



# The indomitable moose



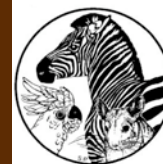
Marcus Clauss

*Clinic for Zoo Animals, Exotic Pets and Wildlife, Vetsuisse Faculty, University of Zurich, Switzerland*

Vortragsreihe Zoologische Gesellschaft Zürich 2011



University of Zurich  
Vetsuisse Faculty



Clinic  
of Zoo Animals, Exotic Pets and Wildlife



96

N. v. TRANSEHE

[ D. Zoolog.  
Garten (NF),

## Elche als Haustiere

Von N. v. TRANSEHE, Gut Osiny (Wartheland)

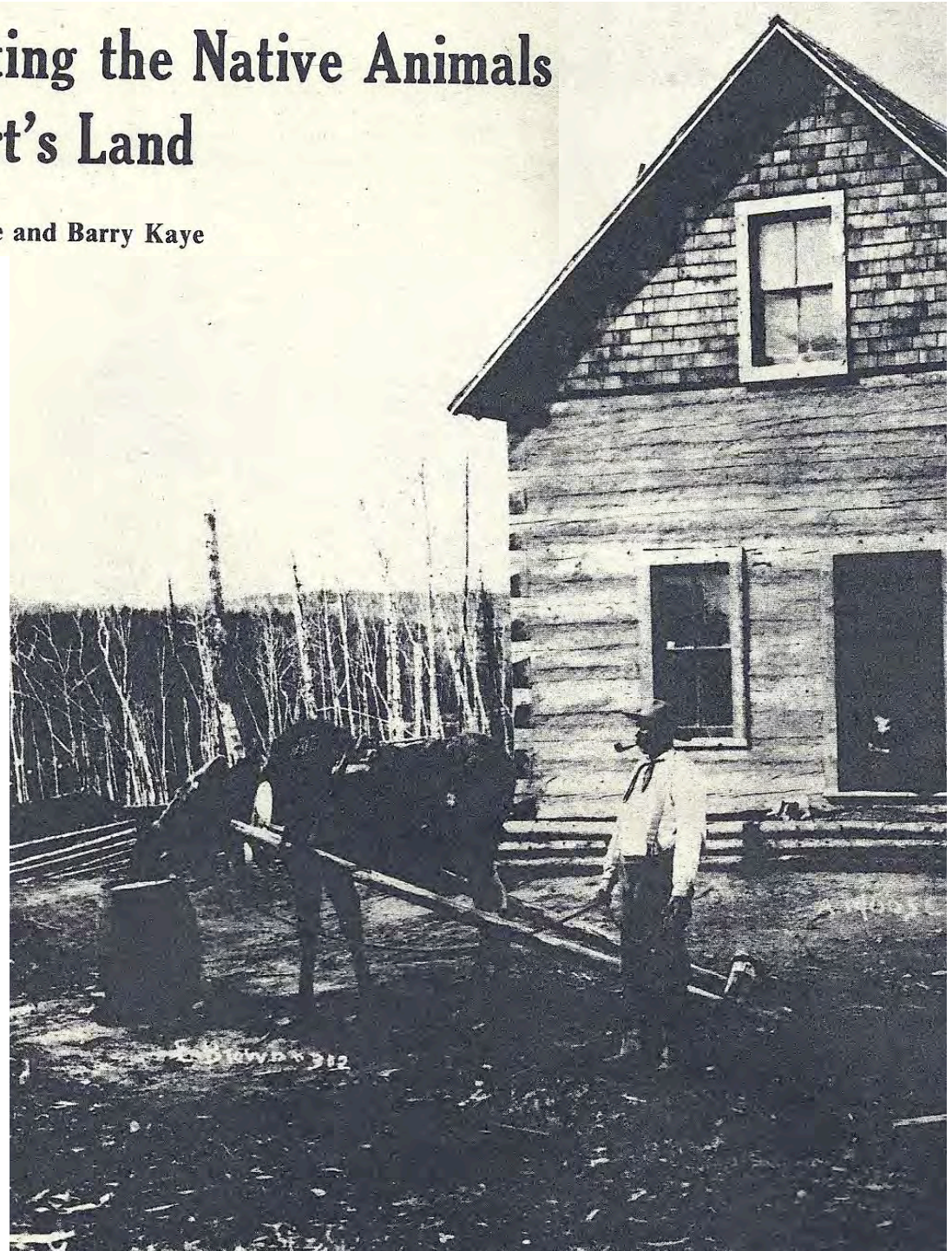
Eingeg. 15. März 1941





# Taming and Domesticating the Native Animals of Rupert's Land

By D. W. Moodie and Barry Kaye









## HALTER-TRAINING MOOSE<sup>1</sup>

R. A. LAUTENSCHLAGER,<sup>2</sup> *College of Forest Resources, University of Maine, Orono, ME 04469*

H. S. CRAWFORD, *USDA Forest Service, Northeastern Forest Experiment Station, Orono, ME 04469*























Ben Thomas, driver, and his horse, George, in front of the house, H.C. Bailey.













# Domesticating Elk in a Russian National Park

*By Yuri Yazan and Yevgeny Knorre*

In the Pechero-Ilych National Park, at the foot of the Ural Mountains in northern European Russia, where a 3-foot snow cover may lie for seven months of the year, experiments in the domestication of elk have been going on for some years. In this article the Director of the Park and his senior research worker describe the wildlife of this large Park, covering 2,758 square miles, and the history of the domesticated elk herd, and estimate the herd's value in the economy of the taiga. The Park gets its name from two rivers which form the western and southern boundaries. A third river, the Kozhim forms the northern boundary, and the Urals the eastern.











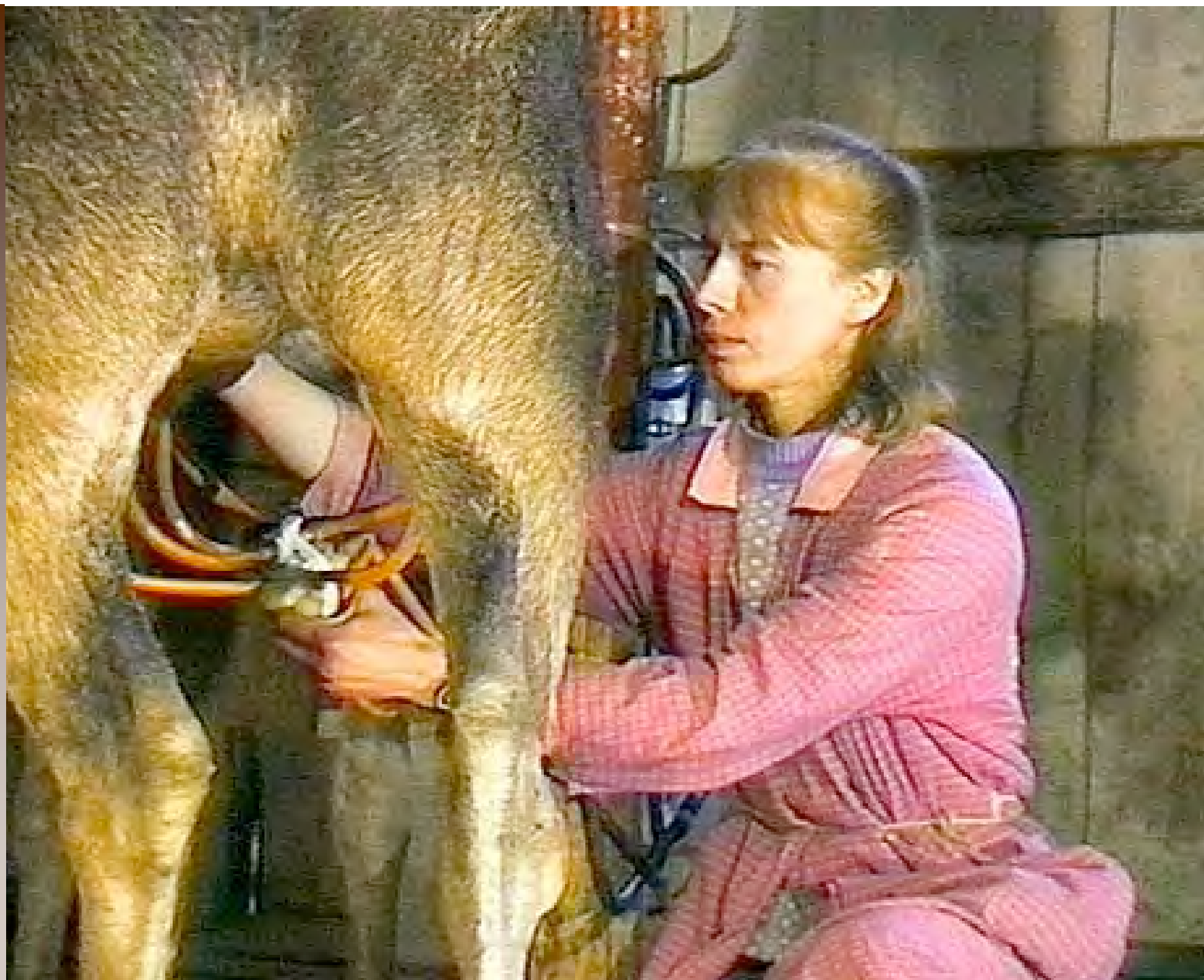


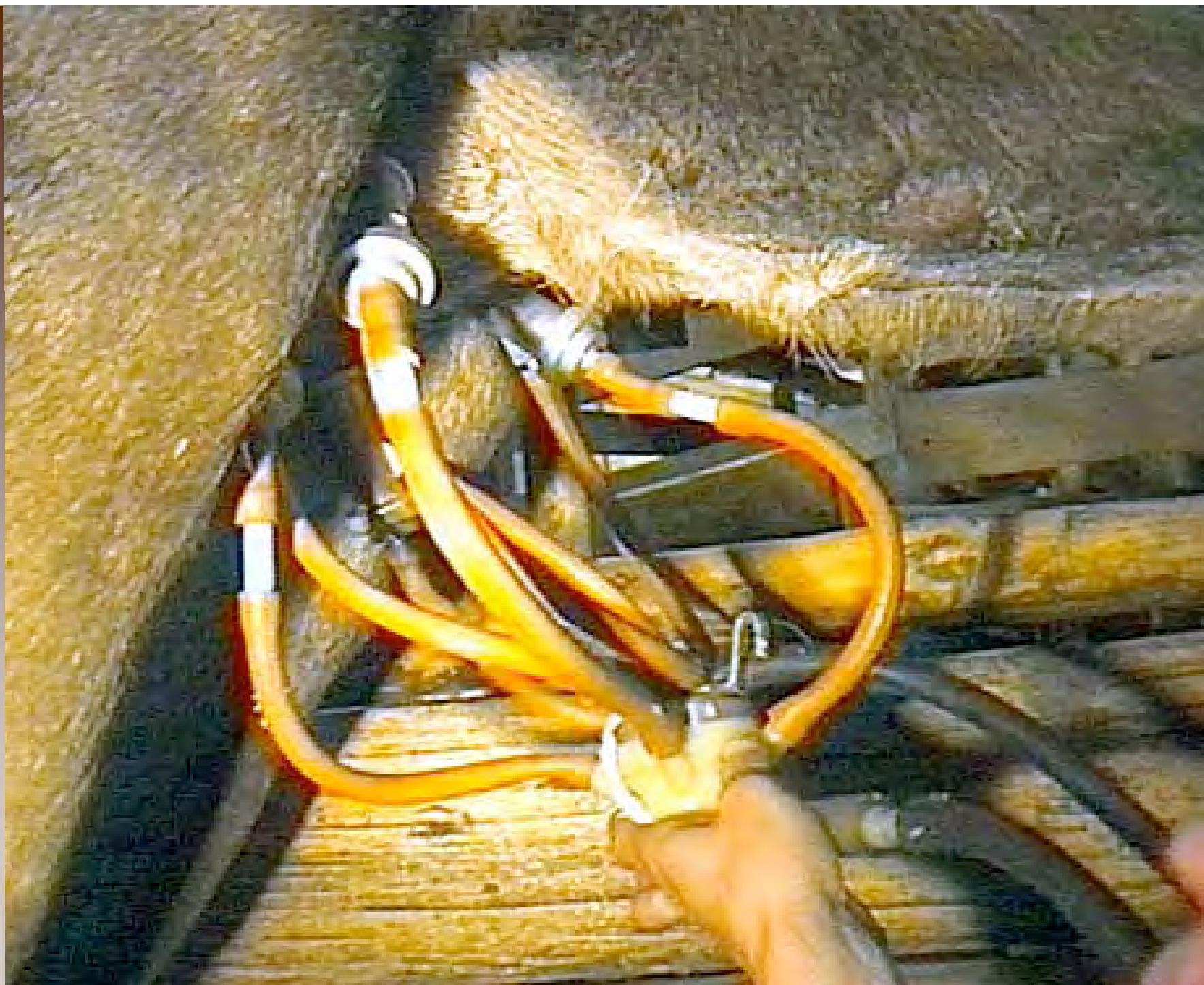






















































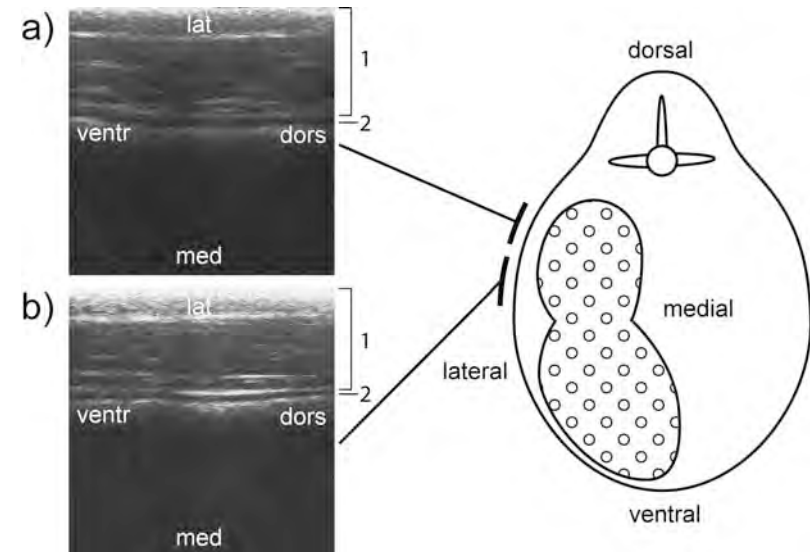








# Testing stratification by ultrasound - moose



from Tschuor & Clauss (2008)









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Eingeg. 15. März 1941

## Der Elch (*Alces alces* L. 1758) als Haustier?

Von PETER KROTT, Kleinsölk/Steiermark

Mit 8 Abbildungen

Eingeg. 6. Jan. 1958





*Naturaliste can.*, 101: 371-377 (1974).

## CHANGES IN THE BEHAVIOR OF MOOSE WITH AGE AND DURING THE PROCESS OF DOMESTICATION

E. P. KNORRE<sup>1</sup>

*Pechora-Ilych Game Preserve,  
Komi, A. S. S. R., U.S.S.R.*











# MOOSE DOMESTICATION EXPERIENCE

By LEONID M. BASKIN

Baskin, L. M. Moose domestication experience.—Swedish Wildlife Research, Suppl. 1, 1987: 741–743.

Experiments on moose domestication conducted in the USSR for over 40 years have failed to bring about changes typical of domestication: i.e. in dimensions, coloration and breeding rhythms. A possible reason is the use for breeding of wild bulls along with cows that are being domesticated. Strong possibilities for changing the attitude of moose to man is interference in behaviour ontogenesis: calf imprinting (up to ten days of age) of a man as mother while being fed on milk. This leads to further social attachment to man, manifestation of sexual behaviour on the part of the males and motherly behaviour on the part of females, including permission of being milked. Imprinting of man as an environmental positive social factor is possible until the calf is three months old, or, at most, one year old. Attempts to develop herding behaviour have failed, as well as management based on the defensive reflex. Moose remain in the surroundings of the farm where they were raised because of attachment to the habitat area. At the present time, domestication may be aimed at assembling moose at logging waste sites and obtaining milk with its alleged medicinal effect. The intuition-based approach (creation of moose similar in behaviour to domestic livestock) is through a scientifically regulated evolutionary process of domestication.

*L. M. Baskin, Institute of Evolutionary Animal Morphology and Ecology, USSR Academy of Sciences, 33 Leninsky Prospekt, 117071 Moscow, USSR.*





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XII.—*The First Steps towards the Domestication of Animals.*  
By FRANCIS GALTON, F.R.S.

No animal is fitted for domestication unless it fulfils certain *stringent conditions*, which I will endeavour to state and to discuss. My conclusion is, that all domesticable animals of any note, have long ago fallen under the yoke of man. In short, that the animal creation has been pretty thoroughly, though half unconsciously, explored, by the every-day habits of rude races and simple civilisations.





# Evolution, consequences and future of plant and animal domestication

Jared Diamond

## The Future of domestication

### Further domestications of plants and animals

Of the world's 14 valuable big domestic mammals, the sole addition within the last millennium has been the reindeer, one of the least valuable of the 14. (In contrast, the five most valuable — the sheep, goat, cow, pig and horse — had all been domesticated repeatedly by 4000 BC.) Long-ongoing efforts by modern livestock breeders to domesticate other large wild mammals have resulted either in virtual failure (for example, eland, elk, moose, musk ox and zebra), or else in ranched animals (deer and American bison) that still cannot be herded and that remain of trivial economic value compared to the five most valuable mammals.



# Attempts to 'domesticate' moose

- *'Attempts to domesticate the moose have all failed'*

Peterson (1950)





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- ***Hardiness***
- ***Desire for comfort***
- ***Breeding freely***
- ***Fondness for man***
- ***Usefulness for man***
- ***Easy to tend***





# How suitable is the moose?

- *Fondness for man*
- *Desire for comfort*
- *Usefulness for man*
- *Breeding freely*
- *Hardiness*
- *Easy to tend*



# How suitable is the moose?

- *Fondness for man* ✓
- *Desire for comfort*
- *Usefulness for man*
- *Breeding freely*
- *Hardiness*
- *Easy to tend*







# How suitable is the moose?

- *Fondness for man* ✓
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# How suitable is the moose?

- *Fondness for man* ✓
- *Desire for comfort* ✓
- *Usefulness for man* ?
- *Breeding freely*
- *Hardiness*
- *Easy to tend*







# How suitable is the moose?

- *Fondness for man* ✓
- *Desire for comfort* ✓
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- *Hardiness*
- *Easy to tend*





## How suitable is the moose?

- *Fondness for man* ✓
- *Desire for comfort* ✓
- *Usefulness for man* ?
- *Breeding freely* ?
- *Hardiness* ✗
- *Easy to tend*





## How suitable is the moose?

- *Fondness for man* ✓
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- *Breeding freely* ?
- *Hardiness* ✗
- *Easy to tend* ✗



## **Hemmer (1988): Which deer is suitable for 'domestication'?\***





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*\*what the author really means is 'farming'*



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# Hemmer (1988): Which deer is suitable for 'domestication'?\*



**Tendency to panic**

**Emotional intensity**

**Social interactions**

**Complex group structure**

*\*what the author really means is 'farming'*



## Hemmer (1988): Which deer is suitable for 'domestication'?\*



Tendency to panic

✗

✗

✓

✓

Emotional intensity

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## Hemmer (1988): Which deer is suitable for 'domestication'?\*



Tendency to panic

✗

✗

✓

✓

Emotional intensity

?

✓

?

✗

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Tendency to panic

✗

✗

✓

✓

Emotional intensity

?

✓

?

✗

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Tendency to panic

✗

✗

✓

✓

Emotional intensity

?

✓

?

✗

Social interactions

?

✓

✓

✗

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✗

✗

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Emotional intensity

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✓

?

✗

Social interactions

?

✓

✓

✗

Complex group structure

✓

✓

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✓

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# Evolution, consequences and future of plant and animal domestication

Jared Diamond





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Horse



Zebra



# Evolution, consequences and future of plant and animal domestication

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Horse



Zebra



Reindeer



Elk





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Horse



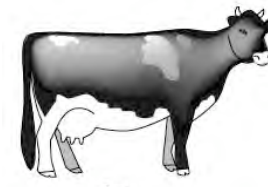
Zebra



Reindeer



Elk



Cow



African buffalo



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Horse



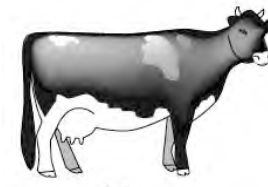
Zebra



Reindeer



Elk



Cow



African buffalo



Sheep



North American  
bighorn sheep



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Horse



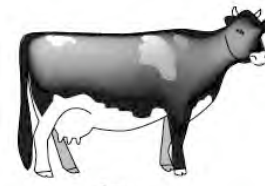
Zebra



Reindeer



Elk



Cow



African buffalo



Sheep



North American  
bighorn sheep



Goat



Rocky Mountain goat





# Evolution, consequences and future of plant and animal domestication

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## Why so few wild species were domesticated

Among wild mammal species that were never domesticated, the six main obstacles proved to be a diet not easily supplied by humans (hence no domestic anteaters), slow growth rate and long birth spacing (for example, elephants and gorillas), nasty disposition (grizzly bears and rhinoceroses), reluctance to breed in captivity (pandas and cheetahs), lack of follow-the-leader dominance hierarchies (bighorn sheep and antelope), and tendency to panic in enclosures or when faced with predators (gazelles and deer, except reindeer). Many species passed five of these six tests but were still not domesticated, because they failed a sixth test. Conclusions about non-domesticability from the fact of non-domestication are not circular, because these six obstacles can be assessed independently.



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diet

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# Evolution, consequences and future of plant and animal domestication

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## Why so few wild species were domesticated

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growth rate

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breeding

hierarchy

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# Evolution, consequences and future of plant and animal domestication

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## Why so few wild species were domesticated

diet

growth rate

disposition

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hierarchy

panicking

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# Evolution, consequences and future of plant and animal domestication

Jared Diamond

diet

growth rate



disposition



breeding

hierarchy

panicking





# Evolution, consequences and future of plant and animal domestication

Jared Diamond

diet

growth rate



disposition



breeding



hierarchy

panicking







# Evolution, consequences and future of plant and animal domestication

Jared Diamond

diet	✗
growth rate	✓
disposition	✓
breeding	?
hierarchy	?
panicking	✓



# Husbandry success

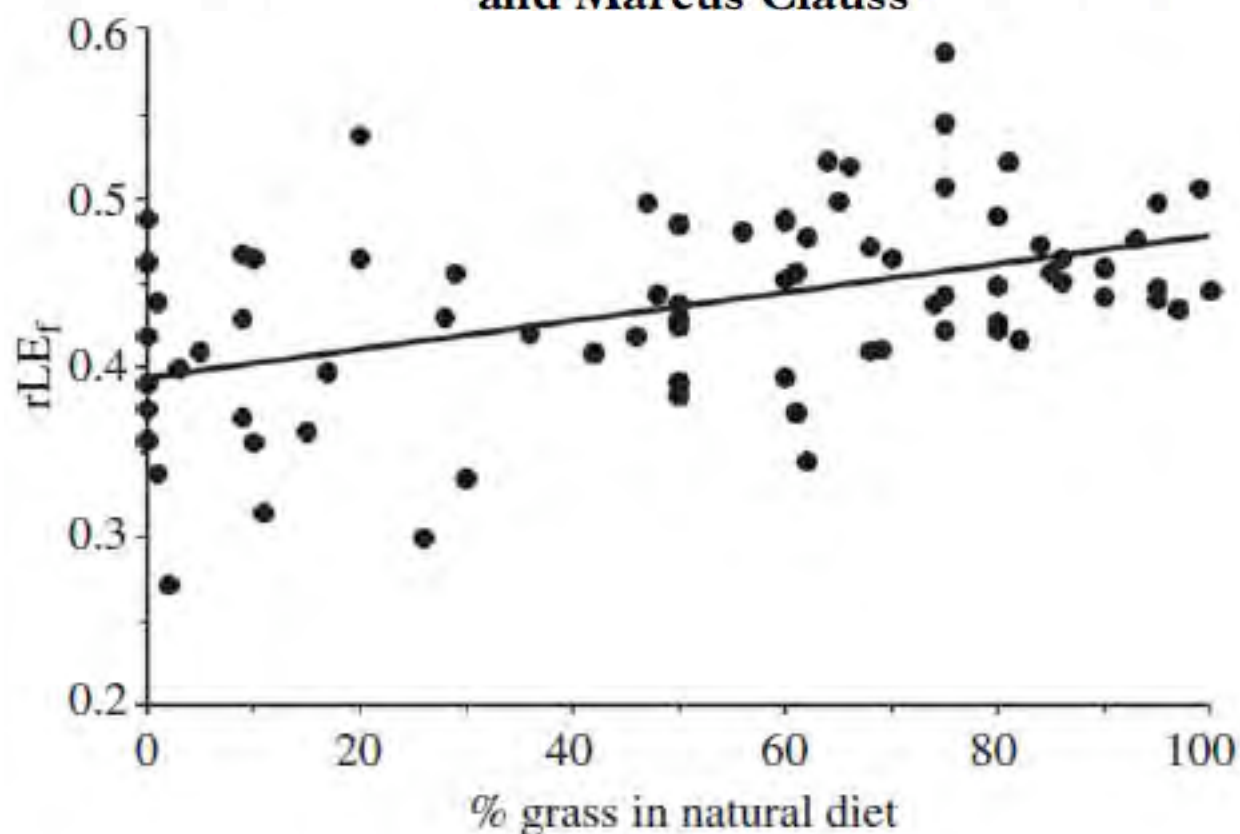
- **Measured as average lifespan in relation to maximum lifespan (humans:  $80/120 = 0.67$ )**





## **Mating system, feeding type and *ex situ* conservation effort determine life expectancy in captive ruminants**

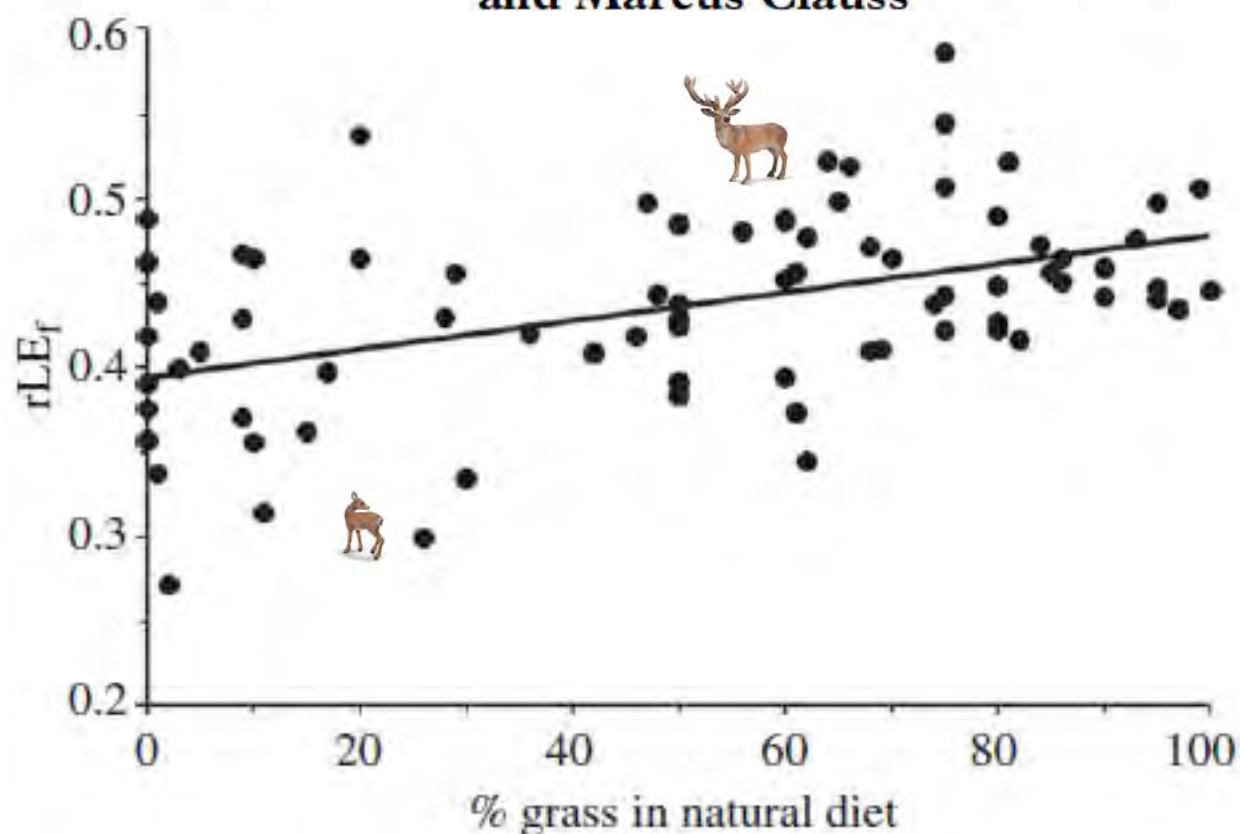
Dennis W. H. Müller<sup>1,\*</sup>, Laurie Bingaman Lackey<sup>2</sup>,  
W. Jürgen Streich<sup>3</sup>, Jörns Fickel<sup>3</sup>, Jean-Michel Hatt<sup>1</sup>  
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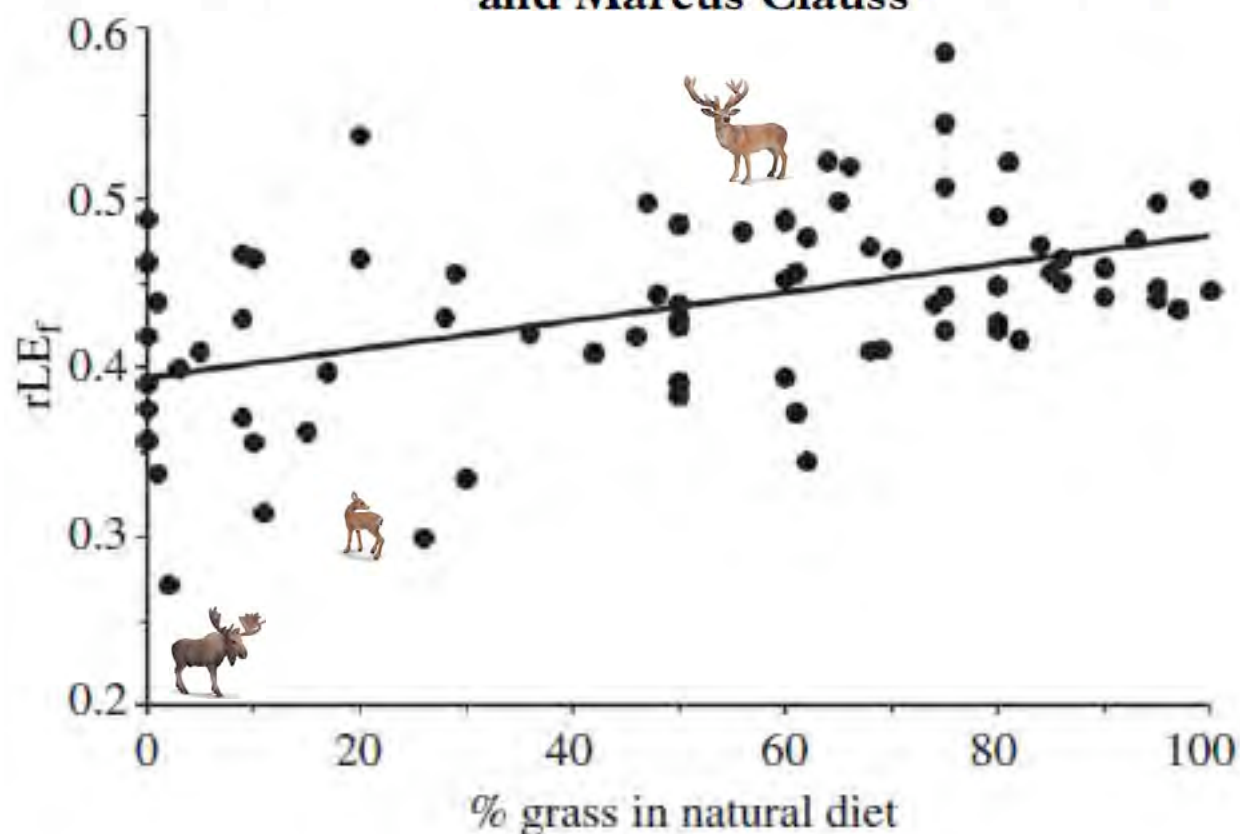
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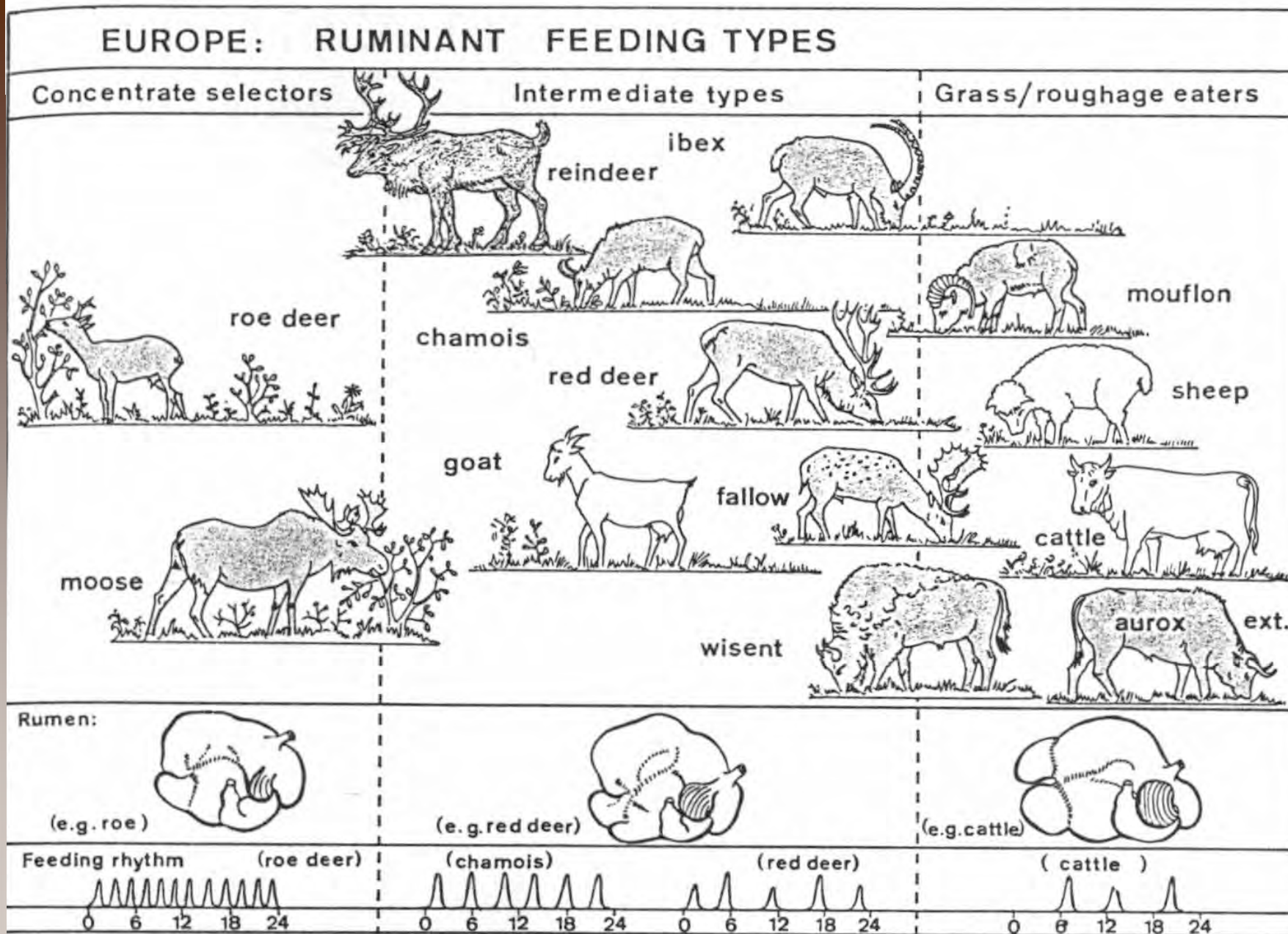


## Attempts to 'domesticate' moose

- *'Attempts to domesticate the moose have all failed [...] In most cases the captive animals tend to develop gastric disorders because of the difficulty of providing foods equivalent to those they feed on in the wild.'*

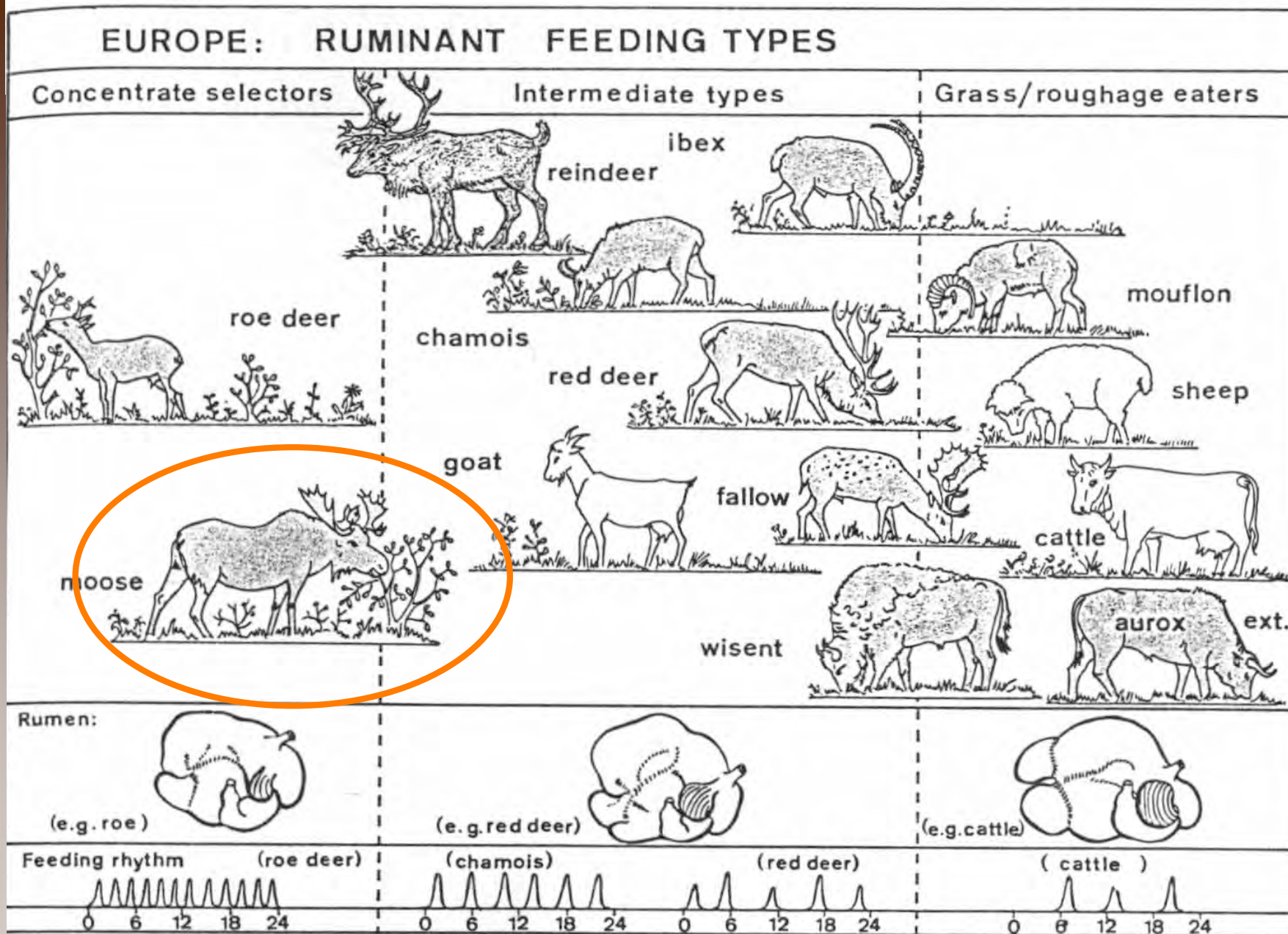
Peterson (1950)





from Hofmann (1989)





from Hofmann (1989)



## Occurrence of digestive tract diseases among different feeding types of zoo ruminants in one survey

Feeding type	n	Diseases of the digestive tract (%)
Grazer	9	11
Mixed feeder	141	31
Browser	61	26

Data from Kiupel (1988)



## Occurrence of acidotic changes of ruminal mucosa among different feeding types of zoo ruminants in one survey

Feeding type	n	Acidotic changes of the rumen mucosa (%)
Grazer	13	23
Mixed feeder	30	27
Browser	24	83

Data from Marholdt (1991)





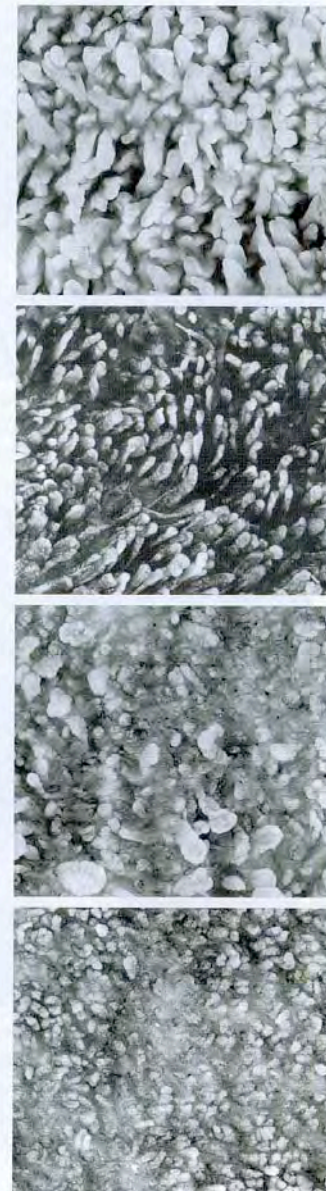
# Rumen mucosa of moose

Finnish  
moose



captive  
moose

(Whipsnade  
Zoo)



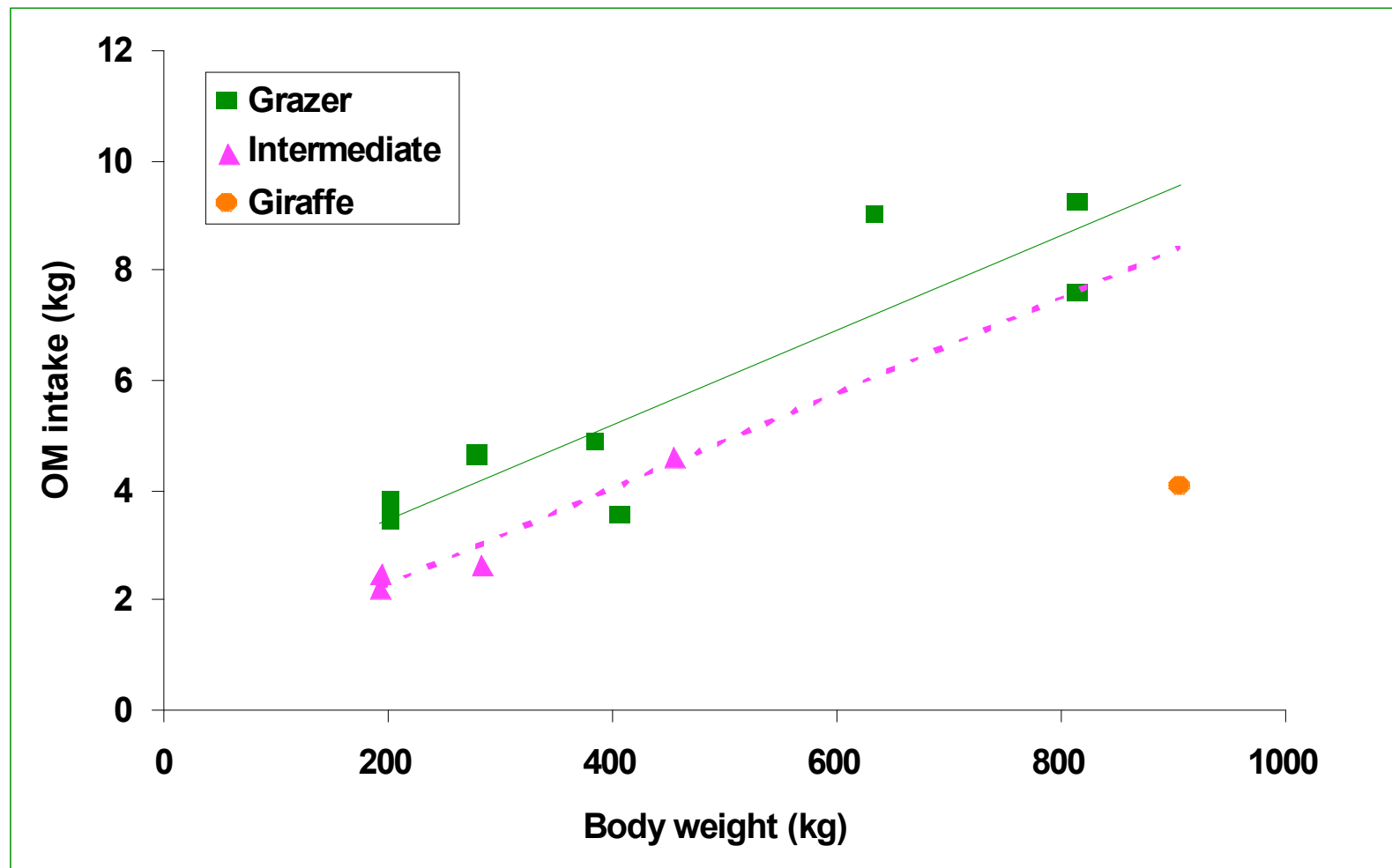
from Hofmann & Nygren  
(1992)



***The so-called “concentrate  
selectors” seem to suffer from the  
ingestion of too much  
concentrates!***



## *Ad libitum* intake of grass hay in different captive wild ruminant species



from Foote (1982)





***The so-called “concentrate  
selectors” seem to suffer from the  
ingestion of too much  
concentrates!***

***Or too little hay.***



## Reports of problems with/ refusal of hay ingestion in browsing/intermediate ruminants

**Giraffe** Fox (1938), Gradwell (1976), Kloeppel (1976), Altmann (1978), Gorgas et al. (1978), Brancker (1980), Foose (1982), Franz et al. (1984), Gutzwiller (1984), Hofmann and Matern (1988), Matern and Kloeppel (1995)

**Moose** Baines (1965), Landowski (1969), Heptner and Nasimowitsch (1974), Bo and Hjeljord (1991), Schwartz (1992), Schwartz and Hundertmark (1993), Shochat et al. (1997)

**Mule deer** Cahart (1943), Doman and Rasmussen (1944), Nagy et al. (1969), Schoonveld et al. (1974)

**Roe deer** Dissen (1983)

**Chinese water deer** Hofmann et al. (1988)

**Duiker** Cowan (1982), Luginbuhl et al. (1991), Van Soest et al. (1995)

**Reindeer** Eriksson and Schmekel (1962), Kurkela (1976), Valtonen et al. (1983)

**Eland** Hofmann (1973, p. 40), Miller et al. (2010)

**Kudu** Miller et al. (2010)















# Pellets for Browsers

## Declared Crude Fiber Content of Select Herbivore Feeds from Catalogs of Two Commercial Suppliers\*

	Diet Name	Crude Fiber (% Dry Matter)	NDF† (% Dry Matter)
	Herbivore 16-ADF <sup>1</sup>	16.7	32.2
	Herbivore 25-ADF <sup>1</sup>	25.6	43.4
	Browser breeder <sup>1</sup>	27.8	43.6
	Browser maintenance <sup>1</sup>	31.1	48.1
	Moose maintenance <sup>1</sup>	35.6	54.8
	Grazer <sup>2</sup>	11.2	
	Browser breeder <sup>2</sup>	18.6	
	Browser maintenance <sup>2</sup>	21.4	
	Moose <sup>2</sup>	24.0	

\*Note that fiber levels do not reflect differences in "fiber requirements" between target species, but that fiber content increases with the recognized target species' reluctance to accept grass or alfalfa (lucerne) hay forage.

†Neutral detergent fiber, a measure of cell wall (fiber) content.

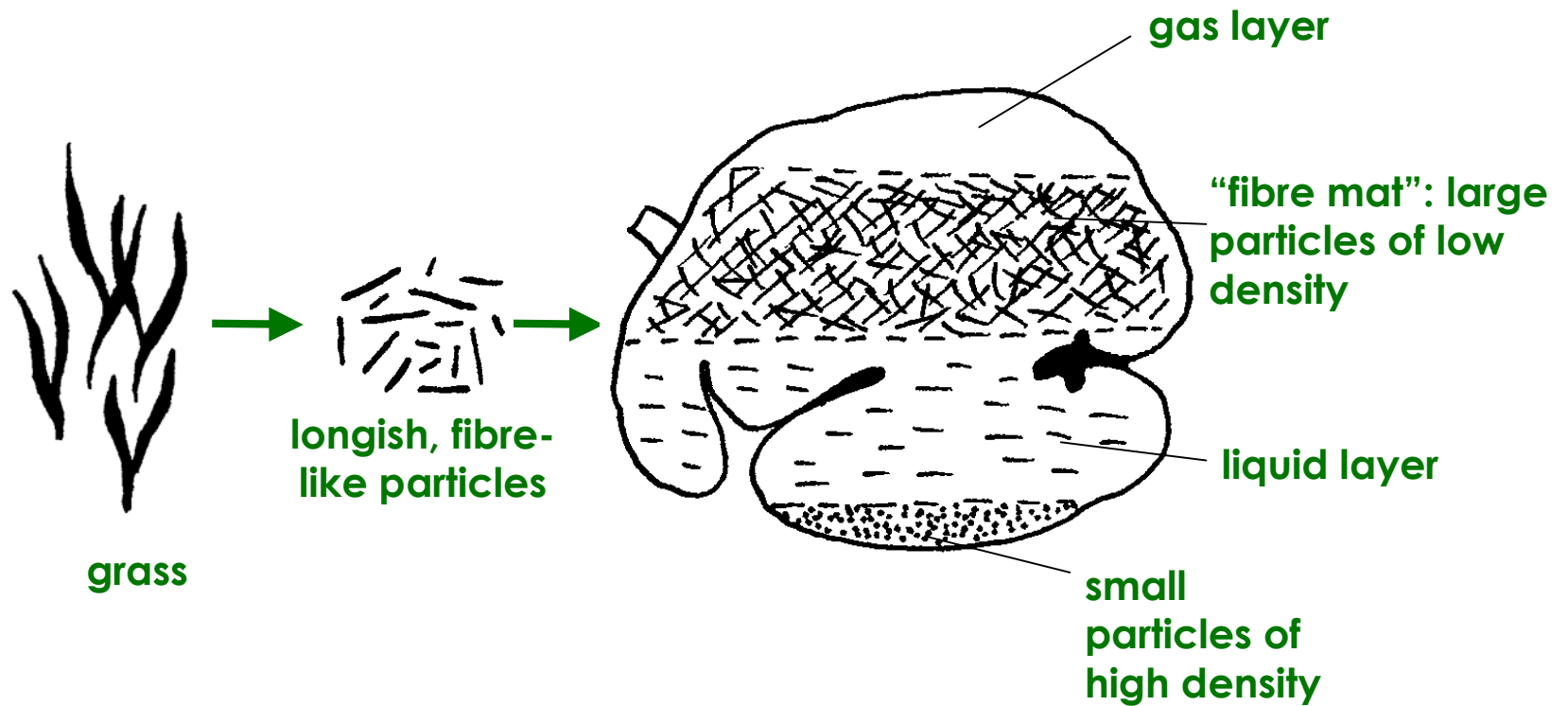
<sup>1</sup>Mazuri (PMI, St Louis, Mo USA).

<sup>2</sup>Mazuri (SDS, Essex, UK).

Clauss & Dierenfeld (2008)



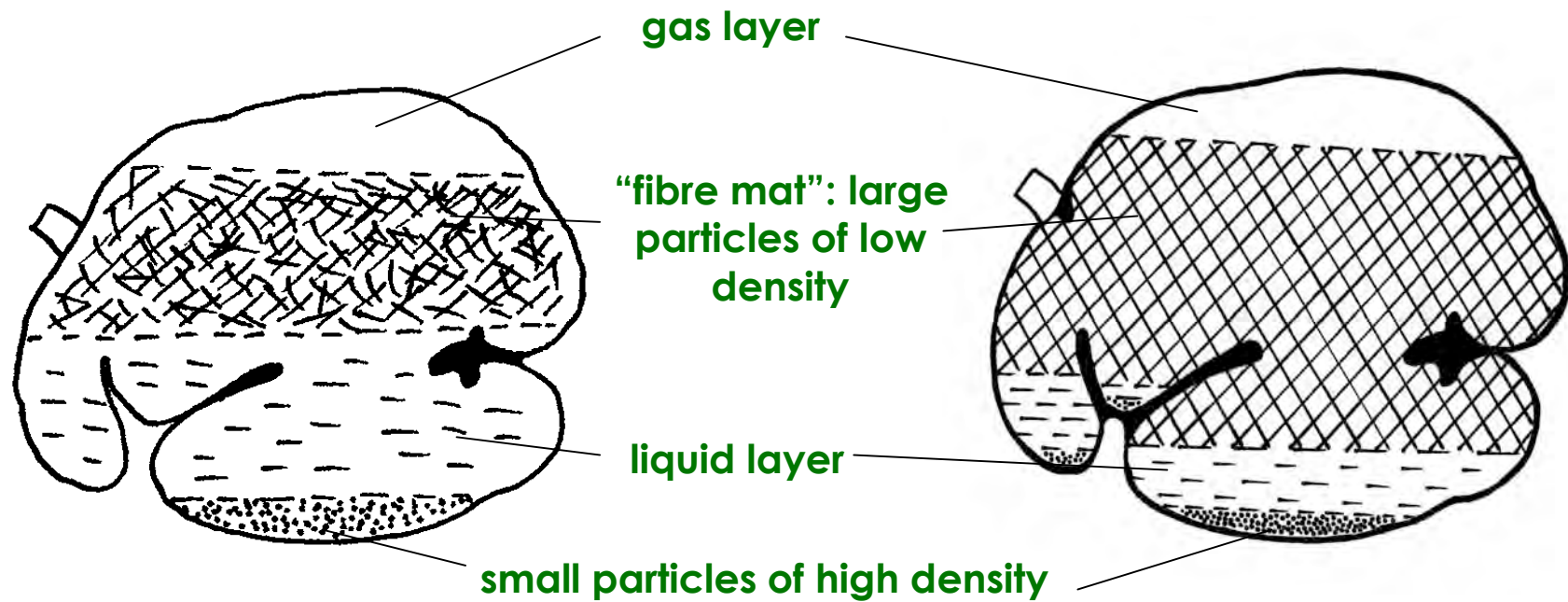
# The stratification of rumen contents





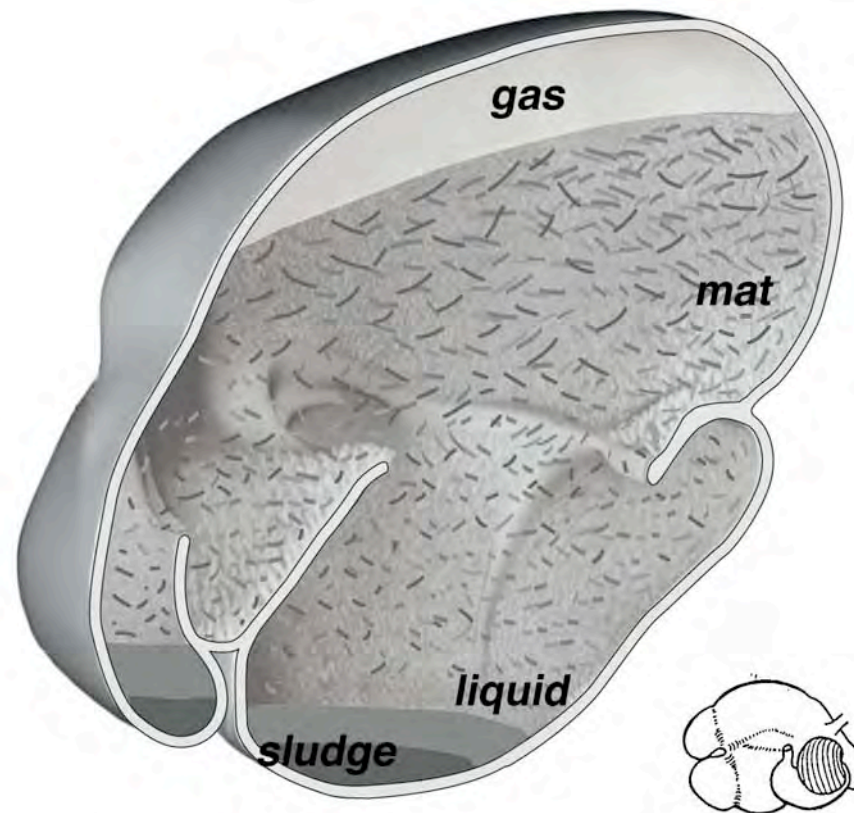
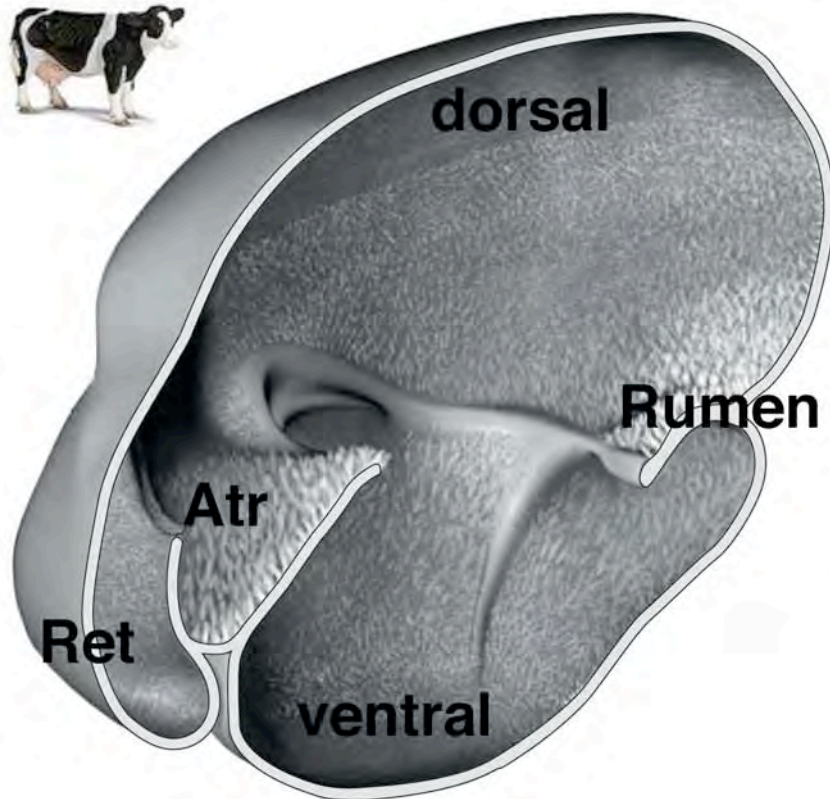


# The stratification of rumen contents





## Stratification of rumen contents: 'cattle-type'







## Rumen of addax - a grazer

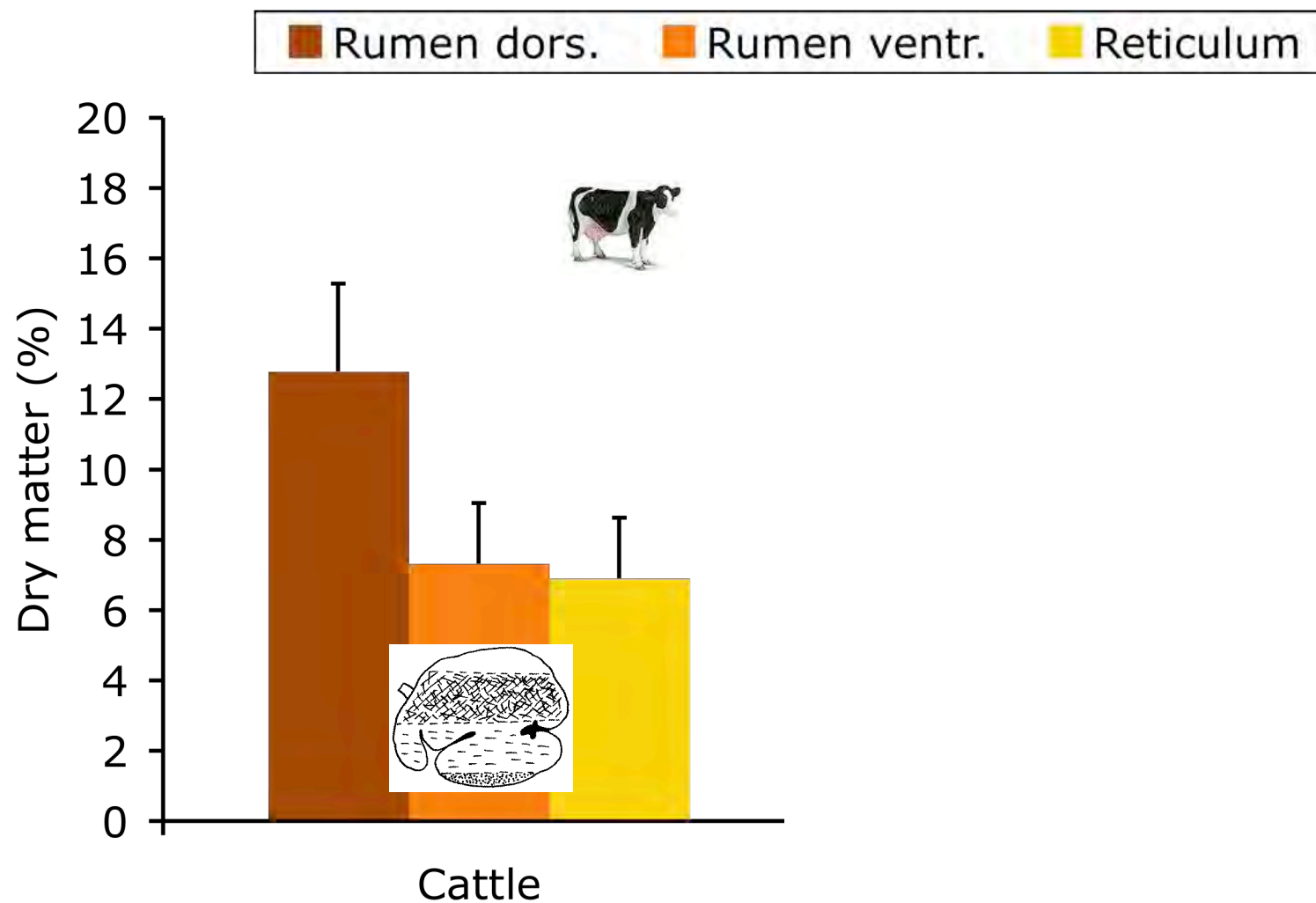


from Clauss et al. (2009)





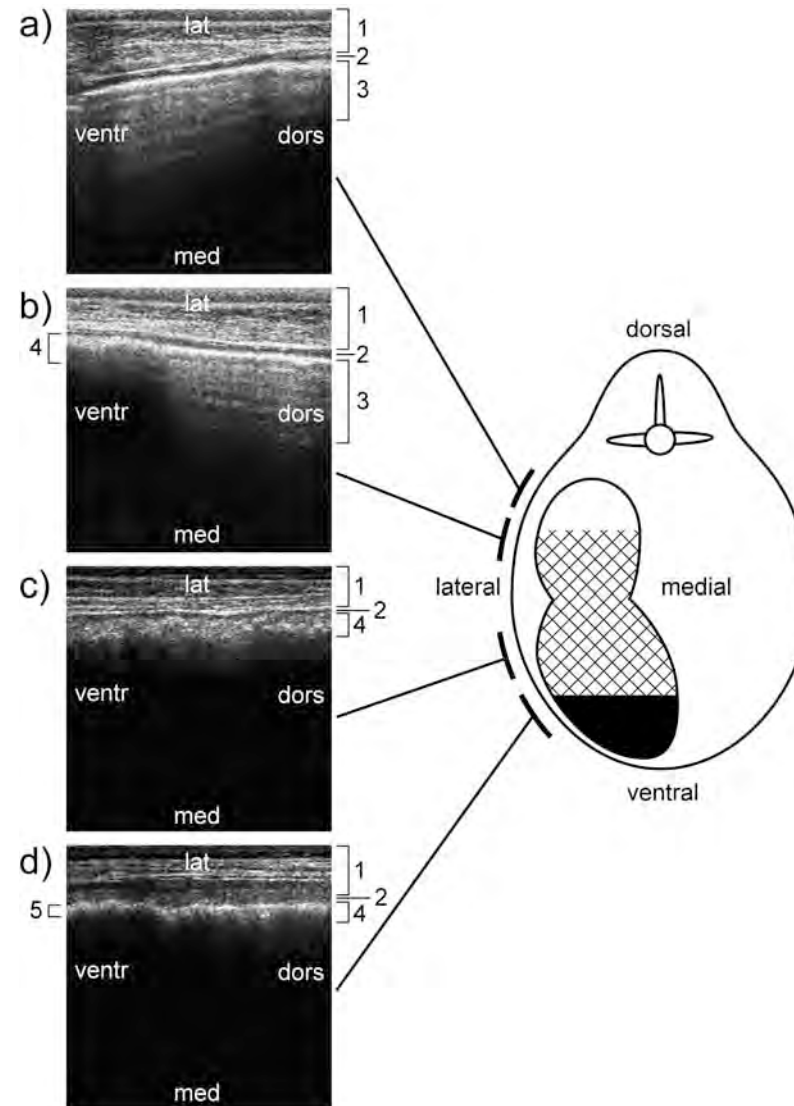
## Stratification of rumen contents



from Clauss et al. (2010)

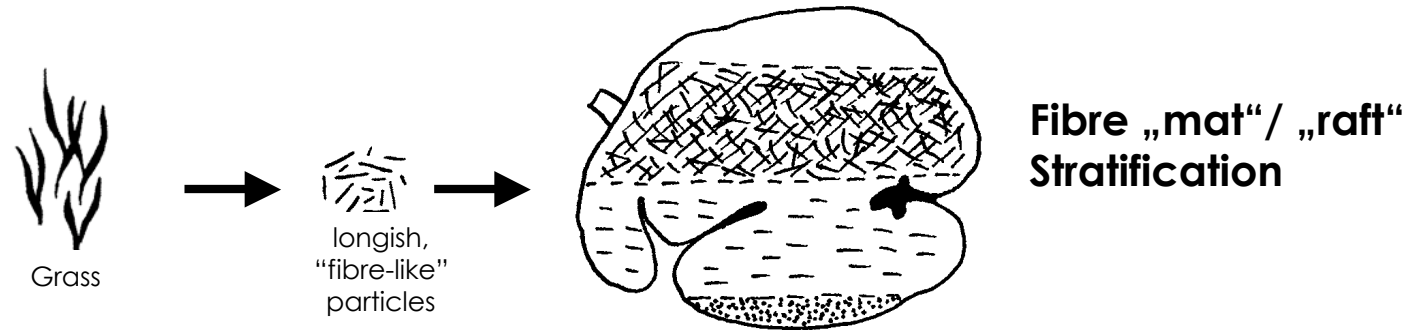


# Testing stratification by ultrasound - cattle

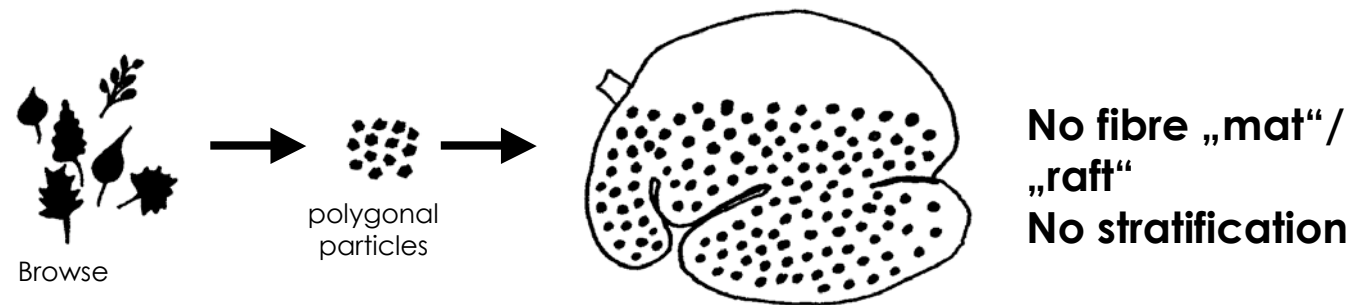




## Grazer



## Browser

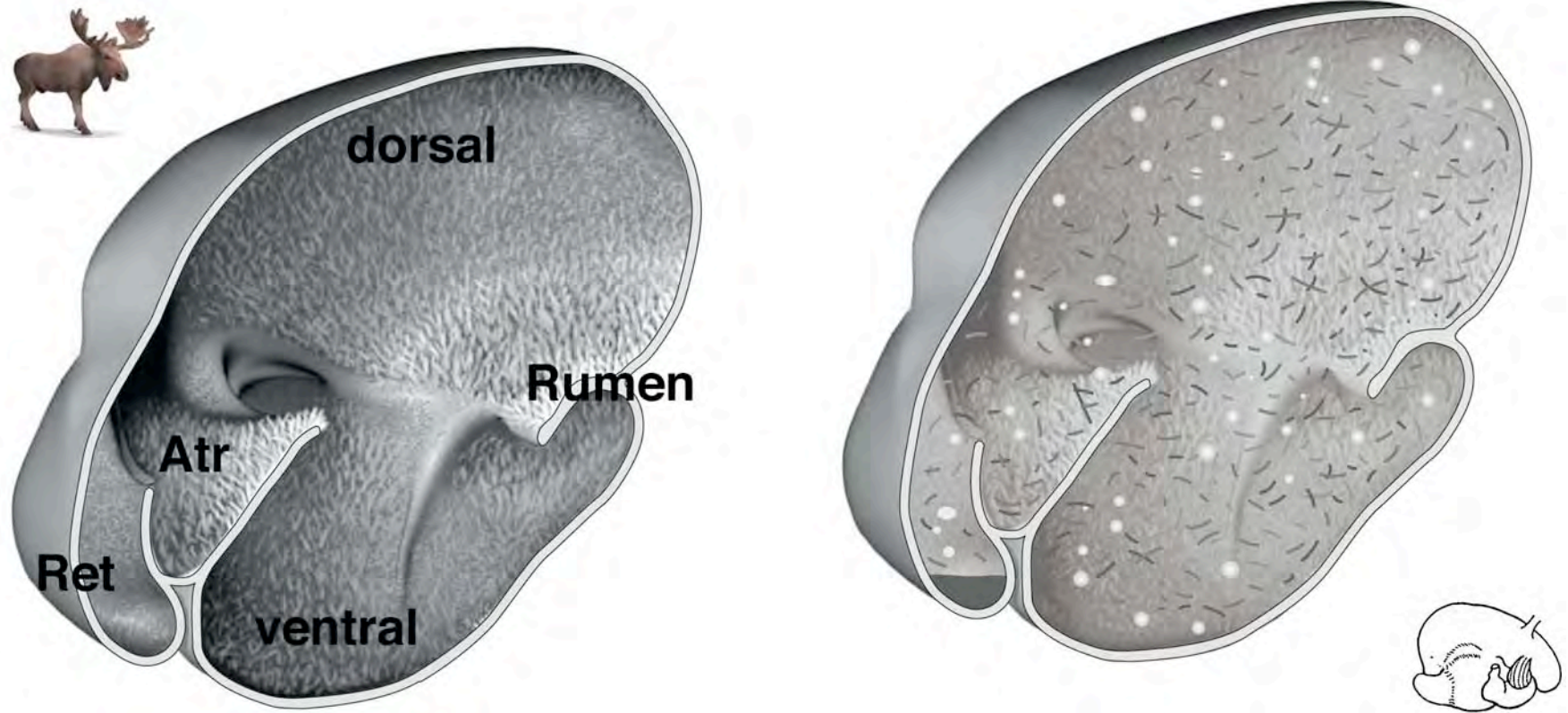


from Clauss et al. (2003)



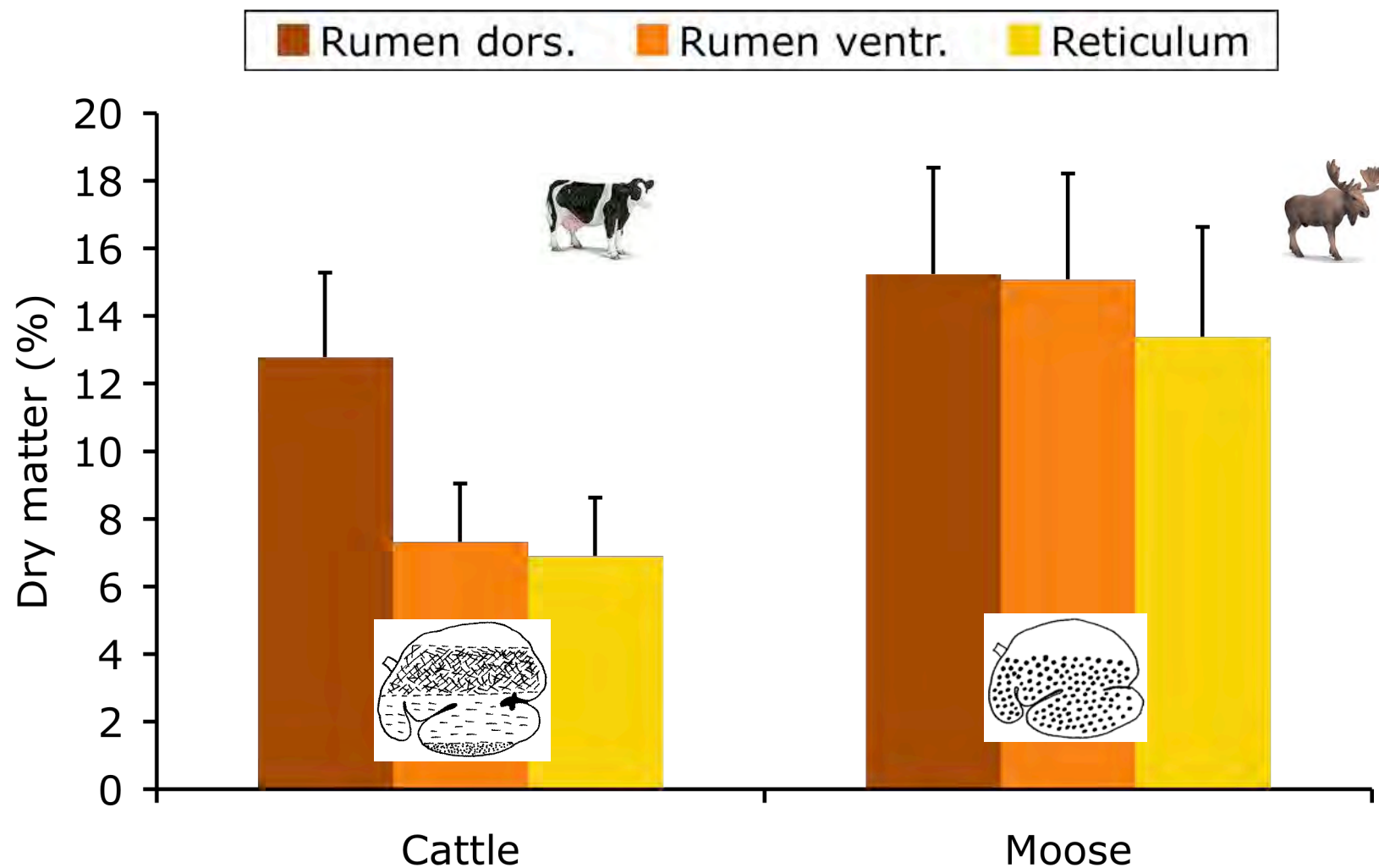


## No stratification of rumen contents: 'moose-type'





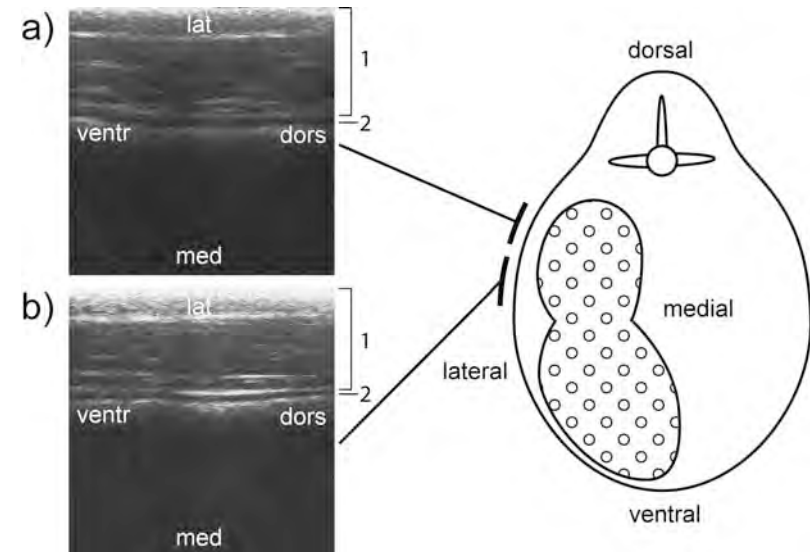
## Stratification of rumen contents



from Clauss et al. (2010)



# Testing stratification by ultrasound - moose

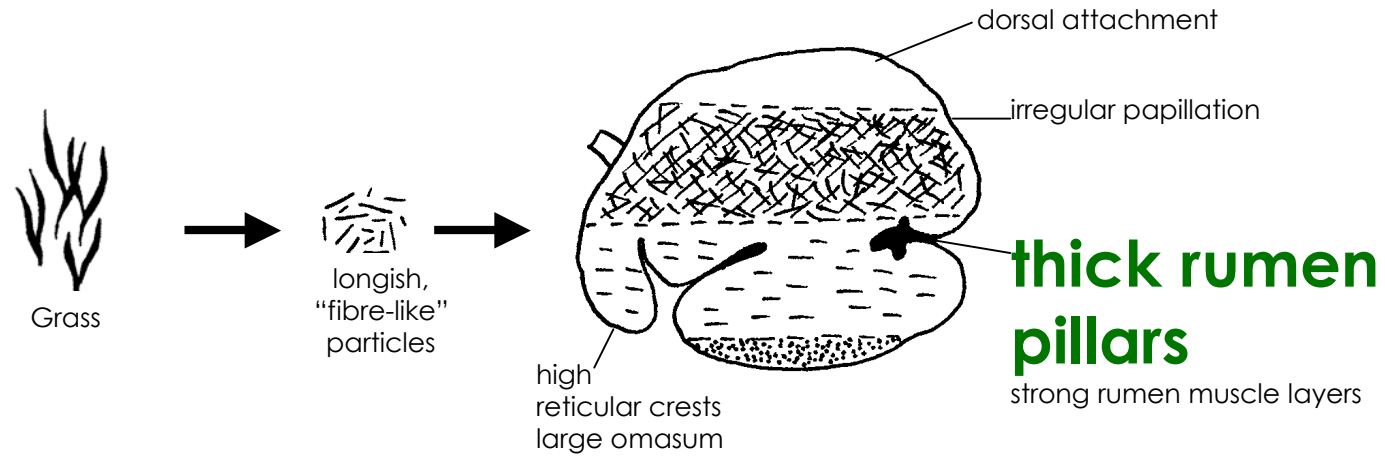


from Tschuor & Clauss (2008)

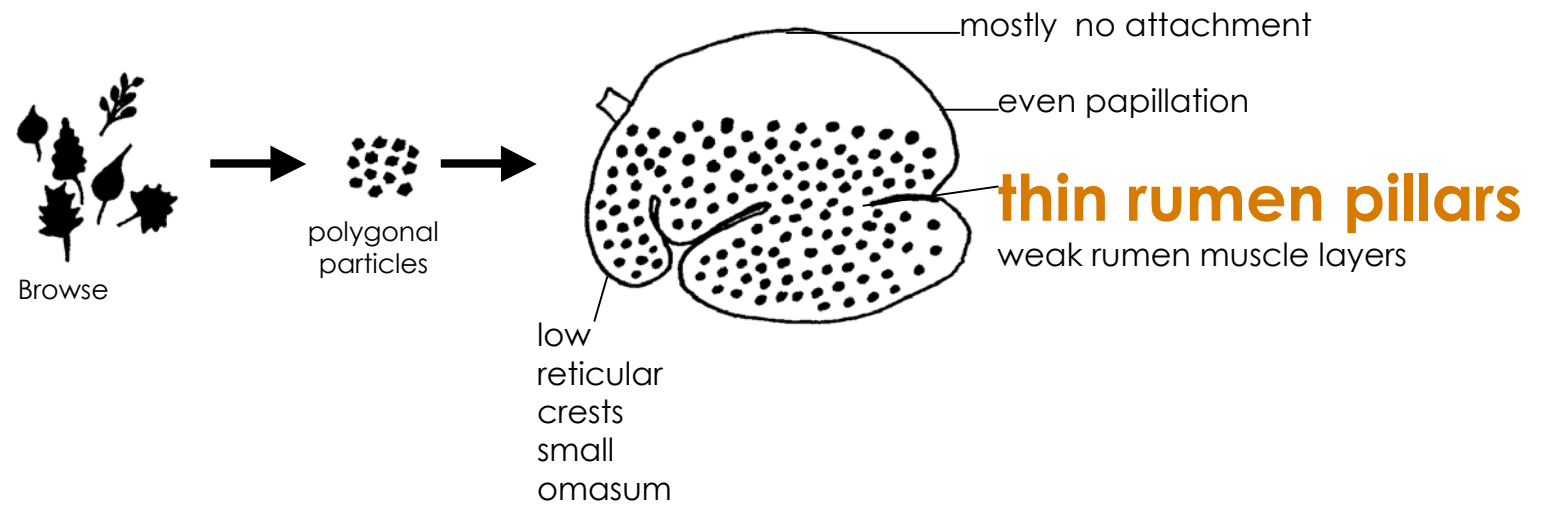




## Grazer



## Browser

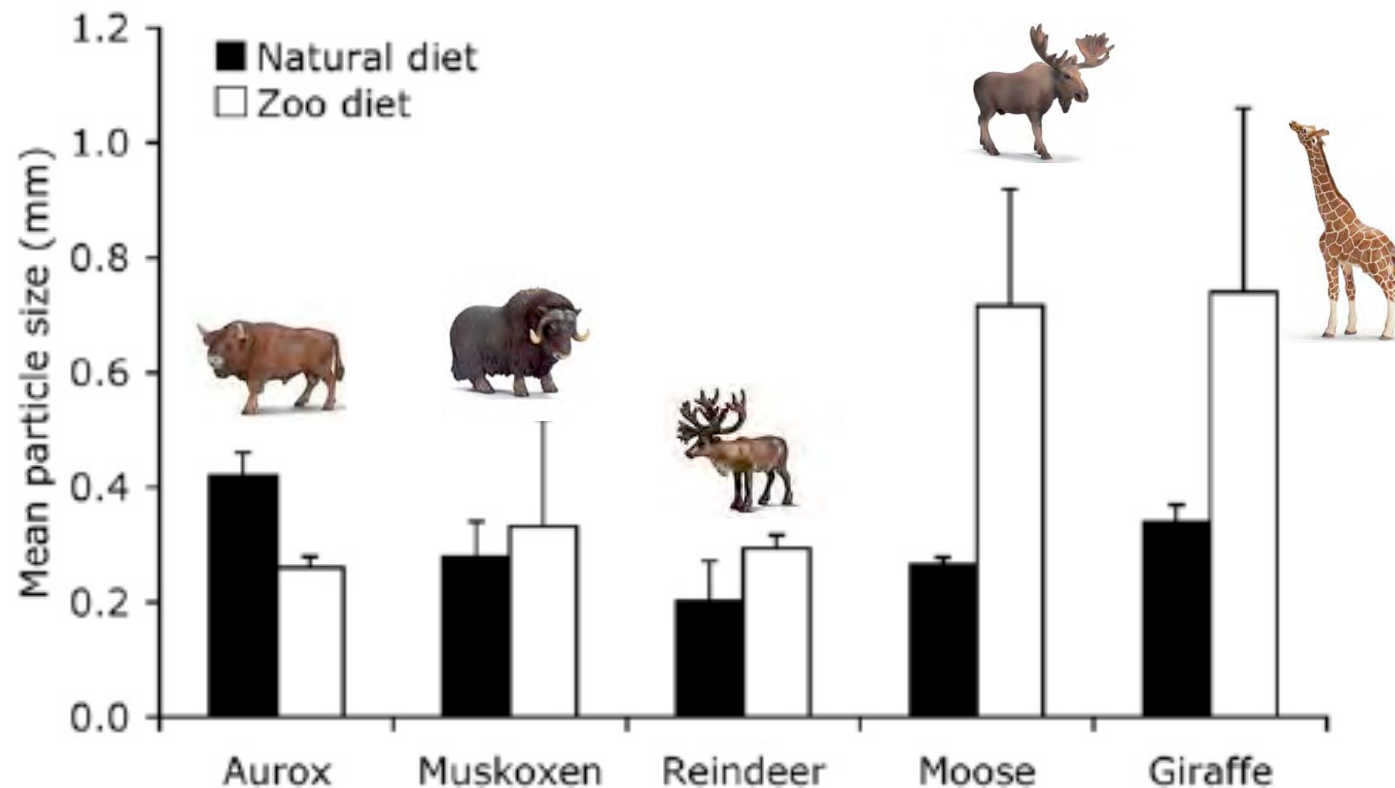




# Differential passage of fluids and different-sized particles in fistulated oxen (*Bos primigenius f. taurus*), muskoxen (*Ovibos moschatus*), reindeer (*Rangifer tarandus*) and moose (*Alces alces*): Rumen particle size discrimination is independent from contents stratification

Isabel Lechner<sup>a</sup>, Perry Barboza<sup>b</sup>, William Collins<sup>c</sup>, Julia Fritz<sup>d</sup>, Detlef Günther<sup>e</sup>, Bodo Hattendorf<sup>e</sup>, Jürgen Hummel<sup>f</sup>, Karl-Heinz Südekum<sup>f</sup>, Marcus Clauss<sup>a,\*</sup>

Comparative Biochemistry and Physiology, Part A 155 (2010) 211–222





**free-range**



**ZOO**







**free-range**

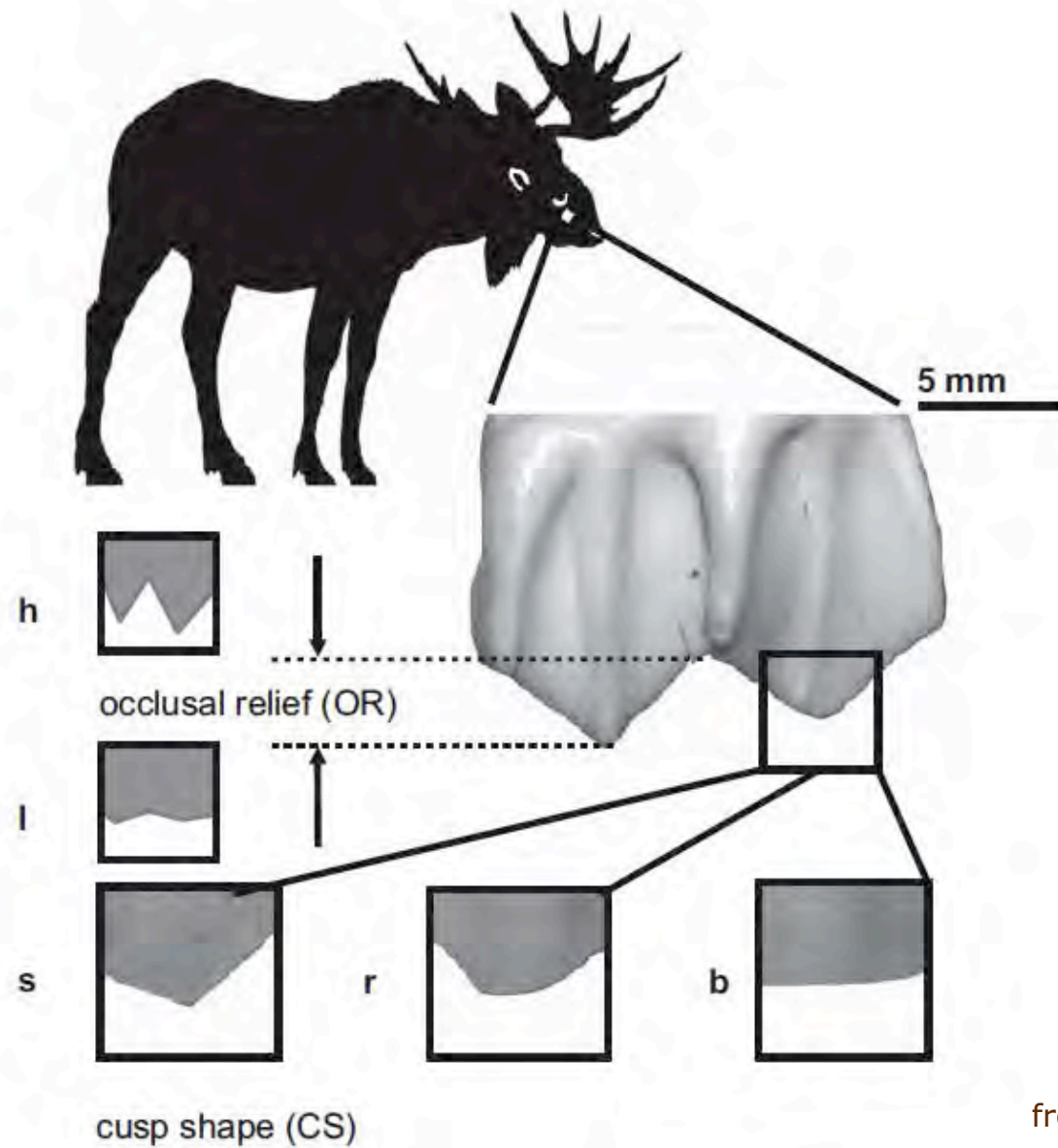


**ZOO**





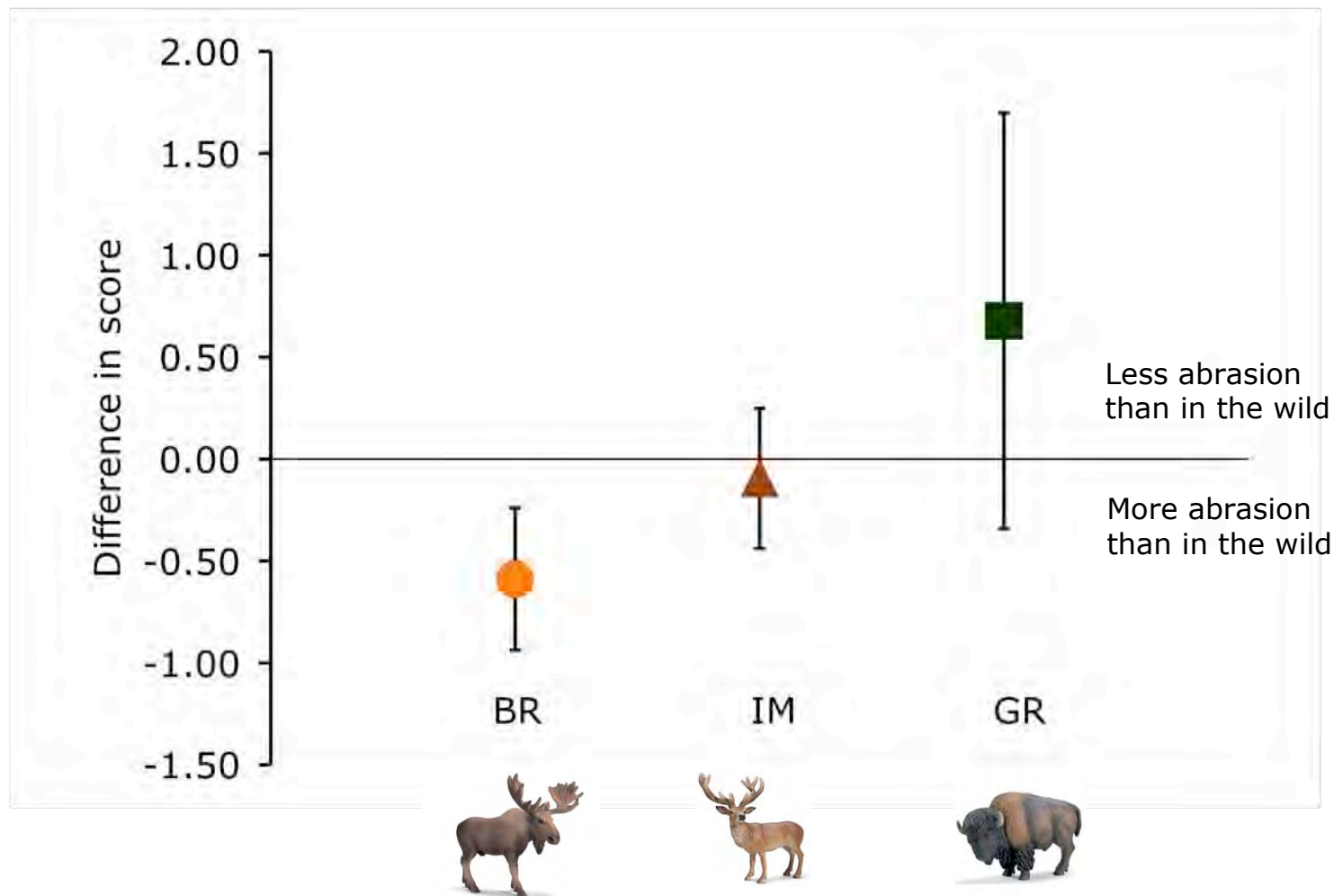
# Mesowear Scoring



from Kaiser et al. (2009)



# Tooth wear in captive ruminants



from Kaiser et al. (2009)





## Diets in captivity are abrasive

Food item	n	AIA (%DM)		Source
		mean	range	
Temperate browse	1	0.0	-	1
	6	0.2	0.0-0.4	2
Lucerne (alfalfa) hay	1	0.2	-	3
	1	0.2	-	1
	9	0.3	0.0-0.7	2
Lucerne meal pellet	1	0.5	-	2
Grass hay	13	2.0	0.3-5.1	2
Fresh grass	2	2.0	1.8-2.2	2
Green meal pellet	1	6.4	-	2
Pelleted compound feed	2	0.9	0.2-1.5	3
	3	0.8	0.7-1.0	1
	24	1.5	0.5-3.1	2

(1=Clauss et al. 2001; 2=Castell 2005; 3=Baer et al. 1985)































# How do you know you feed enough browse?

One hour after feeding:

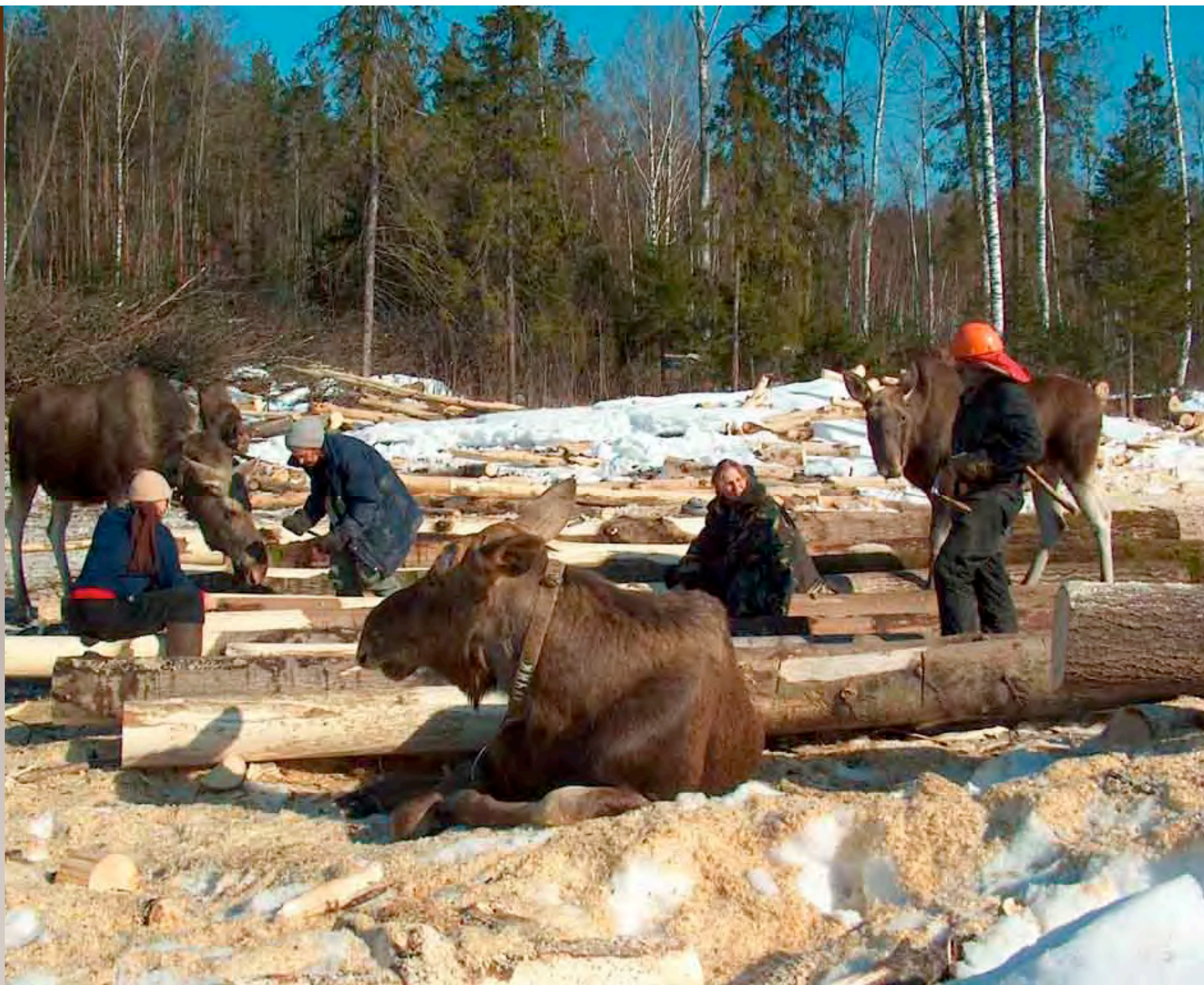


































## Feeding moose

- The logistical challenge to provide moose continuously with the food most suitable for them - browse - is a major limiting factor in moose husbandry.
- Intensive moose farming in Russia only works with a system in which moose roam freely in the woods surrounding the farms (and are 'bound' to the farm by supplemental feeding and ...)





# What we do with moose

- 'Imprinting': Phase-sensitive learning (learning occurring at a particular age or a particular life stage) that is rapid and apparently independent of the consequences of behaviour.
- 'Taming': Process by which a wild animal is subdued into adapting and submitting to human control.
- 'Domestication': Process whereby a population of animals or plants, through a process of selective breeding, becomes accustomed to human provision and control. In the Convention on Biological Diversity a domesticated species is defined as a 'species in which the evolutionary process has been influenced by humans to meet their needs'. Therefore, a defining characteristic of domestication is artificial selection by humans with an effect on the species' genetic makeup.









































# MOOSE DOMESTICATION EXPERIENCE

By LEONID M. BASKIN

Baskin, L. M. Moose domestication experience.—Swedish Wildlife Research, Suppl. 1, 1987: 741–743.

Experiments on moose domestication conducted in the USSR for over 40 years have failed to bring about changes typical of domestication: i.e. in dimensions, coloration and breeding rhythms. A possible reason is the use for breeding of wild bulls along with cows that are being domesticated. Strong possibilities for changing the attitude of moose to man is interference in behaviour ontogenesis: calf imprinting (up to ten days of age) of a man as mother while being fed on milk. This leads to further social attachment to man, manifestation of sexual behaviour on the part of the males and motherly behaviour on the part of females, including permission of being milked.

Imprinting of man as an environmental positive social factor is possible until the calf is three months old, or, at most, one year old. Attempts to develop herding behaviour have failed, as well as management based on the defensive reflex. Moose remain in the surroundings of the farm where they were raised because of attachment to the habitat area. At the present time, domestication may be aimed at assembling moose at logging waste sites and obtaining milk with its alleged medicinal effect. The intuition-based approach (creation of moose similar in behaviour to domestic livestock) is through a scientifically regulated evolutionary process of domestication.

*L. M. Baskin, Institute of Evolutionary Animal Morphology and Ecology, USSR Academy of Sciences, 33 Leninsky Prospekt, 117071 Moscow, USSR.*



## What we do with moose

(due to the logistical challenge of food supply)

- ‘Taming by imprinting’: moose remain attached to humans
- Mating during forest roaming with free-ranging males
- Little active selection





## What we do with moose

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- ‘Taming by imprinting’: moose remain attached to humans
- Mating during forest roaming with free-ranging males
- Little active selection

***no domestication***



Domesticated Moose  
2 years old  
Nipawin, Sask.





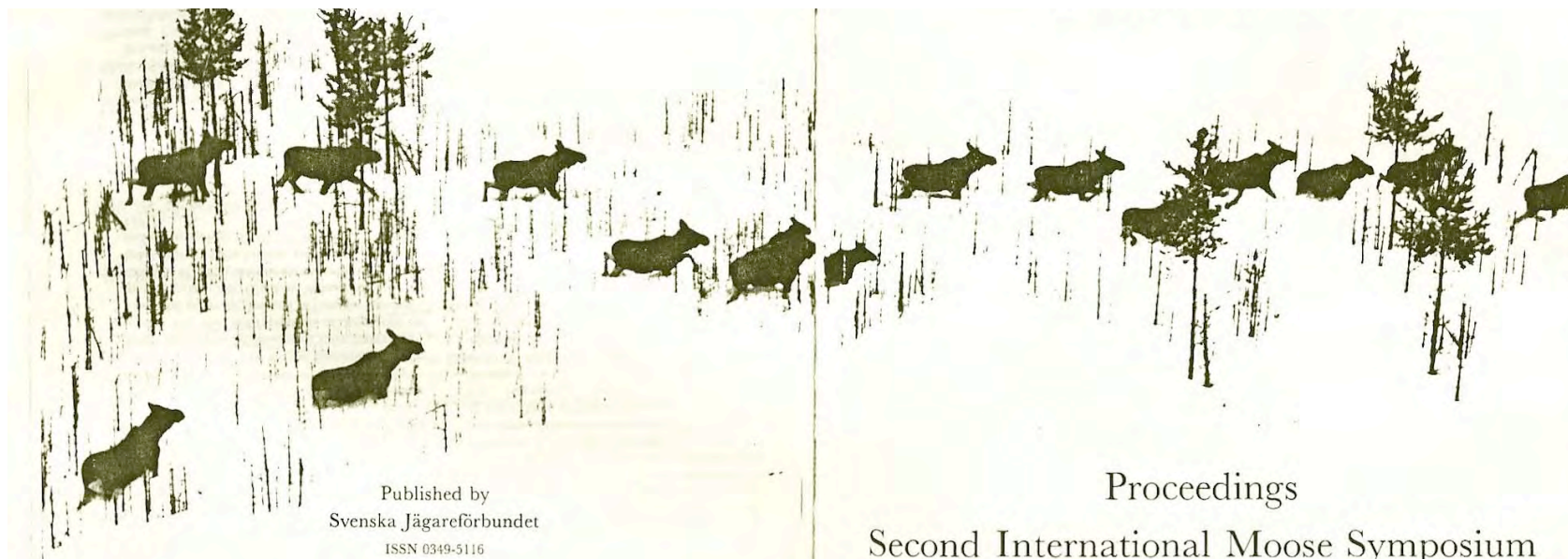


Thanks to  
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**Andreas Peemöller**  
**Kostroma Moose Farm**  
(<http://www.moosefarm.newmail.ru/index.htm>)

and you for your attention







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