

Post-glacial recolonization of insular Newfoundland across the Strait of Belle Isle gave rise to an endemic subspecies of woodland caribou, *Rangifer tarandus terranovae* (Bangs, 1896): evidence from mtDNA haplotypes

Corinne D. Wilkerson, Shane P. Mahoney, and Steven M. Carr

Abstract: Post-glacial origins of woodland caribou (*Rangifer tarandus* subsp.) on the island of Newfoundland and their relationship to mainland populations have been uncertain. Sequence analysis of 2223 bp of the mitochondrial DNA control region and cytochrome *b* gene from 233 Newfoundland caribou identified 32 haplotypes in four major clades. Comparison with other Nearctic caribou confirms a closer affinity of the basal Clade A with animals from the mainland, and as an outgroup to Clades B, C, and D that are endemic to the island. This indicates re-entry of caribou to post-glacial Newfoundland across the Strait of Belle Isle from Labrador, rather than from southern coastal refugia. Newfoundland caribou are a distinct subspecies, *Rangifer tarandus terranovae* (Bangs, 1896). Hierarchical AMOVA shows significant clinal differentiation of the major clades from northwest to southeast across the island. The isolated Avalon Peninsula population in the extreme southeast is genetically depauperate. Founder effects are evident in herds introduced to previously unoccupied areas by wildlife managers over the past 40–50 years. Reindeer introduced in the early 20th century have not contributed to mtDNA diversity in Newfoundland caribou.

Key words: *Rangifer*, insular subspecies, post-glacial recolonization, founder and bottleneck effects.

Résumé : Les origines postglaciaires du caribou forestier (*Rangifer tarandus* subsp.) sur l'île de Terre-Neuve et sa relation avec les populations continentales demeurent incertaines. Le séquençage et l'analyse d'un segment de 2223 pb de la région de contrôle mitochondriale et du gène codant pour le cytochrome *b* chez 233 caribous de Terre-Neuve a permis d'identifier 32 haplotypes formant quatre clades majeurs. Une comparaison avec d'autres caribous néarctiques a confirmé une parenté plus grande entre les animaux appartenant au Clade A (basal) et ceux du continent, et le fait que ceux-ci forment un groupe extérieur par rapport aux Clades B, C et D qui regroupent des animaux endémiques de l'île. Ceci indique une réintroduction postglaciaire du caribou à Terre-Neuve via une traversée du détroit de Belle-Isle à partir du Labrador, plutôt qu'en provenance de refuges côtiers méridionaux. Les caribous de Terre-Neuve sont ainsi une sous-espèce distincte, *Rangifer tarandus terranovae* (Bangs, 1896). Une AMOVA hiérarchique a montré une différenciation significative des clades principaux le long d'un cline qui traverse l'île du nord-ouest au sud-est. La population isolée de la péninsule d'Avalon dans l'extrémité sud-est est appauvrie sur le plan génétique. Des effets fondateurs sont évidents au sein des hardes introduites au cours des 40–50 dernières par des gestionnaires de la faune dans des régions inoccupées jusqu'alors. Les rennes introduits au début du 20^{ème} siècle n'ont pas contribué à la diversité de l'ADN mitochondrial chez les caribous de Terre-Neuve. [Traduit par la Rédaction]

Mots-clés : *Rangifer*, sous-espèces insulaires, phylogéographie postglaciaire, effets fondateurs et de goulot.

Introduction

Populations of woodland caribou (*Rangifer tarandus* subsp.) have declined across most of Canada, and most Canadian subspecies and (or) populations have been formally designated to be at some risk of extinction (COSEWIC 2002). Increased hunting and wolf predation are cited as the main causes (Banfield 1961; Bergerud 1974; Seip 1991). The insular Newfoundland population had relatively high and constant numbers, and was therefore assessed as Not At Risk under the *Canadian Species At Risk Act* (SARA) in 2002. Since then, the population has declined dramatically, and the question of its status and relationships has again become important. In assessing the species as of Special Concern, COSEWIC

(2014) noted, “The present decline appears to be part of natural population fluctuations and recently several indices on health and calf survival suggest that the population will increase.”

The insular Newfoundland population has undergone dramatic fluctuations in population size throughout the past century. From a peak of 40 000 – 100 000 individuals in the early 1900s, counts bottomed out to 2000 animals in 1925, rose in the 1930s and 1940s to 10 000 – 15 000 individuals, then declined again in the late 1950s to ~6500 animals (Dugmore 1913; Bergerud 1971; Williams and Heard 1986; Mahoney et al. 1991; Bergerud et al. 1983). The Amulree Commission in 1933 attributed the decline to extensive overhunting by Newfoundlanders, and gave it as one of the reasons for withdrawal of Responsible Government from Newfoundland by

Received 26 September 2017. Accepted 14 May 2018.

Corresponding Editor: S. Xu.

C.D. Wilkerson and S.M. Carr. Genetics, Evolution, and Systematics Laboratory, Department of Biology, Memorial University of Newfoundland, St John's, NL A1B 3X9, Canada.

S.P. Mahoney. Conservation Visions Inc., 354 Water Street, St John's, NL A1C 5W4, Canada.

Corresponding author: Steve Carr (email: scarr@mun.ca).

Copyright remains with the author(s) or their institution(s). Permission for reuse (free in most cases) can be obtained from [RightsLink](https://www.rightslink.com).