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Distribution and relative abundance of caribou in the Hudson Plains Ecozone of Ontario

Audrey J. Magoun[1], Kenneth F. Abraham[2], John E. Thompson[3], Justina C. Ray[4], Michel E. Gauthier[5], Glen S. Brown[6], Gillian Woolmer[4], Christopher J. Chenier[5], & F. Neil Dawson[7]

[1] Wildlife Research and Management (WRAM), 3680 Non Road, Fairbanks, Alaska 99709, USA (amagoun@ptialaska.net).
[2] Ontario Ministry of Natural Resources, 300 Water Street, Peterborough, Ontario K9J 8M5, Canada.
[3] Ontario Parks, Ontario Government Complex, Hwy 101 East, PO Bag 3020, South Porcupine, Ontario P0N 1H0, Canada.
[4] Wildlife Conservation Society Canada, 720 Spadina Avenue, Suite 600, Toronto, Ontario, M5S 2T9, Canada.
[5] Ontario Ministry of Natural Resources, 2 Third Avenue, PO Box 730, Cochrane, Ontario P0L 1C0, Canada.
[6] Tembec Inc., Hwy 101 West, P.O. Box 1100, Timmins, Ontario P4N 7H9, Canada.
[7] Ontario Ministry of Natural Resources, RR#1, 25th Side Road, Thunder Bay, Ontario P7C 4T9, Canada.

Abstract: To determine past distribution and relative abundance of caribou (*Rangifer tarandus caribou*) in the Hudson Plains Ecozone (HPE) of Ontario, we reviewed past HPE-wide winter systematic aerial surveys, partial winter systematic surveys, summer photographic surveys, incidental observations of caribou, and other sources of information from the period 1950–2003. We conducted new HPE-wide aerial surveys in February 2003 and 2004 to evaluate current distribution patterns. From this information, we defined 9 core wintering areas in the HPE and differentiated between 3 categories of relative abundance. Wintering areas for the January–March period have changed relatively little over the past 45 years. Summer distribution of caribou along the Hudson Bay coast apparently shifted or expanded from the area west of the Severn River to the central and eastern portions of the coast since the 1980s, and caribou observations have become much more common in the area east of the Winisk River since 1998. Because major resource development activities in the HPE are proposed and some are imminent, we recommend additional caribou surveys to document current caribou population identity, size, and distribution, and research projects to better define caribou wintering areas, calving areas, and movement patterns in the HPE.

Key words: aerial surveys, historical review, Hudson Bay, James Bay, Omushkego Cree, photographic surveys, *Rangifer tarandus caribou*, systematic surveys, summer aggregations, wintering areas.

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Introduction

In Ontario, the term Hudson Plains Ecozone (HPE) refers to an ecological region lying south of Hudson Bay and west and south of James Bay (50–59ºN, 76–96ºW; Fig. 1) (Ecological Stratification Working Group, 1996). Historically, the term Hudson Bay Lowland has been used to refer to a physiograhic region of Ontario that corresponds to the area covered by the HPE. The HPE is subdivided into 3 ecoregions: Coastal Hudson Bay Lowland, Hudson Bay Lowland, and James Bay Lowland. Because the term Hudson Bay Lowland is used for the name of an ecoregion in the HPE as well as for the entire physiographic region, we will refer to our study area as the HPE to avoid confusion, even though many of the references cited in this paper use the term Hudson Bay Lowland when referring to the entire region.

As early as the 1700s caribou were documented inhabiting the Hudson Bay coast in Ontario east as far as Cape Henrietta Maria (Banfield, 1961 citing Jérémie, 1720 and Hearne, 1795). At that time,

caribou observed along the coast were thought to migrate seasonally, spending the winter in wooded interior regions of what is now Manitoba and migrating southeastward in summer along the narrow tundra belt bordering the Hudson Bay coast in Manitoba and Ontario. Lytwyn (2002: 84) stated that "caribou did not migrate as far south as the Albany River during the fur-trade period. The most southerly destination was Akimiski Island, where large numbers spent the summer on the tundra of the island's northern shore." Caribou no longer occur on Akimiski Island. An elder Attawapiskat resident who has hunted and trapped on Akimiski Island all his adult life reported seeing caribou on the island for the last time in the 1940s (M. Kataquapit, pers. comm.). Lytwyn (2002: 229), quoting from a 1948 unpublished report by the Department of Northern Affairs and National Resources, wrote "The brush caribou (locally called 'deer') ('hatik'), once fairly plentiful along the west coast of James Bay, has all but disappeared from the country." Other historical references to caribou in the eastern HPE south of the Ekwan River indicate that caribou occurred in small, widely scattered groups (Brokx, 1965 citing the following: Bell, 1886; Dowling, 1904; de Vos & Peterson, 1951). Banfield (1961, citing Tyrrell, 1913) and Lytwyn (2002) reported that heavy kills of caribou to provision the Hudson Bay Company fur-trading posts rapidly reduced the size of the migratory caribou population by the late 1700s and may have changed the population's migratory patterns. Lytwyn (2002) reviewed Hudson Bay Company meat trade records and reported that caribou numbers began to increase again by the late 1800s.

Cringan (1956) contributed more recent information on distribution and abundance of caribou in Ontario based on data collected from trappers and hunters. However, systematic surveys of caribou in the HPE were not begun until 1957, when the Ontario Department of Lands and Forests [reorganized into the Ontario Ministry of Natural Resources in 1973 and hereafter referred to as OMNR regardless of the year] began winter aerial surveys of caribou over large areas of Ontario. Simkin (1965) and Brokx (1965) summarized the results of systematic winter surveys through 1964. Simkin (1965) also reported summer observations of caribou in the northern portion of the HPE collected while doing ground surveys of vegetation in July and August 1960–1962, and an aerial survey in August 1963. From 1967 through 1979, OMNR personnel periodically conducted additional winter aerial surveys in limited areas of the HPE, and in 1982–1984 they carried out a broad-scale systematic winter survey. In an unpublished report, Thompson (1986) summarized the results of the OMNR winter caribou surveys in the HPE from 1959–1984 and Thompson & Abraham (1994) summarized caribou observations from the northwestern HPE for the period 1958–1990. Biologists and others working in coastal areas continued to record incidental observations of caribou along Hudson Bay and in the southeastern portion of the Hudson Bay Lowlands along James Bay. These observations are archived by OMNR.

Using radiotelemetry, Abraham & Thompson (1998) followed the movements of caribou in northwestern Ontario (Pen Islands caribou herd) from 1987 through 1990 and determined that the collared caribou made seasonal movements from wintering areas in the forested interior of northeastern Manitoba and northwestern Ontario to the Hudson Bay coast in spring, and then back again in the fall and early winter. The only other telemetry study of caribou in the HPE was in the southeastern portion near the Quebec border (Brown *et al*., 2003).

Historically, the HPE in Ontario was occupied by the Hudson Bay Lowland Cree (Muskekowuck Athinuwick) living in dispersed bands (Lytwyn, 2002). Today, the human population (approx. 10 000) is largely concentrated in 7 coastal villages—Fort Severn, Peawanuck, Attawapiskat, Kashechwan, Fort Albany, Moosonee, and Moose Factory (Fig. 1). Hunting, trapping, fishing, and tourism dominate the local economies (Berkes *et al*., 1994; Berkes *et al*., 1995; Abraham & Keddy, in press). While patterns of harvesting activities have changed markedly, the geographic extent of land use continues to reach far beyond the settlements (Berkes *et al*., 1995). The HPE remains essentially roadless, with only winter ice roads connecting some of the more isolated communities. One rail line penetrates the HPE in Ontario, and surface access to interior regions is primarily by boat along major rivers and streams in summer and by snowmachine in winter. However, in recent years there has been increasing use of all-terrain vehicles along coastal areas in summer. Commercial forestry does not currently occur in the HPE and mining is in its infancy. However, there are a number of pending or planned resource development projects that will affect the area and potentially caribou populations in the region, including forestry along the southern edge (OMNR, 2001) and development of diamond resources (AMEC, 2004), primarily in the James Bay Lowland. Winter roads have been proposed to develop the mining claims near Attawapiskat (AMEC, 2004). In view of these developments and others that may follow, it is important to develop baseline information on caribou populations in the Ontario HPE and monitor the effects of resource development on caribou numbers, distribution, and movements. Loss of historical range

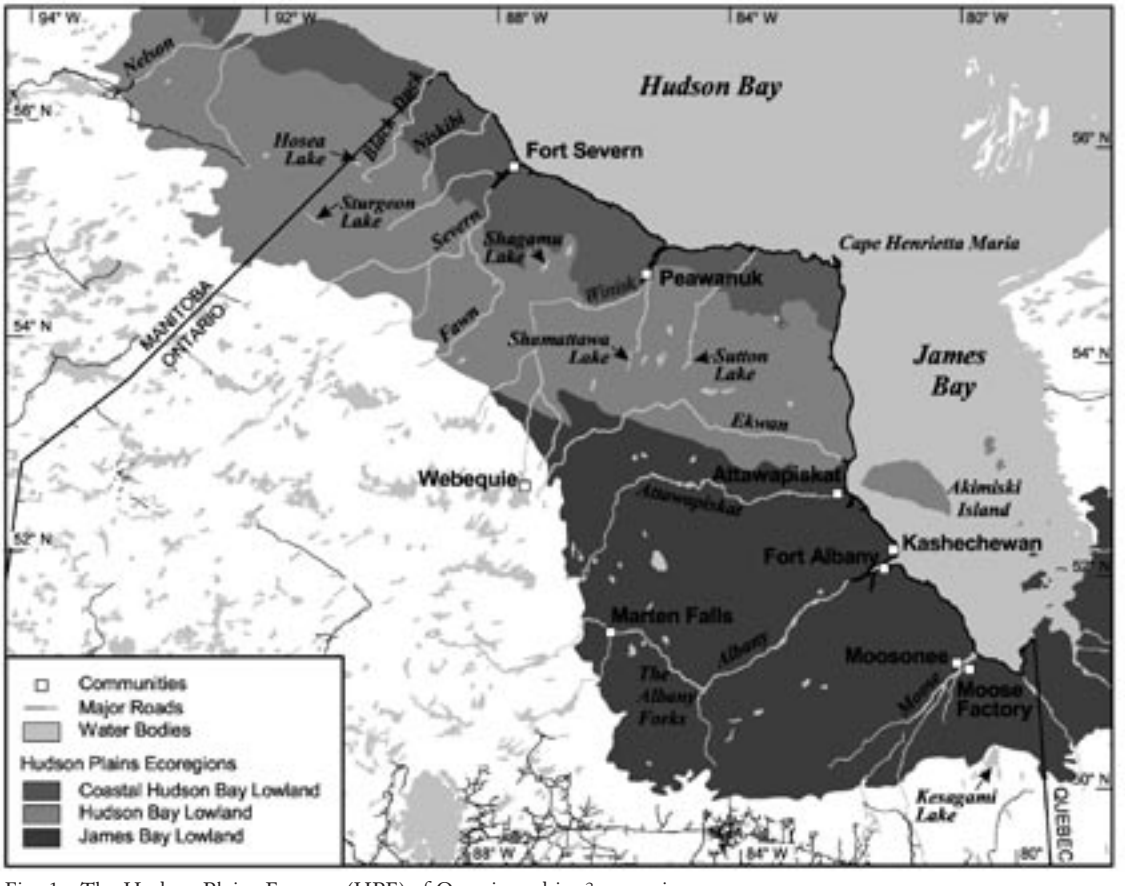

Fig. 1 The Hudson Plains Ecozone (HPE) of Ontario and its 3 ecoregions.

of caribou in the southern half of the province since 1880 (Racey & Armstrong, 2000; Schaefer, 2003) highlights the vulnerability of caribou to changes in human land use patterns and emphasizes the need for knowledge about the status of northern caribou populations before there are appreciable changes in land use in this region of Ontario.

For this paper, we have 3 objectives:

1 Summarize unpublished information on systematic winter surveys and incidental observations of caribou,
2 Discuss patterns of caribou distribution and relative abundance over time, and
3 Recommend future directions for documenting caribou distribution and relative abundance in the Hudson Bay Lowlands in light of impending changes in human land use.

Study area

The study area (Fig. 1) comprises the portion of the HPE that lies within Ontario. Detailed descriptions of each ecoregion in the HPE are provided in *A National Ecological Framework for Canada* (Ecological Stratification Working Group, 1996).

The climate of the HPE is characterized by short, cool summers and cold winters. Ecoregional climates vary from high subarctic along the Hudson Bay coast (cooler and drier) to midboreal around southern James Bay (wetter and warmer). From Fort Severn to Cape Henrietta Maria, 50% of offshore waters can remain ice-covered into late July in some areas (Rouse, 1991). Rowe (1972) described the area as a poorly drained region of unconsolidated glacial and postglacial deposits underlain by Palaeozoic limestone over Precambrian rock, abounding in bogs and shallow lakes. Abraham & Keddy (in press) provide a detailed description of the HPE, with emphasis on the wetland features of the region.

The forested areas of the Coastal Hudson Bay Lowland are characterized by very open stands of stunted black spruce (*Picea mariana*) and tamarack, with secondary quantities of white spruce (*Picea glauca*). In the Hudson Bay Lowland, stands are denser and trees are larger. In both ecoregions, the shrub layer consists of dwarf birch (*Betula nana*), willow (*Salix*

spp.), and ericaceous shrubs, and the ground cover is dominated by sedges (*Carex* spp.) and cottongrass (*Eriophorum* spp.) or moss and lichen (*Cladonia* spp., *Alectoria* spp., *Cetraria* spp., and others). Dry sites in the Hudson Bay Lowland ecoregion support open stands of white spruce with an ericaceous shrub layer and a ground cover of lichen. Poorly drained sites in both ecoregions are characterized by sedge and cottongrass tussocks or sphagnum moss. The James Bay Lowland ecoregion is a transition zone between the coniferous and mixed forests of the clay belt to the south and the tundra to the north. Most of the area is poorly drained and dominated by sedge, mosses, and lichen with or without stunted black spruce and tamarack. In the southern portion of the ecoregion and along the parallel rivers draining east into James Bay, forests are composed of balsam fir (*Abies balsamea*), white and black spruce, trembling aspen (*Populus tremuloides*), and paper birch (*Betula papyrifera*) (Ecological Stratification Working Group, 1996).

Riley (1982) catalogued the wetland types and Riley (2003) provided details of the flora of the HPE. Ahti & Hepburn (1967) provided detailed descriptions of the lichens and noted that lichens used by caribou were most abundant in the Hudson Bay Lowland. Brokx (1965) categorized 25 ecological zones based on physiographic and vegetational characteristics important to caribou in the region north of 52°N.

Methods

Data sources

We used the following data sources to identify past and present distribution patterns and relative abundance of caribou in the HPE of Ontario:

1 HPE-wide systematic surveys—Since 1959 there have been a number of systematic winter surveys of caribou carried out in the HPE using aircraft to fly transects and record the locations of caribou, their tracks, and their feeding craters (caribou sign). These surveys were designed to cover a large proportion of the HPE over a relatively short time period and occurred in 3 periods separated by about 20 years. We used unpublished reports and data from OMNR to summarize the results of the earlier surveys and carried out a new survey in 2003–2004. We compared the results from these 3 survey periods:
   - The first survey period was 1959–1964 (hereafter referred to as the 1960s survey). The results of the surveys are summarized in Simkin (1965) and Brokx (1965). Surveys were carried out in January and February and transects were either 6 km or 13 km apart, depending on the density of forest cover within the survey unit; more intensive coverage occurred where tree cover was dense. Caribou tracks were followed off transect until the caribou were located. Using the original survey data (see Table 1 for references to the original survey reports), Simkin (1965) and Brokx (1965) estimated caribou density using the number of caribou counted within the transect area.
   - From 1982 through 1984, OMNR conducted systematic surveys (hereafter referred to as the 1980s survey) in the HPE from January through March using 171 transect lines spaced 5 km apart (Thompson, 1986). We located the original survey maps showing the locations of caribou sign. Caribou tracks were followed off transect until the caribou were located. Thompson (1986) estimated caribou densities using caribou numbers counted within the transect area.
   - In February 2003 and 2004, we conducted coarse-scale surveys (hereafter referred to as the 2000s survey) for caribou in the HPE as part of a more comprehensive survey of carnivores and ungulates in northern Ontario. We divided the study area into 1000-km^2 hexagons and established flight lines through the centers of the hexagons. Distance between flight lines was usually 34–60 km, with most flight lines in the eastern portion of the HPE separated by 34 km. The survey aircraft (2 Piper PA-18 Super Cubs) were not required to stay on a set GPS track but could deviate up to 2 km from the flight route to check open areas for carnivore and ungulate tracks as long as the aircraft passed through the centers of the hexagons. We recorded caribou sign and counted caribou when they were visible, but we did not follow fresh tracks to count caribou and did not estimate caribou density.

2 Partial systematic surveys—Between 1967 and 2003, OMNR carried out additional surveys in portions of the HPE, including caribou surveys and moose surveys that included observations of caribou. These surveys used the same transect method that was used in the 1960s and 1980s surveys, although transect width differed somewhat between surveys. Unpublished reports on these surveys were reviewed for information on caribou distribution and abundance.

3 Telemetry studies—Two telemetry studies of caribou in the HPE provided locations of caribou in the northwestern (Thompson & Abraham, 1994) and southeastern (Brown *et al*., 2003) portions of the HPE. Only winter locations were available for the northwestern area, but winter and summer locations were available for the southeastern area.

Table 1. Results of caribou surveys in the Hudson Plains Ecozone (HPE) from 1959 to 1964, referred to as the HPE-wide 1960s survey. Caribou counted on transects are expressed as caribou per 100 km^2 of transect area.

Fig. 4 survey area	Survey report[a]	Caribou on transects	Caribou off transects	Number of groups on transects	Total transect length (km)	Transect area (km^2)	Caribou per[b] 100 km^2
1	Simkin (1959)	7	Not reported	Not reported	1261	3061	0.2
2	Simkin (1960)	99	Not reported	9	1888	2611	3.8
3	Simkin (1964)	294	256	35	4624	5102	5.8
4	Simkin (1962a)	61	104	24	2938	3999	1.5
5	Simkin (1961)	140	11	16	2493	3064	4.5
6a	Simkin (1962b) Simkin (1965)	66	Not reported	Not reported	957	1054	6.2
6a+6b	Simkin (1962b) Brokx (1965)	66	Not reported	Not reported	2250	2186	3.0
7a	Goddard (1961) Simkin (1965)	72	Not reported	Not reported	1675	1585	4.5
7b	Goddard (1961) Simkin (1965)	23	Not reported	Not reported	2854	2797	0.8
7a+7b+7c	Goddard (1961) Brokx (1965)	86	Not reported	Not reported	5907	5737	1.5
8	Gagnon (1962) Simkin (1965)	36	0	3	3430	3367	1.1
9	McLellan (1962) Simkin (1965)	45	Not reported	4	5645	6775	0.7

[a] Reference to the original survey report, except for Simkin (1965) and Brokx (1965), which are summaries of the surveys from 1959–1964 (1960s HPE-wide systematic survey). In some cases, data for this table were only available from these summaries. Simkin (1965) separated survey area 6 into 2 parts and calculated density separately for area 6a after finding no caribou in area 6b; Brokx (1965) calculated density for the entire area. Simkin (1965) separated survey area 7 into 3 areas and calculated density separately for 7a and 7b; Brokx (1965) reduced the size of the original survey area (Goddard, 1961) to include only those areas within the HPE and calculated density for the entire area within the HPE.

[b] Density of caribou within the transect area.

4 Incidental summer observations—We used observations of caribou in the HPE, archived by OMNR, to digitize summer locations of caribou from the 1950s to 2003. These sightings were reported by individuals involved in radiotracking caribou, conducting wildlife surveys for other species, and doing vegetation studies as well as by the public.

5 Summer photographic surveys—Photographic surveys of caribou in coastal tundra habitat during summer (Apr–Sep) began in 1986 and ended after 1997. The search area was between Fort Severn and the Nelson River in Manitoba, covering the known summer range of the Pen Island caribou herd (Thompson & Abraham, 1994; Abraham & Thompson, 1998). All aggregations encountered along flight lines parallel to the coast in open tundra habitat were photographed. No sizable caribou groups were noted east of Fort Severn during this period, so the area was not included in the summer photographic surveys, although incidental observations of caribou were recorded.

Analyses

We examined trends in caribou distribution separately for winter (Jan–Mar) and summer (Apr–Sep), because winter data were derived from systematic surveys over broad areas of the HPE, while those from summer were collected nonsystematically, primarily along the coast of Hudson Bay. Flights in March only occurred during the 1980s survey and only 15% of caribou locations were found during the March flights. We believe the March data can be combined with January and February data, because 80% of the March locations were clustered with the January and February locations.

We used ArcView GIS software to digitize locations of caribou sign from incidental observations in summer and from the 1980s and 2000s systematic winter surveys. Because we could not locate original survey maps from the 1960s survey north of 52°N, we were unable to digitize locations of caribou sign from that survey. Instead, we used locations of caribou sign provided by Brokx (1965: Fig. 36) to determine where caribou were distributed north of 52°N

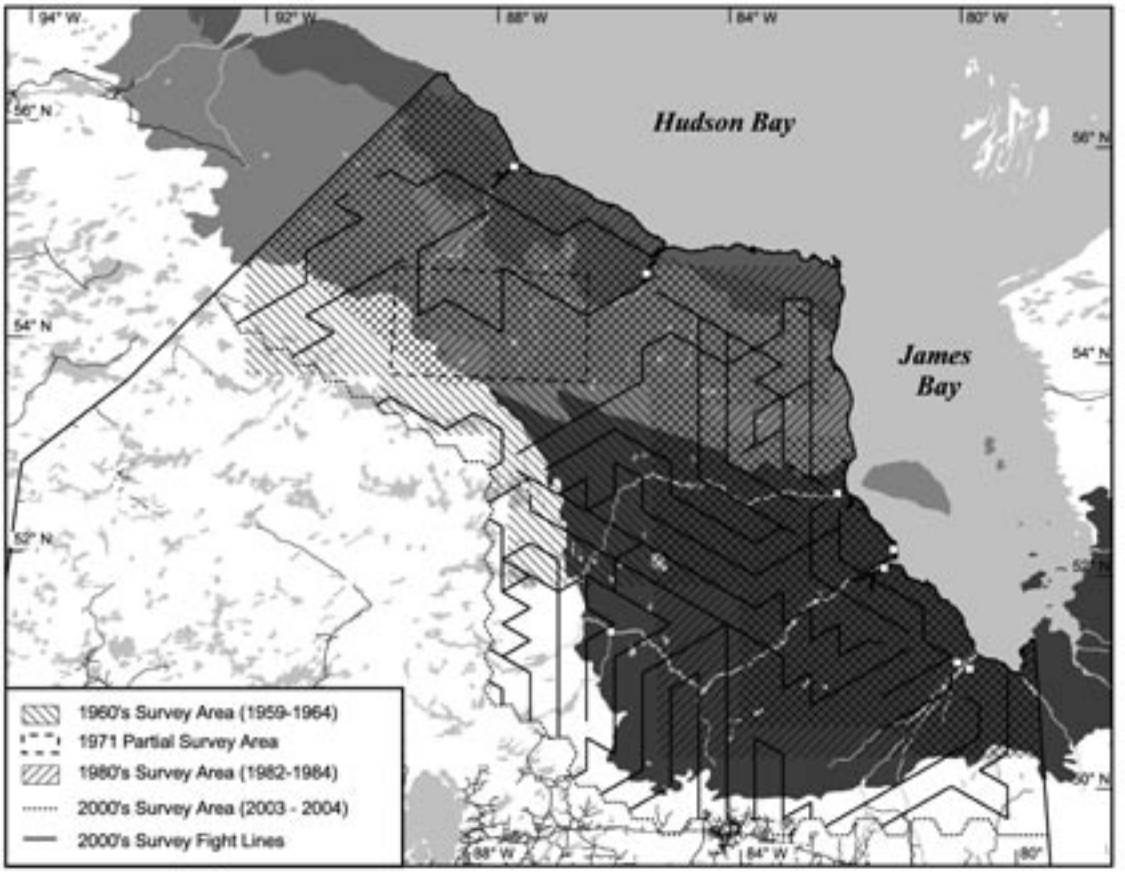

Fig. 2. Coverage of the Hudson Plains Ecozone (HPE) of Ontario by 3 systematic aerial surveys for caribou from 1959 to 2003

(southern boundary of Brokx's study area) during the 1960s survey. South of 52ºN we digitized locations provided by OMNR.

Comparing systematic surveys conducted over a 45-year timespan presented challenges that we acknowledge here. Survey conditions, methodologies, and boundaries of survey areas changed over time, and the rigor of data analysis, interpretation, and reporting varied among the surveys. In the earlier surveys, the number of caribou counted along transects (within a given distance from the transect center) were used to calculate a density for caribou within the area covered by the transects. For some of the later surveys, standard errors and confidence limits were provided for the density estimates, but the usefulness of these figures for comparing caribou densities between areas is questionable at best. Caribou were distributed in a clumped pattern during the winter surveys, sample sizes of caribou groups were usually small, and the boundaries of wintering areas and survey areas changed from year to year.

With no consistency in survey areas and no measure of sampling error, the density estimates cannot be used to compare the number of caribou between survey areas or survey periods. Moreover, because there is no information on caribou subpopulations in the HPE or the extent of their winter ranges, there is no way to know what proportion of the population or subpopulations were included in the surveys. However, we believe that information gathered on caribou numbers during the surveys should not be disregarded despite sampling problems. The density estimates reflect not only the number of caribou seen on transects but also the area covered by transects. As such, the density estimates are the only available and comparable measure of relative abundance of caribou in the HPE for the time period we examined. We used the density estimates only as a means of delineating broad areas of relative abundance. The estimates should not be used to compare population size between areas or evaluate changes in population size in the HPE over time.

We plotted summer distribution in coastal areas along Hudson Bay using incidental observations

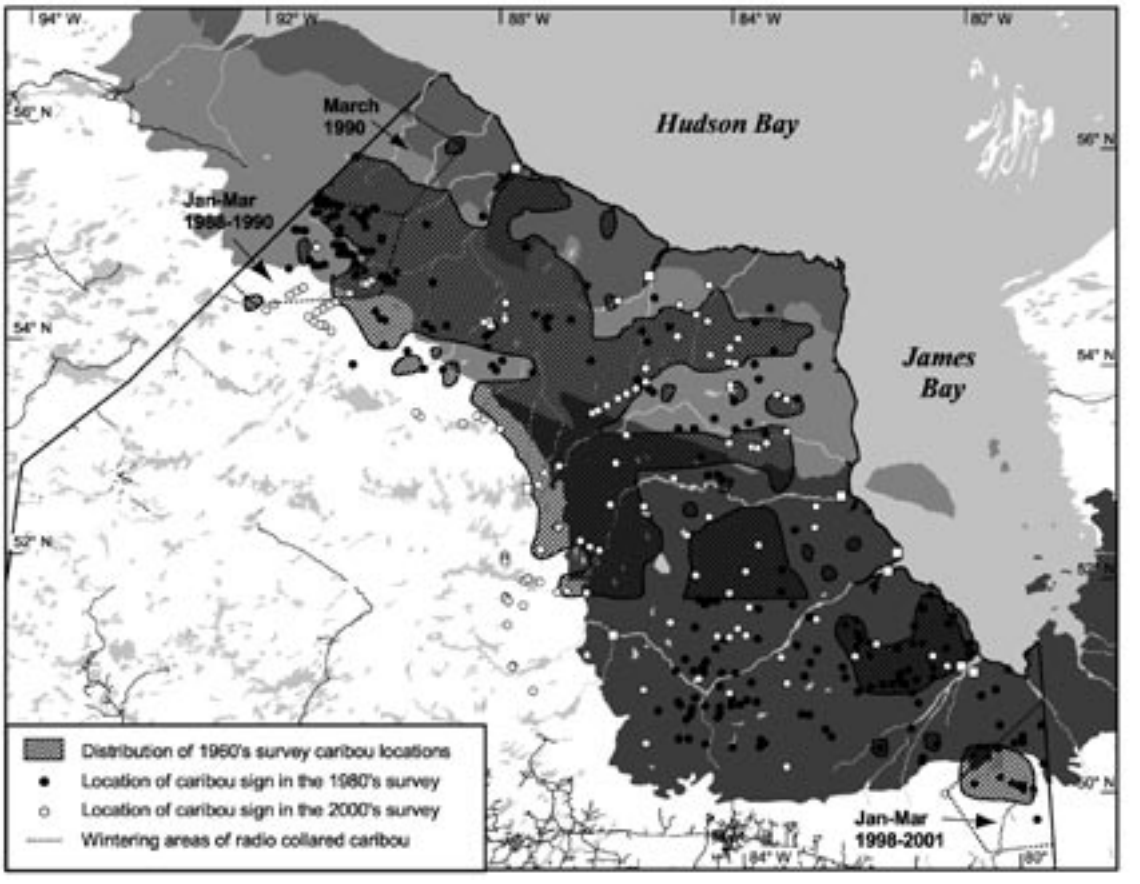

Fig. 3. Areas where caribou and their tracks were located during 3 systematic aerial surveys in the Hudson Plains Ecozone (HPE) of Ontario from 1959–2003. Point locations for the 1960s caribou distribution can be found in Brokx (1965). The arrows point to areas where radiocollared caribou in 2 study areas were concentrated in winter (Jan–Mar) during 1988–1990 (Thompson & Abraham, 1994) and 1998–2001 (Brown *et al*., 2003).

and the results of photographic surveys, however, summer locations in areas away from the coast were generally not available. We plotted summer locations by time period and the approximate number of animals per group.

Results and discussion

Comparing the systematic survey coverages

The areas covered in the HPE-wide systematic surveys are shown in Fig. 2. In all 3 surveys, some portions of the HPE were not surveyed or some data were missing from the original surveys. Also, some portions of the HPE were surveyed more than once during the 1960s survey (Brokx, 1965: Fig. 33). The portion of the HPE lying south of 54°N and west of 85°20'W was not covered in the 1980s systematic survey nor was the small portion of the HPE south of 50°30'N. In the 2000s survey, distances between transects were greater than in previous surveys and coverage was particularly light between Shamattawa Lake and the Fawn River.

Winter distribution

During the 1960s survey, signs of caribou were detected over large areas of the HPE, primarily within the Hudson Bay Lowland and the western third of the James Bay Lowland above 52°N (Fig. 3). Below 52°N, caribou were recorded west and north of Moosonee and near Kesagami Lake. Caribou were not surveyed in the western portion of the HPE near The Albany Forks. Unlike subsequent surveys, the 1960s survey detected caribou tracks in the Coastal Hudson Bay Lowland, mainly east of Fort Severn (Brokx, 1965: Fig. 36). Most caribou from the 1960s survey north of 52°N were concentrated in 5 areas: between Sturgeon Lake and Hosea Lake near the Manitoba border, around Shagamu Lake north of the Winisk River, around Shamattawa Lake, in the area

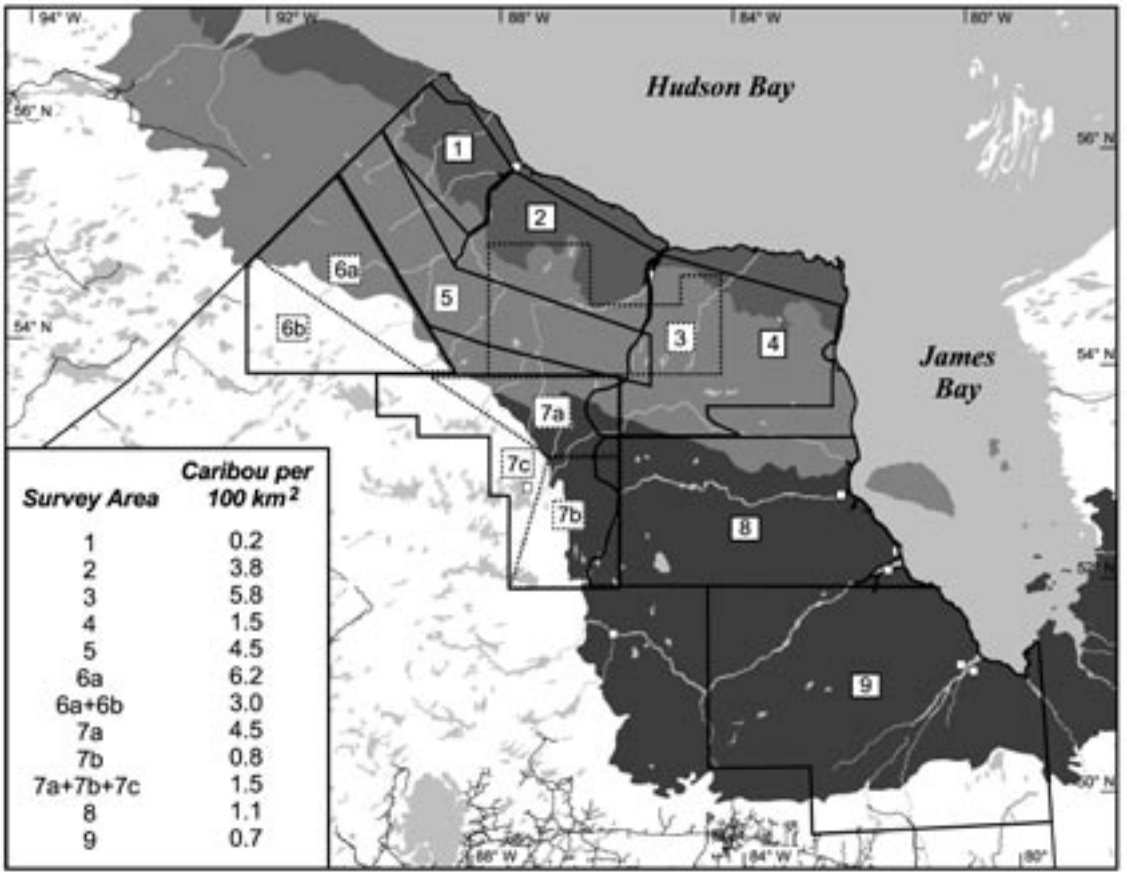

Fig. 4. Location of caribou surveys in the Hudson Plains Ecozone (HPE) of Ontario from 1959 to 1964, referred to as the HPE-wide 1960s survey (details in Table 1). Caribou counted on transects are expressed as caribou per 100 km² of transect area (see Table 1 for references to the original survey reports).

of Sutton Lake, and between the Winisk and Ekwan Rivers northeast of Webequie.

The 1980s survey (Thompson, 1986) also located concentrations of caribou in the Sturgeon Lake area (532 caribou in 67 aggregates observed), however, most caribou in the 1980s were located southeast of where Brokx (1965: Fig. 36) reported concentrations of animals in the 1960s (Fig. 3). Thompson & Abraham (1994) verified that radiocollared caribou from the Pen Islands Herd also used this area during winters 1988–1990 (Fig. 3). During the 1980s survey, caribou were also scattered from the Severn River east to about 83°30'W and south of 54°N as far as the Attawapiskat River. Thompson (1986) reported a concentration of caribou between the Ekwan and Attawapiskat Rivers (108 caribou in 10 aggregates observed) and another concentration in the Shamattawa Lake area (46 caribou in 5 aggregates), which was a smaller number of caribou than he expected based on earlier survey results. Few caribou were located between the Attawapiskat River and 52°N. Thompson (1986) referred to a "second major concentration area" [relative to the one near Sturgeon Lake] near The Albany Forks, a relatively small area where 78 caribou in 12 aggregates were observed. Unfortunately, Brokx's (1965) study area did not include The Albany Forks, so we cannot compare the results of the 1980s survey with the 1960s survey for this area. However, OMNR personnel reported a "large" caribou concentration northwest of The Albany Forks during winter 1962 (Gagnon, 1962). In the 1980s, small groups of caribou and caribou tracks were scattered east of The Albany Forks from about 83°W to Moosonee, and additional animals were located near Kesagami Lake, as they had been in the 1960s.

Although the 2000s survey was coarse-scale relative to earlier surveys, especially in the northwestern portion of the HPE, we found similar patterns in caribou distribution with some minor differences. The center of concentration for caribou in the Sturgeon Lake area was south of where it had been in the 1960s and 1980s (Fig. 3). The center of concentration

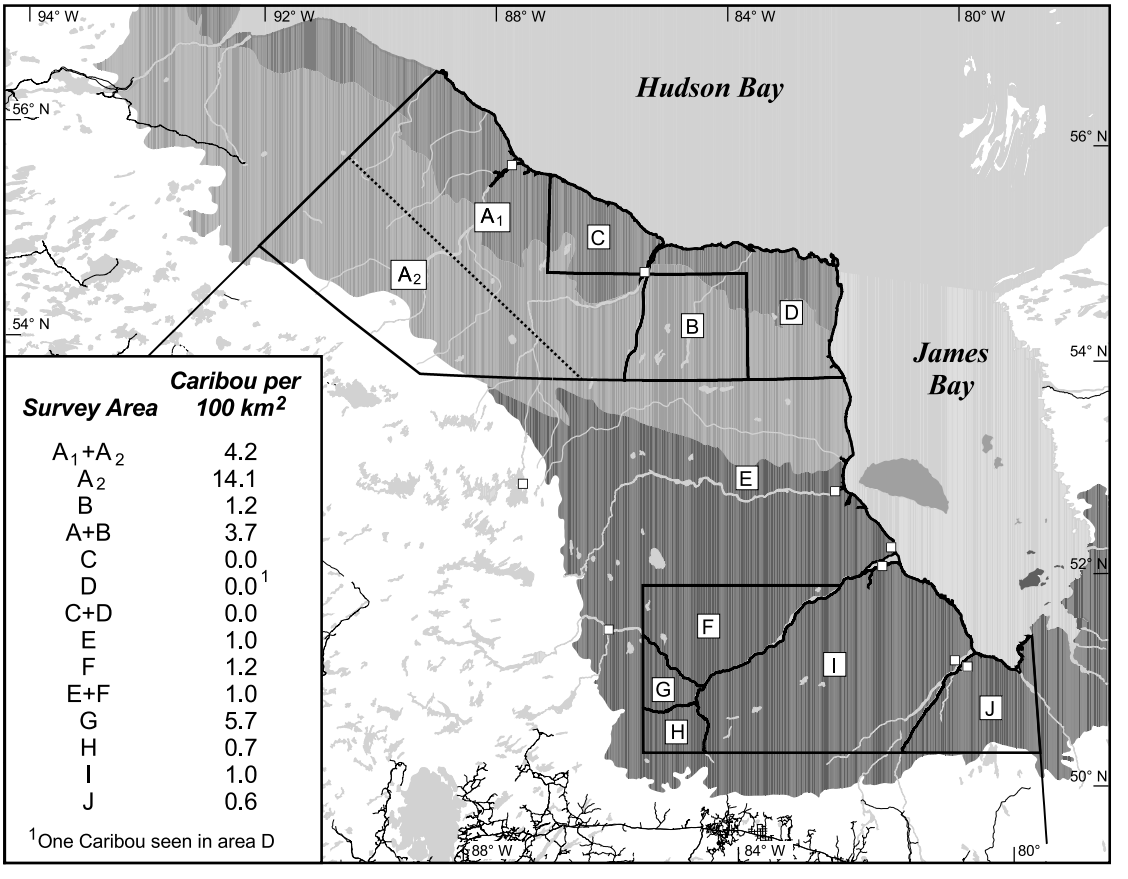

Fig. 5. Location of caribou surveys in the Hudson Plains Ecozone (HPE) of Ontario in 1978 (area A_2) (details in Hamilton, 1978) and from 1982 to 1984, referred to as the HPE-wide 1980s survey (details in Thompson, 1986). Caribou counted on transects are expressed as caribou per 100 km^2 of transect area.

for caribou between the Fawn and Winisk Rivers was southwest of where it had been in the 1960s survey (see Brokx, 1965: Fig. 36). Finally, despite greater distance between survey transects, more caribou observations were recorded in the 2000s survey between 52°N and the Attawapiskatt River than were recorded in that area during the 1980s survey.

Relative abundance of caribou in wintering areas

Using the distribution maps of caribou locations from the 3 HPE-wide systematic surveys (Fig. 3 and Brokx, 1965: Fig. 36) and the caribou density estimates provided in OMNR reports (Figs. 4 & 5), we designated 3 areas of relative abundance for caribou in the HPE: high, moderate, and low (Fig. 6). Areas of high relative abundance had caribou present during the 3 systematic surveys and at least 4 caribou counted per 100 km^2 of transect area. Areas of moderate relative abundance had caribou during the 3 systematic surveys, but less than 2 caribou counted per 100 km^2 of transect area. Areas of low abundance were nearly devoid of caribou during the winter surveys. As we discuss below, it was not possible to define relative abundance more specifically or determine if relative abundance changed over time based on the available data. However, we believe the clumping of the highest density estimates in the northwestern portion of the HPE reflects actual regional differences in the abundance of caribou in the HPE during winter for the period of study.

In the 1960s, the highest reported caribou densities were in the Hudson Bay Lowland, particularly in the west around Sturgeon Lake and in the central portion of the ecoregion surrounding Shagamu, Shamattawa, and Sutton Lakes (Fig. 4: areas 6a and 3, respectively). The only area within the James Bay Lowland with comparable reported densities in the 1960s was north of Webequie between the headwater tributaries of the Winisk River (Fig. 4: area 7a). The lowest estimated caribou densities from the 1960s survey were from the Coastal Hudson Bay Lowland (Fig. 4: area 1) and the James Bay Lowland (Fig. 4:

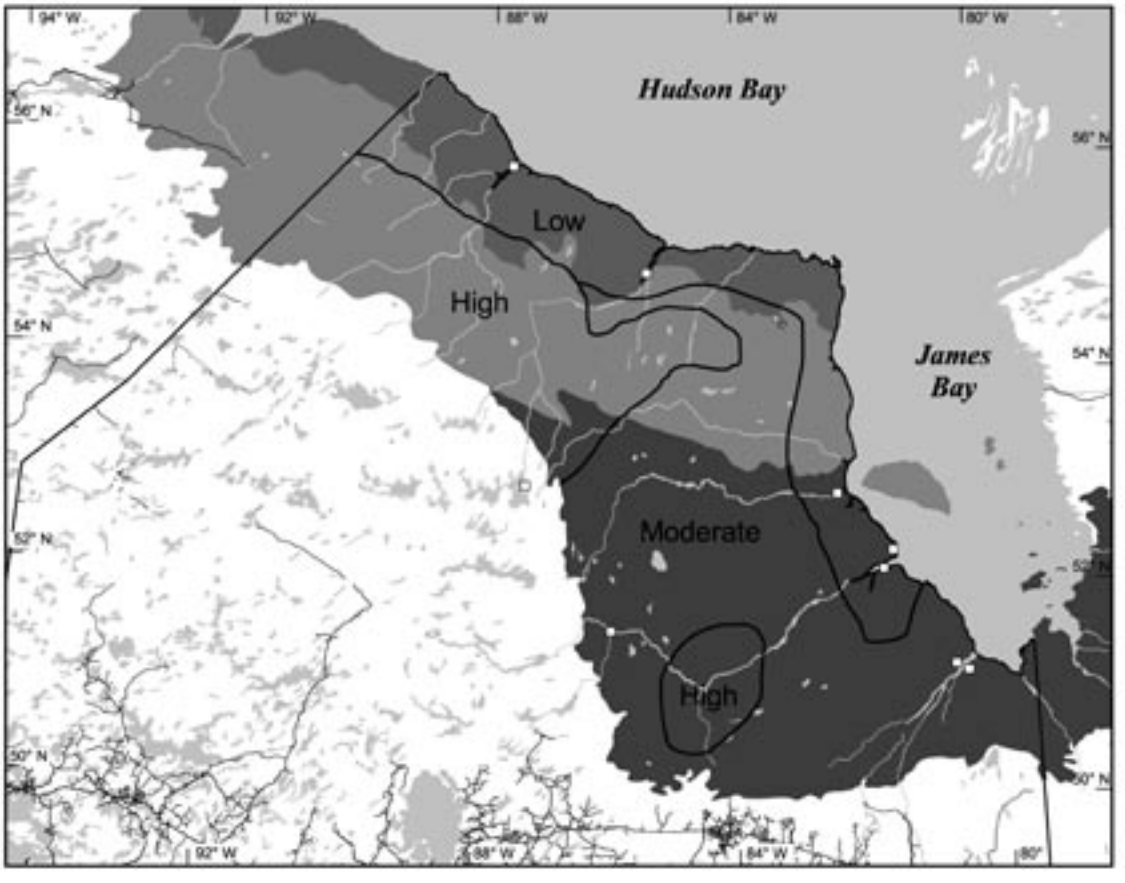

Fig. 6. Relative abundance of caribou in winter (Jan–Mar) in the Hudson Plains Ecozone (HPE) of Ontario based on the results of systematic aerial surveys from 1959 to 2003.

areas 7b, 8, & 9). In Figure 4, areas 2 and 4 had very few caribou in the areas that did not overlap with area 3. In the 1980s survey, reported caribou densities were highest west of the Shamattawa River (Fig. 5: area A) and in a very small area near The Albany Forks (Fig. 5: area G). As in the 1960s survey, caribou density estimates from the 1980s survey were generally low in the James Bay Lowland, except for The Albany Forks.

Changes in caribou numbers and/or shifts in concentration areas may have occurred in portions of the HPE between survey periods, but evaluating such changes was not possible, particularly because survey boundaries usually changed between surveys. However, between the 1960s and the 1980s surveys, 2 partial surveys of the Hudson Bay Lowland were conducted in the same central portion of the Hudson Bay Lowland ("1971 partial survey area" in Fig. 2). Simkin (1967) surveyed this area in 1967 and found about 2 caribou per 100 km^2 of transect area (transects 6 km apart and 914 m in width). The number of caribou counted (including those off-transect) was 477. In 1971, Buss (1971) resurveyed the area and found about 4 caribou/100 km^2 of transect area (transects 6 km apart and 1097 m in width) and counted 929 caribou. When we examined the data from the 1980s survey and determined the number of caribou seen in this same area, we found that only 61 caribou were counted (transects 5 km apart and 1000 m in width in 1982).

The size of survey areas and the location of survey boundaries relative to core caribou wintering areas affected survey results. In 1978, a portion of the Hudson Bay Lowland near the Manitoba border was surveyed (Fig. 5: A_2) as part of a more comprehensive survey for moose and caribou in the West Patricia Planning Area (Hamilton, 1978). Distance between transects in 1978 was 10 km and transect width was 600 m. Estimated caribou density (14 caribou/100 km^2) was more than twice that of any other area surveyed during the 1960s or 1980s. We believe this estimate was high, at least in part, because the 1978 survey area captured most of the wintering area of the Pen Islands caribou herd and included

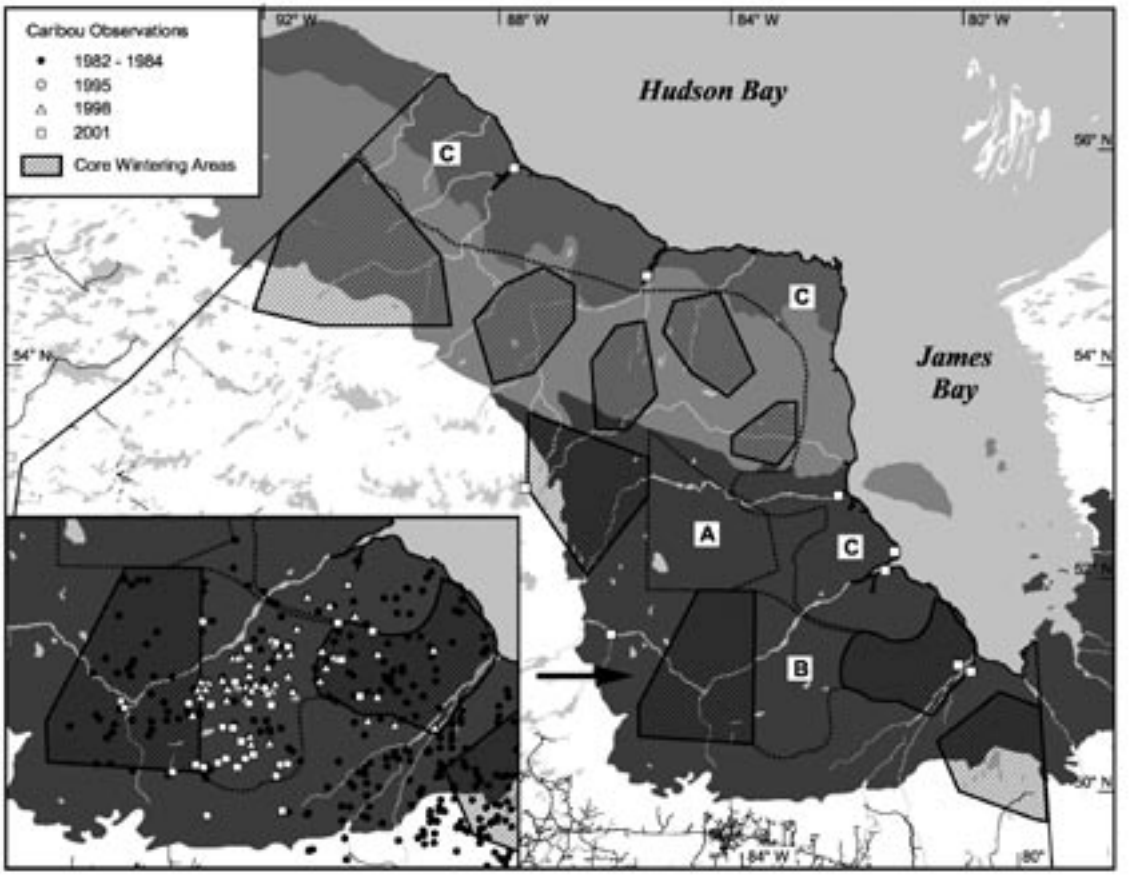

Fig. 7. Core wintering areas used by caribou in the Hudson Plains Ecozone (HPE) of Ontario from January–March 1959–2003 based on the locations of caribou and their tracks from 3 HPE-wide systematic aerial surveys. A, B, and C are areas referred to in the text.

the southern portion of the core area for caribou wintering immediately east of there as well (Fig. 6; also, see discussion of core wintering areas below). The density estimate from the 1980s survey did not center on the wintering range of the Pen Islands herd and included a much larger area than in 1978 (Fig. 5: areas A_1 + A_2), resulting in a density estimate of only 4 caribou/100 km^2, despite the fact that the number of caribou from the Pen Islands Herd using the area west of the Severn River may have increased between 1978 and 1982 when the 1980s survey was done (Abraham & Thompson, 1998).

The James Bay Lowland in general had lower density estimates than the Hudson Bay Lowland. Within the James Bay Lowland, however, there were some relatively small areas where caribou densities were estimated at 4–6 caribou/100 km^2 (Fig. 4: area 7a; Fig. 5: area G). Stewart (1977) estimated 5 caribou/100 km^2 for the portion of the HPE north of Kesagami Lake (roughly area J in Fig. 5), commenting that the estimate has "extreme confidence limits" because 66% of caribou on transects were in just 2 herds. In 2000, the estimate for this area was also about 5 caribou/100 km^2 (Gauthier & Hildebrandt, 2000). Caribou in this area may winter south of the HPE and across the provincial border in Quèbec, so density estimates can be highly variable depending on movement patterns of caribou between years.

Changes in wintering areas confound the interpretation of survey results between years. From 1986 to 2001 there have been 6 systematic winter surveys in a portion of the James Bay Lowland (roughly area I in Fig. 5) with density estimates for caribou ranging from <1 to 6/100 km^2(Chenier, 2001), with the highest density estimates in 1998 and 2001. In surveys carried out in January of 1995, 1998, and 2001 in the southern HPE, a relatively large number of caribou were located in the central part of the area (Fig. 7: area B) compared to the 1960s and 1980s surveys. No caribou were reported in this area in the 1960s (late Jan–early Feb) and only a few in the 1980s (Jan) compared to the areas east and west of area B for those periods. We could not locate the original 1960s survey maps to verify that caribou were absent from area

B during that period. See Figure 3 for the distribution of caribou locations in the 1960s and 1980s surveys. A more thorough discussion of Figure 7 is provided below in the section on core wintering areas.

In summary, based on the available information on the relative abundance of caribou in the HPE over a 45-year timespan, we concluded that caribou were most abundant in the western and central Hudson Bay Lowland during January–March and possibly in a small area of the James Bay Lowland near The Albany Forks. Caribou were largely absent in areas bordering Hudson Bay and James Bay (Fig. 6). For most of the James Bay Lowland, caribou occurred in small, scattered groups during winter, except in The Albany Forks area and possibly east of The Albany Forks to about 82°W in some years.

The relative abundance of caribou in different regions of the HPE support the conclusion of Ahti & Hepburn (1967) that the Hudson Bay Lowland is the most important of the 3 ecoregions in the HPE for caribou wintering habitat. They referred to these regions as the Coastal Tundra Belt (=Coastal Hudson Bay Lowland), the Northern Boreal Lichen Belt (=Hudson Bay Lowland), and the Eastern Swamp Region (=James Bay Lowland). The authors found the Coastal Hudson Bay Lowland to be rich in lichens, especially on the edge of the tundra, and considered the region to be excellent summer range for caribou, but too windswept in winter to supply important winter range. In contrast, they believed the Hudson Bay Lowland comprised year-round caribou range because of extensive lichen growth, more forest cover for shelter, and *Carex* spp. and *Scirpus* spp. in the tamarack swamps and sedge fens. The authors considered the James Bay Lowland poor winter range, but speculated that sedges, shrubs, and forbs in the swamps and fens supplied good summer range. Although we concur that the James Bay Lowland likely provides less winter habitat on the whole than the Hudson Bay Lowland, systematic winter surveys have shown that caribou nevertheless find winter range in this region of the HPE. Apparently, only the tamarack fens bordering the area along the west coast of James Bay are largely devoid of caribou in winter.

Core caribou wintering areas in the HPE

We defined a core wintering area as an area where concentrations of caribou sign were located during the HPE-wide systematic surveys. The core areas had multiple locations of caribou sign during all 3 survey periods, with the exception of The Albany Forks area, which was not part of the 1960s systematic survey but was known to have a concentration of wintering caribou in 1962 (Gagnon, 1962), and the area near Webequie (Fig. 5: area 7a), which was not surveyed in the 1980s but had a large amount of caribou sign in the 1960s survey (Brokx, 1965: Fig. 36). Based on this definition and using the location data in Figure 3 and in Brokx (1965: Fig. 36), we delineated 9 core wintering areas, 5 in the Hudson Bay Lowland and 4 in the James Bay Lowland (Fig. 7), that were used during the survey periods. The sizes of the core areas are not proportional to the number of caribou that were surveyed in those areas. Some areas are relatively large because the center of use changed from one survey to another or, in the case of the area near Webequie, data from the 1980s was not available to more narrowly define the core area. While the core areas had the highest concentrations of caribou during the surveys, caribou were found outside the core areas as well. In fact, caribou harvested by First Nations people outside the core areas appeared to make up a larger proportion of the harvest in the HPE than caribou harvested within the core areas (Brokx, 1965; Simkin, 1965; Thompson, 1986). A key harvesting location for Attawapiskat residents, for example, is south of the Attawapiskat River (Victor Project TEK Working Group, 2004) where no core wintering areas were identified.

Because we could not locate the original 1960s survey maps to verify caribou location data, we are uncertain of the boundaries of the core areas between The Albany Forks and Moosonee (Fig. 7: area B). Data from OMNR files indicated that caribou locations south of 52°N (n = 15) were located near Moosonee and Kesagami Lake during the 1960s survey (Fig. 3), at least in the area east of the Albany Forks for which the data were compiled. It is surprising that not one location was recorded in area B (Fig. 7) during the 1960s survey, considering the spread of caribou locations from The Albany Forks to Moosonee in later surveys (Fig. 7). Surveys in this area from 1995, 1998, and 2001 located relatively large numbers of caribou in area B (Fig. 7) and relatively few near Moosonee. These more recent surveys suggest that caribou, if indeed absent from area B (Fig. 7) in the 1960s and distributed mainly east and west of area B in the 1980s, have increased in numbers and/or distribution in recent decades. The relatively high density estimates for 1998 and 2001 support the argument for an increase in numbers, but the variation in movements of caribou during the winter months could alone account for the differences. Unless surveys are carried out over a large enough area to cover all possible wintering areas for caribou that use this portion of the HPE, it will not be possible to differentiate between changes in numbers and changes in winter distribution.

Unfortunately, there is no way to determine whether the changes in the amount of caribou sign detected

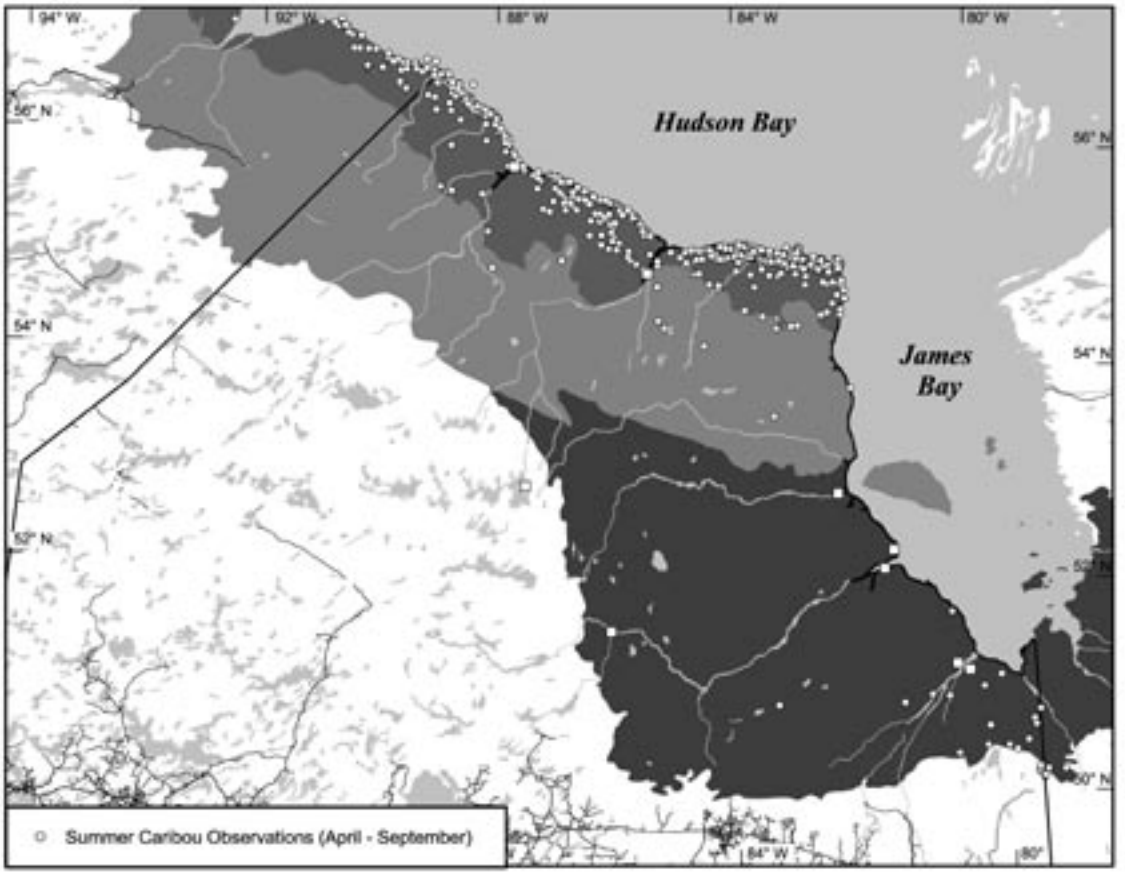

Fig. 8. Summer locations of caribou groups in the Hudson Plains Ecozone (HPE) of Ontario based on incidental observations and photographic surveys from 1950 to 2003.

during the systematic surveys are due to changes in caribou distribution, abundance, or survey design. However, there is reason to believe that there have been changes in distribution and/or abundance of caribou in portions of the HPE in recent years. There was no sign of caribou recorded for the 9000-km^2 area in the northcentral James Bay Lowland (Fig. 7: area A) in the 1980s survey (Fig. 3). In contrast, caribou sign in this area during the 1960s was not uncommon (Brokx, 1965: Fig. 36) and in the 2000s survey, we located caribou sign in 7 of 9 survey hexagons and saw 4 groups of caribou averaging 5.5 caribou per group in 4 different hexagons, even though transects were spaced much farther apart in the latter survey and we did not follow tracks to count caribou numbers. Furthermore, during the 1960s survey caribou sign was uncommon just north of the Ekwan River, but by the 1980s and 2000s surveys, caribou were fairly evenly distributed east of Shamattawa Lake and north of the Ekwan River (Fig. 3). In 1996 there was an unusual movement of relatively large numbers of caribou through the community of Peawanuck in November 1996. The herd was estimated at about 2000 animals and was much larger than any known caribou concentration in the area for more than a decade (Scholten & Chenier, 1996). Our interviews with residents of Peawanuck in August 2004 indicated that, since about the mid-1990s, winter caribou harvesting opportunities have increased substantially for hunters from Peawanuck. Residents reported that caribou used to winter in discrete pockets "until the last 5–10 years," when they now appear to be "everywhere south of the treeline" (i.e., south of the Coastal Hudson Bay ecoregion within the Hudson Bay Lowland).

Summer distribution

Summer locations of caribou from incidental observations and photographic surveys are presented in Fig. 8. Very little is known about the summer distribution of caribou in the HPE, except for the Coastal Hudson Bay Lowland (Thompson & Abraham, 1994) and the area south of James Bay where Brown *et al.* (2003) conducted a study of caribou using satellite

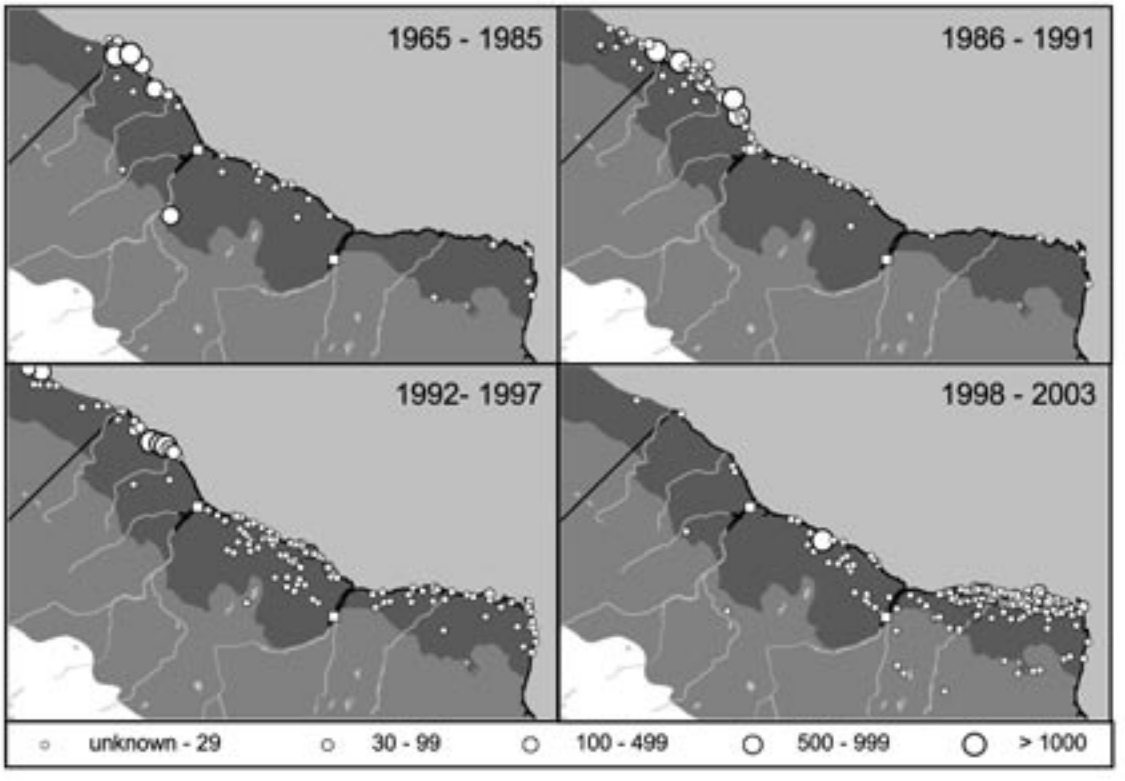

Fig. 9. Summer locations of caribou along the Hudson Bay coast during 4 periods from 1965 to 2003 based on incidental observations and photographic surveys.

collars. While the low number of caribou locations in the interior portions of the HPE most likely results from few observers in that area in summer, the lack of caribou observations along the coast of James Bay compared to Hudson Bay reflects actual caribou distribution in coastal areas in summer. Biologists working on the Hudson Bay coast in summer traveled from Moosonee to Hudson Bay along the James Bay coast and they rarely observed caribou along James Bay.

We divided the summer observations along the Hudson Bay coast by decade and caribou group size to show changes in distribution along the coast over time (Fig. 9). Simkin (1965) reported that caribou were seen all along the Coastal Hudson Bay Lowland in summer, although the largest group he reported was 41 animals east of the Winisk River (early 1960s). He did note a high concentration of caribou tracks near the mouth of the Niskibi River to the west. However, Simkin and others could easily have missed seeing caribou groups along portions of the coast during that period because of the relatively restricted areas of the coast where they spent time during the summer. In the early 1970s evidence began to accumulate that caribou were using the coastal areas in larger numbers than in the past. As many as 2300 animals were photographed at the mouth of the Black Duck River on 6 July 1979 at the Ontario–Manitoba border (Abraham & Thompson, 1998). This was the summer following the 1978 winter survey mentioned previously (Hamilton, 1978) that produced an unusually high density estimate (Fig. 5: area A_2), and Hamilton (1978) estimated that approximately 4500 caribou used the wintering area near the Manitoba border that winter. In 1986, large summer aggregations of the Pen Islands Herd were photographed just on the Ontario side of the border, with one group well to the east. Regular photographic counts of aggregations on the coast in the late 1980s and early 1990s suggested a relatively large and increasing herd (e.g., 10 798 animals photographed in 1994) distributed across the border of Ontario and Manitoba (Abraham & Thompson, 1998). Most of the caribou photographed were in large mixed groups, averaging about 1000 animals and ranging from about 200–2000 animals. This pattern appears to have changed beginning in the mid-1990s, with more but smaller groups of caribou scattered along the coast of Hudson Bay and becoming more common in areas east of Fort Severn.

The last photographic survey of the Pen Island Herd occurred in 1997 and incidental observations west of Fort Severn declined after 1997, likely because fewer field studies occurred there by the late 1990s. However, goose banding has occurred annually in the area in mid- to late July since the late 1970s, and in recent years banders have reported fewer encounters with caribou than previously (D. Byers, pers. comm.). In 2002, a dedicated search for caribou was made from Fort Severn west into Manitoba; no aggregations and virtually no caribou were found (D. Sutherland and M. Obbard, OMNR, pers. comm.). The search was in early July when in the 1980s and 1990s postcalving aggregations would have been peaking in size and occurrence (Thompson & Abraham, 1994). Similar results were obtained on a vegetation survey in mid-July 2000 by K. Abraham and during a 2-week ground expedition to the Pen Islands in July 2004 during the period of peak aggregations; no postcalving aggregations and only a few scattered individuals were observed (D. Sutherland, pers. comm.). However, it is possible that aggregations, even large ones, could have been missed west of the Winisk River. In contrast, from 1998 to 2003, many groups of caribou were recorded east of the Winisk River by observers engaged in studies of geese, polar bears (*Ursus maritimus*), and breeding birds, although these aggregations did not appear to be as large as those of the Pen Island Herd in the 1980s and early 1990s. This increase of caribou in the area east of Fort Severn since the early 1990s was real, not simply an artifact of observer distribution. Annual goose banding, mid-July photographic goose surveys, breeding bird surveys, and polar bear research all took place during in the 1980s and early 1990s as well, but incidental observations of caribou in the coastal zone east of the Winisk River during that period were minimal (Fig. 9). Reasons for the change in summer distribution are unknown.

Interpreting the information available on summer distribution of caribou in the HPE is problematic. Data on caribou numbers and distribution during summer were not collected systematically, and radiotelemetry was not used to find animals that were outside the major coastal aggregation areas. Most summer incidental observations were confined to the areas of the coast where biologists were working on projects unrelated to caribou, so even coastal aggregations were likely missed in some years. Photographic surveys were confined to the western portion of the coast and were discontinued after 1997. Finally, a system for routinely documenting the locations of all caribou sighted in the HPE by biologists working in the area was not put in place until the 1990s. We concluded from our limited information, however, that 1) relatively large numbers of caribou began using the western coastal area of the HPE in Ontario sometime in the 1970s, 2) by the 1980s the coastal area west of the Severn River in Ontario was used by relatively large aggregations of caribou, 3) caribou numbers were low along the coast east of the Winisk River in the 1980s, 4) summer aggregations, although smaller than those of the western coastal area in the 1980s, began to appear in the eastern coastal area in the 1990s, and 5) large summer caribou aggregations largely disappeared from the western coastal area sometime between 1997 and 2000.

The dramatic change in summer distribution along the Hudson Bay coast and the decline in the size of the coastal aggregations calls into question the current range, distribution, and size of the Pen Islands Herd, which is often included in the total population estimate of caribou in Ontario. Up to 52% of the population estimate for the province has been attributed to this herd (Cumming, 1998; Harris, 1999), even though the herd resides partly in Manitoba. The disappearance of large summer aggregations along the coast west of Fort Severn suggests the herd may no longer occupy its past range in Ontario in numbers comparable to the 1980s. On the other hand, reasons for the increase in the number of caribou aggregating on the coast east of the Winisk River in recent years are not known; perhaps the Pen Islands caribou herd has shifted its summer range to the east. Lytwyn (2002) reviewed Hudson Bay Company records to determine the seasonal hunting patterns of the "Lowland Cree" and found evidence that caribou crossed the Severn River in large numbers ("many thousands") in the spring and the fall; a favorite crossing place where caribou were traditionally hunted was about 35 km upstream of Severn House (present-day Fort Severn) (Lytwyn, 2002: 104). He noted that some of the Severn River Lowland Cree moved eastward when hunting the migrating caribou in summer, and the Albany River Lowland Cree traveled north to meet the migrating herds (Lytwyn, 2002: 96). "The main caribou calving grounds were reported to be east of the Severn River in the vicinity of Cape Henrietta Maria, but some caribou spent the summer between York Factory and Severn House" (Lytwyn, 2002: 97). An alternative explanation for the increase in the number of caribou aggregating along the coast east of Fort Severn in summer is a change in the numbers and/or distribution of caribou, not associated with the Pen Islands Herd, that winter in the Hudson Bay Lowland between the Severn River and James Bay.

Conclusions and recommendations

The results of our synthesis of information on caribou in the HPE have shown that over the 45-year period since systematic surveys were initiated, caribou distribution patterns in winter have largely remained the same, although the centers of some core wintering areas may have shifted. Summer use of the Hudson Bay coast west of Fort Severn by the Pen Islands caribou has declined while use of the coastal area east of Fort Severn has increased, although with smaller aggregations. Changes in population size for caribou in the HPE may have occurred over this period as well, but data are insufficient to detect these changes.

Use of satellite collars placed on caribou in the core wintering areas and on those that aggregate along the Hudson Bay coast in summer would greatly improve our understanding of the distribution and movements of caribou in the HPE and would help to determine if caribou using different core wintering areas in the region belong to distinct groups of caribou. Once subpopulations of wintering caribou are identified, future surveys to derive population estimates could encompass entire wintering areas to produce more accurate population estimates that are comparable between years and provide information on annual changes in winter distribution.

Large changes in caribou distribution and numbers in the HPE will have direct effects on the people and ecosystems of the region, yet no comprehensive programs are in place to monitor changes in caribou distribution, abundance, or harvest. The challenges in monitoring caribou in such remote regions of Ontario are daunting, but identification of important wintering areas, summer calving areas, and movement corridors is crucial to conservation of caribou in the HPE as modern, industrial-scale resource development and associated infrastructure expand into this region for the first time.

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