

THE 1990 CANADIAN PEREGRINE FALCON (*FALCO PEREGRINUS*) SURVEY

GEOFFREY L. HOLROYD

*Canadian Wildlife Service, Room 200, 4999-98 Avenue, Edmonton, Alberta T6B 2X3 and
Department of Renewable Resources, University of Alberta, Edmonton, Alberta T6G 2H1 Canada*

URSULA BANASCH

Canadian Wildlife Service, Room 200, 4999-98 Avenue, Edmonton, Alberta T6B 2X3 Canada

ABSTRACT.—In 1990, 24 regions of Canada were searched for nesting peregrine falcons (*Falco peregrinus*). Within the *F.p. anatum* range, 233 sites were occupied: 180 in the Northwest Territories (N.W.T.), Yukon, and Alberta north of 58°N and 32 in southern Canada. The 1990 total of occupied *anatum* nest sites was more than double the number found in 1985–86. *F.p. tundrius* peregrines also increased between 1985–86 and 1990. *F.p. pealei* peregrines on Langara Island were unchanged, but those along the rest of the British Columbia (B.C.) coast increased in numbers. Productivity was high at 1.0–2.9 young per territorial pair, except at the North Slope of the Yukon and Rankin Inlet. With high natural productivity and large releases of captive-raised young in Ontario and Alberta, the peregrine recovery should continue.

KEY WORDS: *peregrine falcon*; *Falco peregrinus*; *populations*; *survey*; *Canada*.

Investigación Del Halcón Peregrino Canadiense, Año 1990

RESUMEN.—En 1990, se buscaron los halcones peregrinos (*Falco peregrinus*) en 24 regiones del Canadá. Dentro del terreno *F.p. anatum*, 233 sitios fueron ocupados: 180 en los Territorios del Noroeste, el Yukón, y Alberta más allá de los 58°N y 32 en el sur del Canadá. La suma de los sitios de nidos *anatum* ocupados es más del doble del número encontrado en 1985–86. Los peregrinos *F.p. tundrius* se aumentaron entre 1985–86 y 1990. Los peregrinos *F.p. pealei* mostraron una población estable en la isla de Langara pero se aumentaron los que están a lo largo del resto de la costa de B.C. (La Colombia Británica). La productividad es fue, de 1.0 a 2.0 crías por pareja territorial, excepto en North Slope del Yukón y Rankin Inlet. Dada la alta productividad natural y el gran número de pájaros criados en cautiverio y puestos en libertad en Ontario y Alberta, la recuperación del halcón peregrino debería continuar.

[Traducción de Peter Imoro y Barbara Krotki]

Falcon enthusiasts and professional biologists conducted peregrine falcon (*Falco peregrinus*) surveys in Canada prior to 1960 and again in 1964–65 (Beebe 1960, Enderson 1965, Fyfe 1969). The 1969 Raptor Research Planning Conference at Cornell University recommended a survey of peregrine falcon nest sites in North America every 5 yr, starting in 1970 (Kiff 1988).

Researchers surveyed peregrines in Canada during 1970 to determine population trends and productivity (Cade and Fyfe 1970) and confirmed the decline that was discussed at the 1965 Madison Peregrine Falcon Conference (Hickey 1969). The 1975 survey further documented declines in the Arctic and boreal forest peregrine populations,

both in Canada and the U.S. (Fyfe et al. 1976). During the last coordinated extensive survey of the species' range throughout North America in 1980, peregrine numbers were reduced but stable in northern Quebec, Northwest Territories (N.W.T.), and Yukon. No sites were occupied in the Prairies and only one pair nested in southern Quebec, the boreal forest south of 58°N and east of the Rockies (White et al. 1990). However, nine pairs occupied nest sites in northern Alberta in boreal forest north of 58°N.

While northern and west coast peregrine populations in Canada remained stable or increased in 1985–86, peregrine numbers in the boreal forest south of 58°N and east of the Rockies remained

Table 1. Nest-site occupancy by *anatum* peregrine falcons in Canada during 1990.

AREA	TOTAL KNOWN SITES ^a	TOTAL KNOWN SITES CHECKED	TOTAL KNOWN SITES OCCUPIED	TOTAL NEW SITES ^b	TOTAL SITES OCCUPIED BY	
					SINGLE BIRDS	PAIRS
Labrador	25	25	20	1	0	21
Bay of Fundy	12	11	7	0	2	5
Southern Quebec	10	10 ^c	10	5	3	12
Southern Ontario	35	23 ^d	1	2	1	2
Southern Manitoba	1	1	1	1	1	1
Southern Saskatchewan	2	2	2	0	1	1
Alberta south of 58°	60	60	2	1	0	3
Alberta north of 58°	18	18	7	2	0	9
Porcupine River, Yukon	34	34	30	6	ND ^e	36
Peel River, Yukon	31	31	12	2	ND	14
Yukon River, Yukon	36	36	27	6	ND	33
Southern Lakes, Yukon	3	3	0	0	0	0
Mackenzie Valley, N.W.T.	107	107	81	7	0	88

^a Known refers to all sites known before 1990.

^b New refers to all sites found in 1990.

^c Plus 135 potential nest sites checked.

^d Plus 121 potential nest sites checked.

^e ND = Not determined.

low at eight occupied sites. Six of these eight sites were in cities (Murphy 1990).

Wildlife agencies continued to monitor known nest sites and found new occupied sites since the 1985–86 survey, especially in southern Quebec, Bay of Fundy, northern Alberta, and in cities. More extensive surveys on the Labrador coast identified a significant breeding population (Lemon and Brazil 1990, J. Brazil, pers. comm.). Here, we present the results of the 1990 Canadian peregrine falcon survey and summarize the 5 yr surveys in Canada as well as results from 1965–66 (Hickey 1969).

METHODS

Remote areas in the Arctic and Labrador were surveyed with helicopters and fixed-wing aircraft. Areas more easily accessible were surveyed by foot and vehicle. Boats and canoes were used to survey some lakes and rivers.

Terminology was a major obstacle to the interpretation of earlier peregrine surveys. We followed Murphy's (1990) definitions of "nest site," the actual site of the nest; "occupied nest site," a nest site where one or two territorial adults were present; "breeding pair," a pair that laid at least one egg; "successful pair," a pair that raised at least one chick to fledging or assumed to have fledged; and "territorial pair," a pair that defended its nesting cliff against other peregrines (Ratcliffe 1980). Most young were counted at 2–4 wk of age and not at fledging. We continued to use the term "historic site" to provide an indication of the intensity of survey effort;

however, historic sites are designated as "known" in the tables and represent any sites used prior to 1990.

Single birds are reported separately from pairs since their breeding status was unknown, especially after one survey. Following terminology of Brown (1974) and Postupalsky (1974), we present productivity as the number of young per territorial pair and per successful pair.

The reported number of young or eggs typically reflects the results of a single nest visit regardless of the stage of development of the young. In Labrador and the N.W.T., nest visits coincided with or were near hatching time so only young chicks were encountered and early failed nesters may have been missed. Such single visits, well before fledging, would obviously overestimate productivity (Ellis 1988). In Ungava Bay and Langara Island, nests were visited and chicks banded when they were 20–30 d old. In the Bay of Fundy, southern Quebec, Ontario, Manitoba, Alberta, N.W.T., and parts of the Yukon, nests were visited several times but, often not as late (nestlings 35 d of age) as recommended by Ellis (1988). Therefore, the estimates of young fledged, and hence productivity, are more accurate for these latter sites.

Since a comparable number of sites were surveyed with similar effort as in the previous 5 yr surveys, we compiled population numbers and productivity data for most regions from Enderson (1969), Hickey (1969), Cade and Fyfe (1970), Fyfe et al. (1976), Court et al. (1988), Munro and Van Drimmelen (1988), Murphy (1990), and White et al. (1990).

RESULTS

The 1990 surveys covered 24 regions of Canada (Tables 1–4), including some regions not surveyed

Table 2. Nest-site occupancy by *tundrius* and *pealei* peregrine falcons in Canada during 1990.

AREA	TOTAL KNOWN SITES	TOTAL KNOWN SITES CHECKED	TOTAL KNOWN SITES OCCUPIED	TOTAL NEW SITES	TOTAL SITES OCCUPIED BY	
					SINGLE BIRDS	PAIRS
<i>tundrius</i>						
Ungava Bay, Quebec	58	58	31	3	0	34
North Slope, Yukon	17	17	1	0	1	0
Rankin Inlet, N.W.T.	26	26	26	0	0	26
<i>pealei</i>						
Langara Island, B.C.	7	7	7	0	0	7
Queen Charlotte Islands, B.C.	144	129	71 ^a	0	6	53
Vancouver & Gulf Islands, B.C. ^b	39	33	17	1	11	7

^a Includes 15 sites estimated by extrapolation to unsurveyed areas plus a correction for detection error due to difficulties of gunfire-from-boat survey method on ocean. Not included are 17 singles that showed no defensive behavior or attachment to a site.

^b Includes 1991 Gulf Islands data because of inadequate survey in 1990.

previously. A total of 631 of 665 (95%) historical peregrine sites were checked for occupancy. A total of 233 sites were occupied within the *anatum* range with the majority (77%) in the N.W.T., the Yukon, and Alberta north of 58°N. Throughout Canada, productivity was 1.0 or more young per territorial pair and as high as 2.9 young, with the exception of Rankin Inlet and the North Slope (Table 6).

Labrador Coast—J. Brazil, Newfoundland and Labrador Wildlife Division. From Cape Chidley in

the north to Table Bay in the south, 25 known nest sites were checked at least once on either 18–19 June or 7–12 July (Table 1). Some sites were visited incidentally on 28 May, 15 July and 7 August. The Kogaluk River was also surveyed on 8 July, where one new site was located.

Twenty-one sites were occupied, two were unoccupied, and the occupancy at three sites was uncertain. Fifteen of the 21 occupied sites had eggs, young, or both. Nest contents were determined at

Table 3. Productivity of *anatum* peregrine falcons in Canada during 1990.

AREA	TERRITORIAL PAIRS	SUCCESSFUL PAIRS	TOTAL YOUNG ^a	AVERAGE YOUNG/TERRITORIAL PAIR	AVERAGE YOUNG/SUCCESSFUL PAIR
Labrador	21	13	26 ^b	2.6 ^c	3.3 ^d
Bay of Fundy	5	3	6	1.2	2.0
Southern Quebec	12	9	17	1.4	1.9
Southern Ontario	2	2	4	2.0	2.0
Southern Manitoba	1	1	2	2.0	2.0
Southern Saskatchewan	1	1	1	1.0	1.0
Alberta south of 58°	3	2	3	1.0	1.5
Alberta north of 58°	9 ^e	5	13	1.4	2.6
Porcupine River, Yukon	30 ^f	18	50	1.7	2.8
Peel River, Yukon	12 ^f	9	29	2.4	3.2
Yukon River, Yukon	27 ^f	19	46	1.7	2.4
Mackenzie Valley, N.W.T.	88	70	182	2.1	2.6

^a Captive-raised young omitted.

^b Includes only young from pairs where number of young were determined (N = 8).

^c Calculation includes only pairs where number of young and eggs were determined (N = 10).

^d Calculation includes only pairs where number of young were determined (N = 8).

^e Includes one pair in the adjacent N.W.T.

^f Production of new pairs unavailable.

Table 4. Productivity of *tundrius* and *pealei* peregrine falcons in Canada during 1990.

AREA	TERRITORIAL PAIRS	SUCCESSFUL PAIRS	TOTAL YOUNG	AVERAGE YOUNG/ TERRITORIAL PAIR	AVERAGE YOUNG/ SUCCESSFUL PAIR
<i>tundrius</i>					
Ungava Bay, Quebec	34	32	100	2.9	3.1
North Slope, Yukon	0	0	0	0	0
Rankin Inlet, N.W.T.	26	8	20	0.8	2.5
<i>pealei</i>					
Langara Island, B.C.	7	5	14	2.0	2.8

Table 5. Total occupied peregrine falcon nest sites found in selected regions of Canada from 1965-66 to 1990. Number in parentheses indicates pairs present.

AREA	1965-66	1970	1975	1980	1985-86	1990
<i>anatum</i>						
Labrador	0	2 (2)	0	ND	2 (2)	21 (21)
Bay of Fundy	ND ^a (2)	0	0	0	1 (1)	7 (5)
Southern Quebec	ND (2)	0	ND	1 (1)	1 (1)	15 (12)
Ontario	0	0	0	0	1 (0)	3 (2)
Manitoba	ND	ND	ND	0	1 (1)	2 (1)
Saskatchewan	ND	0	ND	0	2 (1) ^b	2 (1)
Alberta south of 58°	8 (6)	1 (1)	0	0	2 (2)	3 (3)
Alberta north of 58°	ND (4)	2 (1)	3 (3)	9 (9)	6 (5)	9 (9)
Porcupine River, Yukon	ND	ND	8 (8)	16 (13)	14 (11)	36 (ND)
Peel River, Yukon	ND	ND	ND	18 (12)	12 (10)	14 (ND)
Yukon River, Yukon	ND	6 (5)	6 (5)	12 (10)	22 (18)	33 (ND)
Mackenzie Valley, N.W.T.	14 (ND)	9 (6)	24 (21)	20 (15)	45 (ND)	88 (77)
<i>tundrius</i>						
Ungava Bay, Quebec	ND	12 (9)	11 (9)	10 (10)	23 (23)	34 (34)
North Slope, Yukon	ND	ND	5 (5)	2 (0)	0	1 (0)
Rankin Inlet, N.W.T.	ND	ND	ND	8 (8)	26 (ND)	26 (26)
<i>pealei</i>						
Langara Island, B.C.	9 (6)	6 (5)	6 (6)	6 (6)	6 (5)	7 (7)
Queen Charlotte Islands, B.C. ^c	76 (55)	56 (46)	60 (51)	73 (58)	50 (ND)	64 (53)
Vancouver and Gulf Islands, B.C.	ND	ND	ND	5 (4) ^d	13 (10) ^e	18 (7) ^f

^a ND = Not determined.

^b (1) refers to male peregrine mated with female prairie falcon.

^c First number is an estimate of occupied sites which includes pairs, singles defending/attached to sites plus, except in 1965-66, an extrapolation to unsurveyed areas based on results of other surveys. A correction for detection error is not included.

^d Only Gulf Islands data.

^e Includes one site from Triangle Island (not surveyed).

^f Excludes Triangle Island.

Table 6. Productivity of peregrine falcons found in selected regions of Canada surveyed every 5 years from 1970–1990. Productivity data indicate average young per successful pair, and in parentheses, average young per territorial pair.

AREA	1970	1975	1980	1985–86	1990
<i>anatum</i>					
Labrador	2.0 (2.0)	0	ND	3.0 (1.5)	3.3 (2.6)
Bay of Fundy	0	0	0	0	2.0 (1.2)
Southern Quebec	0	ND ^a	2.0 (2.0)	0	1.9 (1.4)
Ontario	0	0	0	0	2.0 (1.3)
Manitoba	ND	ND	0	0	2.0 (1.0)
Saskatchewan	0	ND	0	0	1.0 (0.5)
Alberta south of 58°	3.0 (1.5)	0	0	2.0 (2.0)	1.5 (1.0)
Alberta north of 58°	0	0	3.2 (2.1)	0	2.6 (1.4)
Porcupine River, Yukon	ND	ND	1.7 (1.2)	2.6 (2.0)	2.8 (1.7)
Peel River, Yukon	ND	ND	0	2.3 (1.9)	3.2 (2.4)
Yukon River, Yukon	2.0 (2.0)	1.0 (0.4)	2.2 (1.3)	2.8 (2.2)	2.4 (1.7)
Mackenzie Valley, N.W.T.	2.3 (1.4)	1.3 (0.9)	2.0 (1.5)	2.1 (1.7)	2.6 (2.1)
<i>tundrius</i>					
Ungava Bay, Quebec	1.7 (1.3)	1.8 (1.8)	2.7 (2.7)	3.2 (2.7)	3.1 (2.9)
North Slope, Yukon	ND	ND	0	0	0
Rankin Inlet, N.W.T.	ND	ND	3.3 (2.9)	1.8 (0.6)	2.5 (0.8)
<i>pealei</i>					
Langara Island, B.C.	2.2 (2.2)	2.4 (2.0)	2.2 (2.2)	2.0 (1.6)	2.8 (2.0)
Queen Charlotte Islands, B.C.	2.5 ^b (ND)	3.2 ^c (ND)	2.5 (2.1)	ND	ND
Vancouver and Gulf Islands, B.C.	ND	ND	ND	ND	ND

^a ND = Not determined.

^b Young per 11 successful pairs (Munro and Van Drimmelen 1988).

^c Young plus 2 pipping eggs per 5 successful pairs (Munro and Van Drimmelen 1988).

10 nests; eight nests contained 26 young and two nests contained four eggs each.

These surveys indicated a reoccupancy rate of 80%, which is likely an underestimate because some females may not have flushed and went undetected. For example, the nest at Cape Kakkiviak appeared unoccupied in mid-June but contained young during the second week of July. Conversely, a nest at Little South Wolf Island, occupied in late May, was abandoned by July.

Bay of Fundy—B. Johnson, Canadian Wildlife Service. In New Brunswick, 11 of 12 known nest sites along the Fundy coast, from the lower end of the Bay at Grand Manan to the upper Bay near Sackville, were surveyed on 4 July. In addition, seven cliffs in the lower Saint John River system were also checked because peregrines had been reported nearby. Fundy National Park staff surveyed all of the park's coastline. In Nova Scotia, Five Islands

was visited on 2 June but Ile Haute was not checked. The Minas Channel and Basin, from Cape Split near Blomidon, were checked on 5 and 18 July.

Five pairs nested in the Bay of Fundy, New Brunswick (Table 1). Three pairs hatched three young each but only one pair fledged three, another pair fledged two, and the last pair fledged one. Although no pairs were confirmed in Nova Scotia, a single immature bird was seen adjacent to the historic nest site near Cape d'Or. Another single male ("6N2"), a 1983 Cape d'Or release, occupied the Blomidon release site from June through August.

Ungava Bay, Quebec—D. Bird, Avian Science and Conservation Centre of McGill University. On 28 and 31 July–2 August, 61 known nest sites were surveyed including three new sites along the Koksoak River, Leaf Bay and the Payne River basins.

Pairs occupied 34 cliffs and 32 sites produced 100 nestlings for an average of 3.1 young per successful pair (Table 4).

These peregrines are subject to human disturbance. One breeding female was shot on Basking Island across from the Payne River settlement. One dead hatchling and an unhatched egg were in the scrape; the male was still present but nondefensive. Occasionally, young were taken as pets by Inuit children along the Koksoak River but the development of "cottages" along this river poses a greater threat to the nesting peregrines.

Hudson Bay Coast, Quebec—R. Perrault and F. Morneau, Hydro Quebec. Between 10–20 July, no occupied peregrine nest sites were found during surveys of the Hudson Bay coast west of the Coats River, inland from the mouth of the Grande Riviere de la Baleine and the Petite Riviere de la Baleine, the islands in the Strait of Manitounuk, part of the Islands of Nastapoka, west of Lake Guillaume Delisle, and the mouth of the Nastapoka River. However, later that summer, three birds were seen in the Strait of Manitounuk as well as one adult and two juveniles at Lake Guillaume Delisle indicating that at least one unknown pair successfully raised young in the area.

Southern Quebec—M. Lepage, Quebec Ministère du Loisir, de la Chasse et Pêche. All 10 known and 135 potential peregrine nest sites were visited repeatedly by B. Blais and Y. Pinsonneault from 16 May–11 July. Of 12 territorial pairs, nine fledged 17 wild young and five captive-raised young. Three pairs nested in cities (Table 3).

Southern Ontario—I. Bowman, Ontario Wildlife Branch. Between 24 April–13 July, 23 of 35 known sites and 121 potential nest sites were visited. Observations occurred at each site for about 1 hr. Pairs occupied two sites; one site had been occupied annually since 1986 and the second site was only 10 km away. A single adult occupied the third site. All adults were unbanded and limited reproductive data were collected indicating 2.0 young per territorial pair (Table 3). An unconfirmed report exists of nesting peregrines in another area.

Manitoba—R. Nero, Manitoba Wildlife Branch. J. and P. Duncan conducted an aerial survey of 3438 km of the Hayes, God's, Nelson, Seal, and Churchill rivers, the Hudson Bay coast between the Churchill and Seal Rivers, and the coast by York Factory, from 12–14, 17, and 22 July and 2 August. This survey coincided with the late nesting period and any early failed nesting attempts were missed.

No peregrines were sighted but 33 suitable cliff sites were documented.

The only pair of peregrines in southern Manitoba fledged two young in Winnipeg. In addition, a male ("1X"), from the 1989 Winnipeg nesting, occupied a territory at the University of Manitoba in Winnipeg after mid-May.

Southern Saskatchewan—L. Oliphant, Saskatchewan Cooperative Falcon Project. Between 7 May–15 June, the South Saskatchewan River from the Alberta border to the Qu'Appelle Dam was surveyed but no peregrines were found. An adult male peregrine occupied a territory at Snake Bite Coulee and courted a female prairie falcon (*Falco mexicanus*) in April. This male also courted a female peregrine flown by a falconer.

One pair of peregrines nested in Saskatoon and fledged three young, two of which were captive-raised (Table 3). Single peregrines were observed in Regina but were presumed to be on passage because none stayed past the end of May.

Alberta South of 58°N—S. Brechtel, Alberta Fish and Wildlife Services. All known nest sites in southern Alberta (Court 1993) along the Red Deer, Oldman, Bow, and Milk rivers and some cliffs in the foothills were surveyed. No occupied nor new peregrine nest sites were located. Insufficient resources precluded complete coverage of the foothills region.

Two pairs nested in Edmonton and Calgary. The Edmonton pair laid five eggs, two of which were crushed in the nest. The remaining three eggs were artificially incubated and replaced with two captive-raised young, one of which was injured at fledging. An additional nonbreeding pair spent much of the summer in southern Edmonton. The Calgary pair laid four eggs, hatched three young, and fledged two.

Another pair was reported west of Calgary, but efforts to confirm its presence were unsuccessful. Therefore, this report was treated as an unconfirmed territorial pair pending further surveys because of its proximity to a confirmed 1989 nest site that was unoccupied in 1990.

Alberta North of 58°N—D. Moore, Alberta Fish and Wildlife Services and J. Dixon, Canadian Parks Service. In and near Wood Buffalo National Park during May–June, nine territorial pairs were located. Seven pairs were at known sites and two at new sites. Four nests were outside the park: one in the N.W.T. and three on Lake Athabasca. Each pair laid four eggs and 25 young hatched (69%). Ten

captive-raised young from Canadian Wildlife Service, Wainwright, were used to increase brood sizes to four young. Twenty young fledged for an average of 1.4 young per territorial and 2.6 young per successful pair. Four nests failed to fledge young. Three were depredated and one cavity collapsed killing three young.

Yukon Territory—D. Mossop and G. Mowat, Yukon Department of Natural Resources. Five subpopulations of peregrine falcons are recognized in the territory. Although the fidelity of peregrines to former nest sites is recognized, all habitat between established pairs was surveyed. Most sites were visited only once during the brood rearing period; however, the Yukon River group was visited repeatedly from incubation through late brood-rearing to maximize the likelihood of determining the presence of newly established and unsuccessful pairs.

Peregrines occupying the Yukon North Slope are considered *F.p. tundrius* (Mossop 1988). In the late 1970s, this population experienced a steep decline and the last productive pair was observed in 1979 (Mossop and Ryder 1980). Annual visits continued since 1979 and the first breeding pair with three eggs was located in 1989 at a site occupied in 1979. A single adult occupied this site in 1990.

In the far northern edge of the boreal forest in the Porcupine River drainage, birds identified as belonging to the interior race or *anatum* (Mossop 1988) declined in the late 1960s and early 1970s. The remnant population showed the first documented recovery in the northwest (Hayes and Mossop 1982). In 1990, we surveyed 34 known sites and located six new sites (Table 1). Reoccupancy was estimated to be 88% and 60% of all known sites produced young. All six new pairs were also productive (Tables 1 and 3). The population is now at its known pre-decline density and apparently still expanding.

In the northeast portion of the boreal forest region in the Peel River drainage and probably communicating directly with the Mackenzie Valley population, there is a subpopulation that declined in the 1960s. Its recovery has been relatively slow and its productivity has been low compared to the other *anatum* subpopulations in the central and north-central portion of the territory (Mossop and Baird 1985).

Only one small segment of this drainage, near the Dempster highway, has been monitored annually. In 1989, we conducted a major survey which gave the data on the current status when combined

with the 1990 survey. Adult peregrines occupied 39% of known sites; 75% of pairs at known sites produced young (Tables 1 and 3). Two new pairs were productive. This population is likely at its pre-decline density and is still expanding.

The longest-known subpopulation of peregrines in the Yukon River drainage, that communicates directly with the Alaska Yukon River basin subpopulation, declined through the early 1970s, and by 1978 contained only one occupied nest site. It has exhibited a strong and sustained recovery since that time (Mossop and Baird 1985). In 1990, we resurveyed 36 known sites and found six new sites (Table 1). Peregrines occupied 27 (75%) known sites, with 19 (70%) pairs producing young (Tables 1 and 3). Five new sites were also productive. The population is at least as large as it was originally and continues to expand.

The Southern Lakes area, which includes the large lakes of the southern Yukon, is assumed to be a continuation of the interior habitats of B.C. It was not monitored regularly and the few known breeders disappeared in the 1970s. The three known historic sites remained unoccupied in 1990. Until a more extensive survey is conducted, this group must be considered locally extirpated.

Mackenzie Valley, N.W.T.—C. Shank, N.W.T. Wildlife Management Division. The 1990 survey covered the Mackenzie Valley from 80 km upstream of Fort Norman to Inuvik. K. Hodson surveyed the Mackenzie River from 15–26 July. L. Wakelyn and S. Matthews of the Department of Renewable Resources and R. Owens of Foothill Pipe Lines Ltd. surveyed peregrine sites in habitat adjacent to the Mackenzie River from 8–12 June and flew a productivity survey from 14–18 July. A total of 107 known nest sites were surveyed and seven new sites were found (Table 1). Of the known sites, 81 (76%) were reoccupied. Productivity (2.1 young per territorial pair and 2.6 young per successful pair) was the highest recorded for the Mackenzie Valley to date (Tables 3 and 6). Occupancy and productivity of Mackenzie Valley peregrines improved significantly during the last decade.

Central Arctic Coast, N.W.T.—C. Shank, N.W.T. Wildlife Management Division. During 1–3 July, approximately 4000 km² near Coppermine were surveyed by L. Wakelyn, A. Gunn and C. Shank. Occupancy by at least one adult was noted at 61 nest sites. Mean clutch size was 3.4 ($N = 23$) and mean brood size was 2.4 ($N = 5$).

C. Shank surveyed approximately 2000 km² east

of Bathurst Inlet between 11–17 July. Single adults were seen at 34 nest sites but eggs and young were counted in only few nests. These populations increased dramatically in the past 7–8 yr (Shank et al. 1993).

Belcher Islands, N.W.T.—J. Nishi, University of Alberta. Cade and Fyfe (1970) reported nesting peregrines on the Belcher Islands during the 1940s and 1950s, but researchers failed to locate peregrines on the adjacent mainland during the 1975 survey (Fyfe et al. 1976). During 1990, while conducting surveys of plant communities, approximately 20% of the land area of the Belcher Islands was searched from 15 June–10 August. The survey was not systematic nor was it structured to search for peregrine falcons. Nevertheless, three occupied peregrine nest sites were found. Two nests found on 18 July were on 30 m cliffs on isolated rock islands and the third nest containing three young was found on 1 August on an accessible rock ledge on a large rocky bluff. Local Inuit hunters knew of the first two nests and said they saw falcons occasionally during summer.

Rankin Inlet, N.W.T.—T. Duncan and M. Bradley, University of Saskatchewan. Nest sites were surveyed from 15 May–15 August within 20 km of Rankin Inlet as part of an ongoing, intensive population study initiated in 1981. Pairs occupied 26 nest sites and only 19 pairs laid 64 eggs. Thirty-nine young hatched and at least 20 fledged from eight nests.

Laying dates and weather conditions indicated that weather did not delay the 1990 breeding season. However, a three-day rain during late July strongly affected the 1990 production. Only 20 of the approximately 39 young hatched survived this storm. Weather appears to be a major factor limiting productivity at Rankin Inlet during at least three of nine years of the study, two of which were successive national peregrine surveys (Bradley 1989, Court et al. 1988).

Frobisher Bay, N.W.T.—C. Shank, N.W.T. Wildlife Management Division. L. Wakelyn and P. Kilabuk surveyed Frobisher Bay as far south as Wiswell Inlet and Newell Sound on 5–7 July. Thirty-two peregrine nest sites were checked, some of which may be alternate nest sites. Single birds and pairs occupied 11 nests. Since females were still incubating, no attempt was made to count eggs.

Thelon Wildlife Sanctuary, N.W.T.—C. Shank, N.W.T. Wildlife Management Division. During two surveys of known nest sites, 25 sites were found to

be occupied. Mean clutch size was 3.0 ($N = 8$) and the mean brood size was 3.3 ($N = 9$). Each nest was visited only once during July or August.

Nahanni National Park Reserve, N.W.T.—S. Meggs, Canadian Parks Service. The First Canyon area along the South Nahanni River was surveyed on 29 May. The cliffs from Dry Canyon to Yohin Lake were surveyed twice, once along the rim and then at a lower elevation approximately halfway down the canyon walls. We saw no peregrines nor did any park staff or visitors. In 1985, two pairs of peregrines were observed in the park but were not reported in Murphy (1990). In July 1985, a pair with one young was seen at a cliff nest in First Canyon and in August 1985 another pair with three young was seen approximately 8 km southeast of the first pair.

Langara Island, B.C.—R.W. Nelson, Camrose, Alberta. All seven known peregrine nest sites on Langara Island, the northwestern island of the Queen Charlotte Islands, were surveyed from 6–15 June. Seven territorial pairs were found but two had no eggs or young. The five successful pairs produced 14 nestlings, slightly above average for the island (Nelson 1990).

Queen Charlotte, Vancouver and Gulf Islands, B.C.—W.T. Munro, B.C. Wildlife Branch. Coastal populations of *F.p. pealei* in B.C. were surveyed on the Queen Charlotte Islands from 21 May–1 June. A total of 59 occupied territories were found. By adding the unsurveyed portion, the number of occupied territories was estimated to be 71.

There were an estimated 10 occupied territories on northern Vancouver Island from a 17 June survey; a single bird also flew from a possible new site. Triangle Island was not checked in 1990 but in 1989 it had seven occupied territories. On the Gulf Islands, three known nest sites were found occupied during a 15 June survey, but a minimum of four sites were assumed occupied because another site appeared to be occupied. This survey was considered incomplete and therefore was repeated in 1991. In 1991 the Gulf Islands shorelines were surveyed on 27–28 May and more inland sites were surveyed on 4 June. The combined 1991 surveys resulted in the location of seven occupied nests.

DISCUSSION

The *Anatum* Peregrine Falcon Team coordinated the 1990 survey and selected target areas to search for nesting peregrines. The team's objective was to resurvey known areas with an effort similar to that

used in previous 5 yr surveys. The approach taken was to survey historic sites within the *anatum* peregrine range every 5 yr and to encourage annual surveys and more detailed monitoring of selected populations (Erickson et al. 1988). In the Arctic, inadequate resources precluded the resurveying of all areas surveyed between 1970–80. Also, the *tundrus* subspecies had increased in most areas that were being monitored annually, so the need for extensive surveys was not as great (Bromley 1991). Other major gaps in the 1990 survey were in central Quebec, northern Ontario and Saskatchewan, and interior B.C.

The number of occupied *anatum* nest sites increased in most regions of Canada from 1985–86 to 1990 and was higher than at any other time. However, peregrine numbers increased substantially along the Porcupine and Yukon rivers and increased slightly along the Peel River. These increases in the north reflected the improved reproduction and survival of peregrines after the ban of DDT in North America and a decline of DDE in the prey of peregrines (Peakall et al. 1990). Counts in the Mackenzie Valley, Rankin Inlet, and central Yukon were also higher than in previous counts but these increases may be a product of increased survey effort. Likewise, on the Labrador coast and Ungava Bay, population increases since 1985 were most likely due to more intensive survey work (Lemon and Brazil 1990). The northern Alberta and Wood Buffalo National Park population has shown a gradual increase, which is expected because of some human assistance through the provision of additional young.

Peregrines have failed to reoccupy the southern Yukon. Given this increase in peregrine numbers in the Yukon, adjacent Alaska (Ambrose et al. 1988), and N.W.T., repopulation is expected to occur naturally.

Peregrine falcon populations in southern Canada appeared to be recovering. In 1990, 17 pairs nested in southern Quebec and New Brunswick, up from two pairs in 1985 (Murphy 1990). Two pairs nested in southern Ontario and five pairs nested on the Prairies, all in cities. This recovery was due to the release of large numbers of captive-raised young (Holroyd and Banasch 1990). All peregrine pairs that nested on the Prairies in 1990 were in cities and the number of pairs increased from four to five since 1985 (Murphy 1990). In Quebec and Bay of Fundy, a dramatic population increase occurred because of large releases of cap-

tive-raised young, but in Ontario the recovery was slower. The scarcity of occupied peregrine nest sites in Ontario fails to reflect the large number of released captive-raised young. Releases occurred at widely scattered locations from Ottawa to Thunder Bay from 1977–90 (Holroyd and Banasch 1990). Apparently, many single falcons returned but never mated and others returned, but to Quebec City, Boston, Toledo, and Winnipeg.

Population trends of *tundrus* were not as clear because of the lack of detailed population data prior to 1980. The increases noted in the number of territorial pairs in the Rankin Inlet population from 1980–85 were primarily the result of more intensive surveys.

Intensive annual monitoring of Langara Island's *pealei* peregrines has shown a stable population with healthy reproduction since 1968 (Nelson 1990) and the population appears to be at capacity in view of the once plentiful but now diminished food supply (Nelson and Myres 1975). Extensive 5 yr surveys of the Queen Charlotte, Vancouver, and Gulf Islands indicate a stable population on the B.C. coast.

The objective of the *Anatum* Peregrine Falcon Recovery Plan is 10 breeding pairs in six of nine management zones by 1992. This goal was reached in three zones: southern Quebec-New Brunswick-Nova Scotia-Prince Edward Island, the Yukon and the Mackenzie Valley. In southern Ontario and the Prairies, the goal of 10 pairs was partly achieved. The number of pairs is unknown in central Quebec, northern Ontario and interior B.C.

Although peregrines showed stable population numbers prior to the DDT era (Hickey 1969), post-DDT populations increased along with the release of captive-raised young and declining DDT levels. In Canada, southern populations reestablished and increased due to the introduction of captive-raised young while northern populations increased with little human intervention and because of lower DDT levels. When annual population growth rates were calculated between 1980, 1985, and 1990, a general pattern emerged. In the north, populations increased annually by 13% in Ungava, 16% in Mackenzie Valley, and 7% in the Yukon. In the south, the populations increased by 72% in southern Quebec and 50% in New Brunswick and Nova Scotia from 1985–90. Thus, populations in certain areas of large releases of captive-raised young increased by 50% or more per year, while populations where few or no releases occurred grew at

16% or less per year. These figures paralleled the number of peregrines in the eastern U.S. which increased at 26% per year with releases and were projected to increase at up to 5% per year without (Grier and Barclay 1988).

The observed productivity of the nesting pairs in most areas was adequate to support continued increases across the range of the peregrine. Newton (1979) stated that stable peregrine populations produced 1.0–1.5 young per nesting pair per year on average. Grier and Barclay (1988) projected that with an average production of 2.5 young per year per successful pair and 66% of nesting pairs being successful (1.68 young per territorial pair per year and no supplemental young), that the eastern U.S. peregrine population would increase at the rate of 0.3–4.5% per year. In 1990, the peregrines surveyed in Canada produced greater than 1.5 wild young per territorial pair except in the Bay of Fundy, southern Quebec, southern Saskatchewan, Alberta south of 58°N, the North Slope and Rankin Inlet.

Although productivity is only one part of any population model and does not itself indicate a population increase (Grier 1979), the consistency of productivity over 1.5 young per territorial pair per year indicates that peregrines throughout much of Canada produced at a rate that should sustain or increase their numbers where they occur in sufficient density. In Ontario and on the Prairies, where the number of pairs is low or the recovery slow, the risk of extirpation from stochastic events indicate a need for the continued release of captive-raised young. In addition, five nesting pairs and six of seven occupied nest sites on the Prairies in 1990 were in cities, not on prairie cliffs.

Nisbet (1988) and Peakall (1990) commented on the relative lack of success of the release program in Canada compared to the eastern U.S. However, they based their comparisons on the number of pairs in 1985, not single birds, which were more numerous than paired birds in the areas of release in southern Canada (Holroyd and Banasch 1990). Also, the number of pairs and singles more than doubled through 1988 (Holroyd and Banasch 1990) and doubled again by 1990. The return rates for captive-raised released young falcons are lower in Canada than in the U.S. (Holroyd and Banasch 1990). The establishment by 1990 of 19 pairs and six single falcons in south-eastern Canada and five pairs and two singles in

the Prairies indicates that breeding pairs were successfully established in most areas of releases.

Throughout Canada, productivity was 1.0 or more young per territorial pair and as high as 2.9 young, with the exception of Rankin Inlet and the North Slope. Low productivity at Rankin Inlet was due to a single rainstorm and did not reflect production in recent years (Court et al. 1988). A single adult occupied a nest site in the North Slope.

Court et al. (1988) criticized 5 yr surveys as too infrequent to accurately monitor population changes in most populations north of 60°N because low production and a decrease in the number of successful pairs may simply represent normal fluctuation rather than a major population decline. At temperate latitudes, however, other authors have noted the relative stability of peregrine populations, especially when unaffected by pesticides or recovering from them (Ratcliffe 1980, Newton and Mearns 1988, Nelson 1990). Since the peregrine is not an ephemeral species (Galushin 1974, Hunt 1988), annual surveys of its entire range are unnecessary to monitor changes in its population size.

A related issue is the effectiveness of single visits to monitor breeding peregrine populations. The single surveys in the N.W.T., Yukon, Ungava Bay, and Labrador occurred at hatching or during the nestling stage. Adult peregrines are more aggressive at this stage than during incubation and thus more likely to be detected. However, any failed nesters are less likely to be detected by later surveys. Mark Bradley (pers. comm.), who monitored the Rankin Inlet population throughout the entire 1986 breeding season, determined that less than 10 of the 26 original pairs remained territorial after nest failure in early incubation caused by the spring snowstorm. Thus, a single survey after such a nest failure would have underestimated the population by 60%. The effect of catastrophic weather was noted by Court et al. (1988) and in Labrador during 1989 and 1991 by J. Brazil (pers. comm.). Thus, the results from single surveys should be used with caution since they could underestimate population size and productivity.

ACKNOWLEDGMENTS

This survey could not have been undertaken without the support of the Endangered Species Recovery Fund and World Wildlife Fund Canada. We thank Margaret Chrumka of WWF and Bruce Bretzloff of the Wainwright and District Wildlife Conservation Society, who administered the funds. We also appreciate comments made by

D. Bird, G. Court, J. Dixon, D. Ellis, C. Marti, R.W. Nelson, L. Oliphant, K. Poole, and W.J.P. Thompson.

LITERATURE CITED

- AMBROSE, R.E., R.J. RITCHIE, C.M. WHITE, P.F. SCHEMPF, T. SWEM, AND R. DITTRICK. 1988. Changes in the status of peregrine falcon populations in Alaska. Pages 73–86 in T.J. Cade, J.H. Enderson, C.G. Thelander and C.M. White [EDS.], *Peregrine falcon populations: their management and recovery*. The Peregrine Fund Inc., Boise, ID, U.S.A.
- BEEBE, F.L. 1960. The marine peregrines of the north-west Pacific coast. *Condor* 62:145–189.
- BRADLEY, D.M. 1989. Factors affecting the reproductive success of peregrine falcons in Rankin Inlet, NWT. M.S. thesis, Univ. Saskatchewan, Saskatoon, Canada.
- BROWN, L. 1974. Data required for effective study of raptor populations. Pages 9–20 in F.M. Hamerstrom, B.E. Harrell and R.R. Olendorf [EDS.], *Management of raptors*. Raptor Research Foundation, Raptor Res. Rep. No. 2.
- BROMLEY, M. 1991. Update report on the status of peregrine falcons (*Falco peregrinus tundrius*) in Canada. Unpubl. rep. COSEWIC, N.W.T. Wildlife Service, Yellowknife, N.W.T., Canada.
- CADE, T.J. AND R.W. FYFE. 1970. The North American peregrine survey, 1970. *Can. Field-Nat.* 84:231–245.
- COURT, G.S. 1993. A review of historical nesting records for the peregrine falcon (*Falco peregrinus anatum*) in Alberta south of 56° North: priorities for surveying a recovering population. Unpubl. rep. Alberta Department Environmental Protection, Fish and Wildlife Services, Edmonton, Alberta, Canada.
- , D.M. BRADLEY, C.C. GATES AND D.A. BOAG. 1988. The population biology of peregrines in the Keewatin District of the Northwest Territories, Canada. Pages 729–739 in T.J. Cade, J.H. Enderson, C.G. Thelander and C.M. White [EDS.], *Peregrine falcon populations: their management and recovery*. The Peregrine Fund Inc., Boise, ID U.S.A.
- ELLIS, D.H. 1988. Distribution, productivity, and status of the peregrine falcon in Arizona. Pages 87–94 in T.J. Cade, J.H. Enderson, C.G. Thelander and C.M. White [EDS.], *Peregrine falcon populations: their management and recovery*. The Peregrine Fund Inc., Boise, ID U.S.A.
- ENDERSON, J.H. 1965. A breeding and migration survey of the peregrine falcon. *Wilson Bull.* 77:327–339.
- . 1969. Population trends among peregrine falcons in the Rocky Mountain Region. Pages 73–79 in J.J. Hickey [ED.], *Peregrine falcon populations: their biology and decline*. Univ. Wisconsin Press, Madison, WI U.S.A.
- ERICKSON, G., R. FYFE, R. BROMLEY, G.L. HOLROYD, D. MOSSOP, B. MUNRO, R. NERO, C. SHANK AND T. WEINS. 1988. *Anatum* peregrine falcon recovery plan. Canadian Wildlife Service, Environment Canada, Ottawa, Canada.
- FYFE, R.W. 1969. The peregrine falcon in northern Canada. Pages 101–114 in J.J. Hickey [ED.], *Peregrine falcon populations: their biology and decline*. Univ. Wisconsin Press, Madison, WI U.S.A.
- , S. TEMPLE AND T.J. CADE. 1976. The 1975 North American peregrine falcon survey. *Can. Field-Nat.* 90: 228–273.
- GALUSHIN, V.M. 1974. Synchronous fluctuations in populations of some raptors and their prey. *Ibis* 116:127–134.
- GRIER, J.W. 1979. Caution on using productivity or age ratios alone for population inferences. *Raptor Res.* 13. 20–24.
- AND J.H. BARCLAY. 1988. Dynamics of founder population established by reintroduction. Pages 689–700 in T.J. Cade, J.H. Enderson, C.G. Thelander and C.M. White [EDS.], *Peregrine falcon populations: their management and recovery*. The Peregrine Fund Inc., Boise, ID U.S.A.
- HAYES, R. AND D.H. MOSSOP. 1982. The recovery of an interior peregrine falcon population in the northern Yukon Territory. Pages 234–243 in W.N. Ladd and P.F. Schempf [EDS.], *Raptor management and biology in Alaska and western Canada*. U.S. Dept. Interior, Fish & Wildlife Service, Alaska Regional Office.
- HICKEY, J.J. [ED.]. 1969. *Peregrine falcon populations: their biology and decline*. Univ. Wisconsin Press, Madison, WI U.S.A.
- HOLROYD, G.L. AND U. BANASCH. 1990. The reintroduction of the peregrine falcon, *Falco peregrinus anatum*, into southern Canada. *Can. Field-Nat.* 104:203–208.
- HUNT, W.G. 1988. The natural regulation of peregrine falcon populations. Pages 667–767 in T.J. Cade, J.H. Enderson, C.G. Thelander and C.M. White [EDS.], *Peregrine falcon populations: their management and recovery*. The Peregrine Fund Inc., Boise, ID U.S.A.
- KIFF, L.F. 1988. Changes in the status of the peregrine in North America: an overview. Pages 123–129 in T.J. Cade, J.H. Enderson, C.G. Thelander and C.M. White [EDS.], *Peregrine falcon populations: their management and recovery*. The Peregrine Fund Inc., Boise, ID U.S.A.
- LEMON, D. AND J. BRAZIL. 1990. Preliminary report of breeding peregrine falcons, *Falco peregrinus*, in Labrador, 1987 and 1988 survey results. *Can. Field-Nat.* 104:200–202.
- MOSSOP, D. 1988. Current status of peregrine falcons in Yukon, Canada. Pages 65–68 in T.J. Cade, J.H. Enderson, C.G. Thelander and C.M. White [EDS.], *Peregrine falcon populations: their management and recovery*. The Peregrine Fund Inc., Boise, ID U.S.A.
- AND G. RYDER. 1980. 1980 North American peregrine falcon survey—Yukon Territory. In *Annual report, inventory, population studies and management*

- projects—birds of prey. Unpubl. Rep., Yukon Territory Game Commission, Whitehorse, Yukon, Canada.
- AND G. BAIRD. 1985. Peregrine falcon recovery project. In 1985 annual report, birds of prey and non-game birds, inventory, population studies and management projects. Unpubl. Rep., Yukon Department Renewable Resources, Whitehorse, Yukon, Canada.
- MUNRO, W.T. AND B. VAN DRIMMELEN. 1988. Status of peregrines in the Queen Charlotte Islands, British Columbia. Pages 69–72 in T.J. Cade, J.H. Enderson, C.G. Thelander and C.M. White [EDS.], Peregrine falcon populations: their management and recovery. The Peregrine Fund Inc., Boise, ID U.S.A.
- MURPHY, J.E. 1990. The 1985–86 Canadian peregrine falcon, *Falco peregrinus*, survey. *Can. Field-Nat.* 104:182–192.
- NELSON, R.W. 1990. Status of the peregrine falcon, *Falco peregrinus pealei*, on Langara Island, Queen Charlotte Islands, B.C. 1968–1989. *Can. Field-Nat.* 104:193–199.
- AND M.T. MYRES. 1975. Changes in the peregrine population and its seabird prey at Langara Island, British Columbia. Raptor Research Foundation, Raptor Res. Rep. No. 3.
- NEWTON, I. 1979. Population ecology of raptors. Buteo Books, Vermillion, SD U.S.A.
- AND R. MEARN. 1988. Population ecology of peregrines in Scotland. Pages 651–665 in T.J. Cade, J.H. Enderson, C.G. Thelander and C.M. White [EDS.], Peregrine falcon populations: their management and recovery. The Peregrine Fund Inc., Boise, ID U.S.A.
- NISBET, I.C.T. 1988. Summary. Pages 851–856 in T.J. Cade, J.H. Enderson, C.G. Thelander and C.M. White [EDS.], Peregrine falcon populations: their management and recovery. The Peregrine Fund Inc., Boise, ID U.S.A.
- PEAKALL, D.B. 1990. Prospects for the peregrine falcon, *Falco peregrinus*, in the nineties. *Can. Field-Nat.* 104:168–173.
- , D.G. NOBLE, J.E. ELLIOT, J.D. SOMERS AND G. ERICKSON. 1990. Environmental contaminants in Canadian peregrine falcons, *Falco peregrinus*: a toxicological assessment. *Can. Field-Nat.* 104:244–254.
- POSTUPALSKY, S. 1974. Raptor reproductive success: some problems with methods, criteria and terminology. Pages 21–31 in F.N. Hamerstrom, B.E. Harrell and R.R. Olendorff [EDS.], Management of raptors. Raptor Research Foundation, Raptor Res. Rep. No. 2.
- RATCLIFFE, D.A. 1980. The peregrine falcon. Buteo Books, Vermillion, SD U.S.A.
- SHANK, C., R.G. BROMLEY AND K.G. POOLE. 1993. Increase in breeding population of tundra peregrine falcons in central Canadian arctic. *Wilson Bull.* 105:188–190.
- WHITE, C.M., R.W. FYFE AND D.B. LEMON. 1990. The 1980 North American peregrine falcon, *Falco peregrinus*, survey. *Can. Field-Nat.* 104:174–181.

Received 23 March 1994; accepted 6 June 1996