same year as Golden Eagles or Gyrfalcons but will nest at those sites when the other species are absent. Peregrine Falcons tend to take over Prairie Falcon nest sites when both are present, and Peregrine Falcons attack passing Prairie Falcons (White *et al*. 2000).

Common Ravens can negatively affect Peregrine Falcon breeding success if nests are close (White *et al*. 2000), although in a European study, Peregrine Falcons selected nest sites nearer to ravens than Golden Eagles (Sergio *et al*. 2004).

Adaptability

The Peregrine Falcon is a remarkably adaptable bird given its wide geographic range and its use of a diversity of habitats. In the last 2-3 decades, many Anatum Peregrine Falcons have acclimatized to nesting in urban habitats where they use buildings, towers or bridges as surrogates for cliffs (Cade *et al*. 1996). Some Peregrine Falcons in Ontario even nest on cliffs in active mine sites and rock pits (A. Dextrase pers. comm. 2006). Another example of adaptability in choosing nest sites is the apparent increased use of old nests of Common Raven, Bald Eagle, Pelagic Cormorant (*Phalacrocorax pelagicus*) (Campbell *et al*. 1990), and Osprey (*Pandion haliaetus*) (T. Antifeau pers. comm. 2003).

The adaptability to breeding in urban environments has proven to be a key in the recovery of North American populations of Anatum Peregrine Falcons. This adaptability may ultimately allow Peregrine Falcons to exceed their known historical abundance (Cade *et al*. 1996).

POPULATION SIZES AND TRENDS

Search effort

Beginning in 1970, a national survey of breeding Peregrine Falcons has been conducted every five years in selected areas throughout southern Canada (Cade and Fyfe 1970; Fyfe and Olendorff 1976; Murphy 1990; White *et al*. 1990; Holroyd and Banasch 1996; Rowell *et al*. 2003; Banasch and Holroyd 2004; U. Banasch pers. comm. 2006). In addition to the broad-scale national surveys conducted, several provinces and territories conduct their own surveys more frequently in selected areas.

The national surveys, which are designed to collect population and productivity trend information, provide a minimum breeding population size only. This is because

they occur at select sites so many areas are not surveyed. Many additional breeding pairs exist, especially Tundrius Peregrines Falcons that breed in a vast, relatively uninhabited Arctic landscape.

Abundance

Although there were no systematic surveys of Peregrine Falcons in North America before their decline, the pre-collapse population of all three subspecies has been estimated at 7,000-8,000 breeding pairs (Rowell 2002). By the late 1990s, an estimated 2,500-3,000 pairs of Anatum, 2,300-3,000 pairs of Tundrius and 850-1,000 pairs of Pealei Peregrine Falcons were thought to breeding in North America (White *et al*. 2002).

Based on information from the 2005 national surveys, the minimum population size for Anatum Peregrine Falcons in Canada is 969 adult birds (464 pairs + 41 single birds = 505 occupied sites; Table 8). Similar survey information for Tundrius Peregrine Falcons shows a total of 94 adult birds (46 pairs + 2 single birds = 48 occupied sites; Table 8) in 2005. If the 105 birds from the most recent surveys at sites generally involved in the national survey, but not checked in 2005 (Ungava Bay (34 pairs), Tuktut Nogait (18 pairs + 1 single bird); Table 8) are added, then the minimum population size for Tundrius Peregrine Falcons is 199 adult birds. Together, a minimum population size for Anatum/Tundrius Peregrine Falcons in Canada is 1168 mature individuals. National survey information for Pealei Peregrine Falcons shows a total of 176 adult birds (67 pairs + 42 single birds = 109 occupied sites; Table 8) in 2005.

As mentioned earlier, population estimates based on national survey information will underestimate the total population of Peregrine Falcons. This is especially the case for Tundrius Peregrine Falcons. For example, surveys conducted by NU and NT governments, along with smaller surveys conducted by the Canadian Wildlife Service and private firms, have found 502 nest sites (approximately 1000 birds; see Appendix A), in addition to national survey sites, that have been occupied at some point since the 1980s (GNWT/GNDoE unpublished data; courtesy of S. Carrière). Thus, the numbers for Tundrius are likely closer to several thousand birds (G. Holroyd pers. comm. 2006).

These populations also have the potential to increase in size, given that other conditions, such as food supply, remain stable and because a number of historic breeding sites remain unoccupied. For example, in Alberta, at least 115 natural historically used Anatum Peregrine nest sites are known, and more likely exist (Alberta Peregrine Falcon Recovery Team 2004), but only 48 are occupied. Similarly, in British Columbia, where there are about 232 known Pealei Peregrine Falcon nest sites (Cooper 2006), only one half are occupied.

Fluctuations and trends

Peregrine populations have recovered considerably in the last two decades because of the ban on DDT, reintroductions of Anatum Peregrine Falcons, and

increased natural productivity (Kiff 1988; Enderson *et al*. 1995; Millsap *et al*. 1998). In Canada, most areas with good survey effort have shown a substantial increase in Anatum and Tundrius Peregrine Falcons since 1970 (Table 8), with tremendous increases between 2000 and 2005 in some areas (e.g. 43% increase in occupied sites in southern Ontario, 107% in southern Quebec). Increased search effort also contributed to the increasing population trends. Pealei Peregrine Falcons, which did not undergo the declines experienced by the other subspecies, increased slightly during this time period (Table 8).

Table 8. Number of sites occupied by Peregrine Falcons in selected areas surveyed in Canada 1970-2005. Numbers in parentheses indicate number of sites occupied by territorial pairs, while the first number includes sites with pairs and with single birds (Rowell *et al*. 2003). Data for 2005 from U. Banasch (pers. comm.).

Area	1970	1975	1980	1985	1990	1995	2000	2005
Anatum								
Labrador, Newfoundland	2(2)	0	nd	2(2)	21(21)	31(31)	22(15)	28(18)
Bay of Fundy (NS,NB)	0	0	0	1(1)	7(5)	6(6)	11(11)	20(16)
Southern Quebec	0	nd	1(1)	1(1)	15(12)	15(13)	28(25)	58(53)
Southern Ontario	0	0	0	1(0)	3(2)	15(14)	53(42)	76(67)
Southern Manitoba	nd	nd	0	1(1)	2(1)	4(4)	3(2)	3(2)
Southern Saskatchewan	0	nd	0	2(1)	2(1)	2(2)	4(3)	1(0)
Alberta south of 58	1(1)	0	0	2(2)	3(3)	13(12)	23(23)	21(17)
South Interior BC	nd	nd	nd	nd	nd	2(2)	1(1)	4(2)
Lower Mainland BC	nd	nd	nd	nd	nd	8(8)	6(5)	7(5)*
Gulf Islands/se Vancouver Island, BC	nd	nd	5(4)[1]	4(2)	6(3)[2]	9(7)	11(9)	12(9)
Alberta North of 58	2(1)	3(3)	9(9)	6(5)	9(9)	23(23)	29(29)	31(31)
Porcupine River, Yukon	nd	8(8)	16(13)	14(11)	36(nd)	29(29)	35(35)	30(30)
Peel River, Yukon	nd	nd	18(12)	12(10)	14(nd)	37(37)	22(22)[3]	22(22)[3]
Yukon River, Yukon	6(5)	6(5)	12(10)	22(18)	33(nd)	46(46)	46(46)	77(77)
Southern Lakes, Yukon						1(1)	nd	2(2)
Mackenzie Valley, NT	9(6)	24(21)	20(15)	45(nd)	88(77)	83(83)	80(80)	113(113)
Total/average	**20(15)**	**41(37)**	**81(64)**	**113(54)**	**239(134)**	**324(318)**	**374(348)**	**505(464)**
Tundrius								
Ungava Bay, Quebec	12(9)	11(9)	10(10)	23(23)	34(34)	nd	nd	nd
North Slope, Yukon	nd	5(5)	2(0)	0	1(0)	5(5)	9(9)	19(19)
Rankin Inlet, Nunavut	nd	nd	8(8)[4]	26(nd)	26(26)	27(27)	25(22)	29(27)
Tuktut Nogait NP, NT					19(19)[5]		19(18)	nd
Total/average	**12(9)**	**16(14)**	**20(18)**	**49(23)**	**80(79)**	**32(32)**	**53(49)**	**48(46)**
Pealei								
Langara Island	6(5)	6(6)	6(6)	6(5)	7(7)	7(5)	9(7)	10(8)
Queen Charlotte Islands	56(46)	60(51)	73(58)	50(nd)	64(53)	62(45)	60(44)	74(46)
N. Vancouver Island/ Scott Islands	nd	nd	nd	6(5)	10(5)	10(6)	20(12)	18(13)
Triangle Island	nd	nd	nd	nd	nd	8(8)	7(6)	7(nd)
Total/average	**62(51)**	**66(57)**	**79(64)**	**62(10)**	**81(65)**	**87(64)**	**96(69)**	**109(67)**

[1]Gulf Islands only
[2]data collected in 1991
[3]a smaller section of the Peel was surveyed in 2000 compared to 1995
[4]only a partial survey was conducted in 1980
[5]data based on surveys in 1988 and 1990
*South Interior, Lower Mainland, Gulf Islands and se Vancouver Island combined.

Anatum Peregrine Falcon

Anatum Peregrine Falcons have generally returned to near historical (pre-DDT) numbers in most regions of Canada, with the 2000 and 2005 surveys confirming that most populations are stable or increasing (e.g. Rowell *et al*. 2003; U. Banach pers. comm. 2006). Overall, occupied sites increased from 20 in 1970 to 505 in 2005, which is a 25-fold increase in numbers (Table 8). Occupied sites increased by 35% alone from 2000 to 2005. Of note is that interim goals for national territory occupancy and productivity set in the Anatum Peregrine Falcon Recovery Plan (Erickson *et al*. 1988), were met by 1995 (Banasch and Holroyd 2004).

The extent of increases from 1970-2005 is striking in many regions (Table 8). For example, Labrador has gone from 2 to 28 known sites. Most areas occupied 75-150 years ago are occupied now, although no information exists on whether or not those birds disappeared during the DDT era (J. Brazil pers. comm. 2006). Occupancy of inland sites in Labrador have, however, decreased since 1999 (J. Brazil pers. comm. 2006). In southern Quebec, occupied sites went from 0 in 1970 to 58 by 2005 (Poulin *et al*. 2006). Similarly, southern Ontario went from 0 to 76 occupied sites during the same time period, and may not yet be at pre-DDT levels (A. Dextrase pers. comm. 2006), although lack of historic data precludes confirmation. Populations remain very small in the southern prairies through 2005, although the number of pairs is higher in the last two decades than previously known. In Alberta, where fostering of captive bred birds has strongly influenced population increases (Stepnisky 1998), Anatum numbers have remained stable since 2000 (Alberta Peregrine Falcon Recovery Team 2004). In the Mackenzie Valley, NT, occupied sites have increased from 9 in 1970 to 113 in 2005.

In British Columbia, Anatum Peregrine Falcons are increasing on the coast but interior populations seem to be holding at low levels. The historical decline of Anatum Peregrine Falcons in interior British Columbia significantly pre-dated the DDT crisis. In the Okanagan valley, there were at least 15 nest sites in use in 1906-1907. One cliff near Vaseux Lake was reported to contain three active Peregrine Falcon nests in one year (Cannings *et al*. 1987). By 1922, all or almost all of these nest sites were inactive and Peregrine Falcons were absent from the valley (Taverner 1922). The status of most other historically known Anatum Peregrine nest sites elsewhere in the interior of British Columbia remains uncertain during the 1940s to the 1980s, but most were unoccupied in the mid-1990s (Cooper 1998).

Reintroductions

The numbers of captive-raised Anatum Peregrines released in Canada are impressive: e.g. 178 in the Bay of Fundy (1982-1991; Amirault 2004), 255 in Quebec (1976-1994; Berthelot *et al*. 2002), 524 in Ontario (1977-1996; Royal Ontario Museum 2004), 103 in Manitoba (1981-2001; Sliworsky and Nero 2003) and about 250 in Alberta (1975-1985; Rowell and Stepnisky 1997). About 1,500 pure Anatum Peregrine Falcons have been released in Canada (G. Holroyd pers. comm. 2006) and these releases have led to the restoration of breeding Anatum populations in many areas.

Tundrius Peregrine Falcon

Breeding populations of Tundrius Peregrine Falcons appear to have recovered to near pre-collapse numbers, with significant increases between 1970 and 2005 (White *et al*. 2002; Table 8). Increases in some areas were exponential through the 1980s (Shank *et al*. 1993). Tundrius Peregrine Falcon numbers in Kugluktuk and Hope Bay, NU were showing upward trends until the surveys ceased in 1996 (Figure 3). In 2005, Tundrius Peregrine Falcons from two survey areas reached all-time highs (Table 8); however, only one of 32 occupied sites in Rankin Inlet was productive, which was an all-time low (M. Setterington pers. comm. 2006). The latter was explained, however, by mortality of eggs/young caused by severe rain-storms in early summer. Although the Ungava Bay area of Quebec was not surveyed from 1995-2005 (Table 8), a partial survey by the Canadian Wildlife Service in 2000 found 18 occupied sites suggesting that the species is still present in this area. Population increases in Canada parallel steady increases in Greenland Tundrius populations (e.g. Mattox and Seeger 1988).

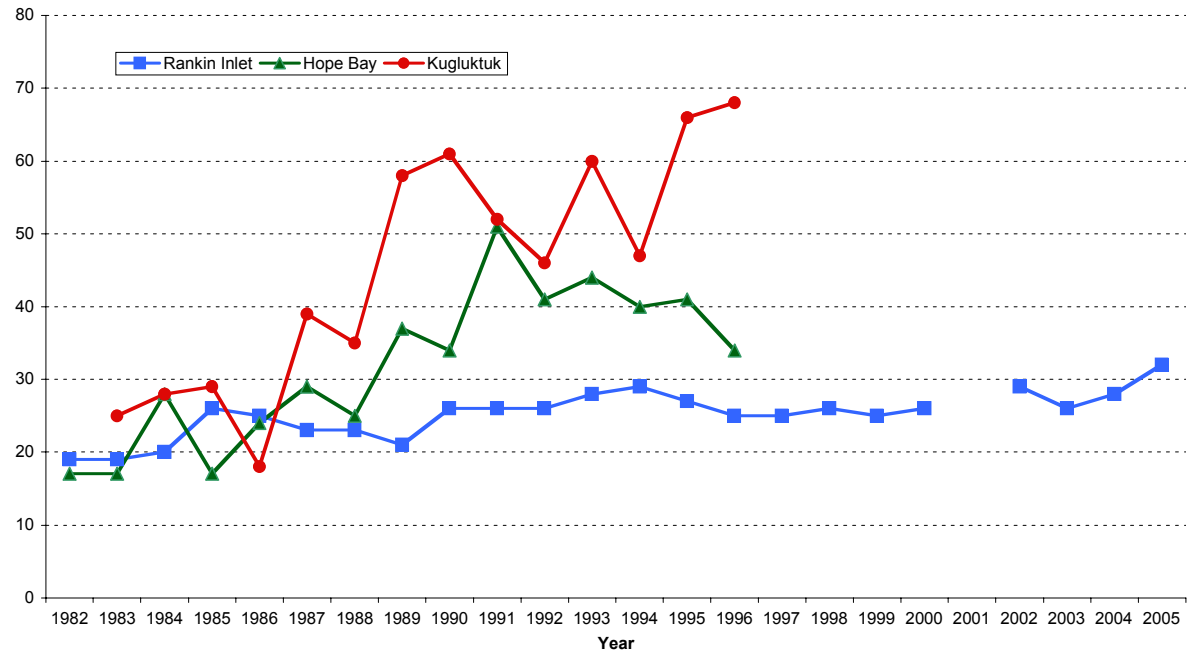

Figure 3. Number of occupied Tundrius Peregrine Falcon territories in Rankin Inlet (530 km^2, early June surveys), Hope Bay area (2000 km^2 early to mid-July surveys) and Kugluktuk (4000 km^2, early to mid-July surveys), Nunavut. Data points not joined by lines indicate that no data were collected in those years (Source: M. Setterington).

Pealei Peregrine Falcon

Pealei Peregrine Falcon populations in Canada are currently increasing (Cooper 2006). In British Columbia, 96 occupied territories were estimated in 2000 versus 87 occupied territories for the mid-1990s. In 2005, Pealei Peregrine Falcons were at their highest level of occupancy (109; Cooper 2006) since before the 1970s (Table 8). On the

Queen Charlotte Islands, there were 74 occupied nest sites in 2005, which is the highest number recorded since 1980 (Table 8). In 2000, Pealei Peregrine Falcons were thought to be increasing on northern Vancouver Island (Rowell *et al*. 2003) as occupied nest sites reached 20; followed by 25 occupied nest sites in 2005 (Table 8).

Pealei Peregrine Falcon avoided precipitous population declines from chemical pesticide contamination. Their non-migratory habits and reliance on remote seabird populations for their food probably saved them from exposure to high levels of DDT, even though recent studies show the continued persistence of organochlorines in seabird tissue within the range (Alaska panhandle) of Pealei Peregrine Falcons (Becker *et al*. 2003).

Rescue effect

The potential for immigration of Peregrine Falcons is high for Anatum and Peale's Peregrines. Anatum Peregrine Falcons in the US, which serve as a potential source of immigrants for Canada, are increasing, and have recently been delisted. It is worth noting, however, that some immigrants from the USA may not be of native stock. By 2002, about 2,000 pairs of Anatum Peregrine Falcons were thought to exist in the USA (USFWS 2003) and current (2004) numbers are undoubtedly higher. There is some evidence that immigration from the US occurs. For example, there are two known Anatum Peregrine Falcons breeding in coastal British Columbia that were banded as nestlings in the San Juan Islands, Washington (D. Doyle pers. comm. 2004). Similarly, a known Peregrine Falcon hatched in the US was observed in New Brunswick in 2006 (D. Amirault pers. comm. 2006), and an adult female breeding on the Bow River in southern Alberta originally fledged from a site in Great Falls, Montana (G. Court pers. comm. 2006). In addition, the success of the introductions through hacking of young birds suggests the potential for rescue is very high.

Most of the world's Tundrius Peregrine population occurs in Arctic Canada, but Tundrius Peregrine Falcons from Greenland are known to migrate through Canada; therefore, some potential for rescue exists.

Pealei Peregrine Falcons in the USA also appear to be stable. Surveys in the mid-1990s found 271 active nest sites in Alaska, 17-20 in Washington and 5-10 in Oregon, although some of the Washington and Oregon birds may not be Peale's (Wilson *et al*. 2000; White *et al*. 2002).

LIMITING FACTORS AND THREATS

Chemical pollution

Widespread use of organochlorine pesticides, most notably 1,1,1 - Trichloro – 2-2 bis (p-chlorophenyl) ethane (DDT), from the late 1940s through the 1970s, with subsequent bioaccumulation within the food chain, was the primary factor causing the dramatic decline of Peregrine Falcon populations (White *et al*. 2002). Major declines in North American populations of Anatum Peregrine Falcons occurred from the 1950s

through 1970s due to egg shell thinning and the resultant reproductive failure (White *et al*. 2002). DDT/DDE was banned in Canada and the United States in the early 1970s and in Mexico in 2000 (G. Holroyd pers. comm. 2006), but is still used in other parts of the world including the winter range of some Anatum and Tundrius Peregrine Falcons (i.e. South and Central America; White *et al*. 2002). In addition, many prey species winter in the south where they may be exposed to and accumulate organochlorines, which may in turn be passed on to falcon predators on their breeding grounds.

Declining organochlorine levels in Peregrine Falcon eggs are encouraging and are linked with improving reproductive success. For example, in Alberta there has been a strong downward trend in DDE concentrations over the last four decades (Court *et al*. 1996). In the Bay of Fundy, unhatched eggs have been recovered from two sites in New Brunswick for toxin analysis. These eggs have been relatively free of the contaminants that cause reproductive failure (L. Shutt, unpubl. data in Amirault 2004).

The current impact of residual organochlorine pesticides in Canada on Peregrine Falcons is not well known. For instance, serum contaminant loads of some individual Tundrius Peregrine Falcons from Rankin Inlet, Nunavut exceed safe thresholds (e.g. 1.8-2.4 ppm in serum; Figure 4), but overall there is a general downward trend in DDE levels in serum samples of adult Rankin Inlet birds collected since 1981 (Figure 4; Franke *et al*. 2006). Some believe that even a minor change in agricultural practices in the peregrine's wintering grounds in Central and South America could result in another population catastrophe (Northwest Territories Wildlife and Fisheries 2004). These concerns are echoed by the Alberta Peregrine Falcon Recovery Team (2004), as they note there are strong lobbies hoping to resurrect chemicals like DDT as a short-term measure to control malaria and other insect-borne diseases in developing nations (Raloff 2000) and as new biocides are licensed for use in Canada.

A toxicological study of Peregrine Falcon prey in the Okanagan Valley, British Columbia has recently been conducted (Elliott *et al*. 2005). Researchers collected potential prey species in the region, analyzed the prey for chlorinated hydrocarbon residues, then used a bioaccumulation model to predict the concentration of DDE in Peregrine Falcon eggs. Due to ongoing contamination in many species found in orchards, the common habitat in the region, it was deemed unlikely that Peregrine Falcons could breed successfully in the Okanagan unless they fed on a diet primarily of doves.

Avicides are also known to kill Peregrine Falcons. Organophosphorus fenthion commonly used as an avicide to control European Starlings and other birds was implicated in the deaths of at least six Peregrine Falcons in North America (Mineau *et al*. 1999). This and other organophosphorus compounds are used widely in North America (Hayes and Buchanan 2002).

A recent discovery of significant uptake of PBDEs (polybrominated diphenyl ethers) by Peregrine Falcons and other raptors raises potential concerns for another DDT-like impact (Lindbergh *et al*. 2004). Research is underway in Ontario on this new threat (T. Armstrong pers. comm. 2006).

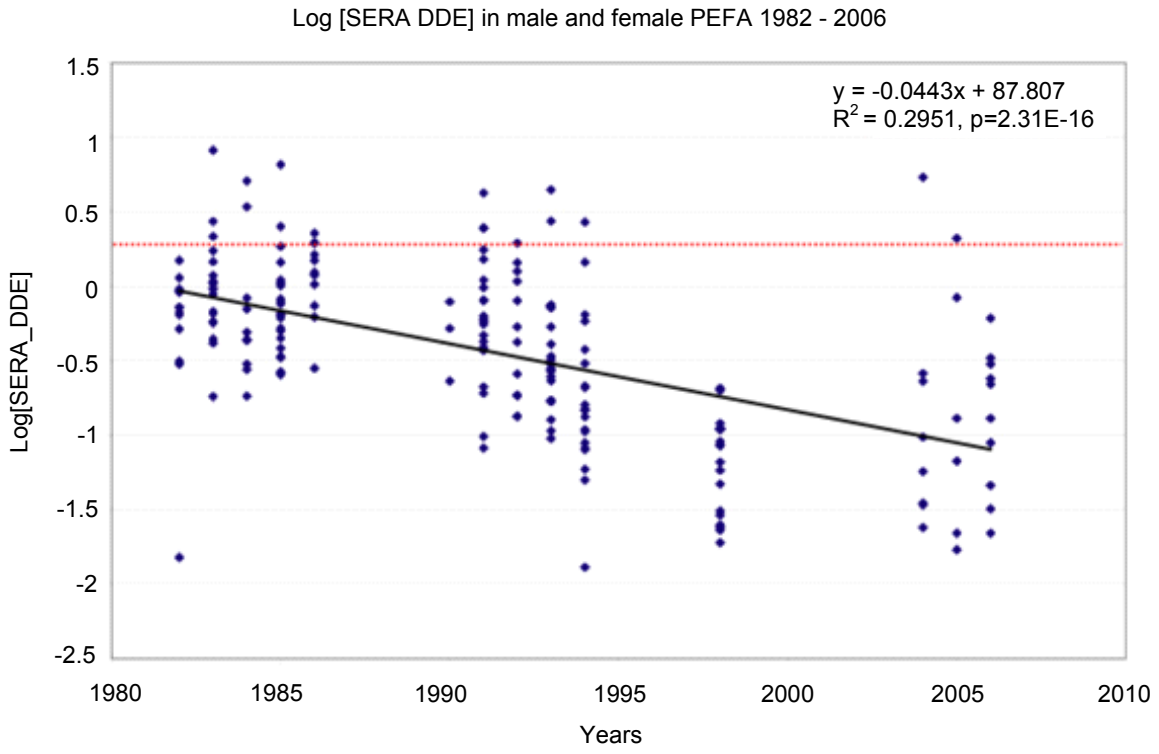

Figure 4. Log DDE levels in blood serum collected from adult Tundrius Peregrine Falcons between 1982 and 2006 in Rankin Inlet, Nunavut. The dashed line at log 0.26 represents the critical threshold of DDE ppm (1.8) above which egg-shell thinning occurs (Franke *et al*. 2006).

Human disturbance

Peregrine Falcons have adapted to urban environments and rarely experience enough disturbance from humans to cause breeding failure. However, there have been occasional nest losses associated with disturbance from construction (T. Maconachie, pers. comm. 2004), bridge maintenance, and excessive visitation by bird watchers (D. Amirault pers. comm. 2006). Adults have also been killed by hitting flares on off-shore oil rigs in Newfoundland (D. Amirault pers. comm. 2006).

Disturbance of wild nests, serious enough to cause nesting failure, is also a relatively rare event (Alberta Peregrine Falcon Recovery Team 2004). In the Northwest Territories and Nunavut, cabin building, recreation and resource exploration and development could impact pairs not habituated to human activity (Carrière *et al*. 2003). Management guidelines for human activities at specific sites where human recreation (rock climbers, hang gliders) conflicts with nesting Anatum Peregrine Falcons has proven successful in British Columbia (M. Chutter pers. comm. 2006). Other jurisdictions in Canada have established minimum disturbance/setback conditions (Ontario, Ontario Ministry of Natural Resources 1987; Nunavut, M. Setterington pers. comm. 2007).

Urban development

Possible hazards in urban environments may include collision with vehicles and buildings and exposure to high levels of contaminants. However, to date, no long-term adverse impacts to Peregrine Falcons living in urban centres have been noted.

Migrants are flexible in their use of foraging habitat and prey selection (White *et al*. 2002), so urban development is not likely a limiting factor during that phase of their life cycle.

Prey availability

For Pealei Peregrine Falcon*s*, the abundance and distribution of seabird prey is considered the primary limiting factor (Cooper 2006). Seabirds, in turn, are strongly limited by ocean productivity, which can be affected by such diverse factors as global warming, El Nino events, and over-fishing. Populations of seabirds can also be adversely affected by other factors such as introduced mammalian predators on nesting islands and oil spills. The impact of mammalian predators on seabird colonies can be very large (Taylor *et al*. 2000) and has been linked to local declines of nesting Pealei Peregrine Falcons (Kirk and Nelson 1999).

In Labrador, coastal nesting Peregrine Falcons seem to be strongly associated with Black Guillemots, a potential prey source, (J. Brazil pers. comm. 2006) and are largely absent from otherwise suitable nesting areas when guillemots are absent.

Harvesting for falconry

Harvesting of Peregrine Falcons for falconry is not currently permitted in most of Canada. However, recent de-listing of the Anatum Peregrine has resulted in the lifting of falconry harvest bans in parts of the US. The Canadian Anatum Peregrine Recovery Team did not, however, endorse a proposal by the International Fish and Wildlife Agencies to reopen a harvest (Allen 2000) as there is no way to guarantee that harvested passage birds are not taken from managed, recovering populations rather than from larger, apparently stable populations from farther north (Alberta Peregrine Falcon Recovery Team 2004). Even so, Saskatchewan has allowed a small harvest of juvenile passage migrants since 2001 (Rowell 2002). Reopening a restricted harvest on the Blue-listed Pealei Peregrine Falcons in British Columbia is under consideration (Cooper 2006) and harvest of Peregrine Falcons is currently being considered for Nunavut's new Wildlife Act Regulations (M. Setterington pers. comm. 2007).

Shooting

In decades past, shooting of adult Peregrine Falcons and destruction of nests occurred in areas occupied by people who viewed "hawks" as threats to other birds and domestic fowl (Bent 1938). This occurs much less often today, although shooting of Peregrine Falcons may occur from time to time.

Poaching

Poaching of eggs or nestlings for falconry purposes occurs, but at an unknown rate. Poaching of eggs and nestlings could impact local productivity rates and, if extensive enough, could impact recovery of some populations. However, occasional poaching would not likely be a serious threat.

SPECIAL SIGNIFICANCE OF THE SPECIES

During the 1970s, the Peregrine Falcon became an environmental icon. The collapse of North American populations of Anatum Peregrine Falcons helped galvanize a shift in public attitude toward better general environmental stewardship.

ABORIGINAL TRADITIONAL KNOWLEDGE

A member of the Sahtu (Northwest Territories) reported that Peregrine Falcons are known but are not harvested for subsistence purposes, nor was there any other Aboriginal Traditional Knowledge available (J. Snortland pers. comm. 2006). One member of the Inuvialuit knew of breeding pairs on the Yukon North Slope and in the Mackenzie Delta (M. Sicotte pers. comm. 2005), but there was no mention of use. Several members of the Haida Nation (including chiefs) were involved in the public inquiry on management of Pealei Peregrine Falcons on the Queen Charlotte Islands, British Columbia and supported closure to harvesting by falconers (Shelford 1988). While culturally significant, no ATK was found that would counter the observed population trends.

EXISTING PROTECTION OR OTHER STATUS DESIGNATIONS

The Peregrine Falcon is protected under the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), which restricts the import and export of birds and eggs in signatory countries. It is listed in Appendix 1 of CITES as a “most critically endangered” species. Like other raptors, Peregrine Falcons are not protected by the federal *Migratory Birds Convention Act*. However, the Peregrine Falcon is listed on Schedule 1 of the federal *Species at Risk Act* (SARA), and therefore, protected on federal lands.

Under SARA, Anatum and Pealei Peregrine Falcons are on Schedule 1 and the Tundrius Peregrine Falcon is on Schedule 3 (see SARA website http://www.sararegistry.gc.ca/ species/schedules). The General Status of Species in Canada gives an overall rank of 4, or Secure in Canada for the Peregrine Falcon. It considers Peregrine Falcons At Risk in AB, SK, MB, ON, NB, NS, Sensitive in YT, NT, BC, QC, NL and Secure in NU (CESCC 2006).

In the USA, the Anatum Peregrine was delisted as an Endangered species and is now managed under control of the Office of Migratory Bird Management (Federal Register 1999). Harvesting is now allowed in the lower 48 states under the USFWS (2003) Peregrine Falcon management plan.

The Peregrine Falcon is also protected under all provincial and territorial wildlife acts but details of such protection vary between provinces and territories. Status designations at the provincial and territorial levels vary across the country with those designations having various legal meanings (Table 9).

Table 9. Status of the Peregrine Falcon in Canadian jurisdictions.

Jurisdiction	Anatum		Tundrius		Pealei	
	NHR Rank	Provincial Status	NHR Rank	Provincial Status	NHR Rank	Provincial Status
BC	S2B SZN	Red List	SZN	Blue List	S3B S2N	Blue List
Alberta	S3B	Threatened				
Saskatchewan	S1B SZN					
Manitoba		Endangered				
Ontario	S2S3B SZN	Threatened		Threatened		
Quebec	S3	Vulnerable	S3	None		
New Brunswick		Endangered				
Nova Scotia		Threatened				
Newfoundland		Threatened		Threatened		
NT	SNR	At risk	SNR	May be at risk		
Nunavut		None		None		
Yukon		Threatened		Special protection		

TECHNICAL SUMMARY

Falco peregrinus pealei
Peregrine Falcon *pealei* subspecies — Faucon pèlerin de la sous-espèce *pealei*
Range of Occurrence in Canada: British Columbia

Extent and Area Information	
• *Extent of occurrence (EO)(km²)* Based on portion of British Columbia occupied by Peale's	47,000 km²
• *Specify trend in EO*	Stable
• *Are there extreme fluctuations in EO?*	No
• *Area of occupancy (AO) (km²)* Minimum - based on home range of 78 km^2 multiplied by the number of occupied nest sites in 2005 national survey (108)	Minimum 8,500 km²
• *Specify trend in AO*	Stable
• *Are there extreme fluctuations in AO?*	No
• Number of known or inferred current locations	N/A
• *Specify trend in #*	N/A
• *Are there extreme fluctuations in number of locations?*	N/A
• *Specify trend in area, extent or quality of habitat*	Stable
Population Information	
• *Generation time (average age of parents in the population)*	4-6 years
• *Number of mature individuals* Minimum - based on number of occupied nest sites counted in the 2005 national survey	Minimum 176
• *Total population trend:*	Increasing
• *% decline over the last/next 10 years or 3 generations.*	0
• *Are there extreme fluctuations in number of mature individuals?*	No
• *Is the total population severely fragmented?*	No
• *Specify trend in number of populations*	N/A
• *Are there extreme fluctuations in number of populations?*	N/A
• List populations with number of mature individuals in each:	
Threats (actual or imminent threats to populations or habitats)	
– Declines in seabird prey associated with changing ocean conditions and alien predators at seabird colonies	
Rescue Effect (immigration from an outside source)	
• *Status of outside population(s)?* **USA: Stable population in Alaska available to provide breeders for BC**	
• *Is immigration known or possible?*	Yes
• *Would immigrants be adapted to survive in Canada?*	Yes
• *Is there sufficient habitat for immigrants in Canada?*	Yes
• *Is rescue from outside populations likely?*	Yes
Quantitative Analysis	None available
Current Status COSEWIC: Special Concern (2001, 2007)	

Status and Reason for Designation

Status: Special Concern	**Alpha-numeric code**: Met criteria for Endangered, D1, but designated Special Concern because of increasing population size, potential for rescue, and because a significant portion of the population breeds in protected areas.

Reason for Designation:

This subspecies occurs in small numbers along most of the coastal area of British Columbia, where it breeds mostly in protected areas. Its population has shown ongoing increases in size over the last 35 years. Immigration from the United States, where numbers are stable, is likely.

Applicability of Criteria

Criterion A: (Declining Total Population): Does not meet criterion.

Criterion B: (Small Distribution, and Decline or Fluctuation): Does not meet criterion.

Criterion C: (Small Total Population Size and Decline): Does not meet criterion.

Criterion D: (Very Small Population or Restricted Distribution): Meets criterion D1 for Endangered because population < 250 individuals.

Criterion E: (Quantitative Analysis): Not applicable.

TECHNICAL SUMMARY

Falco peregrinus anatum/tundrius
Peregrine Falcon *anatum /tundrius* Faucon pèlerin *anatum/tundrius*
Range of Occurrence in Canada: All Canadian provinces and territories except Prince Edward Island

Extent and Area Information	
• *Extent of occurrence (EO)(km²)* Based on portion of Canada's 9.97 million km² land mass occupied by Anatum/Tundrius	9 million km²
• *Specify trend in EO*	Stable
• *Are there extreme fluctuations in EO?*	No
• *Area of occupancy (AO) (km²)* Minimum - based on home range of 500 km^2 multiplied by the number of occupied nest sites counted in the 2005 national survey (596)	Minimum 276,500 km²
• *Specify trend in AO*	Increasing
• *Are there extreme fluctuations in AO?*	No
• *Number of known or inferred current locations*	N/A
• *Specify trend in #*	N/A
• *Are there extreme fluctuations in number of locations?*	N/A
• *Specify trend in area, extent or quality of habitat*	Stable
Population Information	
• *Generation time (average age of parents in the population)*	4-6 years
• *Number of mature individuals* Minimum - based on number of occupied nest sites counted in the 2005 national survey (*Anatum* 969; *Tundrius* 199)	Minimum 1168, likely several thousand additional birds
• *Total population trend:*	Stable to increasing
• *% decline over the last/next 10 years or 3 generations.*	0
• *Are there extreme fluctuations in number of mature individuals?*	No
• *Is the total population severely fragmented?*	No
• *Specify trend in number of populations*	N/A
• *Are there extreme fluctuations in number of populations?*	N/A
• List populations with number of mature individuals in each:	
Threats (actual or imminent threats to populations or habitats)	
– Organochlorine pesticide contamination leading to reproductive failure, controlled now but potential for problems in the future as new pesticides are permitted in Canada – Possibility of increasing DDT use in overwintering areas, in an attempt to combat malaria.	
Rescue Effect (immigration from an outside source)	
• *Status of outside population(s)?* **USA: Recovered to near historic levels**	
• *Is immigration known or possible?*	Yes
• *Would immigrants be adapted to survive in Canada?*	Yes
• *Is there sufficient habitat for immigrants in Canada?*	Yes
• *Is rescue from outside populations likely?*	Yes
Quantitative Analysis	None available
Current Status COSEWIC: ANATUM/TUNDRIUS : Special Concern (2007) ANATUM: Threatened (1999) TUNDRIUS: Special Concern (1992)	

Status and Reason for Designation

Status: Special Concern	**Alpha-numeric code**: not applicable

Reason for Designation:

Continental populations of this species have shown continuing increases in population size since the 1970s up to near historical numbers. Population thresholds for downlisting have been achieved for both the *tundrius* and *anatum* subspecies. This recovery has been the result of reintroductions across much of southern Canada and natural increases in productivity following the ban in Canada of organochlorine pesticides (e.g. DDT), the primary factor responsible for the historic decline. These pesticides continue to be used on the wintering grounds, and continue to be found in peregrine tissues, albeit at levels that do not significantly affect reproductive success. The unknown effects of new pesticides regularly licensed for use in Canada are also a concern.

Applicability of Criteria

Criterion A: (Declining Total Population): Does not meet criterion.

Criterion B: (Small Distribution, and Decline or Fluctuation): Does not meet criterion.

Criterion C: (Small Total Population Size and Decline): Does not meet criterion.

Criterion D: (Very Small Population or Restricted Distribution): Does not meet criterion.

Criterion E: (Quantitative Analysis): None available.

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BIOGRAPHICAL SUMMARY OF REPORT WRITERS

John Cooper is a founding partner of Manning, Cooper and Associates Ltd, a consulting company with three offices in British Columbia. MCA specializes in biodiversity studies, forest biodiversity management and policy development, and environmental impact assessments. John is a leading ornithologist in British Columbia and has authored over 150 books, academic papers, technical reports, and popular articles on birds and other wildlife. He is regularly consulted on the status and conservation of birds by the provincial, territorial and federal governments, industry, and NGOs. In recent years he has contributed to COSEWIC and conservation of species at risk as co-author of COSEWIC status reports for Northern (Queen Charlotte) Goshawk, and Streaked Horned Lark. He has developed Management Plans for Peale's Peregrine, Lewis's Woodpecker and Flammulated Owl, and led development of the

Recovery Strategy for Spotted Owls as required by SARA. John is also a very active volunteer on the Garry Oak Ecosystem Recovery Team, which is leading recovery efforts for several extirpated or rare birds in southwestern British Columbia. John co-authored Status of the Peregrine Falcon in British Columbia (2004) and inventoried most of the historically-known Anatum Peregrine nest sites in British Columbia in 1997.

Suzanne Beauchesne is the principal of Western Wildlife Research, an environmental consulting company that focuses on wildlife and habitat conservation issues. Suzanne has studied forest, grassland, and freshwater birds, mammals, amphibians, and molluscs in British Columbia and the western United States. Suzanne has co-authored the COSEWIC status report for Streaked Horned Lark, co-authored 3 other status reports submitted to COSEWIC, co-authored provincial management strategies for nine bird species, and stewardship accounts for four bird species for the Garry Oak Ecosystem Recovery Team. She is an acknowledged expert in British Columbia on Lewis's Woodpecker, and is completing her graduate degree, which focuses on that species. Suzanne has led numerous environmental assessment studies related to industrial development, conservation of species at risk, and has authored numerous technical reports on birds.

COLLECTIONS EXAMINED

None.

Appendix A. Locations of Peregrine Falcon nesting sites in Northwest Territories and Nunavut. Data from the NU/NT Raptor Database – Accessed February 2007. Sites surveyed since 1980, and for which medium-high quality location data exist. Approximate position of the tree line is indicated by small tree symbols. The Mackenzie Valley (red dots), Tuktut Nogait National Park (orange dots), and Rankin Inlet (green dots) surveys are part of the North American Peregrine Falcon Five-year Surveys. © 2007 Government of the Northwest Territories/Government of Nunavut (provided by Suzanne Carrière and Michael Setterington).