Update
COSEWIC STATUS REPORT
on
Cougar
(*Puma concolor couguar*)
[Eastern Population]

Fred W. Scott

INDETERMINATE
1998

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DE CES EN PÉRIL
CANADA

COSEWIC
COMMITTEE ON THE STATUS
OF ENDANGERED WILDLIFE
IN CANADA

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Cougar - C. Douglas, Canadian Museum of Nature, Ottawa.

Cougar
(Eastern Population)

Reason for status: A number of sightings in the past two decades from eastern Canada. Insufficient scientific data to evaulate taxonomy or assign a status. Apparent threat of hybridization with exotics. [Designated endangered in 1978; considered indeterminate in 1998.]

Occurrence: New Brunswick, Nova Scotia, Ontario, Quebec

NOTES

COSEWIC status reports are working documents used in assigning status. Reports are released in their original form in the interest of making scientific information available to the public.

 The report may be cited as follows:

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COSEWIC

A committee of representatives from federal, provincial and private agencies that assigns national status to species at risk in Canada and the chairs of the scientific subcommittees.

COSEPAC

Un comité de représentants d'organismes féderaux, provinciaux et privés qui attribue un statut national aux espèces canadiennes en péril ainsi que des président(e)s des groupes des spécialistes scientifiques.

Update
COSEWIC Status Report

on

COUGAR
PUMA CONCOLOR COUGUAR
(EASTERN POPULATION)

BY

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Executive Summary

Introduction

The first COSEWIC report on eastern populations of the cougar in Canada assigned Endangered status to the taxon, on the basis of reports of cougars in the wild in large parts of Ontario, Québec and the Maritimes. Since then there has been an enormous increase in cougar research, focused largely on ecology and population biology of western North American animals, and ecological and genetic problems of managing the endangered Florida populations. Strictly taxonomic research has been mostly based on molecular genetic analysis, and has yielded significant new information on variation within and between cougar populations.

Taxonomy

The scientific name should be *Puma concolor couguar* (Kerr 1792), in accordance with the current accepted standard reference on mammal classification, reinforced by new molecular genetic data. There are major grounds for doubting the validity of *P. c. couguar* as a taxonomically or biologically meaningful subspecies, based on the highly questionable original diagnosis and on recent morphological and especially molecular genetic evidence.

Distribution

Distribution of cougar sightings in eastern Canada now extends much further north than historic limits in Ontario and Québec but the taxonomic identity of all but one of these animals is undetermined. Whether this northward extension is real or only the result of increasing accessibility to human observers is unknown.

Apparent population sizes and trends

Population estimates are not possible with the present data and trends cannot be inferred from trends in number of reports, which cannot be separated from changes in the number of human observers or in their willingness to file reports.

Expansion and contraction of distribution can be inferred from some of the data and these may reflect changes in population size as well as in distribution. In Québec, there is evidence of a major southward retraction of cougar distribution between 1980 and 1985. Manitoba is the easternmost part of Canada for which there is objective evidence of the virtually uninterrupted survival of a cougar population from European settlement to the present. Genetically, this population must have been closely related to, if not identical with, the original eastern cougars in western Ontario, and less closely related to the original cougars in Québec and the Maritimes.

Habitat

Puma concolor has by far the greatest latitudinal range (about 110 °) of any non-migratory terrestrial vertebrate except humans. It occupies an altitudinal range from sea level to 4500 m and a climatic range from dry desert to extremely wet lowland tropical rain forest. In eastern North America, it historically inhabited large tracts of forest with minimal human presence or disturbance but apparently did not extend significantly into the lower Boreal Forest zone. Recent sightings indicate a northward extension well into the Boreal Forest in Ontario and Québec.

General biology

Since nothing at all is reliably known of the biology of *P. c. couguar*, information on other subspecies is summarized.

Cougar litters are relatively large (1-6, postnatal mean 2.6), gestation short (mean 91.9 days) and birth weight is fairly low (mean 458g) for an animal of that size class. Young stay with their mother until 1.5-2 years of age and females reach sexual maturity at 2-3 years. There is evidence that cougars living in the wild in eastern Canada sometimes breed. Longevity in the wild is not reliably known but is estimated at 11.2 and 10.5 years for males and females respectively.

Cougars feed on an enormous range of prey sizes and types, but their preferred prey species throughout North America are large ungulates. In southern California an adult cougar killed approximately 48 large and 58 small mammals per year and fed for an average of 2.9 days on a kill. When deer are in short supply, or other species are common, preferred secondary prey are lagomorphs and porcupines.

Distances traveled by dispersing juveniles vary from 19 to 274 km. Cougar males compete directly for access to females; females are not territorial but social intolerance is believed to help regulate their density, which is most directly related to topography, vegetation and prey availability.

Limiting factors

Principally human impacts, especially on habitat fragmentation; also prey availability and stalking cover. In the east, paved road density in km/100 km^2 may be a useful rough indicator of habitat fragmentation significant to cougars.

Special significance of the species

The original Eastern Cougar, if it ever was a valid subspecies, was not a Canadian endemic. Technically a summit predator, it does not appear to have been abundant enough in eastern Canada to have a significant impact on its preferred ungulate prey. It certainly has a high profile in the public consciousness, as its western counterparts can readily be seen in zoos and game parks in every province.

Evaluation and proposed status

There have been two cases of confirmed physical evidence of *Puma concolor* in eastern Canada since the first COSEWIC report in 1978, one of which has been taxonomically determined. They consist of one entire animal from Québec, and one scat associated with fresh tracks from New Brunswick, both in 1992. Genetic analysis proved the Quebec animal to be of Chilean origin.

Though Manitoba is technically not part of eastern Canada, it does adjoin it, and cougars are known to have been killed there in all but two decades between 1870 and 1979 (Nero and Wrigley 1977). This is circumstantial but nevertheless strong evidence that the species has survived virtually continuously in Manitoba since European settlement. While there is no evidence at present that the original eastern cougars have in fact survived in most of eastern Canada, they may well have survived in extreme western Ontario. From central Ontario eastward (and in the adjoining U. S. states) there is circumstantial evidence for virtual or complete extirpation. The increase in credible sightings in the last few decades is less likely to be the result of a recovery of original stocks, than it is due to the establishment of new stocks from escaped/released captives. One of two animals documented from the wild in Canada was an exotic from extreme northwestern Québec. In cases of recent wild animals in the U. S. whose source could be determined, all are believed or known to be escapes or deliberate.

Such circumstantial evidence is clearly and legitimately open to interpretation, and there is presently no consensus on the survival or extinction of the original eastern cougar. The best chance of survival of the original cougar stock is in extreme northwestern Ontario.

The revised status for *Puma concolor couguar* in Ontario, Québec, New Brunswick and Nova Scotia is **Indeterminate.**

Résumé

Introduction

Le premier rapport du COSEPAC sur les populations de couguar de l'est du Canada attribuait au taxon le statut d'espèce menacée de disparition, sur la base de rapports faisant état de couguars sauvages, dans de vastes zones de l'Ontario, du Québec et des Maritimes. Depuis, la recherche sur le couguar s'est accrue de beaucoup, se concentrant largement sur l'écologie et la biologie des populations des animaux de l'ouest de l'Amérique du Nord, et sur les problèmes écologiques et génétiques de la gestion des populations menacées de disparition en Floride. La recherche strictement taxinomique s'est surtout fondée sur les analyses de la génétique moléculaire et elle a obtenu de nouveaux renseignements significatifs sur la variation au sein des populations de couguars et entre celles-ci.

Taxonomie

Le nom scientifique devrait être celui de *Puma concolor couguar* (Kerr, 1972), conformément à la référence actuelle normalisée reconnue pour la classification des mammifères, renforcée par les nouvelles données de l'analyse génétique moléculaire. Il y a de solides bases mettant en doute la validité de *P. c. couguar* comme une sous-espèce probante sur les plans taxinomique et biologique, en se basant sur le diagnostic original hautement discutable et sur les récentes preuves morphologiques, surtout sur celles de la génétique moléculaire.

Répartition

La répartition des couguars aperçus dans l'est du Canada s'étend maintenant beaucoup plus loin qu'aux les limites historiques de l'Ontario et du Québec, mais l'identité taxinomique de l'ensemble de ces animaux est indéterminée. On ignore toujours si cette extension septentrionale est réelle ou si elle résulte seulement d'une accessibilité accrue pour les observateurs humains.

Tailles et tendances apparentes des populations

Les données actuelles ne permettent pas l'estimation des populations et l'on ne peut inférer les tendances à partir des tendances en nombre des rapports, que l'on ne peut distinguer des modifications du nombre des observateurs humains ou de leur empressement à remplir des rapports.

On peut inférer une expansion et une contraction de la répartition à partir de certaines données qui peuvent traduire des changements de la taille des populations ainsi que de leur répartition. Au Québec, des indications semblent révéler une importante rétraction vers le sud de la répartition des couguars entre 1980 et 1985. Le Manitoba est la partie la plus à l'est du Canada pour laquelle il existe des preuves objectives de la survie pratiquement ininterrompue de la population de couguars, à partir du peuplement européen jusqu'à nos jours. Génétiquement, cette population doit avoir été semblable, sinon identique, aux couguars de l'est originaux se trouvant dans l'ouest de l'Ontario, et moins étroitement reliée aux couguars d'origine du Québec et des Maritimes.

Habitat

Puma concolor occupe, de loin, la plus vaste gradient latitudinal (environ 110°) parmi les vertébrés terrestres non migrateurs, à l'exception des humains. Il occupe une aire de distribution en altitude allant du niveau de la mer à 4 500 m et un habitat climatique allant du désert sec à la forêt tropicale ombrophile des basses terres. Dans l'est de l'Amérique du Nord, il a habité historiquement de larges étendues de forêt ayant une présence ou une perturbation humaine minimale, mais apparemment il ne s'est pas étendu de manière significative dans la zone de basse forêt boréale. De

récents aperçus indiquent une extension vers le nord, dans la forêt boréale en Ontario et au Québec.

Biologie générale

Puisque l'on ne connaît rien de fiable sur la biologie de *P. c. couguar*, on résume les informations d'autres sous-espèces.

Les portées des couguars sont relativement importantes (de 1 à 6, moyenne postnatale 2,6), la gestation est courte (91,9 jours, en moyenne) et le poids à la naissance est assez faible (458 g, en moyenne) pour un animal de cette classe de taille. Les jeunes restent avec leur mère de 1,5 à 2 ans, et les femelles atteignent la maturité sexuelle à 2 ou 3 ans. Des indications laissent croire que les couguars qui vivent en liberté dans l'est du Canada se reproduisent parfois. On ne connaît pas de manière fiable la longévité à l'état sauvage, mais on l'estime à 11,2 ans pour les mâles et à 10,5 ans pour les femelles.

Les couguars se nourrissent d'un large éventail de tailles et de types de proie, mais leurs espèces proies préférées, dans l'ensemble de l'Amérique du Nord, sont les grands ongulés. Dans le sud de la Californie, un couguar adulte a tué environ 48 grands mammifères et 58 petits mammifères dans une année et s'est nourrit pendant 2,9 jours en moyenne sur une carcasse. Lorsque les cerfs se font rares ou que d'autres espèces sont plus communes, les proies secondaires préférées sont les lagomorphes et les porcs-épics.

Les distances parcourues par des juvéniles en dispersion varient de 19 à 274 km. Les couguars mâles se concurrencent directement pour l'accès aux femelles : les femelles ne sont pas territoriales, mais on pense qu'une intolérance sociale contribue à régler leur densité, qui est plus directement reliée à la topographie, à la végétation et aux proies disponibles.

Facteurs limitants

Les facteure limitants sont principalement l'impact des humains, surtout par la fragmentation des habitats, ainsi que la disponibilité des proies et des couverts de chasse. Dans l'Est, la densité des routes asphaltées en km/100 km^2 peut être un indicateur approximatif utile d'une fragmentation des habitats importante pour les couguars.

Importance particulière de l'espèce

Le couguar de l'est original, s'il a jamais été une sous-espèce valide, n'était pas endémique au Canada. Techniquement, un prédateur au sommet, il ne semble pas avoir été suffisamment abondant dans l'est du Canada pour avoir un impact significatif sur sa proie ongulée préférée. Il a certainement un profil élevé dans la conscience publique, comme son homologue de l'ouest que l'on peut facilement voir dans les zoos et les parcs d'animaux dans chaque province.

Évaluation et statut proposé

Depuis le premier rapport du COSEPAC de 1978, il y a eu deux cas de preuve physique confirmée de *Puma concolor* dans l'est du Canada, dont l'un a été établi de manière taxinomique. Il consiste en un animal entier au Québec, et d'excréments associés à des traces fraîches, au Nouveau-Brunswick, tous deux en 1992. L'analyse génétique a démontré que l'animal du Québec était d'origine chilienne.

Bien que techniquement le Manitoba ne fasse pas partie de l'est du Canada, il le jouxte, et on sait que des couguars y ont été tués, à l'exception de deux décennies, entre 1870 et 1979 (Nero and Wrigley, 1977). Ceci est circonstanciel, mais constitue néanmoins une solide preuve que

l'espèce a survécu de façon pratiquement continue au Manitoba depuis le peuplement européen. Même s'il n'y a actuellement aucune preuve que les couguars de l'est d'origine ont survécu, en fait, dans la plus grande partie de l'est du Canada, ils peuvent bien l'avoir fait dans l'extrême ouest de l'Ontario. Du centre de l'Ontario vers l'Est (et dans la partie adjacente des États-Unis), il existe des preuves circonstancielles d'une extirpation virtuelle ou complète. L'accroissement d'observations crédibles dans les dernières décennies est probablement moins le résultat d'un rétablissement des stocks d'origine, que l'établissement de nouveaux stocks provenant d'animaux captifs échappés ou relâchés. L'un des deux animaux documentés comme étant à l'état sauvage au Canada, était un animal d'orgine exotique tué à l'extrême nord-ouest du Québec. Dans les cas d'animaux sauvages récents aux États-Unis, dont on peut établir la source, on pense ou l'on sait que tous sont des animaux échappés ou délibérément relâchés.

Ces preuves circonstancielles sont clairement et légitimement sujettes à interprétation, et il n'y a actuellement pas de consensus d'accord sur la survie ou l'extinction du couguar de l'Est original. La meilleure possibilité de survie du stock de couguars d'origine se trouve dans l'extrême nord-ouest de l'Ontario.

Le statut révisé pour *Puma concolor couguar* en Ontario, au Québec, au Nouveau-Brunswick et en Nouvelle-Écosse est **Indéterminé**.

Introduction

The first COSEWIC report on eastern populations of the cougar in Canada (van Zyll de Jong and van Ingen 1978) assigned Endangered status to the taxon, on the basis of reports of cougars in the wild in large parts of Ontario, Québec and the Maritimes. At that time there was no physical evidence of cougar presence in eastern Canada. The authors implicitly assumed that there was at least a possibility that some of these sightings represented remnant survivors of the original cougar population in the east. Escaped or released captive animals were not mentioned. They also called attention to the very uncertain taxonomic status of the eastern subspecies, *Puma concolor couguar*. At the time they wrote, systematic autecological studies of cougars in western North America were just beginning and very little was yet known about cougar prey base requirements, home range size, dispersal or survival. The authors concluded that, though the number of cougar reports had risen during the1940s, numbers were still very low and the limiting factors were probably prey availability and human impacts.

Since then there has been an enormous increase in cougar research, focused largely on two areas: the ecology and population biology of western North American animals, and the ecological and genetic problems associated with management of the endangered Florida populations. Unfortunately, strictly taxonomic research has been relatively neglected, but much of what has been done is based on molecular genetic analysis, and has yielded significant new information on variation within and between cougar populations, and the phylogenetic place of cougars in the Felidae.

Wildlife managers in eastern Canada and the United States have continued keeping records of cougar reports and there is an increasing amount of documentation of the captive cougar population in eastern North America, which provides plausible circumstantial evidence that escapes from the captive pool are at least the major, if not the only, source of wild sightings. In 1992 physical evidence of wild-living cougars was finally obtained, in Québec and New Brunswick, and the former proved to be an exotic animal.

Taxonomy

Classification

Mammal (Class Mammalia, Order Carnivora, Family Felidae)

Felis concolor has been placed in the monotypic genus *Puma* Jardine 1834 on morphological grounds by at least four authors revising the Felidae, three of them since 1960 (Wozencraft, in Wilson and Reeder 1993). In view of recent molecular genetic analysis showing that *Puma concolor* belongs in a clade with the cheetah (*Acinonyx jubatus*), quite distinct from the *Felis* and *Panthera* clades (Janczewski *et al.* 1995), it is most appropriate to refer to the species as *Puma concolor* (Linnaeus 1771).

Common Name

Eastern Cougar; Eastern Puma (English); couguar (French).

Also commonly Mountain Lion, "panther". The latter is a generic popular term for any large unmaned long-tailed felid, with no taxonomic meaning except in the loose sense of belonging to the genus *Panthera,* which the cougar does not; unfortunately, this misuse has been entrenched in the case of the Florida subspecies, *P. c. coryi.*

Scientific Name

Puma concolor couguar (Kerr 1792).

Felis couguar Kerr 1792. (Pennsylvania, North and South Carolina, Georgia.)

Felis concolor couguar Kerr 1792: Nelson & Goldman, 1929, J. Mamm. 10:347. Type locality (by subsequent restriction): Pennsylvania.

Taxonomic status of *P. c. couguar*

Fifteen subspecies (some of disputed validity) are currently recognized (Hall 1981) in North America (Fig. 2), five of them occurring in Canada and two (*schorgeri* and *couguar*) in eastern Canada.

Though a systematic revision of even the eastern North American populations of *Puma concolor* is far beyond the scope of this report, the true status of the taxon known as the Eastern Cougar or Puma is highly relevant here. In fact there are major grounds for doubting the validity of *P. c. couguar* as a taxonomically or biologically meaningful subspecies, based on the highly questionable original diagnosis and on recent morphological and especially molecular genetic evidence.

Nelson and Goldman's assignment of *Felis couguar* Kerr 1792 to *Felis concolor* Linnaeus 1771 was the first use of that trinomial combination, but they merely listed it as a subspecies and did not define it. Much later it was characterized by Goldman (1946:204-206) based on what, by today's standards, is an inadequate sample of 8 specimens, none of which were formally designated as types. Seven were represented by skulls only (one fragmentary), and one by a skin only. They were from six mostly imprecise localities, four in New York and one each in Pennsylvania and West Virginia, and together came from an extremely small central region within the total range he assigned to the subspecies (Fig. 1).

He summarized *couguar* as:

General characters.—

A medium sized or rather large, dark subspecies. Similar to *coryi*, of Florida, but cranial characters, especially the anteriorly more convergent zygomata and narrower, flatter nasals, distinctive. Similar in general to *hippolestes* . . . but smaller and the skull differing in detail. . . .

Remarks.—

. . . Skulls from the State of New York are assumed to represent typical *couguar* which was described from Pennsylvania. The skulls indicate that it was a well-marked form, differing from *coryi* and *hippolestes* in cranial features such as commonly distinguish other subspecies. Unfortunately no skins that have not been exposed to light for a long period are known to be available for comparison, and the color is therefore imperfectly known.

Thus the four specimens Goldman considered characteristic of his new subspecies were all from New York State, one from the Catskill Mountains and three from the Adirondack Mountains, a large forested montane block that commonly reaches elevations of more than 1000 m; the remaining two specimens were also from mountain regions in the Appalachians and all may simply represent a geographically restricted montane phenotype that was most distinctive in the Adirondack population.

Lazell (1981), after examining and measuring 215 *P. concolor* specimens belonging to all subspecies occurring in the United States and Canada (map, Fig. 2), including 17 *P. c. couguar*, could find no discontinuous variation. Furthermore, he concluded that the western subspecies were no more than an assemblage of clines and not even three out of four skulls could be assigned to a particular subspecies without referring to their locality data, which tends to disqualify the subspecies. At best, he found it was possible only to separate the skulls of *couguar* or Florida *coryi* from those of the lumped western North American populations, on the basis of condylobasal length, zygomatic breadth, upper canine length and the relative size and shape of the premaxillary, maxillary, frontal and nasal bones; even so there was considerable overlap in all characters. Lazell also found both the 1973 Manitoba specimen, identified as *missoulensis* by the U. S. National Museum (Nero and Wrigley 1977), and the 1857 Wisconsin type specimen of *P. c. schorgeri* (Jackson 1955), to be closer to *couguar* than to western populations by those criteria (Goldman had speculatively included all of Wisconsin in the original range of *couguar*). *Schorgeri* has also been disputed as a valid subspecies by Jones (1964) and Bowles (1975), on the grounds that differences found were the result of an inadequate sample (a single old mount and two skulls). Lazell believed that all of the putative Great Plains subspecies (*schorgeri*, *stanleyana* and at least eastern *missoulensis* and *hippolestes*) were misidentified *couguar*, *coryi* or western animals, or intergrades between them, and not good subspecies in their own right.

While Lazell's work is unpublished, and was not a rigorous multivariate analysis (differences were only evaluated with a student's T test and the 0.05 level was taken to be statistically significant), it remains the *only* attempt since Goldman to morphologically evaluate the recognized subspecies north of Mexico. Gay and Best (1996) did look at the relation of abiotic variables to geographic variation in cougars throughout the Western Hemisphere, and were able to correlate size with latitude (Bergmann's rule), precipitation regime and temperature. However, their North American groupings were based almost entirely on political jurisdictions rather than on ranges of recognized subspecies, and some subspecies (i.e. *schorgeri*) were not represented while others (i.e. *missoulensis*) were represented by as many as seven separately analyzed samples. The sample that represented *P. c. couguar* (New England) contained only 8 unsexed skulls. All this makes it difficult to taxonomically interpret their results, which also differed markedly for each age class and sex within the sample. They did conclude that cougars from New England (*couguar*) and Arkansas-Louisiana (*coryi*) were as small as some from South America (contradicting Goldman's characterization of *couguar* as a "medium sized or rather large" subspecies).

Recent work undertaken on genetic geographic variation in cougars by Melanie Culver and colleagues (Culver and O'Brien, in prep.; Culver *et al.* in prep.) has shown that, although South American populations can easily be distinguished by mitochondrial DNA or microsatellite loci, it is presently not possible to reliably separate eastern from western cougars in this way (or western Canadian from Arizonan), because they differ only slightly in the mean frequency of some genes. A colleague of hers is developing a computer program that will make it possible to test the statistical significance of these differing frequencies (Culver, pers. comm.).

In summary:

1) Goldman's (1946) original diagnosis of *P. c. couguar* was inadequate even by the standards of his time (possibly because it was published in his own book rather than a refereed journal) and, aside from the lack of any statistical treatment, would certainly have been summarily rejected by any established journal today, principally because:

    a) the sample on which it was based was not even remotely representative geographically of the distribution he actually ascribed to the subspecies (the polygon defined by localities comprises about 6.6% of the total area; see Fig. 1) and available specimens from other parts of the assigned range (e.g., Wardsboro, Vt.and Trois-Rivières, Québec) admittedly not even examined;

b) though he restricted the type locality to Pennsylvania (the northern limit rather than the centre of the distribution given by Kerr), he only examined one skull from that state (from the extreme northwest corner) and explicitly *assumed* that the remainder of his sample, despite being based predominantly on Adirondack specimens, truly represented the "typical" population in Pennsylvania and all the rest of the range;

c) the sample was both unnecessarily small and heavily biased in favour of skulls, yet pelage characters known to be unreliable because of fading were part of the definition, based on a single selected skin of at least a dozen available.

2) Lazell's (1981) work shows that although *couguar*, *coryi* and western populations do show some morphological differences, there is considerable overlap in diagnostic skull characters and members of the three groups cannot always be distinguished from one another;

3) Culver's work (Culver, in prep.) shows that western and eastern cougars (non-Florida *coryi* material was not available for analysis) cannot reliably be told apart by mitochondrial DNA or microsatellite loci, but South American populations show some regional differences in these markers (Central American populations are intermediate in regional differences). An exception is in the southernmost of the two Florida populations of cougar: molecular evidence shows that the one found in the Everglades apparently is not the original *P. c. coryi* but is in part descended from recently translocated animals including one from South America (O'Brien *et al.* 1990, Barone *et al.* 1994).

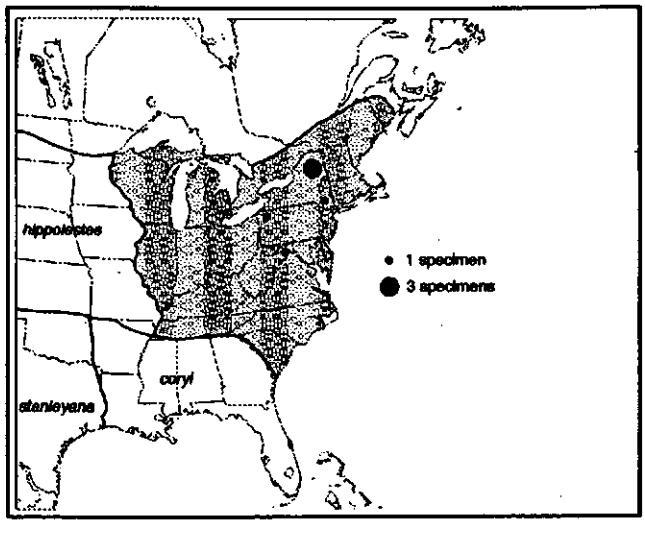

Fig. 1. Distribution originally assigned to *P. c. couguar* by Goldman (1946) and the localities of specimens on which he based his description.

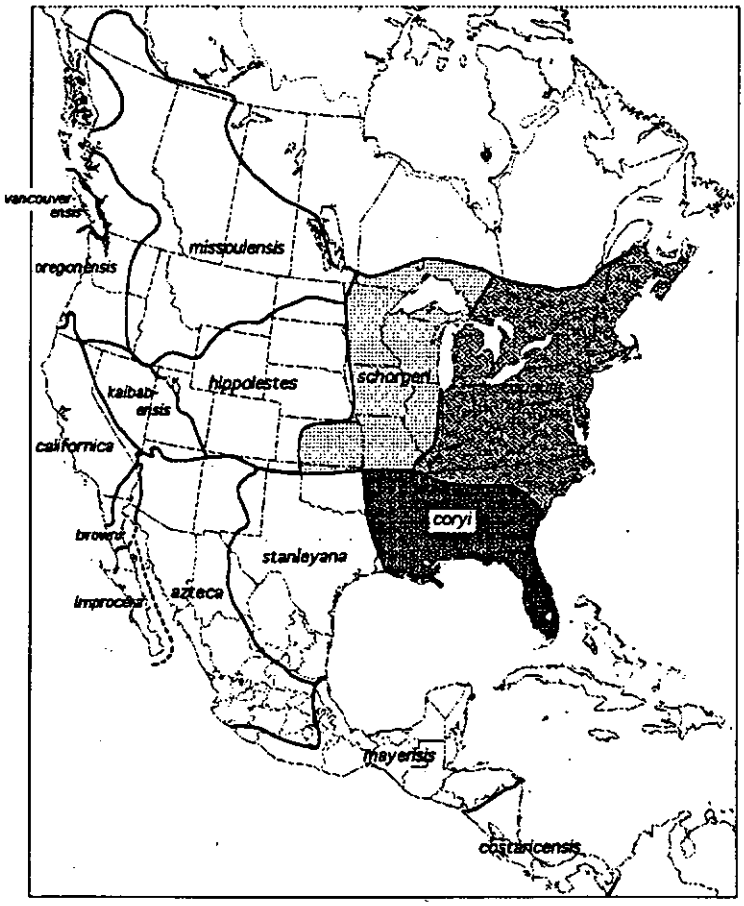

Fig. 2. Distribution of North American subspecies of *Puma concolor* recognized by Hall (1981).

If the genetically better-differentiated subspecies of cougar are to stand, then the very poorly differentiated ones, between which even morphological variation is so small and clinal that it cannot reliably distinguish them, should logically be merged in a single subspecies. In eastern North America this should include *couguar* and probably at least *schorgeri*, eastern *missoulensis*, *hippolestes* and *stanleyana*, and arguably non-Florida *coryi* as well. According to the rules of nomenclature, the name *couguar* Kerr 1792 is available for this merged subspecies and has priority, being the first name applied to any North American population (the only older name, the nominate *concolor* Linnaeus 1771, was given to material from Cayenne, French Guiana).

Distribution

The species is found through most of the Western Hemisphere.

Since *Puma concolor couguar* was formally described by Goldman (1946), the subspecies *schorgeri* has been erected by Jackson (1955) (Fig. 2) to occupy the northern Mississippi drainage where *couguar* and *hippolestes* formerly met. Since this subspecies is of very doubtful validity (Jones 1964, Bowles 1975), in this report I do not distinguish between *couguar* and *schorgeri* when discussing the northern limits of cougar distribution in eastern Canada.

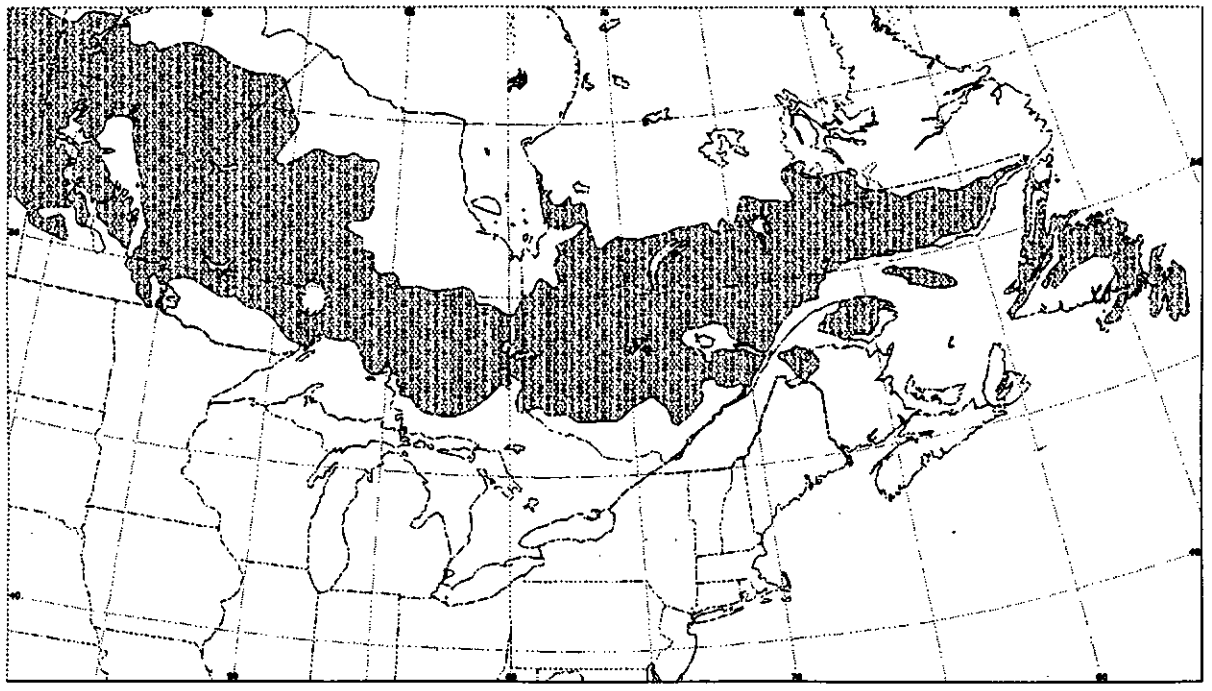

Fig. 3. Approximate distribution of the lower Boreal Forest zone (Black and White Spruce, Balsam Fir, Jack Pine, White Birch, Trembling Aspen) (after Stanford 1992).

Present distribution is shown in Fig. 5, based on published reports or those provided by the wildlife agencies responsible in each jurisdiction. There is no evidence that cougars were ever naturally present on the island of Newfoundland, historically or prehistorically (Fig. 4). However, there have been eight or nine cougar sightings in Newfoundland since 1960 and these are believed to be of animals from western North America (one male, two females) deliberately released into the area at about that time, or their descendants (Parker1998).

Distribution of cougar sightings (Fig. 5) now extends much further north than historic limits in Ontario and Québec (van Zyll de Jong and van Ingen 1978, Gerson 1988, Tardif 1997) (Figs. 6 and 7) but the taxonomic identity of all but one of these animals is undetermined. Whether this northward extension is real or only the result of increasing accessibility to human observers is unknown.

Cougar reports

Given the lack of actual specimens, all recent authors (Nero and Wrigley 1977, van Zyll de Jong and van Ingen 1978, Gerson 1988, Stocek 1995, Tardif 1997) addressing the status and distribution of cougars in eastern Canada have had to rely almost entirely on unverified reports (usually sightings) for an overall picture of where and when the animals apparently occur. There are obviously serious problems inherent in a database of largely anecdotal evidence, especially when record credibility is extremely variable. The portion of such reports that may actually represent cougars is less than 10% according to Brocke (1996), and their usefulness even in establishing simple presence, let alone arriving at any estimates of population size, has been rejected by Van Dyke and Brocke (1987a).

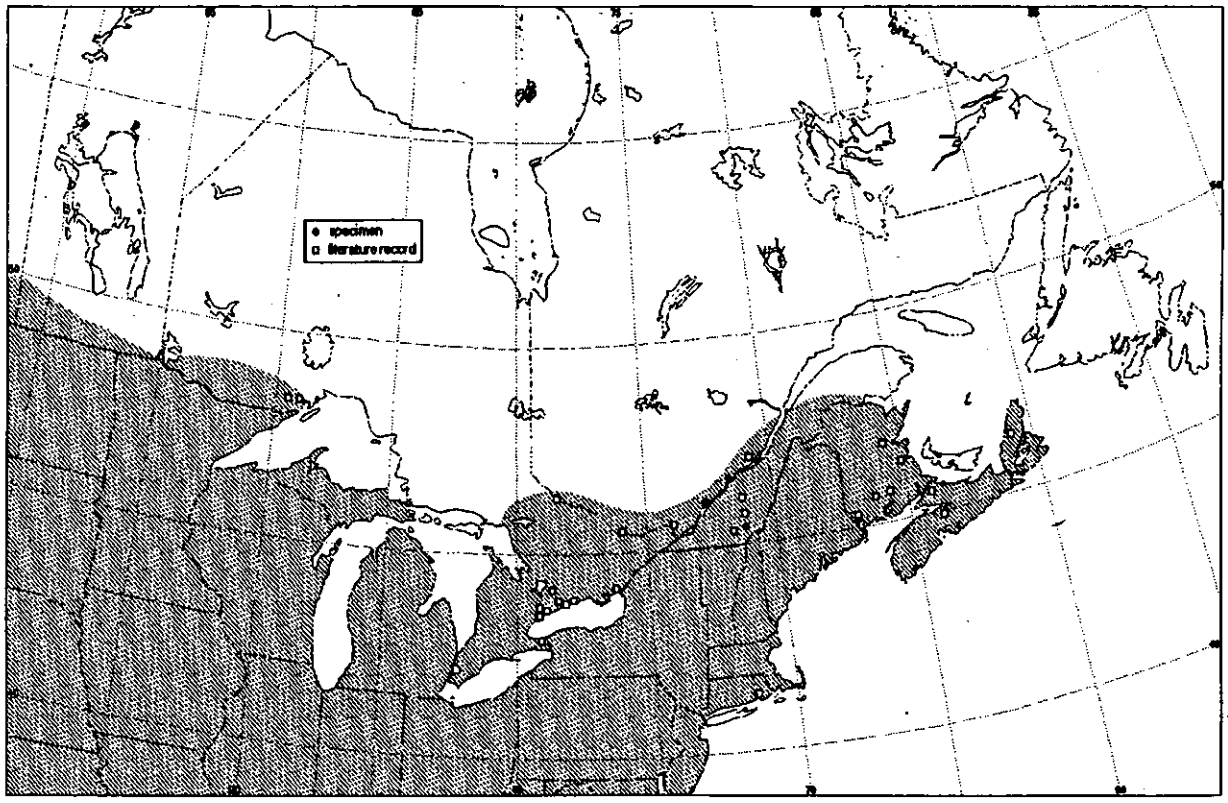

Fig. 4. Historic distribution of the cougar in eastern Canada (Peterson 1966).

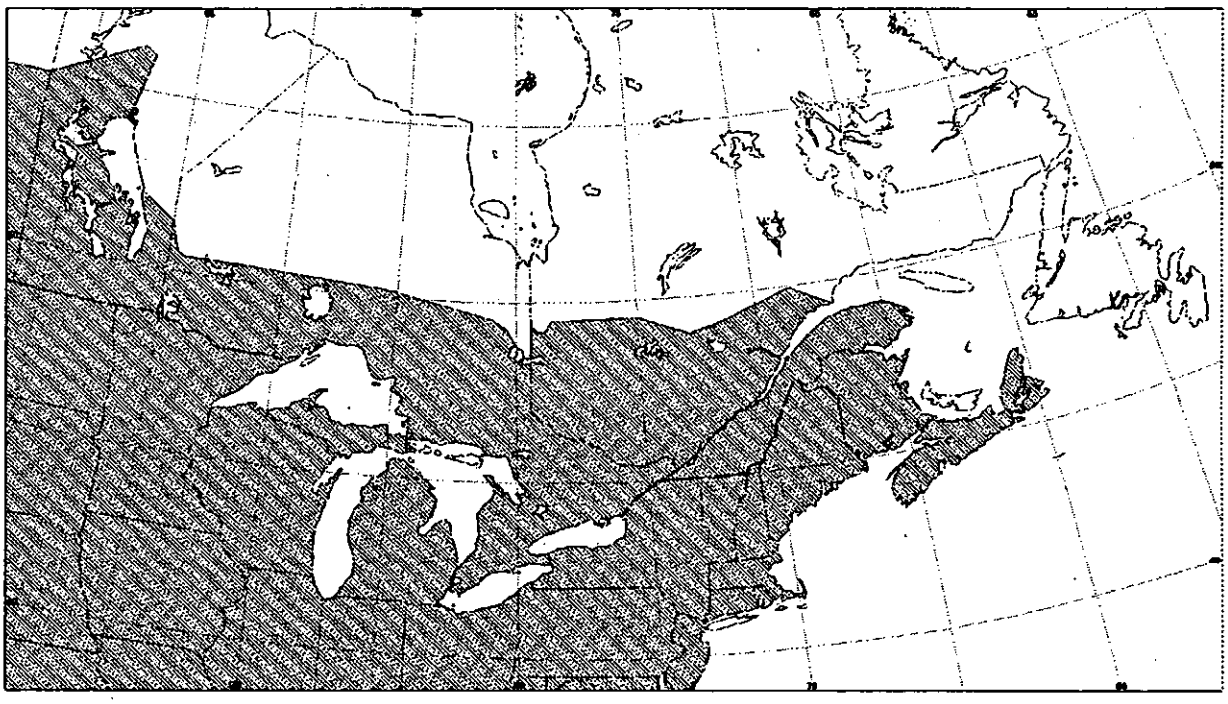

Fig. 5. Present distribution limits of the cougar in eastern Canada (see sources in text) (Manitoba limits from Nero & Wrigley 1977).

Cougar detectability

A major issue in evaluating reports is that of the innate detectability of cougars. Under good conditions, positively identified tracks are far better than positively identified sightings because they contain objective information, can be photographed, measured, cast and independently verified, which an unrepeatable sighting cannot. A body is of course the best evidence of all, and the most difficult to obtain.

Tracks

There have been at least a dozen recent papers on the reliability, interpretation and usefulness of cougar tracks for population estimates, population trend detection, and inexpensive monitoring of individual animals (e. g., Van Dyke 1983; Van Dyke and Brocke 1987; Roof and Maehr 1988; Van Sickle and Lindzey 1992; Smallwood and Fitzhugh 1993, 1995; Beier and Cunningham 1996). Under good tracking conditions on dirt roads there is a 95% probability of detecting the presence of a resident female cougar if 31.6 km of road in the animal's range is searched (Brocke 1996). In Arizona and Utah, resident females required the least effort to detect (51.1 km searched per track set found); all residents, 78% of transients and 58% of cubs were detected by track searches; in the least favourable conditions, a search of 360 km per 500 km^2 should be sufficient to detect cougars and, under ideal weather, substrate and road density conditions, <90 km should be enough (Van Dyke, Brocke and Shaw 1986). Whether these criteria apply in areas with no permanently resident or breeding populations is not clear. Vehicular traffic does not deter cougars from crossing unpaved roads and can be a problem during surveys because it obliterates tracks before they can be found by searchers (Beier and Cunningham 1996).

Roadkills

Cougars are often killed by motor vehicles in many jurisdictions, even ones where they are not especially common; 22 were fatally struck by vehicles in California between 1971 and 1976 (Sitton 1977) and a total of 19 in Florida up to 1976 (McCauley 1977). In southeastern British Columbia, where the population density was between 3.5 and 3.7 per 100 km^2, four of seven recorded mortalities were vehicular (Spreadbury *et al.* 1996). Even in Florida where the population is presently very small and relatively low density (30-50 animals; 0.6/100 km^2) there is still an average of 1.2 traffic deaths per year (Downing 1996b), 47% of total mortality (Maehr, Land and Roelke, 1991). This is an exceptionally high mortality rate and is presumably related to a very high traffic volume on the roads the cougars are crossing.

Because of these and other figures, the documented occurrence of roadkilled cougars has been posited as necessary to prove their existence in the east outside of Florida (Guynn *et al.* 1985). However, in light of the 1992 confirmations from Québec (a shot animal) and New Brunswick (confirmed track with associated scat), where no roadkills or even vehicle strikes are reported to have occurred, the absence of roadkilled cougars obviously proves nothing (except that none have been recorded). In Nova Scotia there have been three non-fatal vehicle strikes of cougars reported, in one of which the unconscious animal was moved off the pavement by the people in the vehicle (the record mapped with a star in Fig. 12). A fourth unconfirmed report was of an animal with a crushed head found dead beside a road (Nova Scotia Cougar Report Database, held at the Nova Scotia Museum of Natural History, Halifax).

Melanism

A serious credibility issue is the extremely high proportion (4.6 to 27%) of "black" cougars reported in eastern Canadian and a variety of American jurisdictions (e.g., Gerson 1988; Stocek 1995; 10Greenwell 1996; Tardif 1997; Dawson 1997 pers. comm.).

The allele that produces extreme melanism in members of the cat family is the "non agouti" allele, an autosomal recessive. In large felids it occurs uncommonly but consistently only in leopards (*Panthera pardus*) and jaguars (*P. onca*) (Robinson 1976a, 1976b, 1978)

No North American melanistic cougars were known to Young (1946); there is only one record in the literature since then of a melanistic cougar actually killed in the wild and preserved, in Colorado (Barnes 1960), though the author gives absolutely no useful details and I am inclined to dismiss it until it is properly documented. There are only a few from tropical America (Cabrera and Yepes 1940). One from Brazil was well described and truly black (Thompson 1896), and one was shot and photographed in Costa Rica in 1959 (Tinsley 1987) but none are known from the temperate southern parts of South America where the species is more common than anywhere else on the continent (Young 1946). I can find no records at all in the published literature of melanistic cougars having been born in captivity in North America (Coleman 1974) or England (Baker and Wilson 1996). Cat authorities in the North American zoo community do not know of any unpublished occurrences, even in the very large population of captive cougars in private hands, where one would expect such a notable event to be widely talked about (J. Seidensticker; A. Shoemaker; D. Wildt; pers. comms.). This indicates such a low frequency of the non-agouti allele that no known genetic mechanism (M. Snyder, pers. comm.) could account for such a startlingly high reported frequency in the wild among animals that must be derived predominantly or entirely, through escape or release, from that same captive and genetically mixed population (see *The origin problem*). Ironically, the "circus train wreck" as a source of melanistic large cats does not hold up to even cursory examination (Coleman 1996). In view of all this, I suggest that reports of black animals be automatically discounted unless there is unambiguous and indisputable supporting evidence.

Ranking credibility of reports

The Nova Scotia Cougar Report Database (NSCRD) is maintained at the Nova Scotia Museum of Natural History, Halifax. I spent about 150 hours over several months checking each computer record against the original report, correcting errors of entry, reorganizing the data structure to make the information maximally useful, and adding georeferences whenever possible to allow mapping of the records. One of the goals was to come up with a filter that would eliminate as many as possible of both Type I and Type II errors (respectively, identifying as cougars animals that were not, and not identifying as cougars animals that were).

I set up five categories, based on how closely the animal reported matches the major descriptive parameters for a cougar (size, shape, colour, behaviour, location, in decreasing order of importance). All-black colouration in *good* lighting is not appropriate for a cougar, for genetic reasons, though it is not absolutely impossible (see Melanism, above). Many records with convincing size, shape or colour information are not convincing when it comes to location or behaviour. When there was any uncertainty about which of two ratings to give a record, I automatically gave it the lowest of the two.

X = definitely *not* cougar, on the basis of tracks, animal description, behaviour or location (i.e., spending ten minutes rooting around in garbage on a back porch in a residential subdivision)

0 = not enough information to

a) know what the animal looked like at all, or

b) confidently rule out one of the species often mistaken for cougar (usually coyote, domestic dog and domestic cat, sometimes black bear or fisher)

or, ***only one*** of the major descriptive parameters (size, shape, colour, behaviour, location) is appropriate for cougar

1 = **possible cougar;** *two or three* of the major descriptive parameters (size, shape, colour, behaviour, location) are at least *largely* appropriate for cougar

2 = **probable cougar;** *four or five* of the major descriptive parameters (size, shape, colour, behaviour, location) are at least *largely* appropriate for cougar

3 = **confirmed cougar;** *all* major descriptive parameters (size, shape, colour, behaviour, location) are *completely* appropriate for cougar and the animal is examined and/or photographed at very close range (from a few metres to arm's length) while conscious, unconscious or dead

Neil Dawson has applied these criteria to the Ontario sightings and the ones mapped are only those in classes 1 or 2 (possible or probable).

For a cougar sighting to occur, both a human and a cougar have to be present at the same time. Cougar sightings in eastern Canada are accidental rather than the result of deliberate searches for the animals. The likelihood of an accidental sighting is theoretically lowest at the respective centres of human and cougar abundance (where humans are densest, cougars are least likely to venture, and vice versa). Humans gain access to cougar territory mainly by means of roads and trails. Given access by humans, the highest probability of accidental sighting is thus not where cougars are most abundant, but where the distance/density trends for each species in the graph intersect (Fig. 12). The distribution of cougar sightings in Nova Scotia (Fig. 12) supports this, showing a preponderance of records in regions of moderate human density, and at the immediate periphery of the most densely human-populated areas.

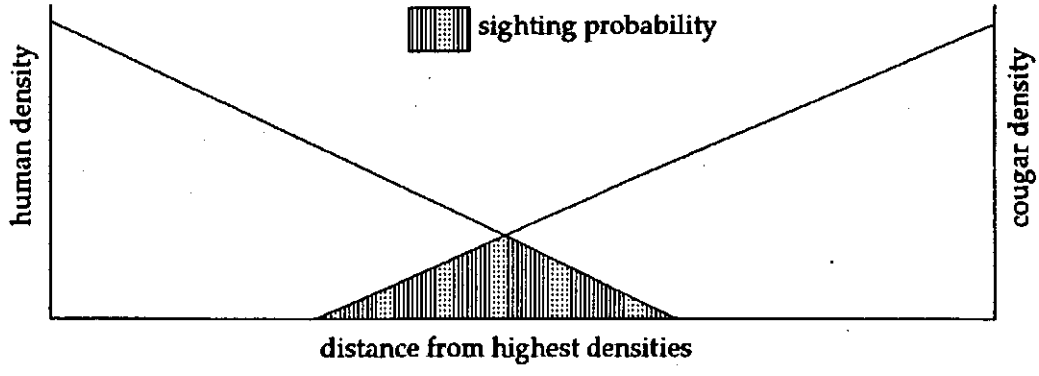

Fig. 6. Theoretical relationship between human and cougar density and sighting probability.

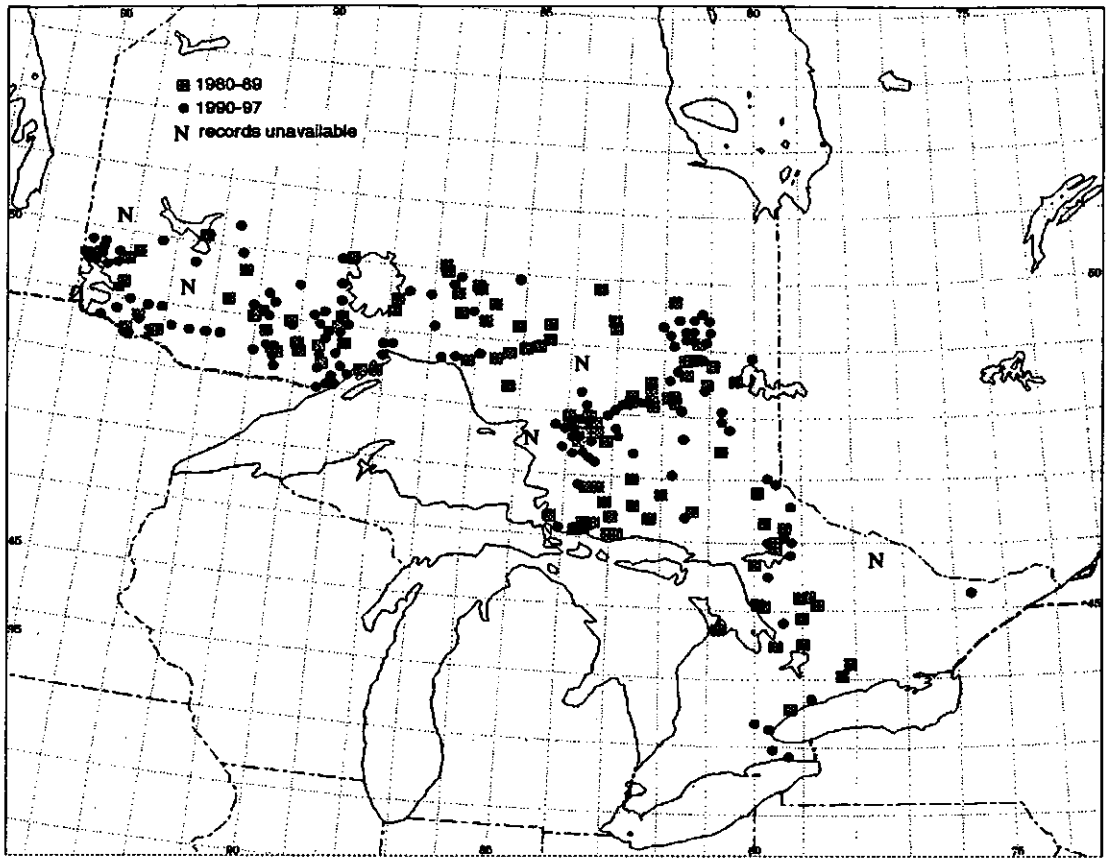

Fig. 7. Ontario cougar reports, class 1 and 2, 1980-97 (Dawson 1997 pers. com.)

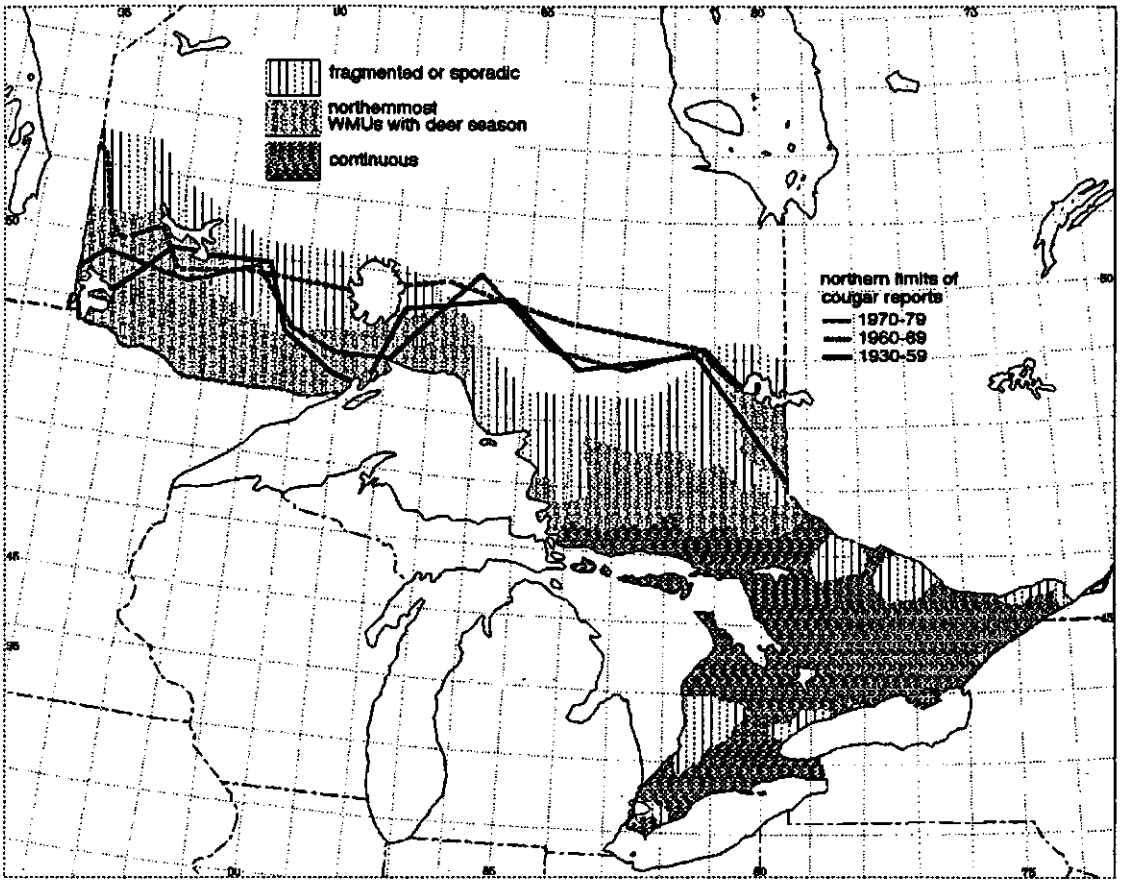

Fig. 8. Changes in northern limits of cougar reports in Ontario to 1979 (Gerson 1986) superimposed on present distribution of white-tailed deer. Continuous and fragmented/sporadic deer range from Dobbyn (1994); northernmost Wildlife Management Units (WMUs) with deer season from Dawson (1997 pers. com.).

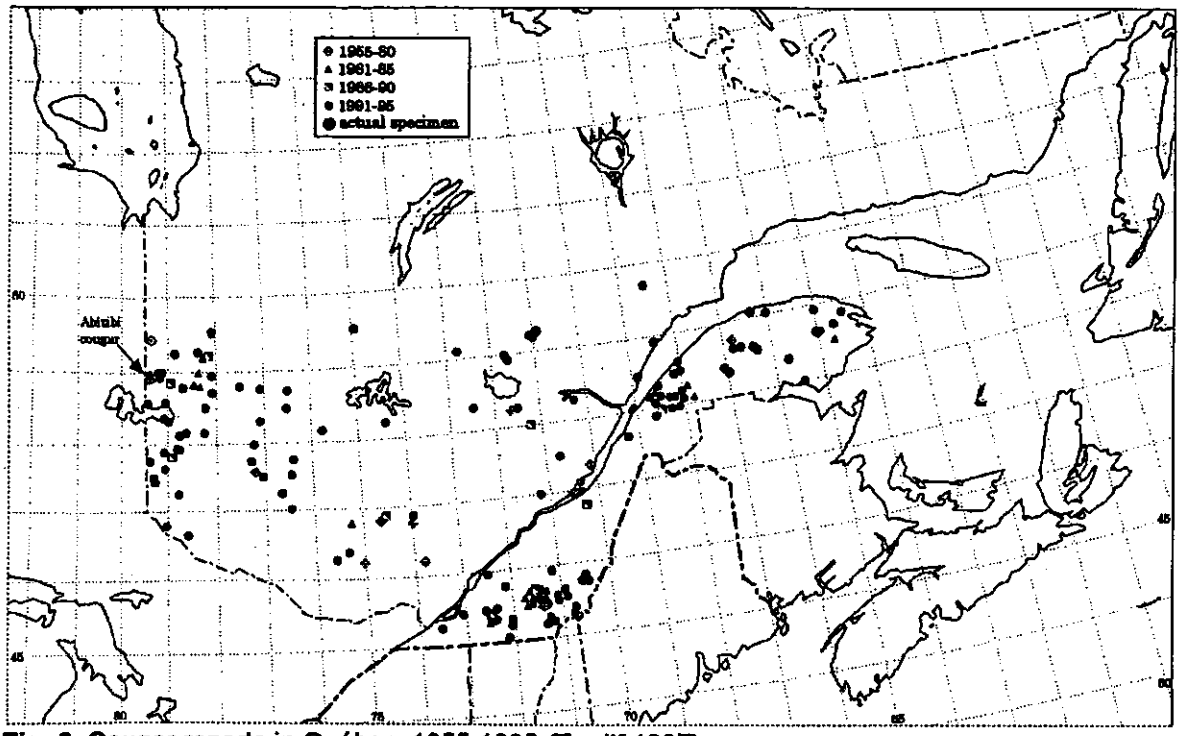

Fig. 9. Cougar reports in Québec, 1955-1995 (Tardif 1997).

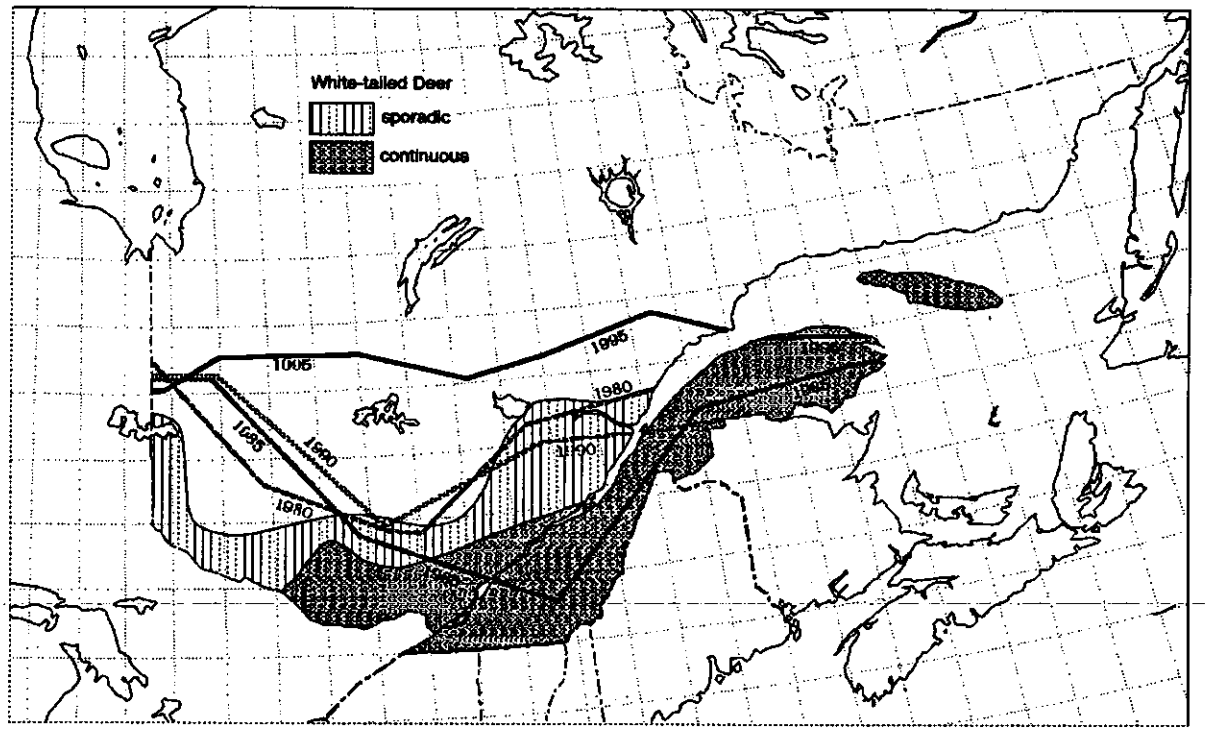

Fig. 10. Extension of northern limits of cougar reports in Québec, 1980-1995 (Huot 1997, pers. comm.) in relation to northern limits of White-tailed deer (Lamontagne & Potvin 1994).

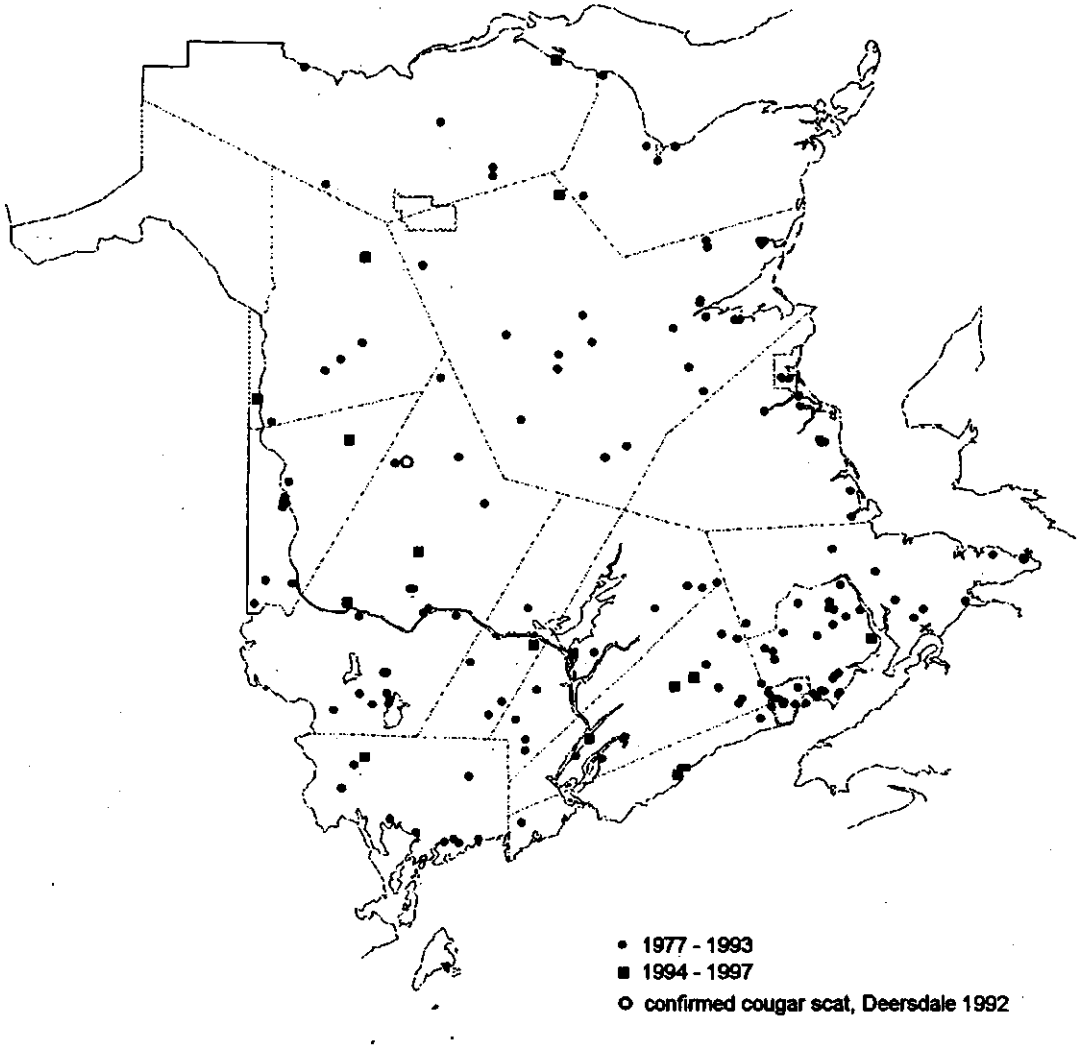

Fig. 11. Cougar reports in New Brunswick, to 1993 (Stocek 1997 pers. comm.) and since then. Of 61 reports on file from 1994 onward (New Brunswick Museum records), only 15 had localities that were in the New Brunswick gazetteer and could be mapped here.

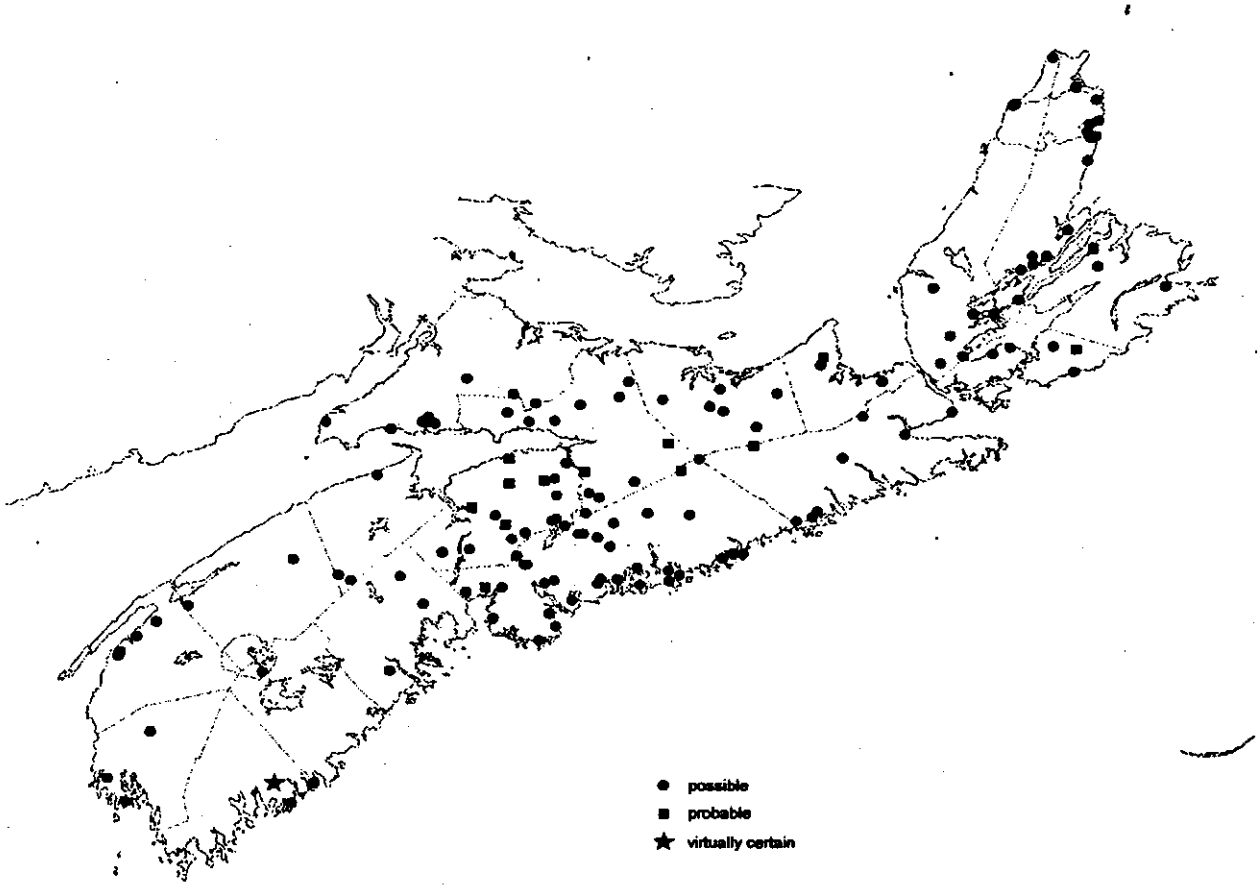

Fig. 12. Cougar reports in Nova Scotia, 1978-1996 (NSCRD; N = 450, possible = 150, probable = 15).

Apparent population sizes and trends

Population estimates are not possible with the present data and trends cannot be inferred from trends in number of reports because those, however real, cannot be separated from changes in the number of human observers or in their willingness to file reports.

However, expansion and contraction of distribution can be inferred from the data and these may reflect changes in population size as well as in distribution. In Québec, there is evidence of a major southward retraction of cougar distribution between 1980 and 1985 (Fig. 8) followed by a reoccupation and further northward extension, indicating that populations might be regionally extirpated for short periods. Much of the southward retraction was in the region where deer populations are sporadic. In Nova Scotia, there is definite temporal and regional clustering of reports, indicating that animals or groups of animals might periodically leave or die off and subsequently may return or be replaced; in any given year cougars seem to be absent from one-half to two-thirds of the area of the province (Nova Scotia Cougar Report Database, held at the Nova Scotia Museum of Natural History, Halifax). This may be because there is a geographic bottleneck at the Isthmus of Chignecto that impedes immigration from New Brunswick.

Habitat

Puma concolor is one of the most adaptable of all mammals and has by far the greatest latitudinal range (about 110 °) of any non-migratory terrestrial vertebrate except humans. It occupies an altitudinal range from sea level to 4500 m and a climatic range from dry desert to extremely wet lowland tropical rain forest (Nowak 1991). In eastern North America, it historically inhabited large tracts of forest with minimal human presence or disturbance but apparently did not extend significantly into the lower Boreal Forest zone (Goldman 1946, Peterson 1966, Hall 1981) (Figs. 3, 4). Recent credible sightings indicate both a northward extension well into the Boreal Forest in Ontario and Québec (Figs. 6, 7) and, in all provinces, an increased tolerance of human presence/disturbance (farms, roads, logging, etc.) as long as there are extensive forest tracts of at least several square kilometres, and adequate populations of deer and other prey species (see also *Limiting factors*).

General biology

Since nothing at all is reliably known of the biology of *P. c. couguar*, we must rely on knowledge of other subspecies.

Reproduction

Cougars are a little closer than other large cats to the *r* end of the *r*-K continuum in reproductive strategy; litters are relatively large (1-6, postnatal mean 2.6), gestation short (mean 91.9 days) and birth weight is fairly low (mean 458g) (Anderson 1983) for an animal of that size class. Young stay with their mother until 1.5-2 years of age and females reach sexual maturity at 2-3 years (Currier 1983).

There is evidence that the cougars living in the wild in eastern Canada sometimes breed. A few reports in each province describe young accompanying a female, or alone, sometimes playing (Table 1). Given the probable origin of most cougars (escaped or released from captivity; see *The origin problem*), the incidence of sterility is probably high, and the distribution of females both patchy and noncoincident enough with males, that reproductive rates do not come close to those in normal wild populations. When fertile former captives from allopatric genetic stocks do meet and mate in the wild, the offspring may be less viable than normal because of maladaptation to local conditions or lack of genomic coadaptation (outbreeding depression; Shields 1982, Templeton 1986, Templeton *et al.* 1986).

Table 1.

Reports of adult cougars with young, or obvious young alone, in Manitoba and eastern Canada.

Province	Number	Source
Manitoba	12	Nero and Wrigley 1977
Ontario	7	Gerson 1988;
Québec	1	Tardif 1997
New Brunswick	2	(to 1993) Stocek 1995
Nova Scotia	7	(to 1993) Stocek 1995

Longevity in the wild is not reliably known but is estimated at 11.2 and 10.5 years for males and females respectively (Anderson 1983).

Diet

Cougars feed on an enormous range of prey sizes and types, but their preferred prey species throughout North America are large ungulates, principally mule and white-tailed deer (*Odocoileus hemionus* and *virginianus*) (Anderson 1983). Some western populations utilize moose (*Alces alces*) (Ross and Jalkotzy1996). Where elk (*Cervus elaphus*) occurs it is the major or preferred prey. In southern California an adult cougar killed approximately 48 large and 58 small mammals per year and fed for an average of 2.9 days on a kill. Generally, a single adult male would need to kill 44 deer per year, an adult female 22 deer per year, and a female with 2 or 3 yearling cubs about 113 deer annually (Beier, Choate and Barrett 1995). When deer are in short supply, or other species are common, preferred secondary prey are lagomorphs and porcupines. In a British Columbia study, in peak hare abundance years, 27% of cougar diet was snowshoe hares (*Lepus americanus*) (Spalding and Lesowski 1971). In Utah, jackrabbits (*Lepus* spp.) comprised 17.2% of the diet (Ackerman, Lindzey and Hemker 1984).

In 32 reports summarized by Anderson (1983) porcupines were a major prey item in 12 and a minor one in 2, based on stomach content/scat examination. Cougars can apparently swallow and pass porcupine quills through their digestive tract without incapacitating injury. According to Young (1946), cougars kill porcupines with a ventral bite and eat them from the ventral side, but they do accidentally swallow quills; he reproduces a photo of a cougar scat that is almost entirely compacted quills. Porcupines and snowshoe hares are common to extremely abundant in all forested parts of the range occupied by cougars in Canada and are reliable fallback prey species if ungulate populations become low.

Precise relationships between cougar density and major prey abundance are still far from certain but deer density and distribution are probably not the only factors controlling cougar density (Lindzey *et al.* 1994). In eastern Canada the number of cougars is apparently so low that even the absence of deer does not seem to limit cougar distribution. The northern limit of cougar records extends only slightly beyond the northern limit of deer in northeastern Ontario (Fig. 7) but in Québec the northern limit of cougar reports has at times extended several hundred km north of the northern limit of deer (Fig. 8).

Nero and Wrigley (1977) have shown that the northward expansion of cougars in Manitoba has followed an equal northward expansion of white-tailed deer, which have moved in from the east and largely replaced mule deer in the last few decades. While found in all suitable habitats in New Brunswick and Nova Scotia, white-tailed deer are known to be at the northern limit of their range in the Maritimes, and have disappeared from there when climates cooled in the past, as they did during the Little Ice Age from about 1350 to 1870, only to reinvade when the region warmed (Benson and Dodds 1977).

Dispersal

Distances traveled by dispersing juvenile cougars vary almost as much as do home ranges and the variance is presumably related to adult density and resource distribution. In southern California, in an area of approximately 2200 km^2, nine juveniles dispersed from 19 to 77 km over periods ranging from 20 - 536 days (Beier 1995). In the same study, transient home ranges were larger (by 2 to 30%) and were occupied longer than resident home ranges. Logan, Irwin and Skinner (1986) recorded dispersal distances of 9 to 274 km in Wyoming. Lindzey *et al.* (1994) recorded a similar range (39 - 241 km) in southern Utah.

Spatial requirements

Cougar males are generally territorial and their territories/home ranges average much larger than those of females (Seidensticker *et al.* 1973). Among females, which are not territorial, home areas/ranges [both terms are used in the literature] often overlap and may do so completely; home ranges of both sexes are generally largest in arid regions with low prey density and smallest in moist or wet regions with high prey density (Anderson 1983). In southern Utah, home area ranged from 396 to 1454 km^2 (Hemker, Lindzey and Ackerman 1984). In south Florida mean home area was 435 and 202 km^2 for males and females respectively; based on habitat available, southern Florida can support 30 to 40 cougars, and 27 individuals were identified in 1983 (Belden *et al.* 1988). In southern California home ranges of transient males ranged from 23 to 276 km^2, and those of resident males from 134 to 704 km^2 (Beier 1995). In southern Texas, home ranges of males ranged from 236 to 1826 km^2 and females from 352 to 1717 km^2 (McBride 1976).

Cougar males compete directly for access to females; females are not territorial but social intolerance is believed to help regulate their density, which is most directly related to topography, vegetation and prey availability (Seidensticker *et al.* 1973). On release or escape, female cougars could be expected to select the first unoccupied area they come upon with suitable vegetative cover and food resources. Males, however, would often be looking not for adequate cover and food resources (which they could find almost anywhere with little difficulty), but for an area occupied by one or more resident females. Since the distribution of established females is probably very patchy at any given time, escaped/released males might have to travel distances many times greater than would wild animals in an established population. Some might never succeed in finding females.

Seven wild animals from western Texas were translocated to an area straddling the Florida - Georgia border. Individual total ranges varied from 21 to 9136 km^2 (almost one-sixth the area of Nova Scotia!) and home ranges within those areas from 96 to 930 km^2 over a time in the wild of 17 - 244 days. Mean distance between established home range centres was 16.6 km (2.8 - 32.7). Some animals wandered into urban areas (Belden and Hagedorn 1993).

Limiting factors

Principally human impacts, especially on habitat fragmentation; also prey availability and stalking cover. Road density in km/100 km^2 may be a useful rough indicator of habitat fragmentation significant to cougars (see below).

Human disturbance

Logging/clearcutting

In Utah cougars avoided active logging sites (1 of 479 radio locations) and did not use areas until at least 6 years after logging ceased; transient animals encountered human disturbance at 6 times higher rates than residents. Only major habitat alteration appeared to affect habitat use by resident cougars (Van Dyke *et al.* 1986).

Human settlement density

In California, adult and dispersing cougars occasionally bedded for the day 20-100 m from trails heavily used by pedestrians, bicyclists and equestrians. Dispersers showed no aversion to parked vehicles, occasionally walking within 2 m of a researcher sitting in a vehicle

on a dirt road with the engine off. They also passed within 30 m of isolated homes and buildings with no outdoor lighting (Beier 1993). Dispersers will use habitat corridors containing unnatural features such as golf courses and freeways (Beier 1995). In California, one male dispersed from 60 km away to a new home range that straddled a multiple-lane freeway, and crossed it at least 16 times in eight months (Beier 1993).

In California, cougars regularly moved through areas with low density housing (about 1 occupied dwelling /16 ha) but found areas with >20/ha impassable (Beier 1995). Increasing encroachment by humans on cougar habitat in California has led not to retreat or disappearance of cougars, but to an increase in pet depredations as well as attacks on humans, from none between 1910 and 1985 to nine since then, with two fatal ones in 1994 (Torres *et al.* 1996), to the point where Pemble (1991) explicitly addressed the problem of evading cougar attacks in residential areas.

Road density as an index of habitat fragmentation

In Utah, total road densities in cougar-occupied areas were 0.6 km/km^2 (60 km/100 km^2) in logged areas used by cougars, compared with 0.4 km/km^2 (40 km/100 km^2) in unlogged areas (Van Dyke *et al.* 1986). In Utah and Arizona, road densities by type ranged from 2 - 4 km/100 km^2 for dirt roads to 26 - 44 km/100km^2 for paved roads (Van Dyke, Brocke and Shaw 1986).

In the sparsely inhabited part of the north Florida - south Georgia border region (< 3.5 occupied dwellings per km^2), where cougars from Texas were released, road density was 24 km/100 km^2 for primary hard-surface highway, 37km/100 km^2 for secondary hard surface highway, 82km/100 km^2 for light-duty [unpaved] road and 36km/100 km^2 for other roads and trails. Hard-surfaced [paved] roads thus totaled 61 km/100 km^2 Road densities for each road class within home ranges were about half as great as within the total study area. The seven animals settled down, hunted successfully, and crossed roads an estimated 2612 times during the study (2.7 crossings per cougar/day) (Belden and Hagedorn 1993).

Special significance of the species

The original Eastern Cougar, if it ever was a valid subspecies, was not a Canadian endemic. Technically a summit predator, it does not appear to have been abundant enough in eastern Canada to have a significant impact on its preferred ungulate prey species (White-tailed Deer, *Odocoileus virginianus*). As a member of the so-called Charismatic Megafauna, it certainly has a very high profile in the public consciousness, especially because its western counterparts can readily be seen in zoos and game parks in every province.

Evaluation and proposed status

The origin problem

In order to evaluate and propose a status, there are three questions that must be answered. First, is there any chance that some part of the original genome might persist in any population? Second, what physical evidence is there on the taxonomic identity of existing wild cougars in the east? Third, if any of these animals are exotics, where are they coming from?

There is no objective evidence (actual cougar specimens or other unequivocal confirmation) for the *continuous* presence of cougars since the last century anywhere in eastern Canada or the eastern United States outside of Florida. There have been no cougars reported killed in this century in Ontario (Gerson 1988) or in Québec from 1900 until 1992, when an

exotic animal was shot (Tardif 1997). In New Brunswick the hiatus was from 1932 (Wright 1953) to 1992 (Cumberland and Dempsey 1994), and in Nova Scotia the hiatus is unknown.

In Manitoba (Nero and Wrigley 1977), cougars are known to have been killed in all but two decades between 1870 and 1979. The gap was in the period 1940-1959 (during which there were nevertheless 31 sightings), and could well be explained by the fact that a majority of the men likely to see or shoot cougars were serving in the armed forces during World War II and the Korean War. This is strong evidence that the species has survived continuously in Manitoba since European settlement. Given the very questionable validity of subspecies *schorgeri* (see *Taxonomy*), these cougars, and presumably those in adjoining extreme northwestern Ontario, may be genetically the closest living relatives of the original eastern Canadian (and U.S.) cougar populations that may have been extirpated.

The taxonomic identity of actual recent specimens

There have been two cases of confirmed physical evidence of *Puma concolor* in eastern Canada since the first COSEWIC report in 1978, one of which has been taxonomically determined. They consist of one entire animal, and one scat associated with fresh tracks. Chronologically, they are:

1) a live cougar shot on 27 May 1992 in the Abitibi district of Québec, in front of a house in Saint-Lambert de Desméloizes (48° 57' 05" N, 79° 27' 22" W), a small community about 20 km NNW of La Sarre (Fig. 9). This specimen is commonly referred to as "the Abitibi cougar." The animal was killed by three shots to the head at close range from a heavy-calibre rifle. It was a young adult male weighing 41 kg. Its teeth and claws were intact and there was no indication it had been collared. There were no signs of any identifying tattoo or of sterilization and it did not appear to be a recently liberated or escaped animal. The skull was too badly damaged to permit subspecific identification by cranial characters (all information from M. Huot 1997, pers. comm.). Subsequent genetic analysis by Melanie Culver showed that it had a mitochondrial haplotype found only in animals from Chile and at two microsatellite loci it had an allele found only in South America. Since mitochondria are inherited maternally, this means that it had at least a South American mother (probably Chilean) if not two parents from South America (Culver, pers. comm.). A. Shoemaker (1997, pers. comm.) informs me that the official North American cougar studbook records no animals of Chilean origin and only 3 from Latin America (2 Costa Rican, 1 Venezuelan), all back in the 1920s.

2 cougar tracks and associated scat, found near Deersdale, New Brunswick, on 16 November 1992 (Cumberland and Dempsey 1994). The fresh tracks were followed for 2.5 km and showed all the requisite characteristics of cougar, including a 5.25 m leap over a snow-covered stand of 1 m-high balsam fir without disturbing the snow on the branches. The scat contained cougar underfur and guard hairs, as would be expected if ingested while grooming. The genetic origin of this specimen has not been determined but should be checked; though it is not possible to distinguish between eastern and western animals on the basis of MtDNA or microsatellite loci, it should be possible to determine whether or not it came from outside of North America.

Interestingly, in April 1994, near Craftsbury Vermont, 40 km south of the Québec border, wild cougar presence was confirmed by tracks of three animals and an associated scat which proved to contain cougar hair (Parker1998).

Known and potential sources of exotic animals

Until fairly recently, it was assumed that cougars recorded in eastern North America were improbably surviving relics of the once widespread original population (e. g.,Wright 1948, 1961,1972). Young (1946) stated that tame captive adults could become so untrustworthy that they were killed or given to zoos. Nowak (1976) first suggested that human intervention (*e. g.*, transportation, release or escape of captives) could be responsible for at least some sightings in the east. Since then there has been speculation that most if not all of the credible cougar sightings outside of peninsular Florida are actually of animals that have escaped or been released from captivity by roadside zoos, carnivals, pet dealers and private individuals (*e.g.*, Lazell 1981). The vast majority of captive cougars (other than *coryi*) in North America are from western populations, though there are evidently at least a few from South America.

The plausibility of the captive cougar population in eastern North America as a source for wild sightings depends on its size and the rate of escapes or releases from it that can be documented. According to a just-completed census, there are only 137 cougars in accredited North American zoos, but this is "dwarfed by the number in private hands" (D. Wildt, pers. comm.). There is apparently no central society or association of private large cat owners or breeders that keeps statistics on cougars in the hands of its members (Hutchins, pers. comm.). Downing (1996a) estimated the captive population in private ownership in the eastern United States to be in the thousands. At least six cougars have been killed in the eastern and midwestern states in the past 15 years and each displayed evidence of captivity and/or abnormal behaviour (Downing 1996a). He believed this indicates that captive animals are apparently released or escape regularly (Downing 1996b).

There are about 100 captive cougars in Alabama (Parker 1998). McGinnis (1996) reported that in Pennsylvania, according to state authorities, in 1979 there were at least 31 cougars in captivity, mostly in private hands, and that at least four people in and immediately outside the state bred and sold cougars. In 1997 there were about 200 licensed private cougar owners alone in Pennsylvania (J. Seidensticker, pers. comm.), an increase of at least 640% in 18 years. Up to 1979 the captive Pennsylvania population of just 31 animals had generated four known escapes and a possible fifth, which appeared to be wearing a collar when seen but was never recaptured (McGinnis 1996). Parker (1998) summarizes records of nine animals that had escaped or been released and were recovered alive or shot in Massachusetts, Connecticutt, Rhode Island, Virginia and North and South Carolina, all since 1980.

Alan Shoemaker (pers. comm.) of the Riverbanks Zoological Park in Columbia, SC, has no doubt that the captive pool is large enough to account, via escape or release, for the persistent rateof credible cougar reports in the wild throughout the east. Several people in South Carolina breed them and over the last 25 years he has turned down offers to the zoo at the rate of "an animal a day, a carnivore a week and several hundred cougar cubs." This works out to a figure in the neighbourhood of one unwanted cougar a month (250 over 25 years would be one every 36.5 days), just from South Carolina and adjoining states. Shoemaker believes the ultimate fate of most of these rejected animals is recirculation in captivity, to increasingly substandard captive settings, but some do escape and the more substandard the setting, the more likely this is. It is reasonable to speculate that most unwanted animals are juveniles or young adults, and that deliberate releases, if or when they occur, are very unlikely to be admitted because of legal liability issues.

I have been unable to find any figures or estimates for the cougar numbers in private hands in eastern Canada, but it could be as high, relative to the human population, as in the United States. According to B. Valliere (cited in Gerson 1986), captive cougars are "fairly common" in southern Ontario. Such captives are presumably concentrated in the most populous parts of Ontario and Québec.

Cougars bred in captivity are usually declawed (Shoemaker, pers. comm.) and may have their canines filed. Even if their hunting equipment is intact, they have no acquired hunting skills and must rely on instinctive behaviour, which appears to be sufficient. Non-dependent captive bred cougars translocated to northern Florida began making large kills within a few days of release (Belden and McCown 1996).

Escaped captives might also bear other distinctive marks, such as identifying tattoos or a pet-style collar (or signs of having worn one). However, even the absence of all of these does not prove the animal was never captive. Nor does the presence of a tattoo absolutely prove an animal is an escape. Captive cougars may be tattooed, but wild ones are also often tattooed and/or ear-tagged in studies involving radiocollaring of animals (Lindzey *et al.* 1988, Ross and Jalkotzy 1992). However, no such studies have ever been carried out in eastern Canada or the northeastern United States.

Mobility of released/escaped animals

The movement potential of escaped captives is important because in some cases they have turned up many hundreds of kilometres from the closest areas where they could have been held. There are two sources of information useful in estimating this movement potential: the distances known to be covered by dispersing wild animals, and the movements of monitored translocated animals. There have been many studies of the first, and only a few of the second. Belden and McCown (1996) carried out the first monitored release of captive-bred cougars into the wild, along with newly wild-caught and wild-caught/captive-held animals, and compared their behaviour. The captive bred animals were more likely to be seen by people, preyed on livestock significantly more often, suffered significantly lower mortality, established home ranges more quickly, and appeared to be more social, than either of the other groups.

An important factor in extrapolating from movements of translocated wild animals to those of released captives is the greater familiarity of the latter with humans and the consequently smaller likelihood that their movement will be impeded by density of human settlement or habitat fragmentation. Even dispersing wild animals will come extremely close to human-used areas: in southern California nine continuously monitored dispersing juvenile cougars all came within 100 m of urban areas and heavily peopled parklands for several hours to several weeks at a time, though only five sightings, involving three animals, were reported (Beier 1995).

Present conservation rankings of *Puma concolor couguar*

Global: (Canada, United States): Endangered (CITES Appendix 1).

National: Endangered (COSEWIC).

Subnational:

Ontario: Historic occurrence only. Because of this ranking , it is not covered by Ontario's Endangered Species Act, so its only protection is within protected areas.

Québec: S1 (highest priority for status designation under the province's Endangered Species Act; presently being evaluated for that designation)

New Brunswick: Endangered; protected everywhere under the New Brunswick Endangered Species Act.

Nova Scotia: Protected; presently being re-evaluated for formal designation

Protected areas comprise less than 10% (in some jurisdictions very much less) of the total area apparently occupied by cougars in eastern Canada.

In the original status report (van Zyll de Jong and van Ingen 1978) it was assumed that the animals accorded Endangered status were probably or possibly remnants of the original eastern population. This assumption is now clearly questionable.

Though Manitoba is technically not part of eastern Canada, it does adjoin it, and cougars are known to have been killed there in all but two decades between 1870 and 1979 (Nero and Wrigley 1977). The gap was in the war period 1940-1959, during which sightings continued. This is circumstantial but nevertheless strong evidence that the species has survived virtually continuously in Manitoba since European settlement. While there is no evidence at present that the original eastern cougars have in fact survived in most of eastern Canada, they may well have survived in extreme western Ontario, given that they appear to have done so in Manitoba, the populations of which are not demonstrably taxonomically distinct (Lazell 1981). From central Ontario eastward (and in the adjoining U. S. states) there is circumstantial evidence for virtual or complete extirpation. The increase in credible sightings in the last few decades is less likely to be the result of a recovery of original stocks, than it is to be the establishment of new stocks from escaped/released captives. One of two animals documented from the wild in Canada was an exotic. In cases of recent wild animals in the U. S. whose source could be determined, all are believed or known to be escapes or deliberate releases (Parker 1998).

Such circumstantial evidence is clearly and legitimately open to interpretation, and there is presently no consensus on the survival or extinction of the original eastern cougar. My own considered view is that the likelihood of survival is lowest in the eastern United States and increases to the north and west as tracts of wilderness become larger and more continuous and human impacts smaller and more localized. Thus the best chance of survival of the original cougar stock is in extreme northwestern Ontario.

What nobody disputes is that clearly at least small numbers of exotic cougars are living in the wild in many parts of the eastern United States and Canada. These animals are genetically diverse, though largely from western stocks, and they have reoccupied much of the former range of the species and invaded regions it did not formerly occupy. They appear to be breeding successfully in some areas. If they are sympatric with animals harbouring all or any of the original eastern genome there is a high probability of introgression which eventually could result in complete swamping or loss of that genome.

The proposed revised status for *Puma concolor couguar* in Ontario, Québec, New Brunswick and Nova Scotia is **Indeterminate.**

It is up to the wildlife managers in each province to decide whether and how to manage the populations that are probably established exotics. In the functional view, we have inadvertently reintroduced to eastern Canada an extirpated summit predator species (not subspecies). If this is considered desirable (in other words, if it was practical and affordable, would we have deliberately done it ?) then those populations should receive some management attention, at least in the form of continued monitoring by collecting of reports. At present, the data show that numbers are very low, well below carrying capacity, are not stable and self-sustaining and the animals can become locally extirpated for periods of time.

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Biographical summary of author

Fred W. Scott was a biologist and illustrator at the Nova Scotia Museum of Natural History in Halifax for 30 years, retiring as Assistant Curator of Zoology in 1995. For most of that time he was responsible for curation and development of the bird and mammal collections. He took a two year leave of absence, from 1975 to 1977, to serve as Curator of Natural History at the National Museum of Papua New Guinea in Port Moresby. His principal research interest has been the small mammals of Nova Scotia, particularly the taxonomy and zoogeography of the rare and disjunct species, and he was the discoverer of *Sorex dispar* in Nova Scotia. He has recently become interested in the impacts of climate change on Nova Scotian animals and has co-authored several papers on the subject. Fred Scott has been Curator of the Wildlife Museum at Acadia University, Wolfville NS, since 1995. He is also a Research Associate in Mammalogy at The Nova Scotia Museum of Natural History and is preparing a book on the mammals of Nova Scotia.

MANDATE

COSEWIC determines the national status of wild species, subspecies, varieties and nationally significant populations that are considered to be at risk in Canada. Designations are made on all native species for the following groups: fish, amphibians, reptiles, birds, mammals, molluscs, lepidoptera, vascular plants, mosses and lichens.

MEMBERSHIP

COSEWIC is comprised of representatives from each provincial and territorial government wildlife agency, four federal agencies (Canadian Wildlife Service, Parks Canada, Fisheries and Oceans, Canadian Museum of Nature), three national conservation organizations (Canadian Nature Federation, Canadian Wildlife Federation, and World Wildlife Fund Canada) and the chairs of the scientific species specialist groups. The Committee meets annually in April to consider status reports on candidate species.

DEFINITIONS

Species	- Any indigenous species, subspecies, variety or geographically defined population of wild fauna and flora.
Extinct (X)	- A species that no longer exists.
Extirpated (XT)	- A species no longer existing in the wild in Canada, but occurring elsewhere.
Endangered (E)	- A species facing imminent extirpation or extinction.
Threatened (T)	- A species likely to become endangered if limiting factors are not reversed.
Vulnerable (V)	- A species of special concern because of characteristics that make it particularly sensitive to human activities or natural events.
Not at Risk (NAR)	- A species that has been evaluated and found to be not at risk.
Indeterminate (I)	- A species for which there is insufficient scientific information to support status designation.

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) was created in 1977 as a result of a recommendation at the Federal-Provincial Wildlife Conference held in 1976. It arose from the need for a single, official, scientifically sound, national listing of wildlife species at risk. In 1978, COSEWIC designated its first species and produced its first list of Canadian species at risk. COSEWIC meets annually in April each year. Species designated at this meeting are added to the list.

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