Cascading effects of chronic heavy browsing on life-history traits in a large herbivore

Anouk Simard*, Steeve D. Côté, Robert B. Weladji and Jean Huot
NSERC-Produits forestiers Anticosti Industrial Research Chair and Département de biologie & Centre d’études nordiques, Université Laval, Québec, PQ, G1K 7P4, Canada,
ww.cen.ulaval.ca/anticosti/ *anouk.simard@bio.ulaval.ca

Introduction
The increasing abundance of ungulates is becoming problematic worldwide. The short term effects of high ungulate densities on their habitat are well documented, as well as density-dependent effects on their populations1, but the long-term consequences are less known2. Anticosti Island allows the investigation of long term effects since white-tailed deer (Odocoileus virginianus), introduced in 1896, have remained at high density (≈20 deer/km²) on the island for at least the last 80 years. In the 1950-60’s signs of severe browsing were evident as well as reduced deer body condition and doe reproduction compared to mainland deer.

A continuous decline in winter browse over the last 25 years has also been reported3. Therefore, we predicted that forage quality in summer-autumn might have also declined since 1975. Considering that resource availability may have cascading effects on deer life history traits, we expected both deer body mass and doe reproduction to have declined as well.

Study Area and Methods
Anticosti Island (7,943km²) is located in the Gulf of St-Lawrence (Québec, Canada) at the north-eastern limit of white-tailed deer distribution.

Forage quality:
Forage quality in summer-fall was estimated using the nitrogen concentration of the rumen content of white-tailed deer harvested in September of the study period.

Body mass:
Deer harvested were weighed during three time periods 1) 1966-70, 2) 1977-79 and 3) 2002-04.

Reproduction:
Ovaries were collected in 1975-79 and in 2002-2004, their histological examination allowed to monitor indices of ovulations by identifying scars of previous reproductive episodes, i.e. corpus albicans.

Results and Discussion

Forage quality
Rumen nitrogen content in September was 22% higher in 1976-79 than in 2002-2004 (Fig. 2).

![Fig. 2](image)

This indicates that habitat quality on Anticosti has declined over the last 25 years, both in winter and summer-fall (this study), a century after deer introduction.

Body mass
Body mass has clearly declined since the late 1960’s for both males and females (Fig. 3). Variations in body mass between 1977-79 and 2002-04 differed with age for males (i.e. from 4% for 1.5-year-olds to 15% for ≥ 8.5 years), but did not change for females (Fig. 3).

![Fig. 3](image)

Dressed body mass (kg) in 1966-70 (mean ± SE), 1977-79 and 2002-04 (means ± SE) according to age but corrected for harvest date (excepted in 1966-70). Fig. 4) according harvest date but corrected for age (1966-70 is not included).

Variations in body mass between 1977-79 and 2002-04 also depended on the date of harvest. Differences in body mass increased between time periods when deer were harvested late, for both males and females. At the rut, males were 7% heavier 25 years ago than nowadays, whereas females were 6% heavier, although doe body mass did not differ in September (Fig. 4).

![Fig. 4](image)

Reproduction
The probability of ovulation increased by 11% on average from 1975-79 to 2002-04 (Fig. 5a). On the opposite, litter size at ovulation decreased by 11% during the same period, especially for does ≥ 3.5-years-old (Fig. 5b). Consequently, the mean ovulation rate did not change between time periods, although it increased for 1.5-years-old between 1975-79 and 2002-04 (Fig. 5c).

![Fig. 5](image)

Our results suggest that despite a decrease in body mass for females, ovulation rate has not changed between 1975-79 and 2002-04. Adult does seem to have adjusted their resource allocation strategy, securing the probability of ovulation and reducing litter size at ovulation.

Conclusion
White-tailed deer on Anticosti Island have adapted incredibly well to their introduction even after major degradation of their habitat. After >100 years, both the island vegetation and the deer population continue to change. Such plasticity, even for white-tailed deer, is surprising and would have been very difficult to predict. However, since forage quality is still decreasing on Anticosti Island, it is not clear for how long deer could maintain a high population density under these difficult conditions at the northern fringe of their distribution.

References