INCIDENCE OF INCISIFORM TOOTH BREAKAGE AMONG MOOSE FROM THE SEWARD PENINSULA, ALASKA. USA

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ABSTRACT: Mandibles from 270 moose harvested during 1988-1990 from the Seward Peninsula, Alaska were examined. Broken incisiform teeth were observed in 61% of 243 adult moose and 41% of 27 yearling moose examined. First incisors (I1) were the most frequently (48%) broken teeth in adults. All yearling moose had newly emerged I1's and 60% had permanent 2nd incisors (I2) when killed, consequently deciduous third incisors (I3) and canines were most frequently (35%, 9%) broken. Severity of tooth breakage was correlated ($P<0.001$) with age. All moose $\geq$ 7 years-of-age had broken incisiform teeth. This level of incisiform tooth breakage has not been previously observed in North American moose.

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Colonizing herbivores tend to (a) increase rapidly, (b) overexploit food resources and (c) decline (Caughley 1977). Moose (*Alces alces*) have occupied the Seward Peninsula within the last 4 decades (LeResche *et al.* 1974) and large resident populations have exploited all available habitat within the last 30 years (Grauvogel 1984). Snow cover generally makes forage unavailable to moose in late winter except along narrow riparian corridors where willows, *Salix* spp. protrude through the snow (Grauvogel 1984, Gillingham and Klein 1992). Grauvogel (1984) reported winter moose densities exceeding 8 animals/km^2.

The distal portion of moose mandibles containing the incisiform teeth are routinely collected from Seward Peninsula hunters for age determination. During examination, a high incidence of broken teeth was observed. No comparable occurrence of tooth breakage has been reported in other parts of North America. The purpose of this report is to document patterns of incisiform tooth breakage in moose from the Seward Peninsula, Alaska.

STUDY AREA

The Seward Peninsula is approximately 53,000 km^2 and varies from coastal lowlands to rugged mountain ranges with a maximum elevation of 1,438 m. (Fig. 1)

Temperature, rainfall, snow, and icing conditions are typical of maritime areas in northwestern Alaska. The climate of the Peninsula's interior is more continental, with greater temperature extremes and lower precipitation. During 1948-1987 annual precipitation at Nome ranged from 48 cm - 84 cm. Average temperature was -3.4° C with extremes of 30° C to -43° C. Snowcover normally persists from November. through May and can be hard-packed and include ice layers, particularly near the coast. Mean annual snowfall was 141 cm with a maximum of 188 cm (Leslie 1989).

The western portion of the Seward Peninsula is largely treeless, vegetated by tundra plant communities. Willows (*Salix alaxensis*, *S. pulchra* and *S. glauca*) which grow to 3 m along streams and on favorable upland sites (Gillingham and Klein 1992) are the principal moose browse.

More than 7,000 moose occur on the Seward Peninsula (Nelson 1990). The best historical population information is from Game Management Unit 22D, a 23,570 km^2 area in the West-central portion of the Seward Peninsula (Fig. 1). Estimates of moose numbers for this area document a rapid increase (Fig. 2). Wolves (*Canis lupis*) occur rarely and grizzly bears (*Ursus arctos*) occurred at a density of 1 bear per 34 km^2 in a portion the

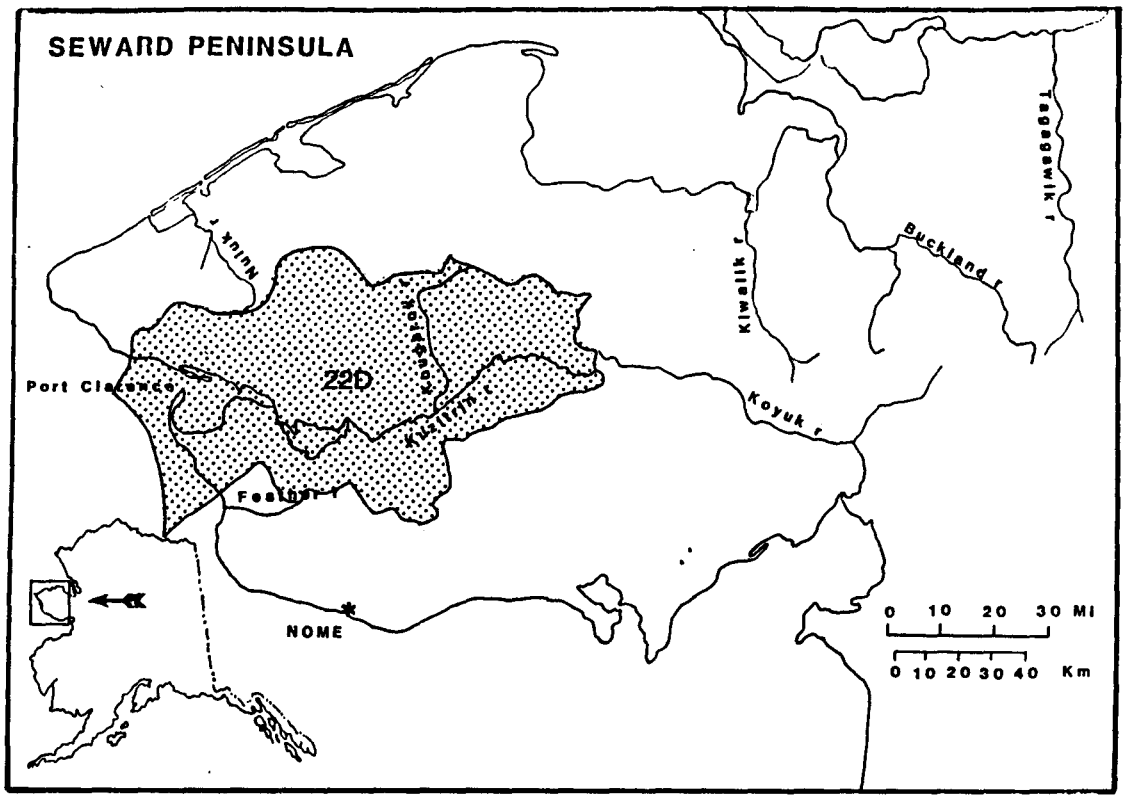

Fig. 1. Map of the Seward Peninsula, Alaska and Game Management Unit 22D.

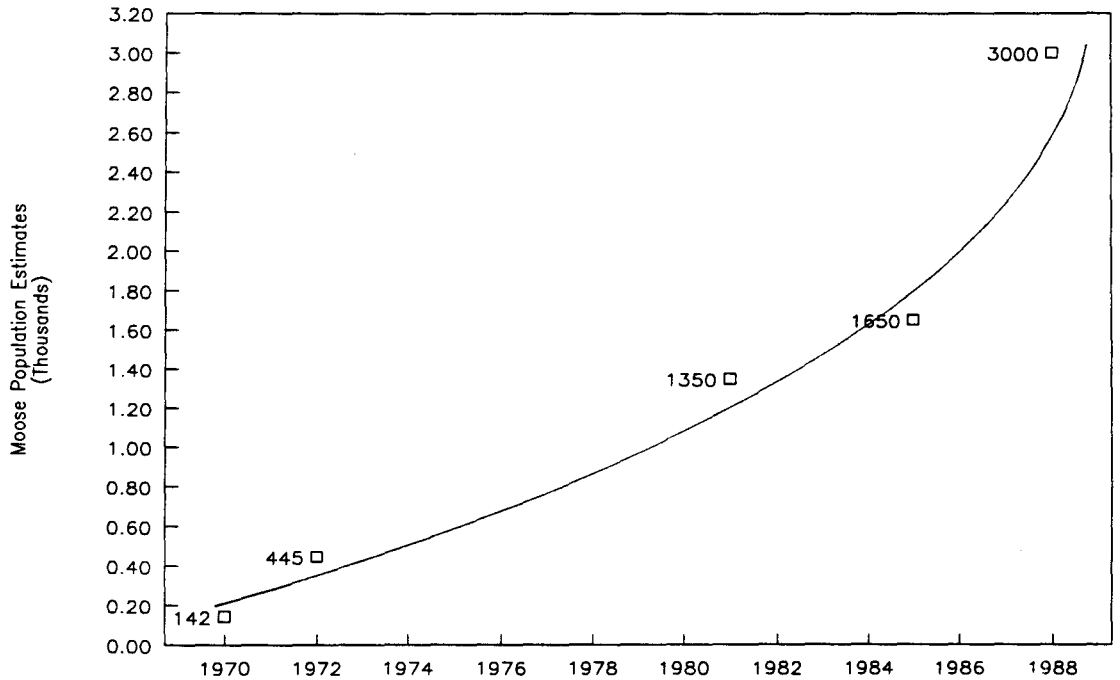

Fig. 2. Estimated numbers of moose in Game Management Unit 22D, a 23,570 km sq. portion of the Seward Peninsula, Alaska. 1970-1988.

southern Seward Peninsula in June 1991 (Ak. Dept. of Fish and Game unpubl. data). No other large terrestrial predators inhabit the Seward Peninsula. Moose are harvested by recreational and subsistence hunters from 1 August - 31 March. The majority of the harvest occurs in September and October. Hunters reported an average annual harvest of 351 moose, 1985-90, (range 290-408) composed of 80% males (Alaska Dep. of Fish and Game files, Nome).

An estimated 35,000 reindeer (*Rangifer tarandus*), (Reindeer Herder's Association, unpubl. data), 500-600 muskoxen (*Ovibos moschatus*) (Smith 1989), hares (*Lepus othus* and *L. americanus*), beavers (*Castor canadensis*) and ptarmigan (*Lagopus lagopus*) also utilize willows and may compete with moose for forage.

METHODS

Moose hunters were asked to provide the distal portion of mandibles including the incisiform teeth from harvested moose. Mandibles were examined fresh or stored frozen until they could be examined. Teeth broken prior to death had dark stained surfaces and rounded edges in the area of the break and could easily be differentiated from the few teeth broken postmortem which had white surfaces and sharp edges. Each tooth was examined for breakage and the amount of tooth material lost was rated on a scale of 0-5: 0 = unbroken, 1 = ≤ 15% of crown missing, 2 = 15-25% of crown missing, 3 = 25-35% of crown missing, 4 = 35-50% of crown missing or majority of enamel gone, 5 = ≥50% of crown missing, pulp canal exposed. Mandibles from moose 1-2 years old were examined for tooth replacement status (permanent or deciduous) in addition to breakage.

First incisors (I1) were sent to a commercial laboratory (Matson's, Milltown, Montana USA) for age determination by analysis of cementum annuli.

Ratio and proportion data were compared by Chi-square tests (Sokal and Rohlf 1969) Correlation between age and breakage score was determined by regression analysis (Lotus Development Corp., Cambridge)

RESULTS

Mandibles from 270 of the 665 moose reported harvested, during 1988-1990 were examined. Broken incisiform teeth were observed in 61% of 243 adults and 41% of 27 yearlings. There was no difference ($P>0.05$) between the frequency of broken teeth between males (61%) and females (62%).

Unbroken or slightly broken teeth often displayed patterns of superficial or deep fractures almost through the tooth. Breakage occurred along these fracture lines removing angular chunks of tooth material. Occasionally plates of surface tooth material were lost and entire crowns could be broken off below the gum line.

First incisors were the most frequently broken teeth (Figure 3) and there was no difference between teeth from left or right mandibles ($P>0.05$). The severity of breakage for I1's was also greatest (Figure 4) but the difference was not significant ($P>0.05$). All of the yearling moose had permanent I1's at the time they were killed and 60% had permanent second incisors (I2). These teeth would have been replaced since the previous winter and were unbroken. Deciduous teeth which were present during the animal's first winter exhibited breakage patterns similar to permanent teeth in adults (35% of third incisors and 9% of canines broken) indicating that breakage probably occurred in winter.

The severity of incisiform tooth breakage increased ($P<0.001$) with age (Figure 5). Although some yearlings had severely broken teeth, 111 of 270 moose ≤ 7 years had no broken teeth. In contrast, all moose > 7 years old had broken teeth.

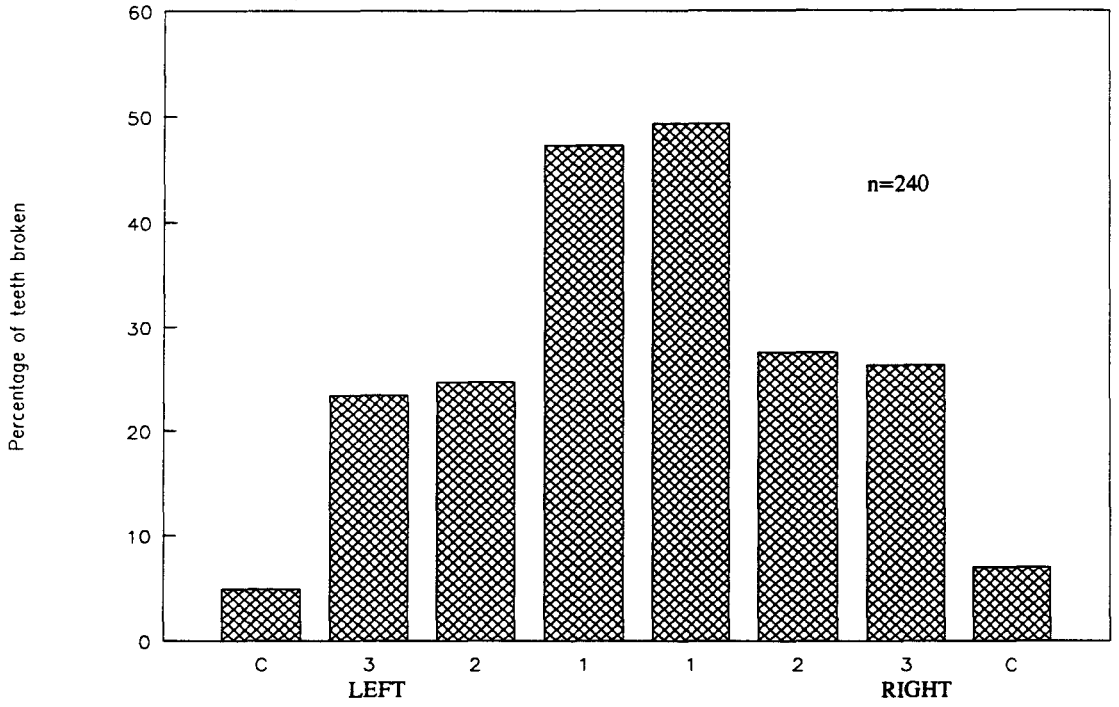

Fig. 3. Percentage of incisiform tooth breakage in hunter killed adult moose from the Seward Peninsula, Alaska.

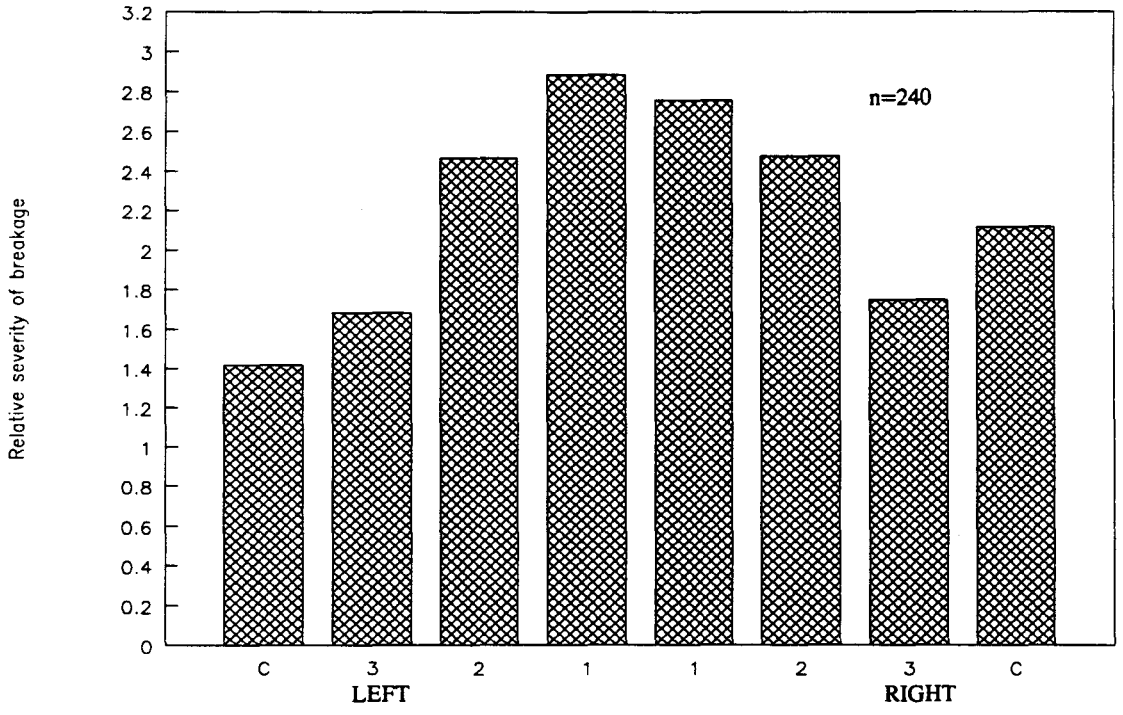

Fig. 4. Average incisiform tooth breakage severity score (see text) in hunter killed moose from the Seward Peninsula, Alaska during 1988-90. Only broken teeth were included in analysis.

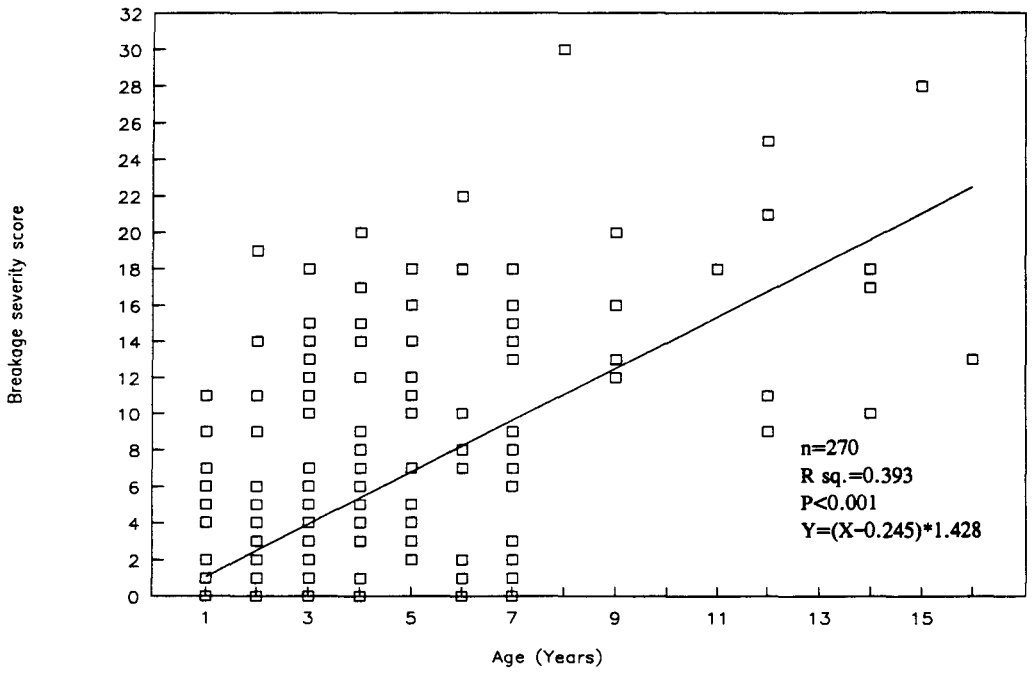

Fig. 5. Relationship between moose age and incisiform tooth breakage severity score (see text), linear regression, for hunter killed moose from the Seward peninsula, Alaska. 1988-90.

DISCUSSION

The significance of incisiform tooth breakage to the welfare of the Seward Peninsula moose population is unknown. Some of the moose jaws examined had teeth broken to the gum line with exposed pulp canals. This condition would probably impair the animals ability to feed on frozen vegetation.

There is no evidence that nutritional deficiencies make teeth from Seward Peninsula moose susceptible to breakage. Neonatal development and juvenile growth appear normal and skeletal measurements and antler growth are typical (Grauvogel 1984). Franzmann and Schwartz (1983) reported the results of moose blood and hair from Alaskan moose populations analyzed for zinc, copper, potassium, cobalt, iron, lead, calcium, magnesium, sodium, cadmium, manganese, chromium, molybdenum, selenium, and aluminum. Values for moose from the Seward Peninsula fell within the range of values for moose populations which do not exhibit high incidence of broken teeth. Microbeam elemental analysis of teeth from 40 moose harvested from the Seward Peninsula, 20 moose harvested near Galena and 1 moose harvested near Fairbanks in Fall 1991 done at the University of Alaska Fairbanks, Department of Geology and Geophysics found no significant difference in relative abundance of zinc, copper, manganese, magnesium, calcium, phosphorus, and fluorine (Alaska Department of Fish and Game unpubl. data). Moose in Interior Alaska which includes the Galena and Fairbanks areas rarely have broken teeth (W. B. Ballard, R. H. Bishop, W. C. Gasaway, C. A. Grauvogel, J. B. Faro, all Alaska Department of Fish and Game pers. commun.)

CONCLUSIONS

High incidence of tooth breakage as reported in this study has not been previously reported in North American moose including food stressed populations. Tooth breakage could be an early symptom of density related problems for Seward Peninsula moose or some other unknown factors.

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