Regurgitieren und Wiederkauen – Krankheit, Laune, Erfolgsstrategie

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Seniorenuniversität UZH 2020

University of Zurich[UZH]

Clinic of Zoo Animals, Exotic Pets and Wildlife

JOH. CONRADI PEYERI
Med. Doct. & Acad. Nat. Cur. Collegæ
cognomento Pythagoræ

MERYCO-LOGIA

SIVE DE

RVMINANTIBVS
ET
RVMINATIONE

COMMENTARIVS,

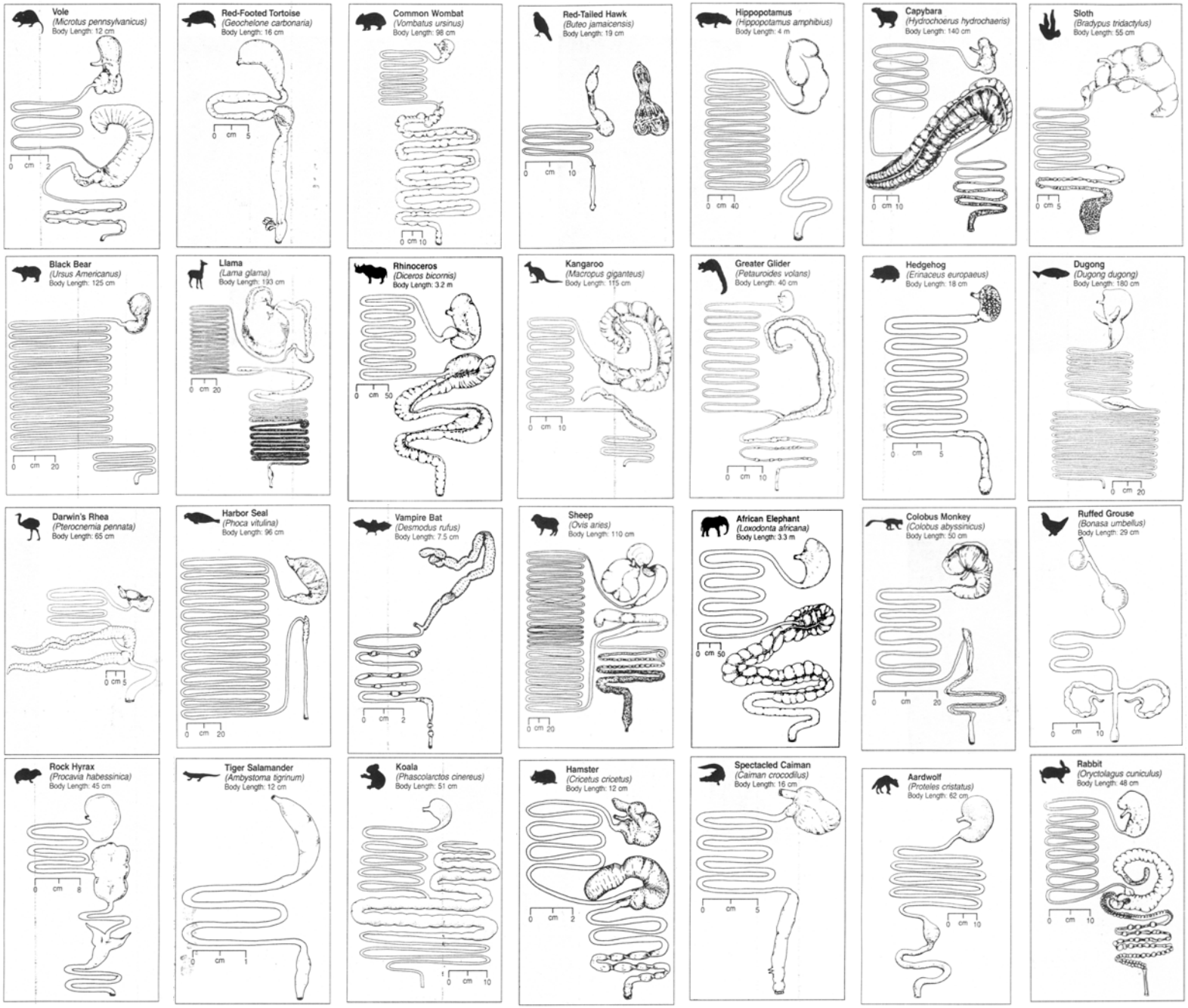
Quo primùm exponuntur

RVMINANTIVM SPECIES ET DIFFE-rentiæ, per omnia animalium genera; deinde organorum ruminationi inservientium admiranda structura detegitur, & iconibus ari incisis ante oculos ponitur: denique de ruminatione ipsa ejusque causis ac utilitate disseritur.

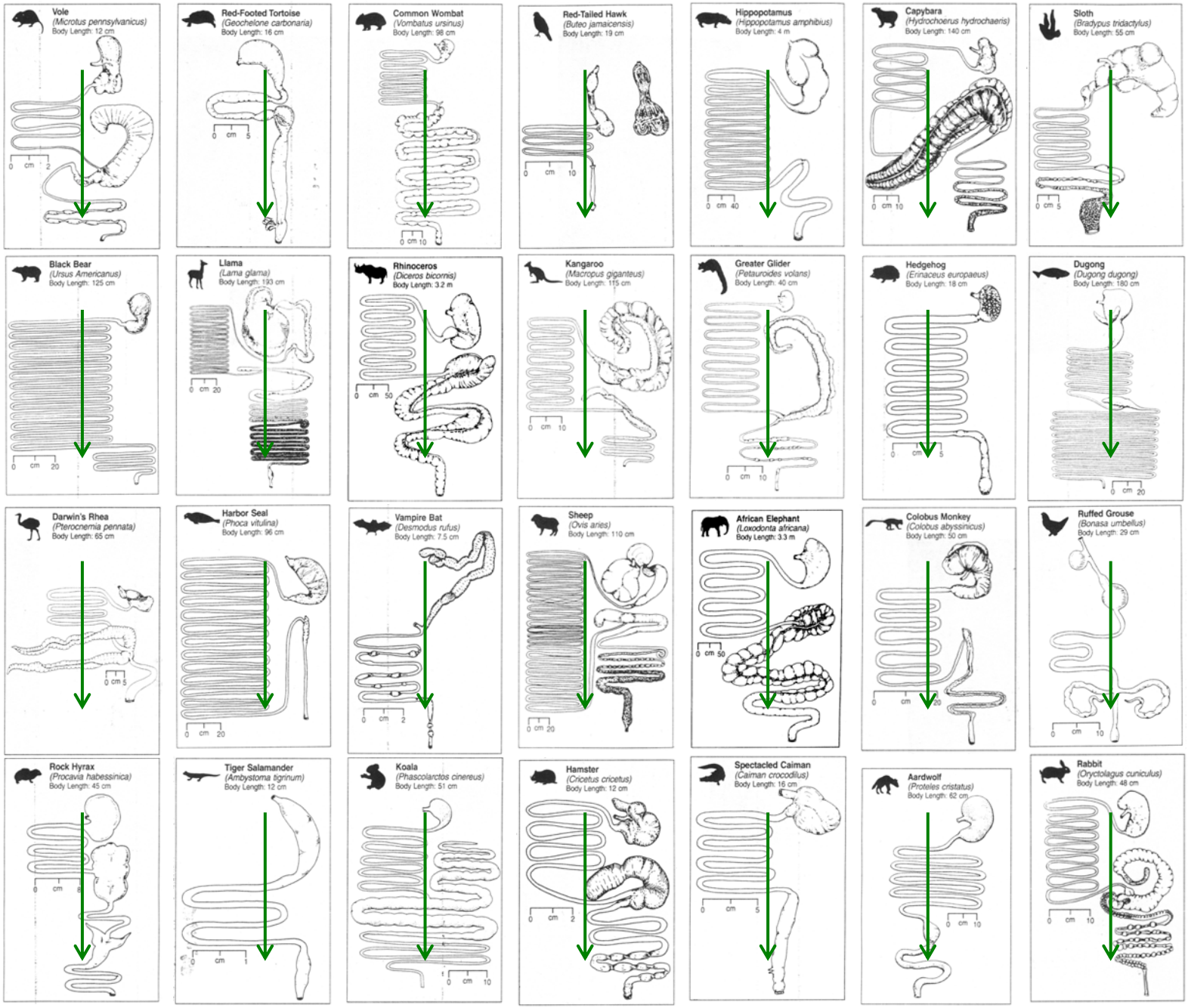
BASILEÆ

Apud JOH. LUDOVICUM KOENIG
& JOH. BRANDMYLLERUM.

CI DC LXXXV.



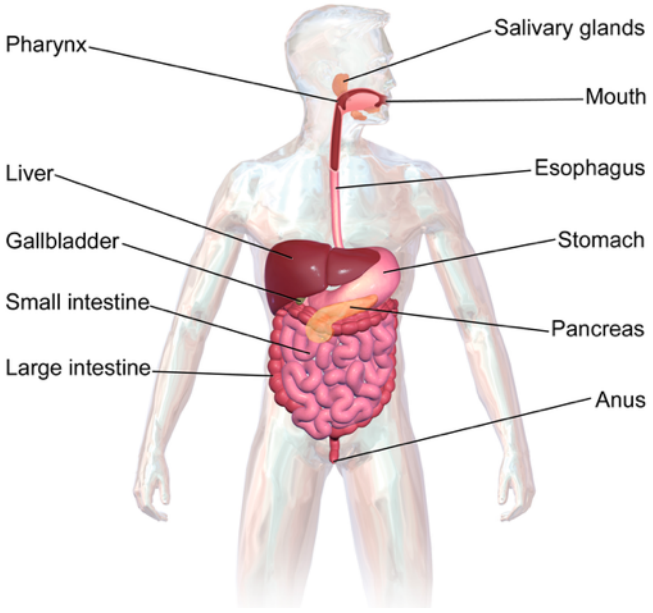
from Stevens und Hume (1995)

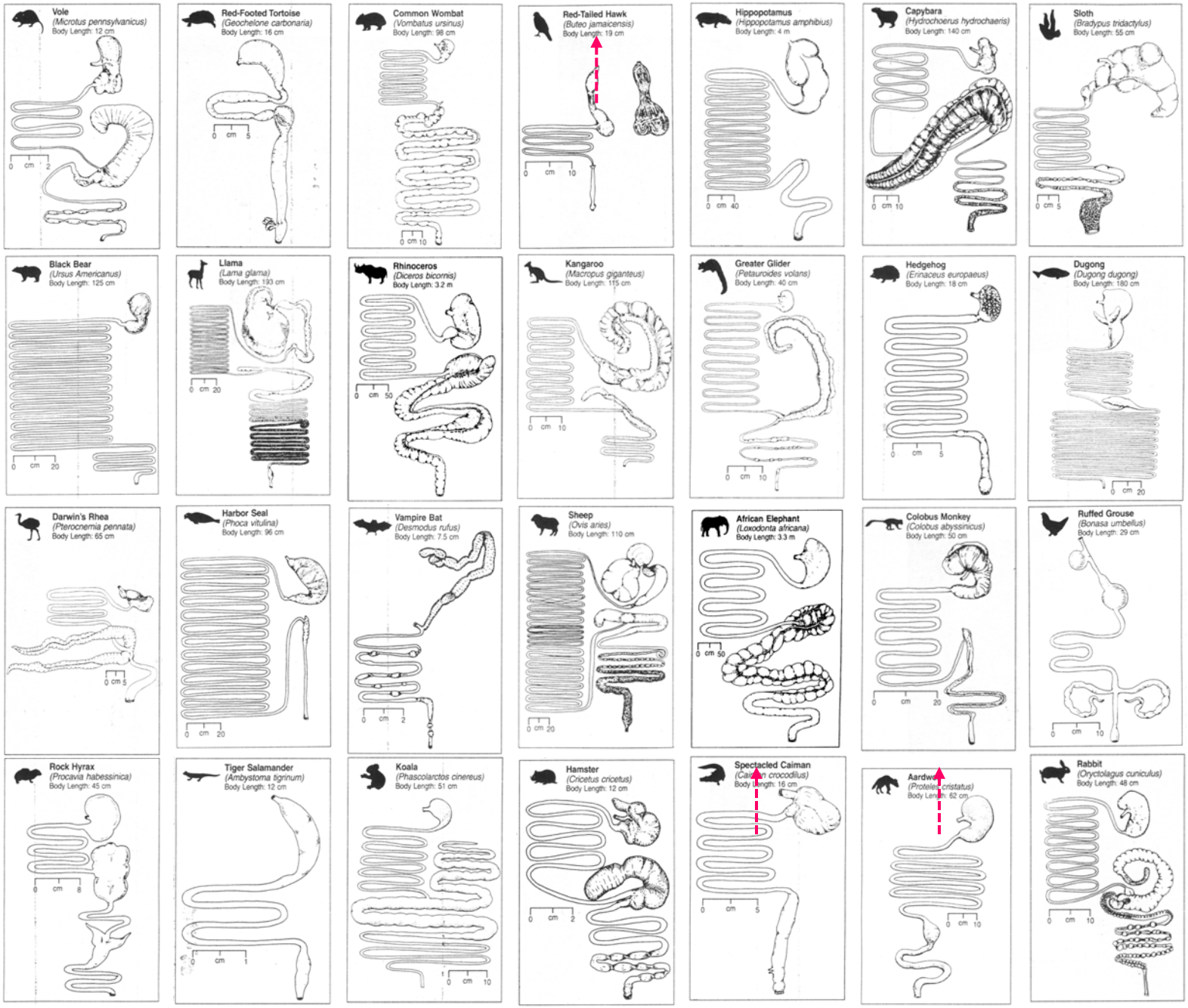


from Stevens und Hume (1995)

Definitionen

- Verdauung
  - mechanische und chemische Zersetzung von Nahrung in kleinere Bestandteile, die absorbiert werden können
  - findet während der Verweildauer im – und während der Passage durch – den Verdauungstrakt statt





from Stevens und Hume (1995)

Definitionen

- Erbrechen (Vomitus)
  - unfreiwilliges Ausstossen von Mageninhalt

    => im Zusammenhang mit Verderb, Giften, aversen Reaktionen (Gastritis)

    => 'stoppt nicht im Mund'

- Regurgitation
  - (un)freiwilliges Hochwürgen von Material aus Magen/Speiseröhre/Rachenraum

    ⇒ Transport: Jungenaufzucht/Futterteilen

    ⇒ Produktion spezieller Stoffe im Verdauungstrakt (Tauben – Kropfmilch, Bienen – Honig)

    => Elimination: unverdauliche Bestandteile (Gewölle bei fleisch- u. fischfressenden Vögeln; Magenausstülpen bei Haien)

Krokodil Regurgitieren

Hai Magenausstülpen

Adler Gewöll

Würger Gewöll

Eule Gewöll

Gewöll Eule

http://en.wikipedia.org/wiki/File:Pelotes_r%C3%A9jection_Asio_Otus.jpg

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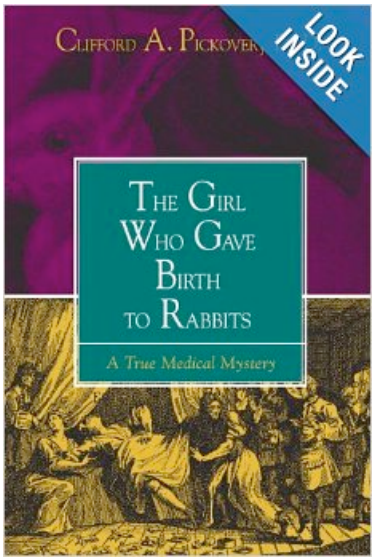
    => 'Regurgitationskünstler'

Regurgitatoren

- 1621 der ‘Nägel-speiende Jungeaus Boston’
- 1642 Catharina Geisslerin, die ‘Kröten-speiende Frau aus Deutschland’
- 1694 Theodorus Döderlein (Molche und Frösche)
- 1834 Henriette Pfenning (Frösche)

- zwanghafte Verschlucker (1927 Patient mit Zahnbürsten und Rasierer in seinem Magen)

- Stevie Starr – the ‘professional regurgitator’



http://sprott.physics.wisc.edu/pickover/vomit.html

Regurgitatoren

Stevie Starr
The Regurgitator
Unofficial Fan Site

Stevie Starr Swallows and Then Regurgitates Things in the Most Amazing Way

Stevie Starr

Stevie Starr on Czech and Slovak Got Talent (October 2011)!

Stevie is in another "Got Talent" competition, this time in the Czech and Slovak Republics. He is in the first round and "everyone loves him," according to fan Václav C.

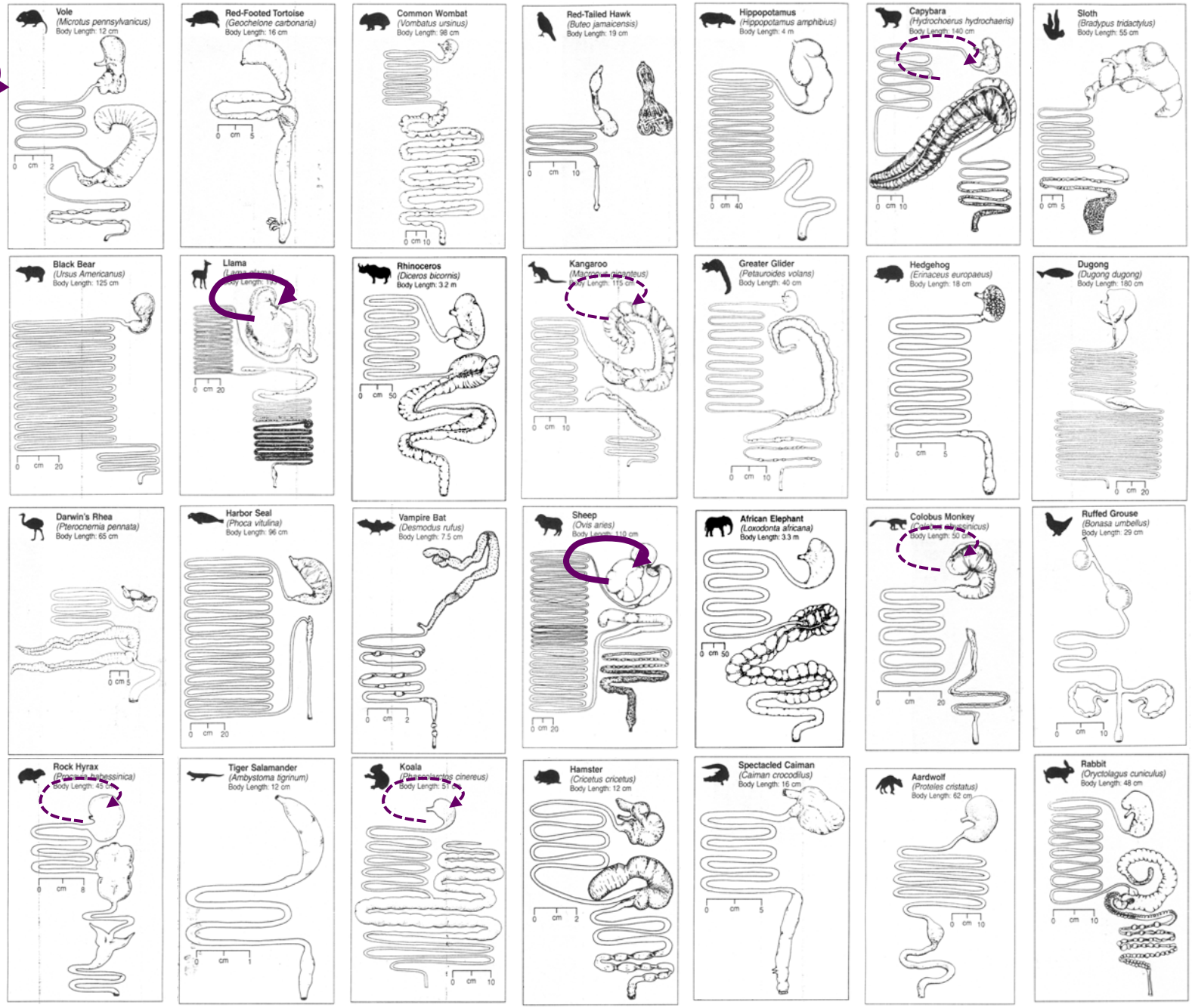
In 2010, Stevie made it to the semi-finals on "Britain's Got Talent" as well as on "Das Supertalent," Germany's version of the show.

About The Regurgitator

I first saw "The Regurgitator" (Stevie Starr) on a rerun of the Tonight Show with Jay Leno in 2005, and I decided I needed to make a fan site for him.

Stevie Starr is amazing. I have no idea how he does it and I couldn't find out any more information in a google search.

Menschliche Regurgitatoren



from Stevens und Hume (1995)

Definitionen

- Rumination (Wiederkäuen) / Merycismus
  - “im Geiste hin- und herbewegen”
  - “to chew the cud” - wiederkäuen

    => beinhaltet Regurgitation, Kauen, Wieder-Schlucken

    => Verhaltensstörung bei Menschen und bei manchen Zootieren (‘rumination syndrome’ / ‘RR’)

Gorilla R/R

A review of nutritional and motivational factors contributing to the performance of regurgitation and reingestion in captive lowland gorillas (*Gorilla gorilla gorilla*)

Kristen E. Lukas *

Applied Animal Behaviour Science 63 (1999) 237–249

Despite findings that provision of browse and removal of fruit from the diet reduces R/R (Loeffler, 1982; Gould and Bres, 1986a; Ruempler, 1992; Wiard, 1992; Velderman, 1997), no one has yet documented the elimination of this behavior from an individual's repertoire. Ruempler (1992), however, reported that one gorilla's R/R had completely ceased for over a year after removing all but huge portions of vegetables and browse (18 kg per adult animal per day) from the diet at Cologne Zoo in Germany. For comparison, an adult male gorilla consumes approximately 6 kg/day at Zoo Atlanta (G. Hamor, personal communication), 13 kg/day at Brookfield Zoo (C. Demitros, personal communication), and 30 kg/day in the wild (*G.g. beringei*, Goodall, 1977). Unfortu-

Removing Milk from Captive Gorilla Diets: The Impact on Regurgitation and Reingestion (R/R) and Other Behaviors

Kristen E. Lukas,[1,2,3*] Gloria Hamor,[3] Mollie A. Bloomsmith,[2,3] Charles L. Horton,[3] and Terry L. Maple[2,3]

Zoo Biology 18:515 - 528 (1999)

TABLE 6. Comparisons of gorilla behavior between conditions in Phase 2

	Baseline (32 oz milk)	Treatment 32 oz diluted (fruit juice)	Baseline (32 oz milk)	Hypothesis test: baselines vs. treatment	Probability ($\alpha = 0.05$)
Scan data (percentage of time)					
R/R	5.9%	3.7%	6.3%	F = 8.508	$P = 0.010$
Eat hay	1.3%	1.6%	0.3%	F = 0.767	ns
Inactive	45.5%	46.6%	46.3%	F = 0.115	ns
Drink water	3.4%	3.3%	2.9%	F = 0.011	ns
Social (affiliative)	8.4%	8.0%	11.7%	F = 1.221	ns
Other undesirable	1.0%	1.2%	2.0%	F = 0.594	ns
Self-directed behavior	17.1%	17.5%	13.9%	F = 1.681	ns
Social (agonistic)	0.1%	0.3%	0.4%	F = 0.136	ns
Other active behavior	16.0%	16.7%	15.0%	F = 0.605	ns
All-occurrence data (no. per 5 - min)					
R/R attempts	0.022	0.017	0.011	F = 0.000	ns
R/R bouts	0.428	0.256	0.422	F = 4.684	$P = 0.045$
Feed on another's regurgitant	0.061	0.061	0.072	F = 0.239	ns
Examine another engaging in R/R	0.056	0.056	0.072	F = 0.221	ns
Agonistic behavior	0.089	0.111	0.233	F = 1.342	ns

Schimpanse R/R

An analysis of regurgitation and reingestion in captive chimpanzees

Kate C. Baker [a,*], Stephen Phillip Easley [b]

Applied Animal Behaviour Science 49 (1996) 403–415

of cagemates or housing history; nor were sex differences detected. Meal composition was not found to effect the time devoted to R/R. Statistical tests did show a strong positive relationship between rates of R/R and elapsed time since feeding. These results suggest that increasing meal frequency or providing consistently available edible material may prove more broadly effective than altering meal composition. Temporal distributions of R/R differed from those of abnormal

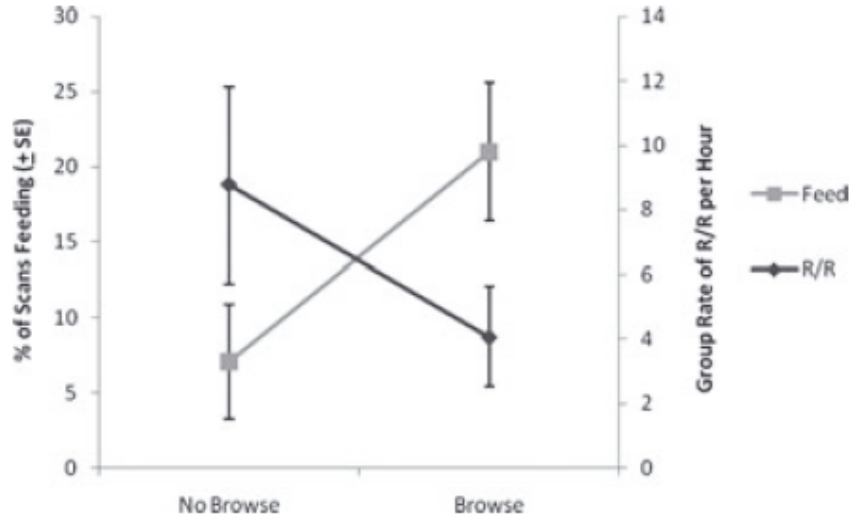
old male) (Morgan et al., 1993). That study found that R/R occurred within minutes of each meal, and was most frequent following meals consisting of fruit. Reductions in R/R occurred during behavioral training sessions and when more browse was provided.

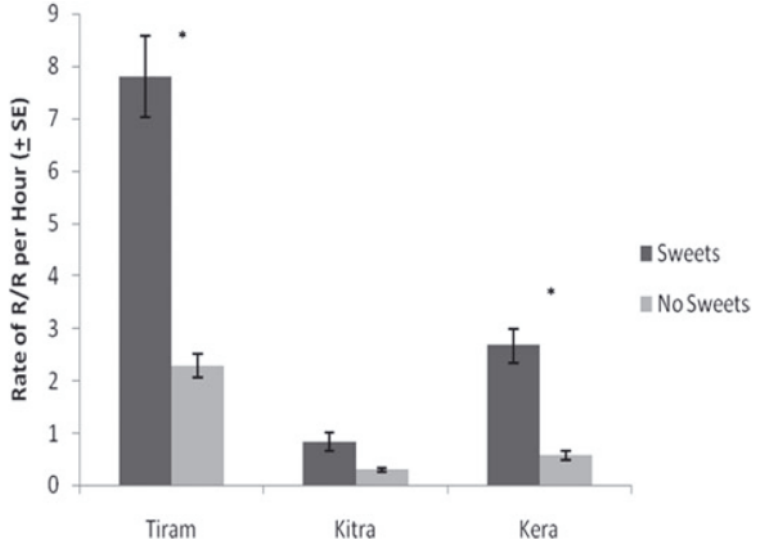
Orangutan R/R

Prevalence of Regurgitation and Reingestion in Orangutans Housed in North American Zoos and an Examination of Factors Influencing its Occurrence in a Single Group of Bornean Orangutans

Zoo Biology 31: 609–620 (2012)

Christine M. Cassella,[1,2]* Alyssa Mills,[1] and Kristen E. Lukas[1,2]





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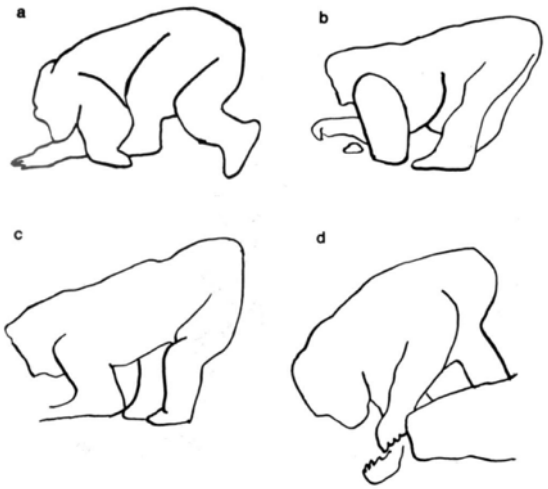
DEVELOPMENTAL AND BEHAVIORAL PEDIATRICS

Vol. 7, No. 5, October 1986
Printed in U.S.A.

Special Articles

Regurgitation in Gorillas: Possible Model for Human Eating Disorders (Rumination/Bulimia)

EDWIN GOULD, PH.D.
Department of Mammalogy, National Zoological Park, Smithsonian Institution, Washington, D.C.
MIMI BRES, M.S.
Department of Biological Sciences, The George Washington University, Washington, D.C.



Rumination beim Menschen

MAY 4, 1907.] MEMORANDA. [THE BRITISH MEDICAL JOURNAL 1053

MERYCISM OR RUMINATION IN MAN.

BY J. GRANT MILLAR, M.B., CH.B.GLASG.,

BRITISH MEDICAL JOURNAL VOLUME 287 23 JULY 1983

Habitual rumination: a benign disorder

D F LEVINE, D L WINGATE, J M PFEFFER, P BUTCHER

British Journal of Psychiatry (1994), **165**, 303–314

Review Article

Merycism or Rumination Disorder
A Historical Investigation and Current Assessment

BRENDA PARRY-JONES

Rumination beim Menschen

- historisch: Vermutung boviner Vorfahren (incl. Autopsie um nach gekammertem Magen zu suchen)

  => (primitiver Impuls)

- 6-10 % von hospitalisierten Personen mit schwerer verzögerter geistiger Entwicklung
- Komplikationen: Mangelernährung, Gewichtsverlust, Aspiration/Ersticken

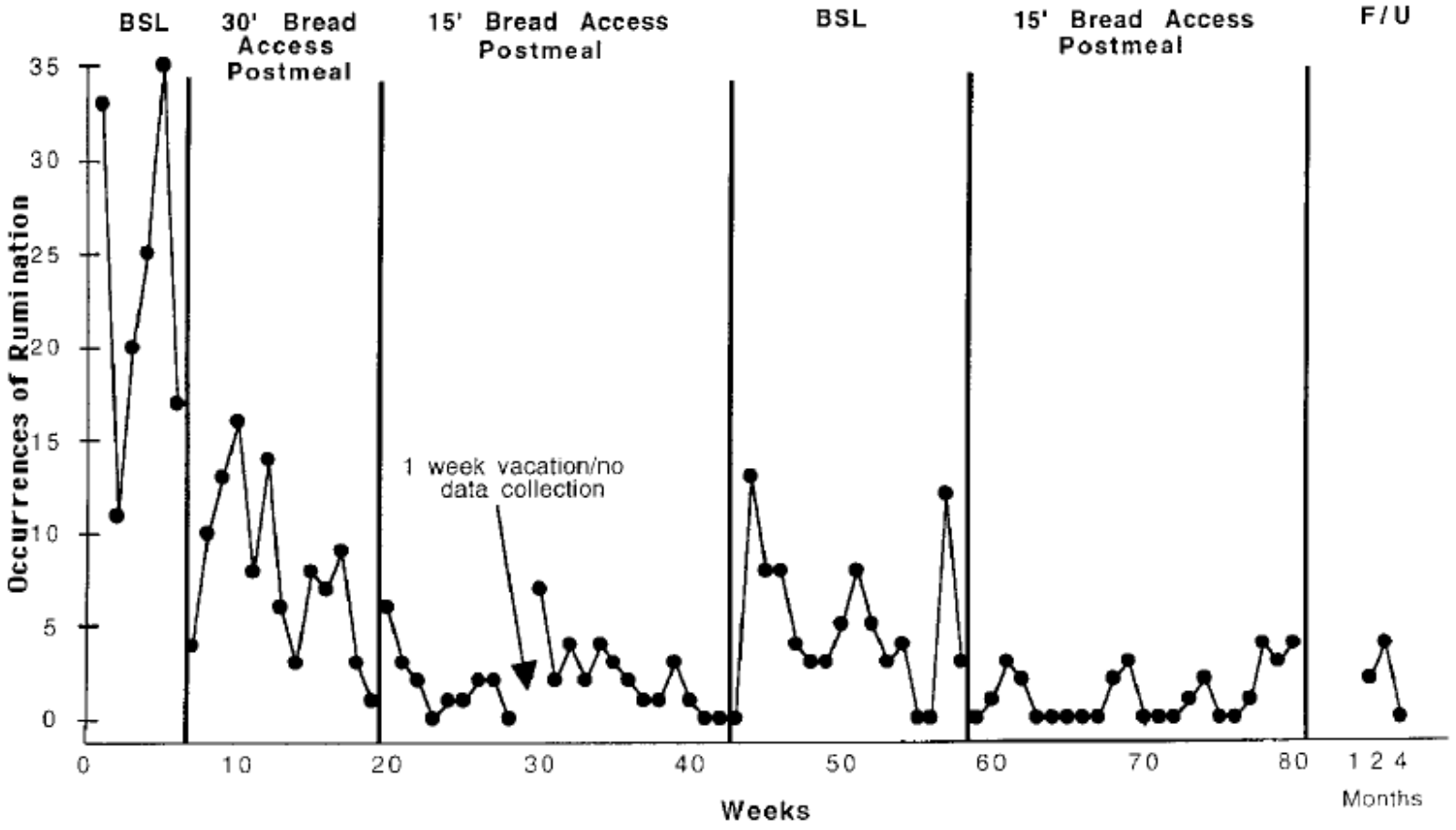
  => Aspiration verursacht Tod bei 5-10% von 'Ruminatoren'
- soziale Isolation

- Behandlungsoption: *ad libitum* Essensaufnahme/Sättigung

BRIEF REPORT: EFFECTS OF SUPPLEMENTAL FEEDINGS OF WHITE BREAD ON CHRONIC RUMINATION

Behavioral Interventions
Behav. Intervent., 13, 227–233 (1998)

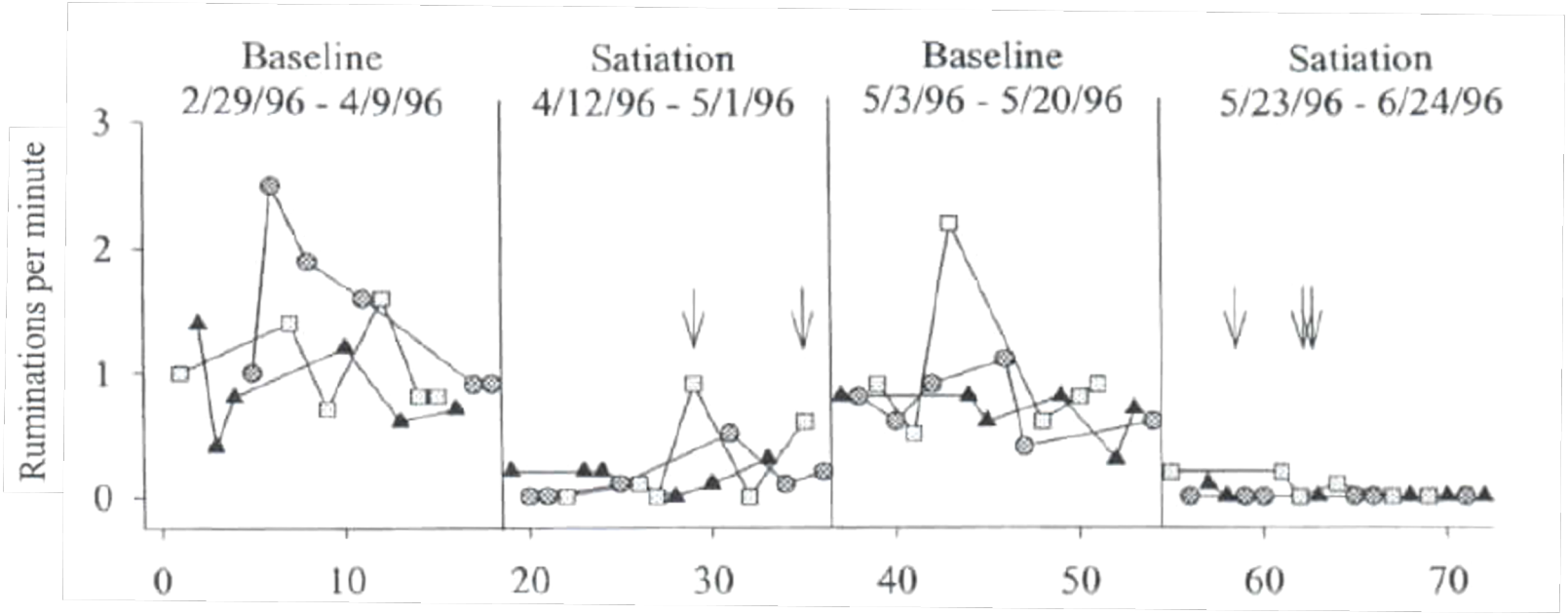
Christopher J. Masalsky* and James K. Luiselli



Behavioral Interventions
Behav. Intervent. **17**: 21–29 (2002)

DECREASING RUMINATION USING A STARCHY FOOD SATIATION PROCEDURE

Laura L. Dudley[1,2]*, Cammarie Johnson[1,2]* and R. Scott Barnes[1]



Definitionen

- Rumination (Wiederkäuen) / Merycismus
  - “im Geiste hin- und herbewegen”
  - “to chew the cud” - wiederkäuen

    => beinhaltet Regurgitation, Kauen, Wieder-Schlucken

    => Verhaltensstörung bei Menschen und bei manchen Zootieren (‘rumination syndrome’ / ‘RR’)

    => obligatorischer Mechanismus bei funktionellen Wiederkäuern

    => vermutlich fakultativer Mechanismus bei einigen Pflanzenfressern

Wiederkäuen bei Wiederkäuern

Wiederkäuen bei Wiederkäuern

Wiederkäuen bei Kameliden

Warum Wiederkäuen ?

- Predations-Vermeidung
  - *"Wiederkäuen erlaubt es Pflanzenfressern, rasch zu fressen und das Kauen auf später zu verschieben"* (Karasov & Del Rio 2007)

    => Wiederkäuer sollten gleich viel fressen wie andere Pflanzenfresser und 'später kauen' – oder in der Futteraufnahme zeitlich limitiert sein

Life cycle period and activity of prey influence their susceptibility to predators

A. Molinari-Jobin, P. Molinari, A. Loison, J.-M. Gaillard and U. Breitenmoser

ECOGRAPHY 27: 323–329, 2004

We found more chamois predated when feeding, whereas roe deer were predated mainly when ruminating.

Warum Wiederkäuen ?

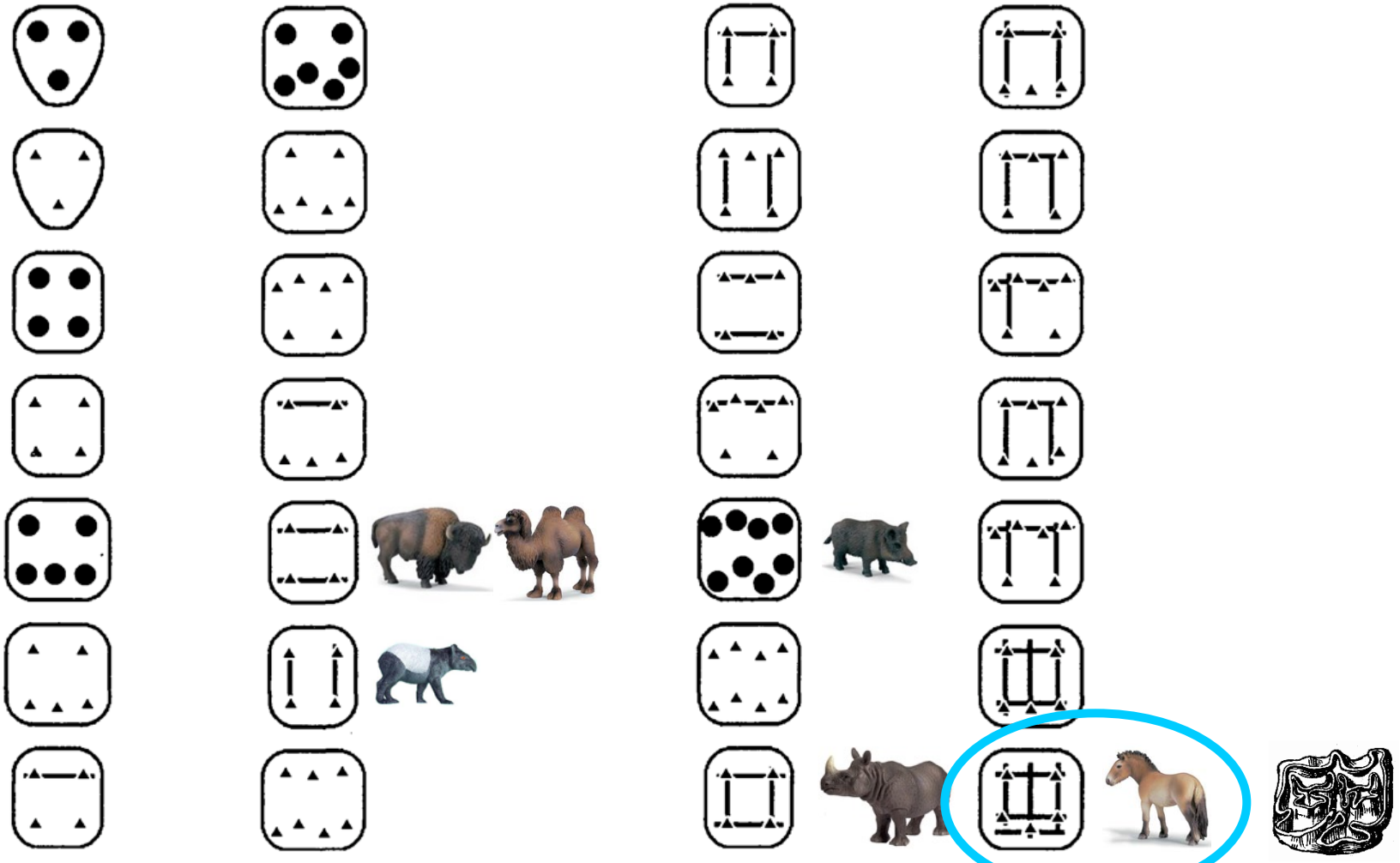
- Predations-Vermeidung
  - *"Wiederkäuen erlaubt es Pflanzenfressern, rasch zu fressen und das Kauen auf später zu verschieben"* (Karasov & Del Rio 2007)

    => Wiederkäuer sollten gleich viel fressen wie andere Pflanzenfresser und 'später kauen' – oder in der Futteraufnahme zeitlich limitiert sein
- Energie-Spar-Mechanismus
  - Wiederkäuern geschieht in einem ruheähnlichem Zustand der 'Dösigkeit'; weniger Zeit wird 'hellwach' verbracht, was Energie spart(Gordon 1968)

    => Wiederkäuer sollten geringeren Energiebedarf/höhere Produktivität haben als andere Pflanzenfresser
- Beschleunigung/Verbesserung der Verdauung
  - Wiederkäuen reduziert die Partikelgrösse und ermöglichst so eine schnellere Verdauung bei gleicher Futteraufnahme

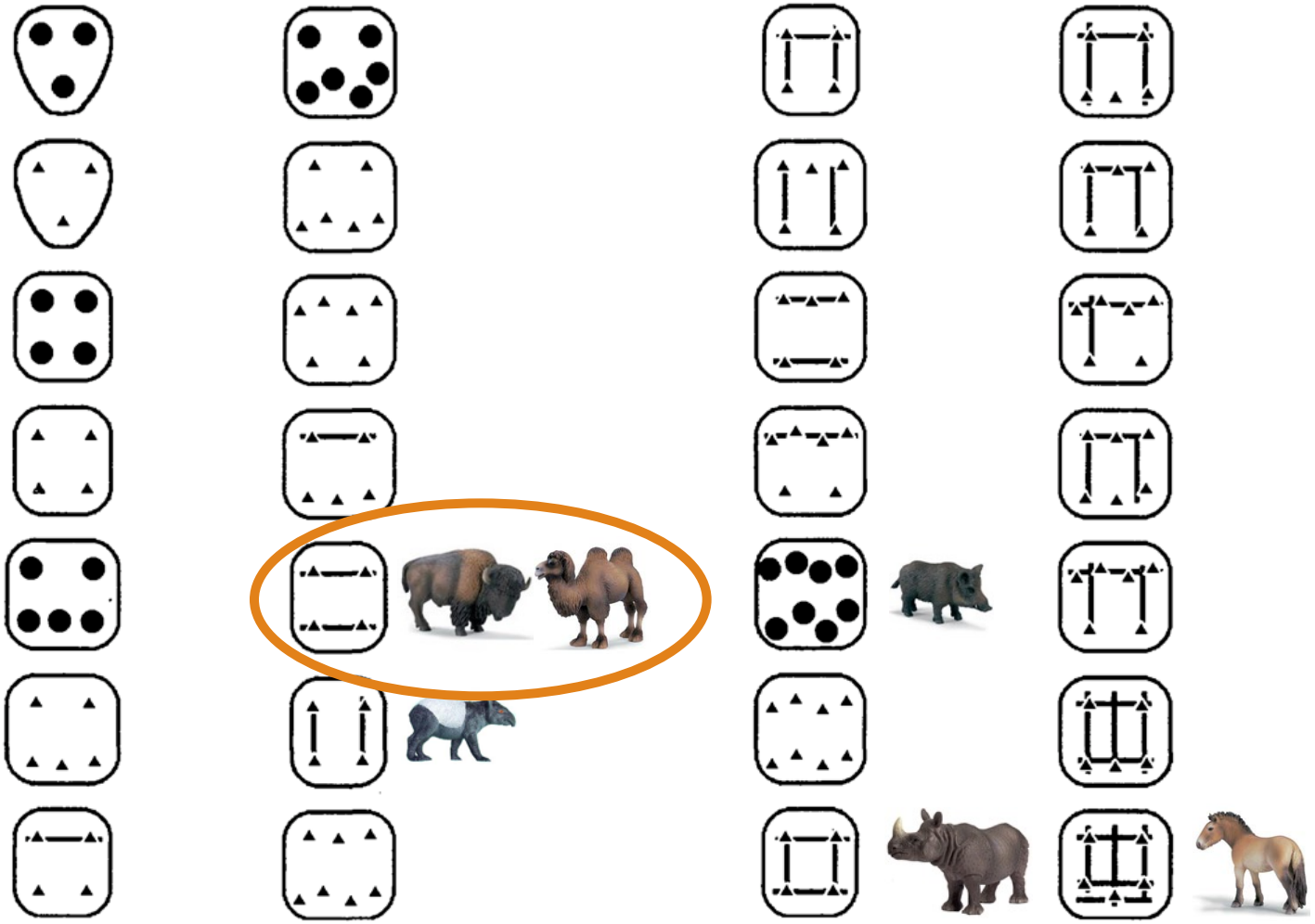
    => Wiederkäuer sollten kleinere Kotpartikel und höhere Futteraufnahmen haben als andere Pflanzenfresser

Backenzahn-Oberflächen



aus Jernvall et al. (1996)

Backenzahn-Oberflächen

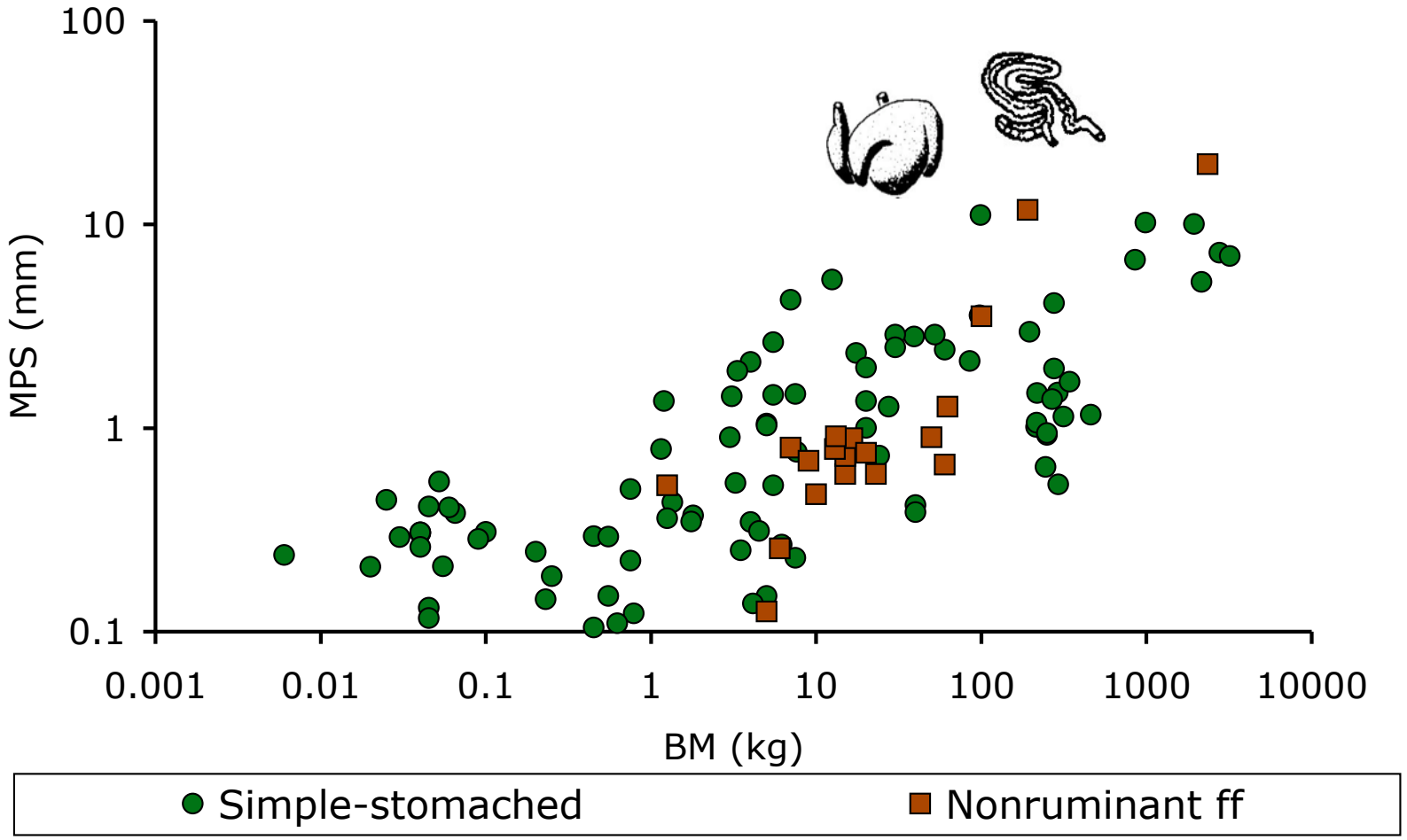


aus Jernvall et al. (1996)

Comparative chewing efficiency in mammalian herbivores

Julia Fritz, Jürgen Hummel, Ellen Kienzle, Christian Arnold, Charles Nunn and Marcus Clauss

Oikos 118: 1623–1632, 2009



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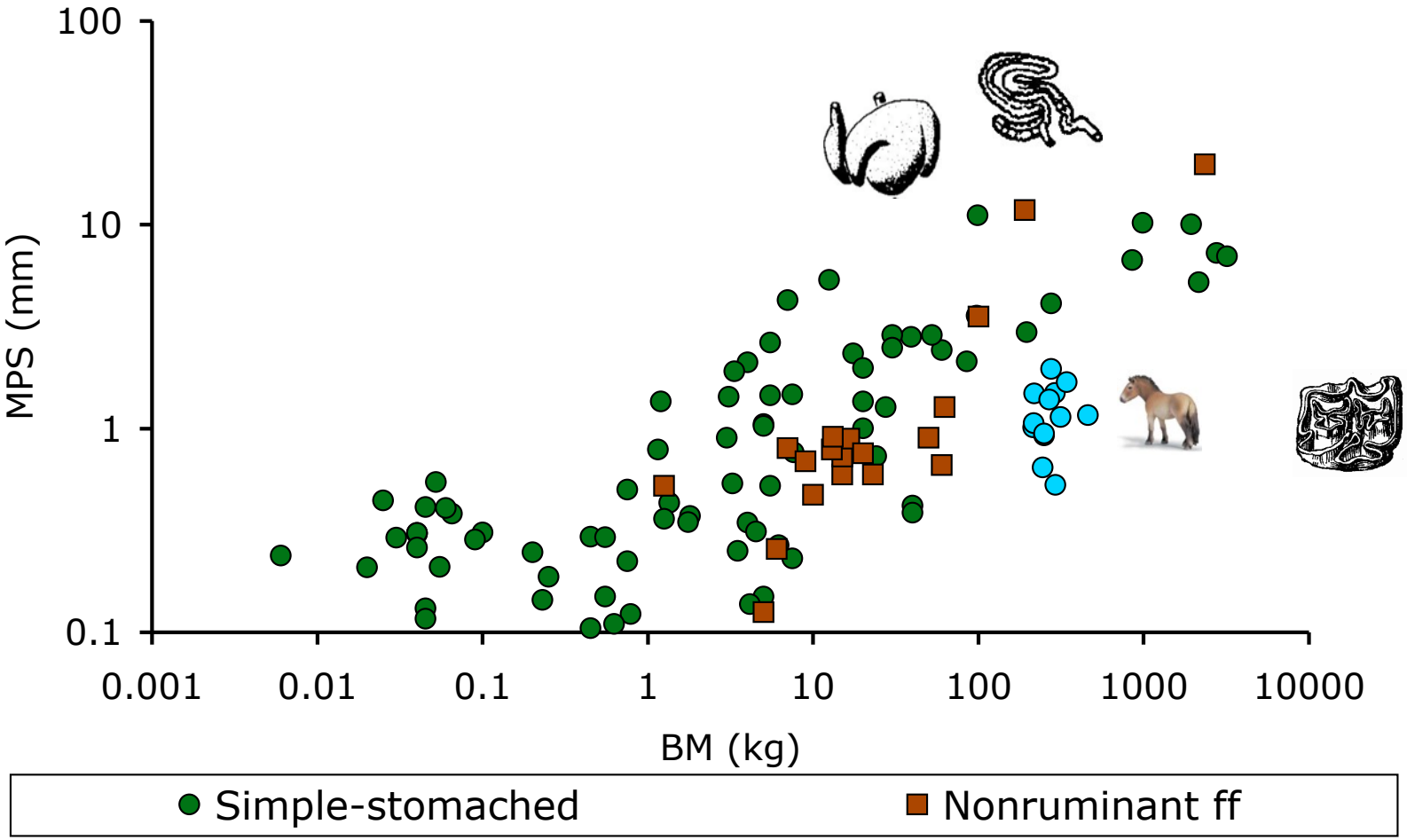

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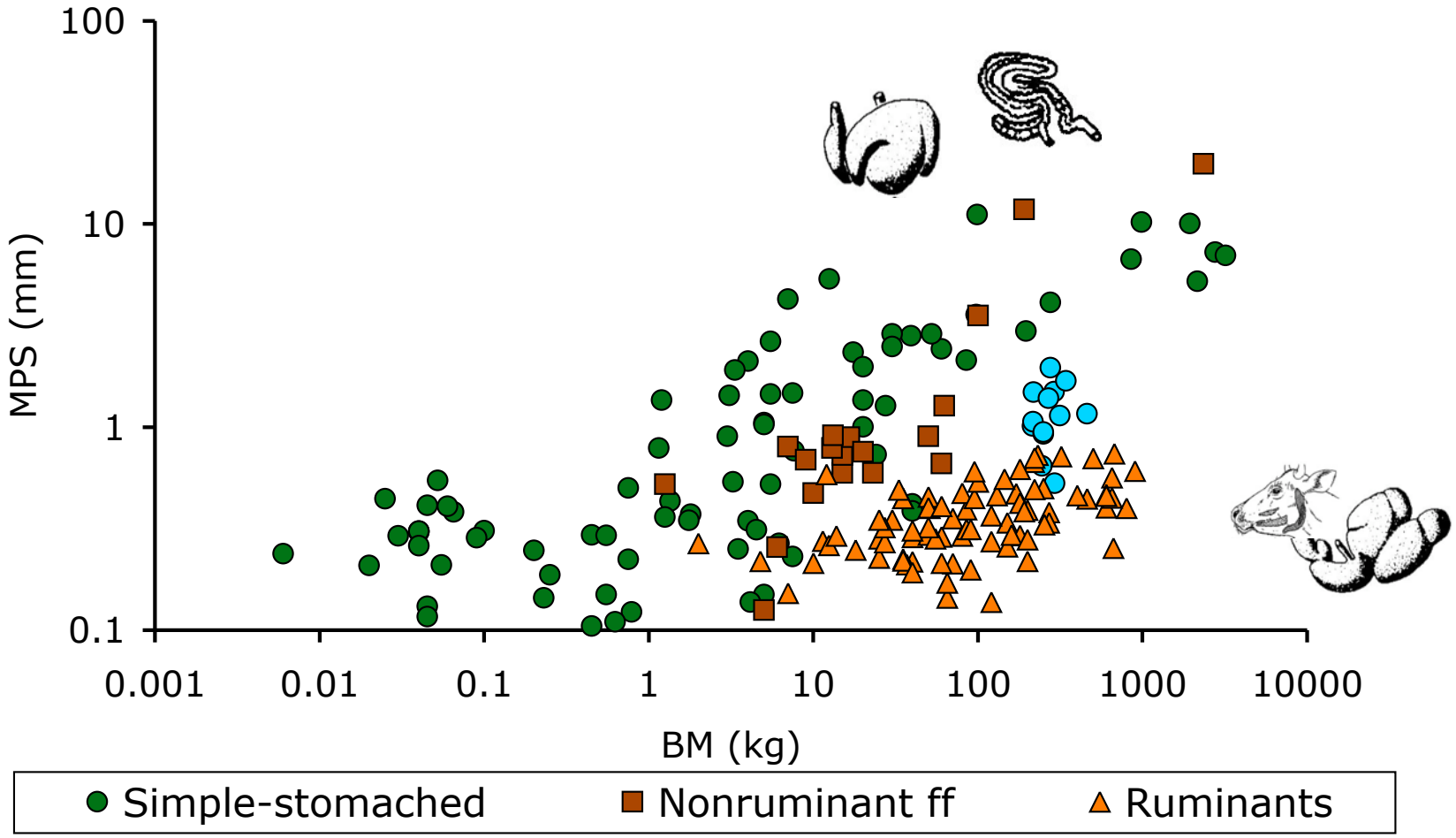
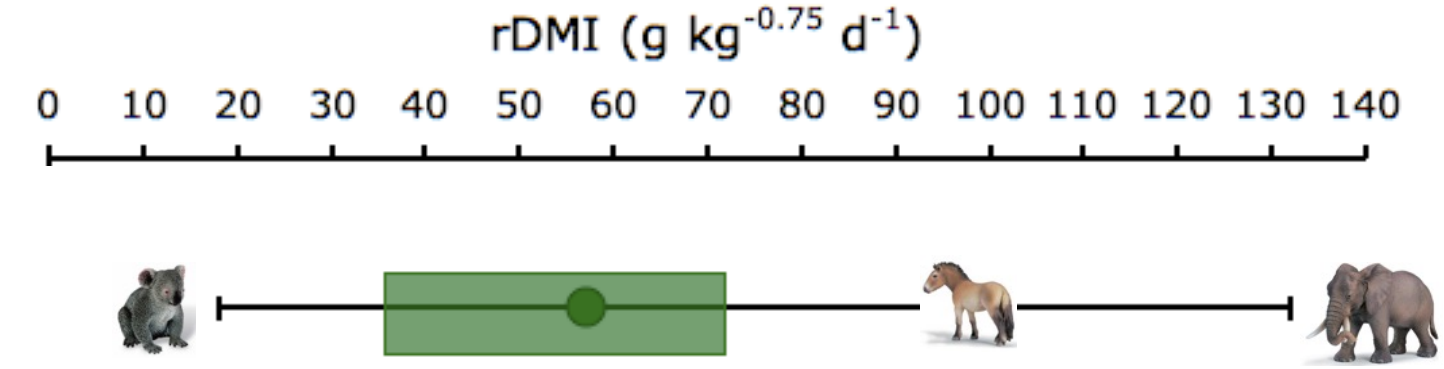


Futteraufnahme bei Pflanzenfressern



from Clauss et al. (2010)

Einfach öfter kauen ?

Kotpartikel bei Wiederkäuer und Nicht-Wiederkäuer

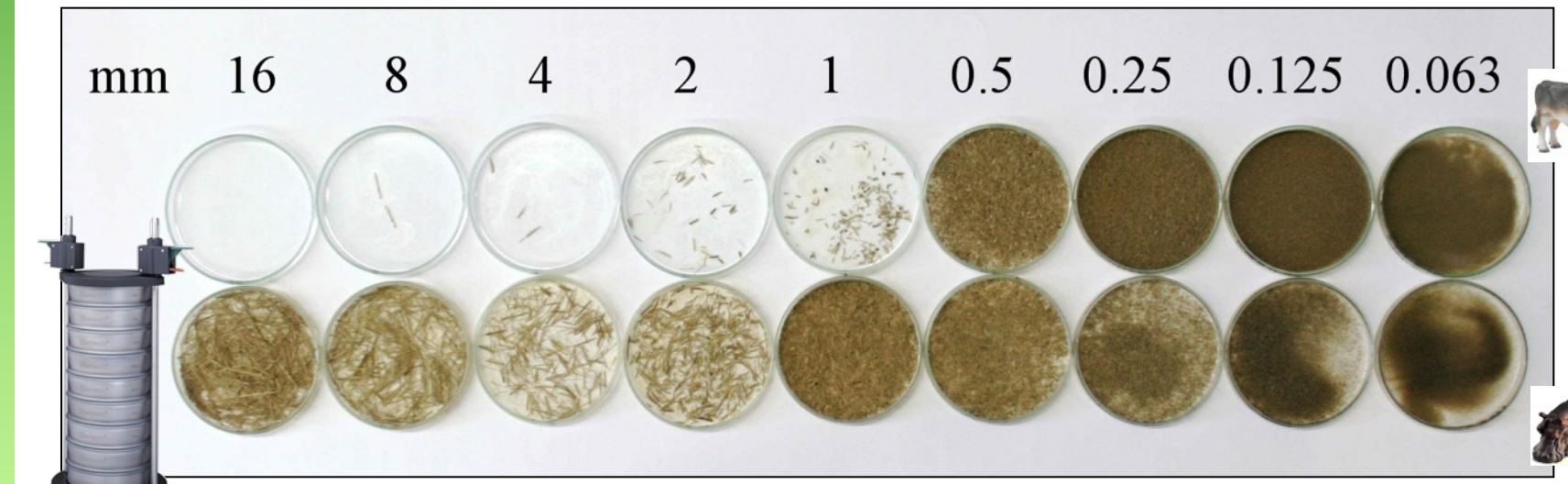
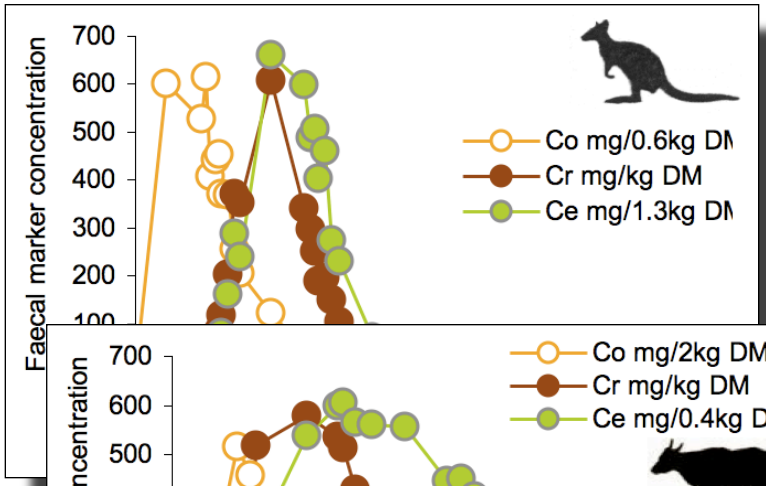
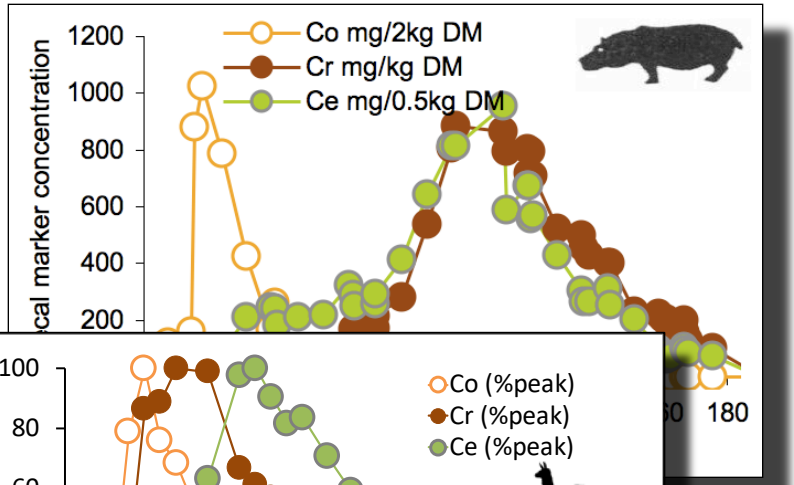
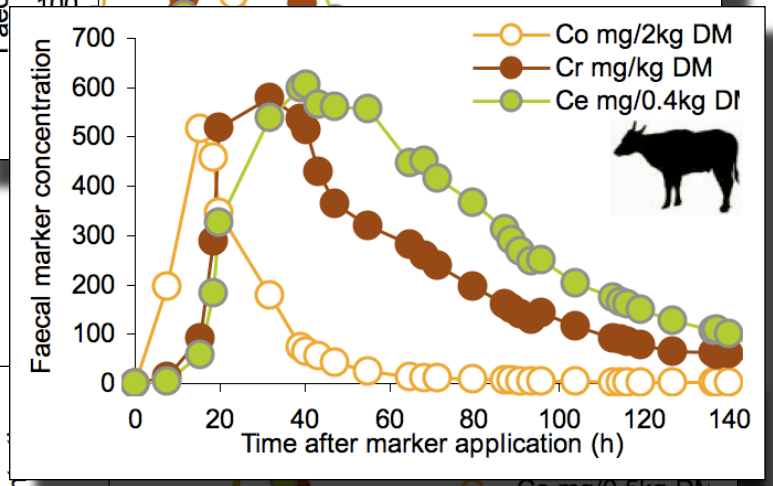


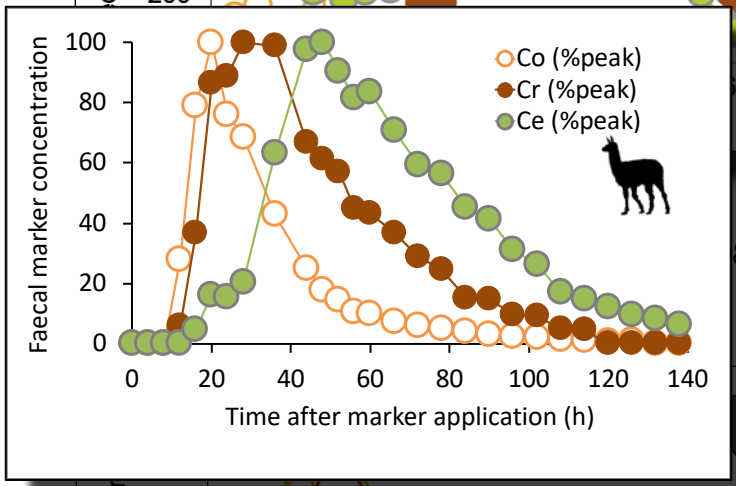
Photo A. Schwarm

Wer sortiert im Vormagen ?

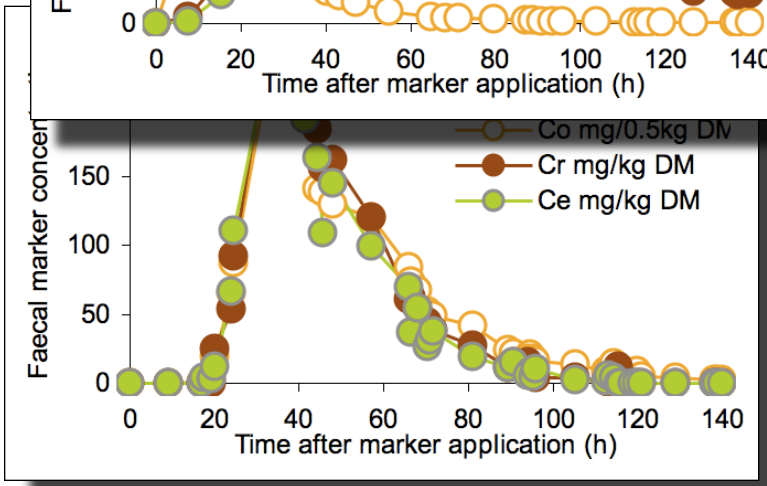


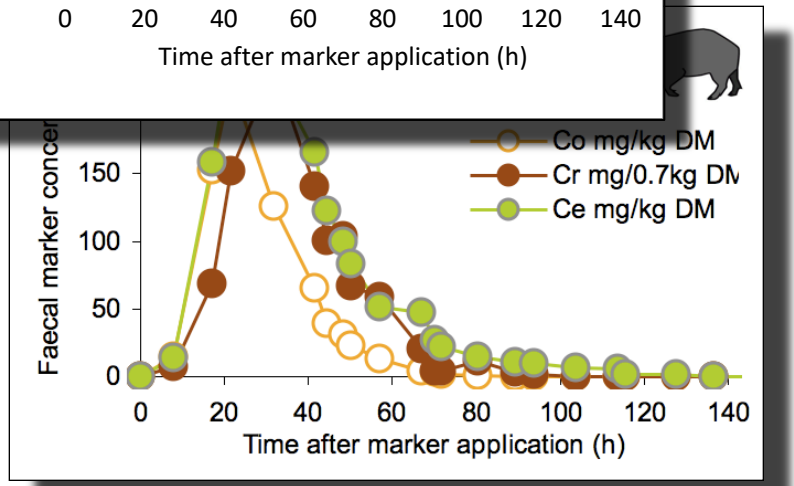






8,2009)





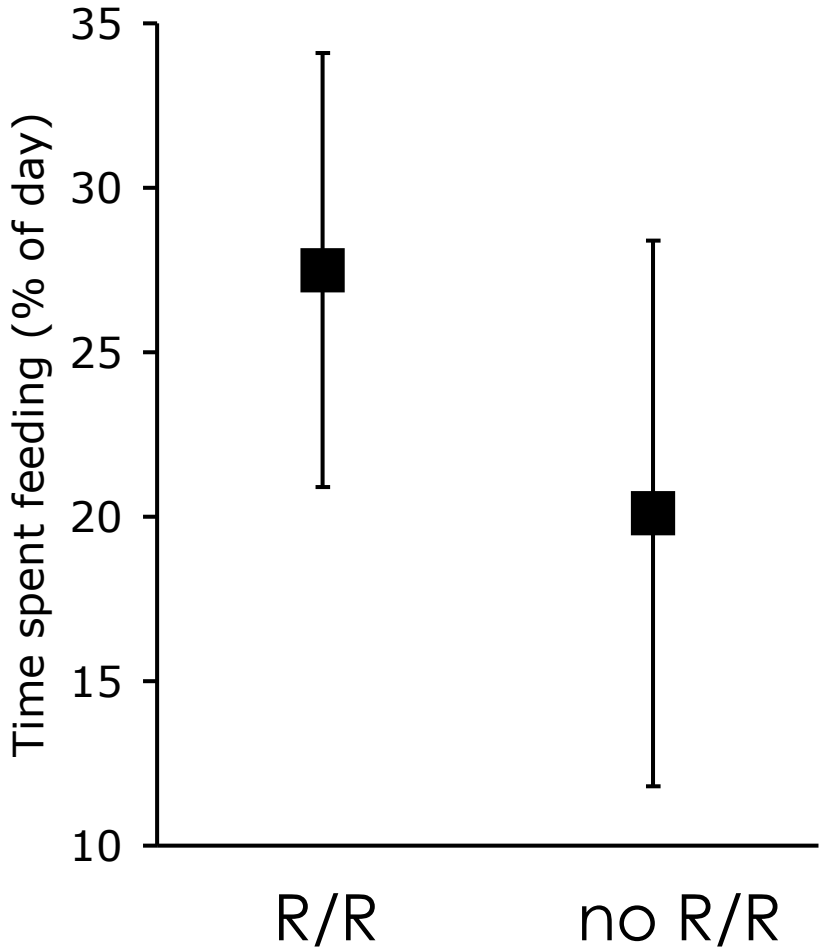
Nasenaffen (*Nasalis larvatus*)

biology letters
Physiology

Biol. Lett. (2011) 00, 1–4
doi:10.1098/rsbl.2011.0197
Published online 00 Month 0000

Regurgitation and remastication in the foregut-fermenting proboscis monkey (*Nasalis larvatus*)

Ikki Matsuda[1,*], Tadahiro Murai[1], Marcus Clauss[2], Tomomi Yamada[3], Augustine Tuuga[4], Henry Bernard[5] and Seigo Higashi[6]



Kängurus

The case of the kangaroos

Food Regurgitation in the Macropodidae

S. BARKER,* G. D. BROWN† and J. H. CALABY*

BIOLOGISCHES ZENTRALBLATT

Band 84 November–Dezember 1965 Heft 6

Vergleichende Untersuchung des Wiederkauverhaltens

Von HUBERT HENDRICHS[1])

Dagegen sah ich folgende Marsupialier wiederkauen:

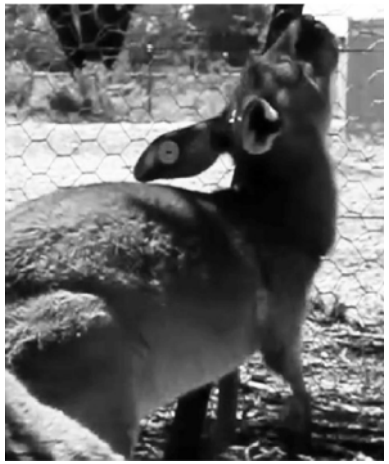
Thylogale eugenii (DESMAREST, 1817)
Setonix brachyurus (QUOY et GAIMARD, 1830)
Dendrolagus ursinus (TEMMINCK, 1836)
Dendrolagus ursinus iniustus (MÜLLER, 1840)
Protemnodon agilis (GOULD, 1842)
Protemnodon rufogrisea (DESMAREST, 1817)
Macropus gigantea (ZIMMERMANN, 1777)
Macropus (Megaleia) rufus (DESMAREST, 1822)
Macropus (Osphranter) robustus (GOULD, 1841).

Kängurus

Merycism in western grey (*Macropus fuliginosus*) and red kangaroos (*Macropus rufus*)

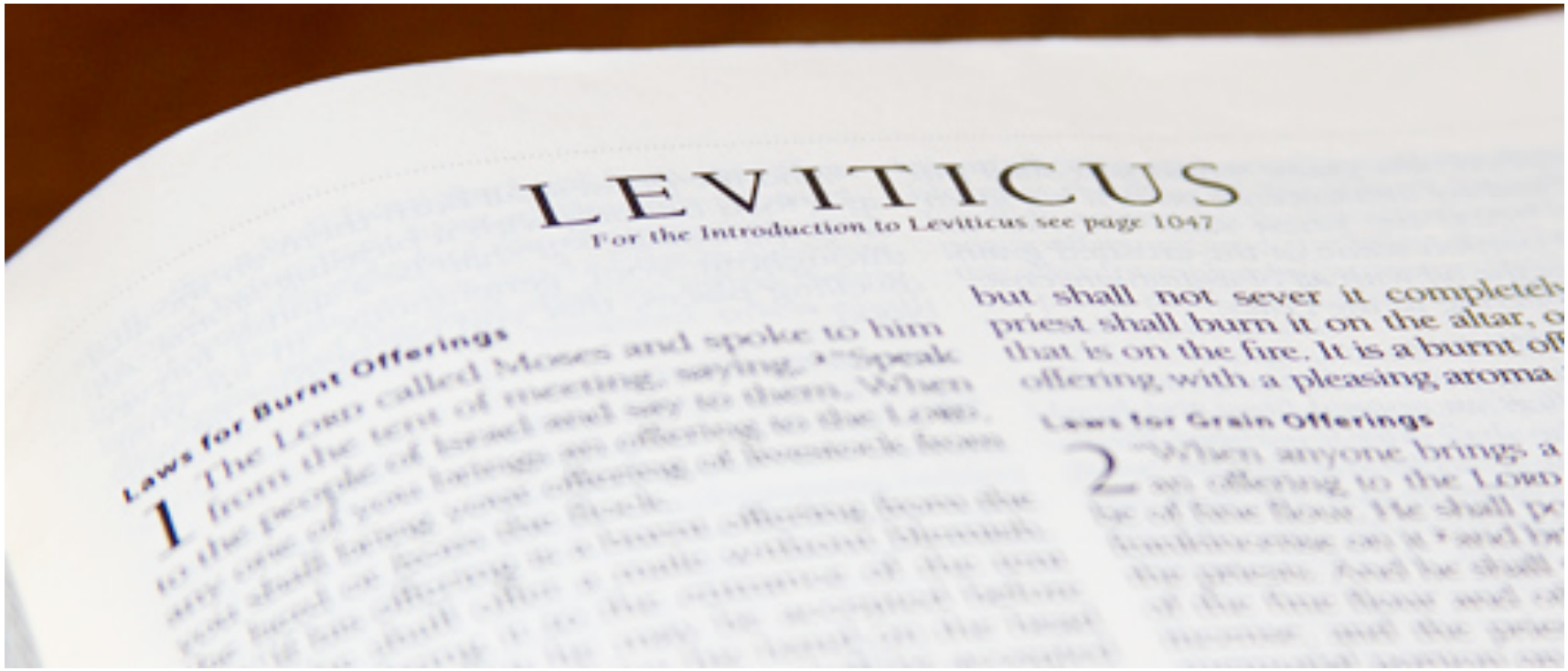
Catharina Vendl[a,c,*], Adam Munn[a], Keith Leggett[b], Marcus Clauss[c]

Mammalian Biology 86 (2017) 21–26



Klippschliefer (*Procavia* spp.)

Klippschliefer (*Procavia* spp.)



Leviticus 11 (New International Version NIV)
Clean and Unclean Food

11 The Lord said to Moses and Aaron, [2] "Say to the Israelites: 'Of all the animals that live on land, these are the ones you may eat: [3] You may eat any animal that has a divided hoof and that chews the cud. [4] "'There are some that only chew the cud or only have a divided hoof, but you must not eat them. The camel, though it chews the cud, does not have a divided hoof; it is ceremonially unclean for you. [5] **The hyrax**, though it **chews the cud**, does not have a divided hoof; it is unclean for you.

Klippschliefer (*Procavia* spp.)

BIOLOGISCHES ZENTRALBLATT

Band 84 November–Dezember 1965 Heft 6

Vergleichende Untersuchung des Wiederkauverhaltens

Von HUBERT HENDRICHS[1])

VI. Entdeckung von Wiederkauen bei einer Säugetierordnung

bereiste, schreibt vom „Aschkoko", dem Klippschliefer: „Ich hörte nie einen Laut von ihm, aber er käuet zuverlässig wieder: um dies zu untersuchen unterhielt ich ihn hauptsächlich eine Zeitlang lebendig".

Klippschliefer (*Procavia* spp.)

Koala (*Phascolarctos cinereus*)

J. Zool., Lond. (2001) **255**, 83–87 Printed in the United Kingdom

Evidence for the occurrence of rumination-like behaviour, or merycism, in the koala (*Phascolarctos cinereus*, Goldfuss)

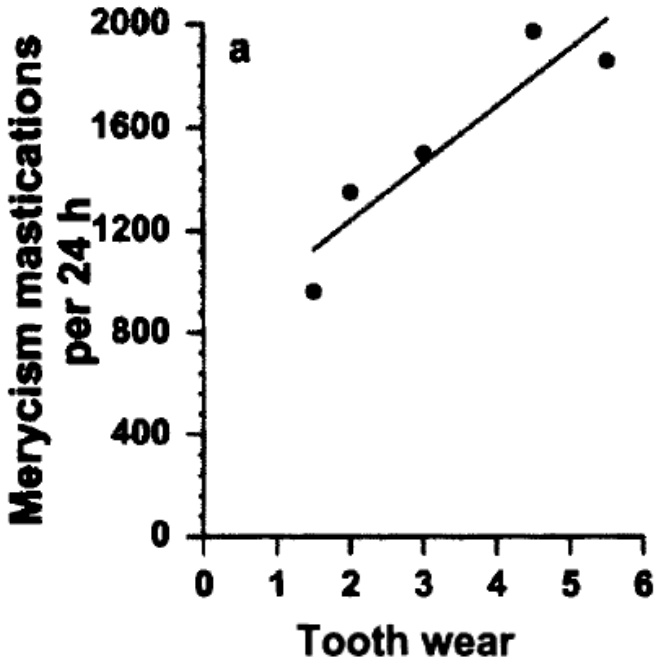
M. Logan

Koala (*Phascolarctos cinereus*)

EFFECT OF TOOTH WEAR ON THE RUMINATION-LIKE BEHAVIOR, OR MERYCISM, OF FREE-RANGING KOALAS (*PHASCOLARCTOS CINEREUS*)

M. LOGAN*

Journal of Mammalogy, 84(3):897–902, 2003

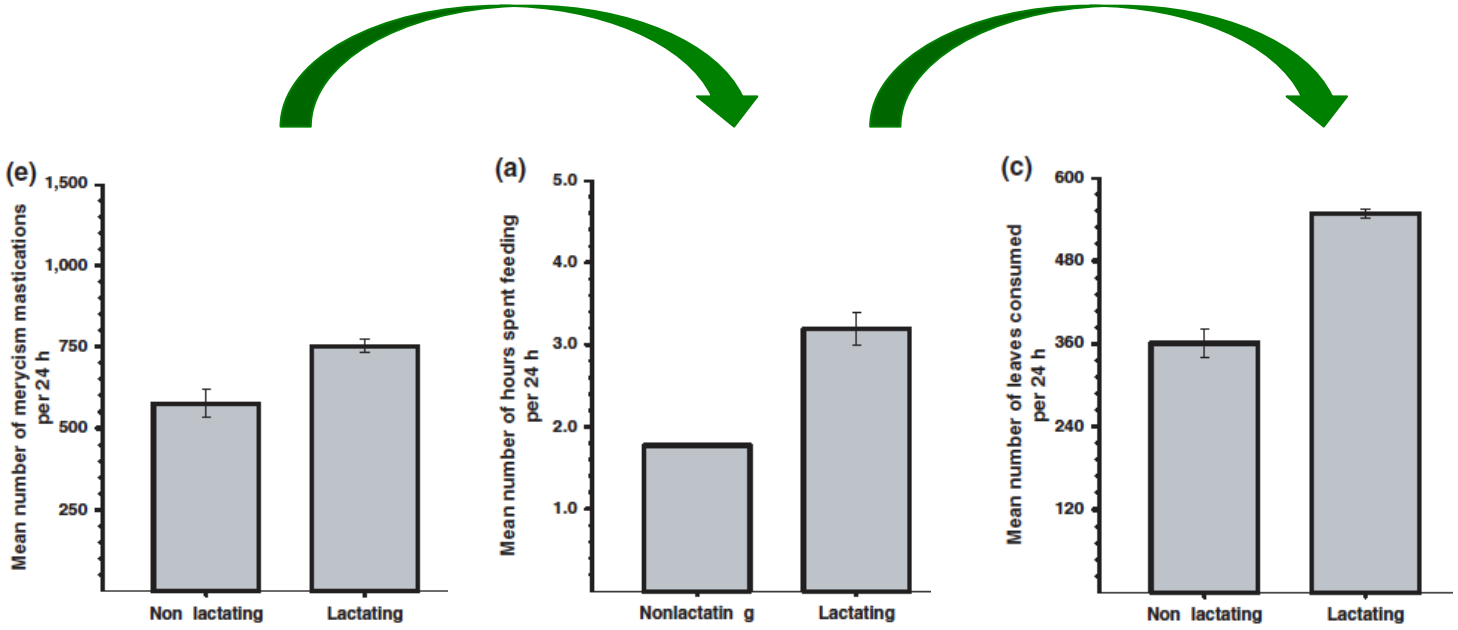


Koala (*Phascolarctos cinereus*)

The effects of lactation on the feeding behaviour and activity patterns of free-ranging female koalas (*Phascolarctos cinereus* Goldfuss)

Australian Journal of Zoology, 2003, **51**, 415–428

M. Logan and G. D. Sanson



Warum Wiederkäuen ?

- Predations-Vermeidung
  - *"Wiederkäuen erlaubt es Pflanzenfressern, rasch zu fressen und das Kauen auf später zu verschieben"* (Karasov & Del Rio 2007)
    => Wiederkäuer sollten gleich viel fressen wie andere Pflanzenfresser und 'später kauen' – oder in der Futteraufnahme zeitlich limitiert sein
- Energie-Spar-Mechanismus
  - Wiederkäuern geschieht in einem ruheähnlichem Zustand der 'Dösigkeit'; weniger Zeit wird 'hellwach' verbracht, was Energie spart(Gordon 1968)
    => Wiederkäuer sollten geringeren Energiebedarf/höhere Produktivität haben als andere Pflanzenfresser
- Beschleunigung/Verbesserung der Verdauung
  - Wiederkäuen reduziert die Partikelgrösse und ermöglichst so eine schnellere Verdauung bei gleicher Futteraufnahme
    => Wiederkäuer sollten kleinere Kotpartikel und höhere Futteraufnahmen haben als andere Pflanzenfresser

Kauhalftermessungen

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Validation of a pressure sensor-based system for measuring eating, rumination and drinking behaviour of dairy cattle

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[b] Natural Resources Institute Finland (Luke), Green Technology, Maaninka, Finland
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ABSTRACT

The main objective of our study was to validate, for dairy cows, a new pressure-based system (RumiWatch noseband sensor, Itin + Hoch GmbH, Liestal, Switzerland; RWS) that measures eating, rumination and drinking time. In experiment 1, eating, rumination and drinking time (RWS, min/h) measurements were compared with continuous behaviour recording (CR) of six dairy cows in tie-stalls (a total of 72 h). In addition, eating time measured by RWS was compared with the visiting time at automated feeders of a widely used type (Roughage Intake Control, RIC, Insentec BV, Marknesse, The Netherlands) to gain experience of the utility of RWS in a loose-housing system (experiment 2). A total of 403 h of RWS and RIC data from 18 cows was used for these two comparisons in experiment 2. In experiment 1, RWS and CR had a very dependable relationship (random coefficient regression model) for eating and rumination: eating, $y = 0.98$ (0.89–1.07)$x + 3.25$ (1.35) (the slope with the 95% confidence interval and the intercept with standard error of the mean) and rumination, $y = 0.88$ (0.73–1.02)$x + 1.77$ (1.00). The R^2 values were 0.94 and 0.93, respectively, i.e. random error was small. The 95% confidence intervals of the slopes included value 1, and the intercepts did not differ from 0; i.e. there was no significant systematic error. However, experiment 2 confirmed a tendency observed in experiment 1 that RWS overestimated eating, since RWS eating time (5.1 ± 2.7 h/24 h) exceeded significantly visiting time (RIC) (3.2 ± 1.1 h/24 h; paired t-test, $n = 18$) in the setup where, in principle, eating was possible only in the RIC feeders. In experiment 1, the relationship between drinking time (RWS) and CR was poor: $R^2 = 0.20$, and $y = 0.49$ (0.12–0.85)$x + 0.64$ (0.13). However, this may reflect more the challenges in measuring drinking in general than merely with RWS. In conclusion (i) the RWS results were relatively free from random errors for rumination and eating, but not for drinking, (ii) there was systematic error for eating and drinking, but not for rumination, and (iii) due to the relatively limited size of our data, further validation of RWS is recommended and RWS needs further development at least for eating and drinking measurements.

1. Introduction

Eating, rumination and drinking are essential components of the nutritional behaviour of dairy cows (Phillips, 2002). In scientific studies, the feeding behaviour of loose-housed cattle has been measured traditionally by direct observation methods. Automated equipment for measuring feeding behaviour and feed intake of cattle is, however, used more and more widely, because of the very labour-intensive requirements for conducting visual observations of behaviour (Beauchemin et al., 1989; Elischer et al., 2013). These types of automated equipment could also be of great benefit in large commercial dairy herds because ingestive behaviour can also be regarded as an important parameter for predicting health issues (as reviewed by Weary et al., 2009).

Devices used for measuring the feeding behaviour of dairy cows can be classified into two categories: stationary systems and systems based on sensors attached to animals. Stationary feeding systems use transponder tags that identify the individual animals and measure either the duration of visits at a feed alley (DeVries et al., 2003) or the visit duration and feed intake at feed troughs

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0168-1591/

Kauhalftermessungen

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Validation of a sensor-based automatic measurement system for monitoring chewing activity in horses

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ABSTRACT

The aim of this study was to determine the feasibility of using a jaw movement measuring system developed for cattle, the "RumiWatchSystem", on horses. The system records the chewing activity and consists of a noseband pressure sensor, integrated into a halter, and a software package. To investigate the accuracy of the system, 10 horses (5 mares, 5 stallions) were equipped with the device. Additionally, they were observed visually as a reference method, while feeding three different feeds (hay, haylage and concentrate). To ensure similar conditions, the horses were stabled individually and fed twice daily with roughage and twice or three times with concentrate. The results of the visual observation were compared to the automatic measurement as an evaluation of the accuracy of the automatic measurement system.

The overall agreement of the observed and automatically measured data within all feedstuffs was 93%. The agreement of feeding roughage was even higher with 95%. However, for concentrate the visual observations and automatic measurements agreed only in 91.4%. The decreased agreement compared to the roughage is due to the high sensitivity of the automated system. Horses tend to display a high amount of lip movements towards the end of the concentrate intake. This is different compared to cattle behaviour and their feeding regime. However, the system was not specifically adapted to horses so far and can be optimized in order to improve accuracy. Consequently, the system has a high potential to become a reliable tool for research and practical use.

1. Introduction

The chewing activity of horses can be a suitable parameter for health and welfare assessment as the prevalent housing and feeding conditions often leave horses unsatisfied. Evolutionary, horses adapted over a long period of time to their ecological niche (Janis, 1976). They used to live as grazers in steps with poor vegetation. Therefore, they are adjusted to a low energy and high fibre diet. The feed intake behaviour is defined by a long intake time of 12–16 h (Zeitler-Feicht, 2008; McGreevy, 2004) and travelling long distances of up to 28 km a day (Hampson et al., 2010). Because of the natural food resource, the gastric system is well adapted to small feeding bouts and a consistent filling of the stomach. With the help of microbial fermentation in the large caecum, it is possible to split high fibre feed (Frape, 2010). In modern housing systems, compared to the natural behaviour, horses are often fed roughage restrictive (twice daily) with an additional feeding of grains. This leads to a high amount of starch over a small period of time and can cause illness of the gastrointestinal system like gastric ulcerations (Hymøller et al., 2002). Even in pleasure horses the prevalence of gastric ulcer is 40–60% (Niedzwiedz et al., 2013). Additionally, horses are mostly individually stabled and there is often little or no possibility of social contact to other horses. In Northern Germany, 10% of stabled horses do not even have the possibility to observe their environment (Petersen et al., 2005). This deviation of natural behaviour may lead to abnormalities or stereotypies (Cooper and Albentosa 2005) and even to serious health problems. To evaluate and monitor the feed intake behaviour of a horse, it would be very valuable to measure the chewing activity automatically. The "RumiWatchSystem" could provide us with an assessment tool for different feeding regimes and husbandry systems.

There are still a number of unanswered questions, e.g. why such a high number of stomach ulcers occur in horses. Analyzing the chewing behaviour linked to different feeding regimes would provide us with valuable information and might lead us to the solution how to reduce stomach ulcers. Another possibility to use

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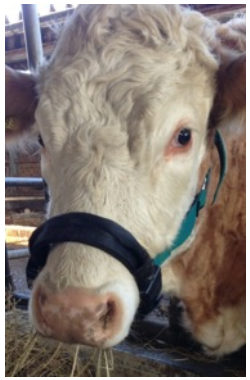
1871-1413/

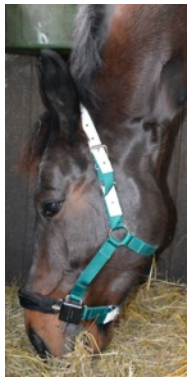
Methoden

6 Simmental Färsen (*Bos taurus*, 459 ± 110 kg)
6 Trampeltiere (*Camelus bactrianus*, 645 ± 60 kg)
6 Warmblutpferde (*Equus caballus*, 563 ± 44 kg)

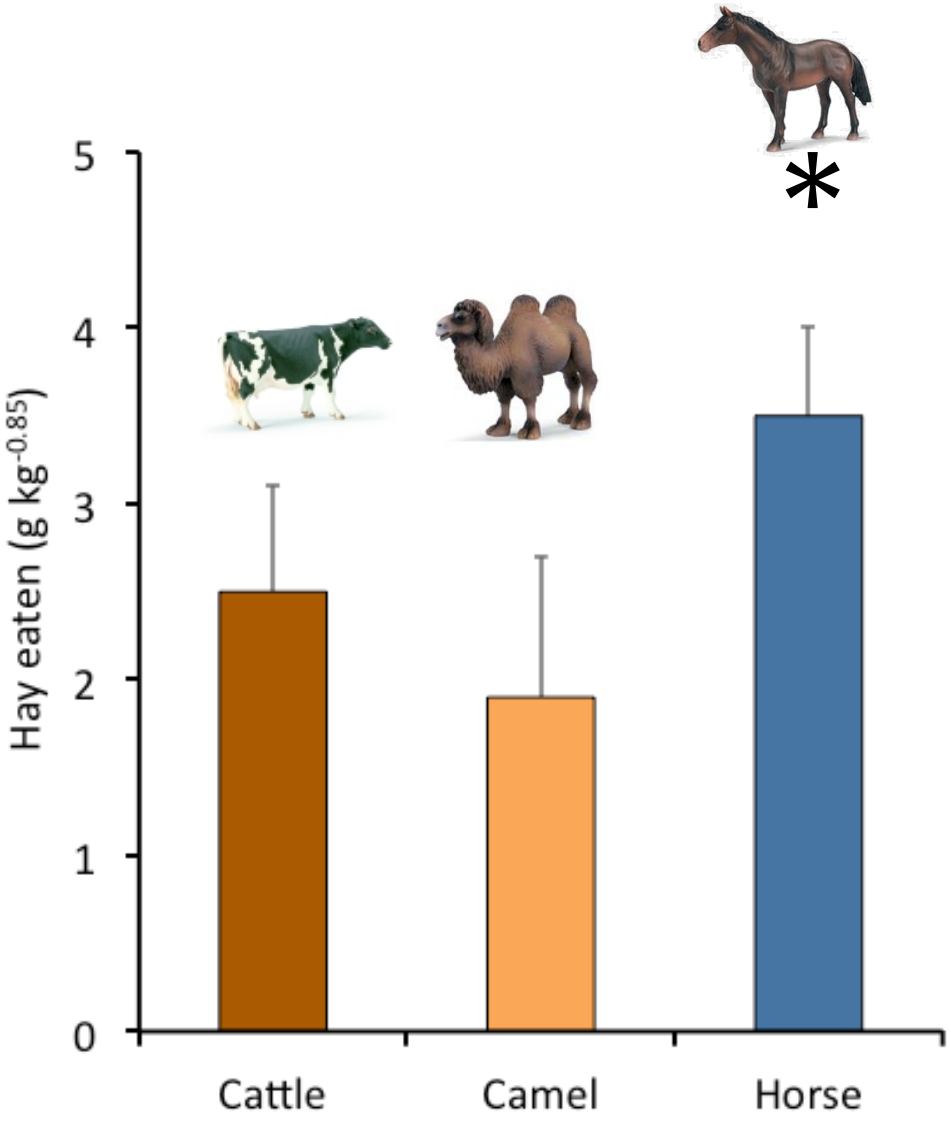
Rumiwatch Kauhalfter

Ganzes Heu (CP 74, NDF 607, ADF 324 g/kg DM)
für 15 Minuten (plus 2 h max. bis Wiederkäuen)
Futteraufnahme gemessen





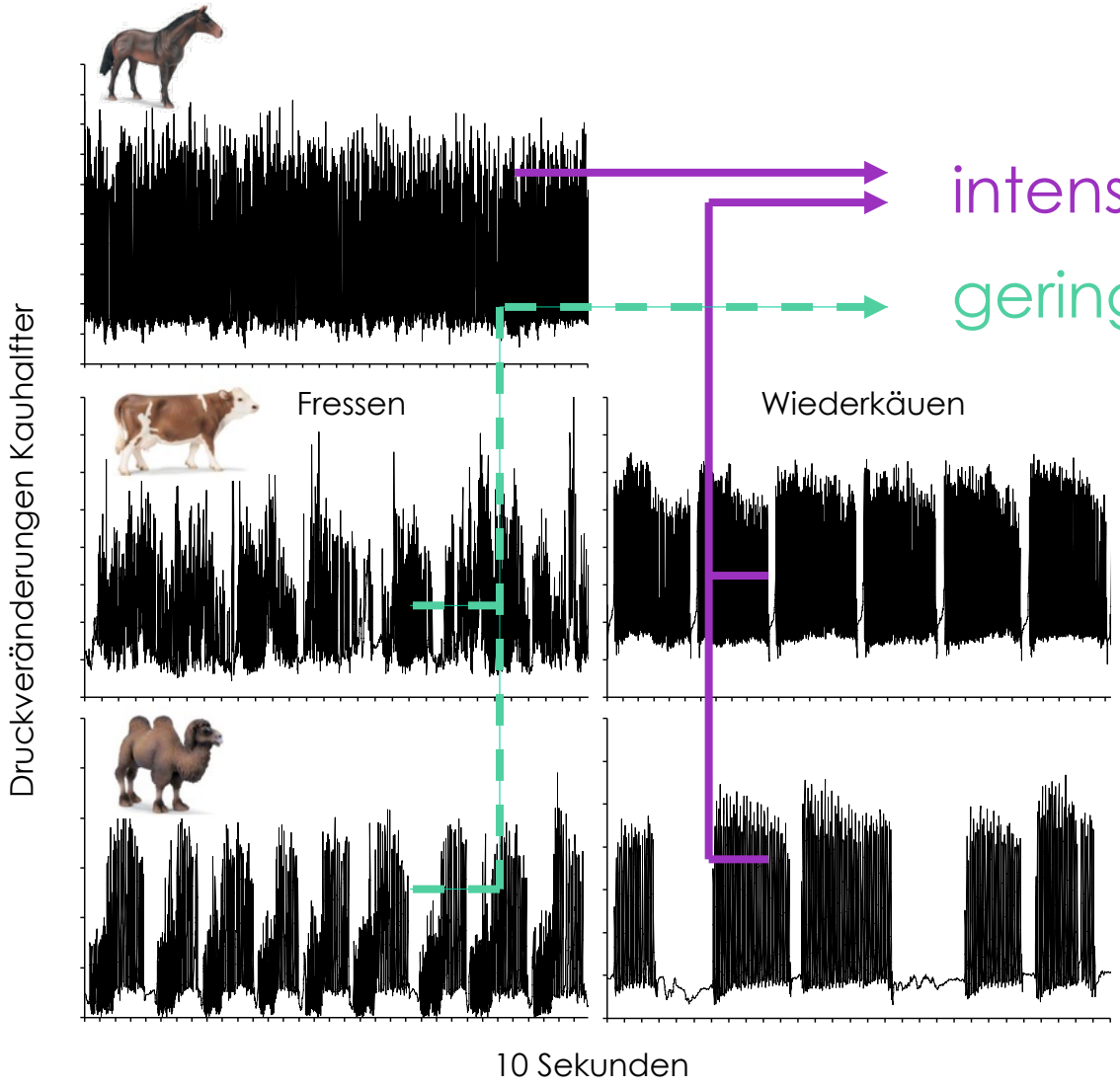
Futteraufnahme



Ingestive mastication in horses resembles rumination but not ingestive mastication in cattle and camels

J. Exp. Zool. 2017;**327**:98–109.

Marie T. Dittmann[1,2,3] | Michael Kreuzer[2] | Ullrich Runge[4] | Marcus Clauss[3]



intensive

geringe

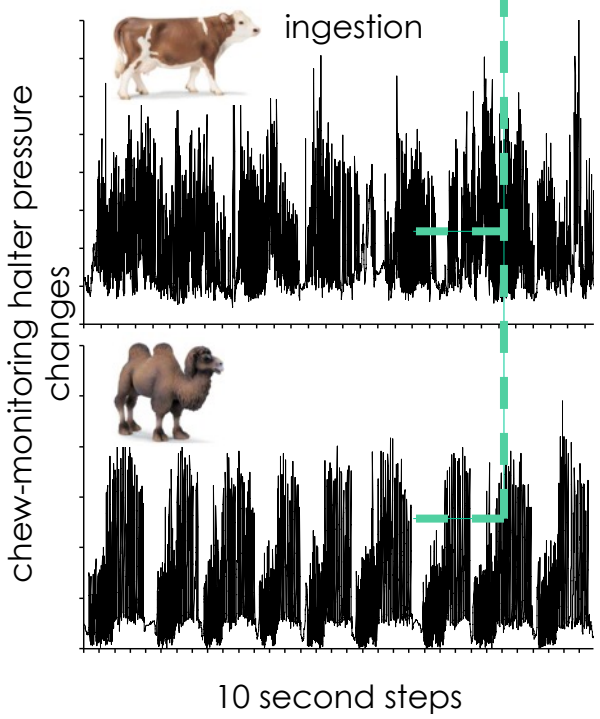
Partikel-Zerkleinerung

Die wirklich spannende Frage ist …

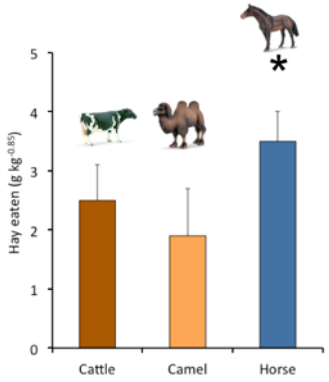
… warum kauen Wiederkäuer so 'nachlässig' beim Fressen ?

Partikel-Zerkleinerung

geringe



… wenn es nicht um die Futteraufnahme geht ?



Die wirklich spannende Frage ist ...

Wenn es um eine Optimierung der Partikelzerkleinerung ginge, sollten Wiederkäuer schon beim Fressen den rhythmischen/gleichmässigen Kauschlag verwenden.

Ein zusätzlicher Vorteil für Wiederkäuer

Wiederkäuer-Kau-Strategie:

Die Abriebs-intensiven gleichmässigen Kauschläge erst anwenden, wenn der Nahrungsbrei im Vormagen von Staub/Erde freigewaschen wurde.

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Original investigation

The rumen washes off abrasives before heavy-duty chewing in ruminants

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ABSTRACT

Based on comparative mandibular anatomy, observations of chewing behaviour, chewing forces and dental microwear, it has been suggested that an additional effect of the ruminant digestive strategy could be a reduction of both the required chewing load and tooth wear ruminants are exposed to. This effect is hypothesized to be the result of digestion, mixing, and digesta sorting prior to regurgitation for rumination, which might both soften the material and wash off external abrasives such as sand, grit and dust. Putatively, these external abrasives would thus be trapped in the (fore)stomach and excreted via the faeces. We investigated the location of sand in the stomach of goats fed diets containing phytoliths and sand for several months. The contents of the stomach section from where rumination material is recruited were comparatively depleted of sand. Sand mainly accumulated in another stomach section, the abomasum, without causing clinical problems. A certain phytolith content should hence affect ruminants and non-ruminant herbivores somewhat alike; however, a certain external abrasives content should affect ruminants less than non-ruminants. Results from feeding experiments as well as tooth wear studies support this hypothesis, and caution against the default use of dental anatomy and wear as taxon-free environmental proxies in paleobiology.

Introduction

It is well-known that the ruminant forestomach serves simultaneously as a site of microbial fermentation for plant material (Van Soest, 1994) and as a growth environment for microbiota later harvested by the host (Clauss and Hummel, 2017). Additionally, it comprises a sorting mechanism (Lechner-Doll et al., 1991) that facilitates a particle size reduction of the ingested food via rumination unrivalled by other herbivores (Clauss et al., 2015). This sorting mechanism is based on the interplay between a liquid medium and the floating and sedimenting properties of the digesta (Lechner-Doll et al., 1991).

Based on comparative mandibular anatomy (Fletcher et al., 2010; Zhou et al., 2019), observations of chewing behaviour (Janis et al., 2010; Dittmann et al., 2017), chewing forces (Williams et al., 2011) and dental microwear (Mihlbachler et al., 2016), it has been suggested that an additional effect of the ruminant digestive strategy could be a reduction of both the required chewing load and tooth wear ruminants are exposed to. This effect is hypothesized to be the result of digestion, mixing, and digesta sorting prior to regurgitation for rumination, which might both soften the material and wash off external abrasives such as sand, grit and dust. Putatively, these external abrasives would thus be trapped in the (fore)stomach and excreted via the faeces. Because the majority of particle size reduction occurs in ruminants not during ingestive masticaton but during rumination (McLeod and Minson, 1988), and because the chewing pattern during rumination is much more regular and systematic than during ingestion (Dittmann et al., 2017), rumination can be considered 'heavy-duty' chewing in contrast to ingestive mastication.

Here, we trace silica content in the digestive tract of goats (*Capra aegagrus hircus*) fed pelleted diets of different abrasives content (Ackermans et al., 2018, 2019). Three diets increased gradually in phytolith content (from lucerne [L] to grass [G] to a mix of grass and rice hulls [GR]), and the fourth diet added sand to the highest level of phytoliths [GRS] and therefore also represented external abrasives.

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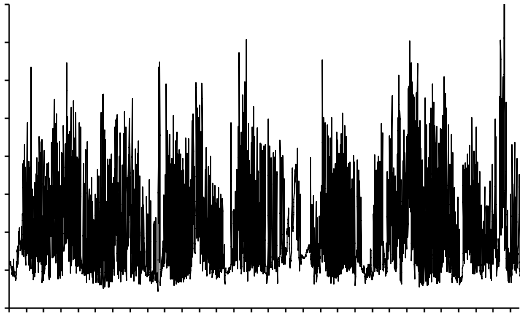
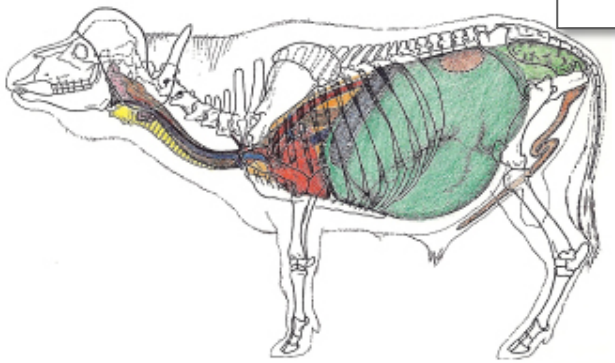
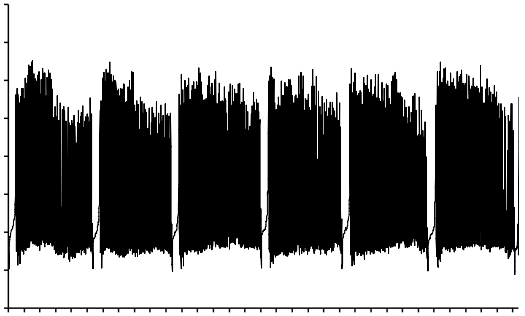
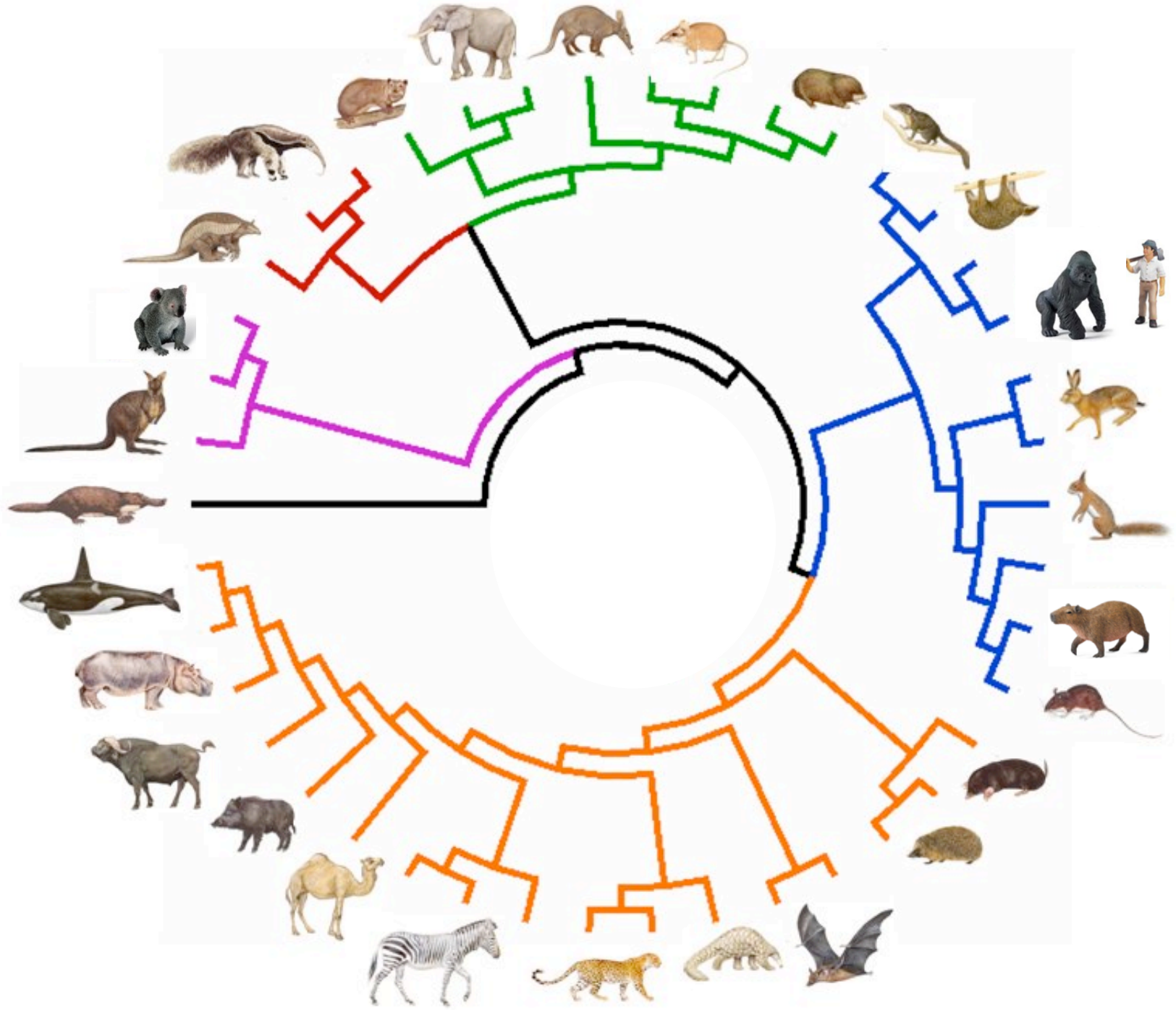
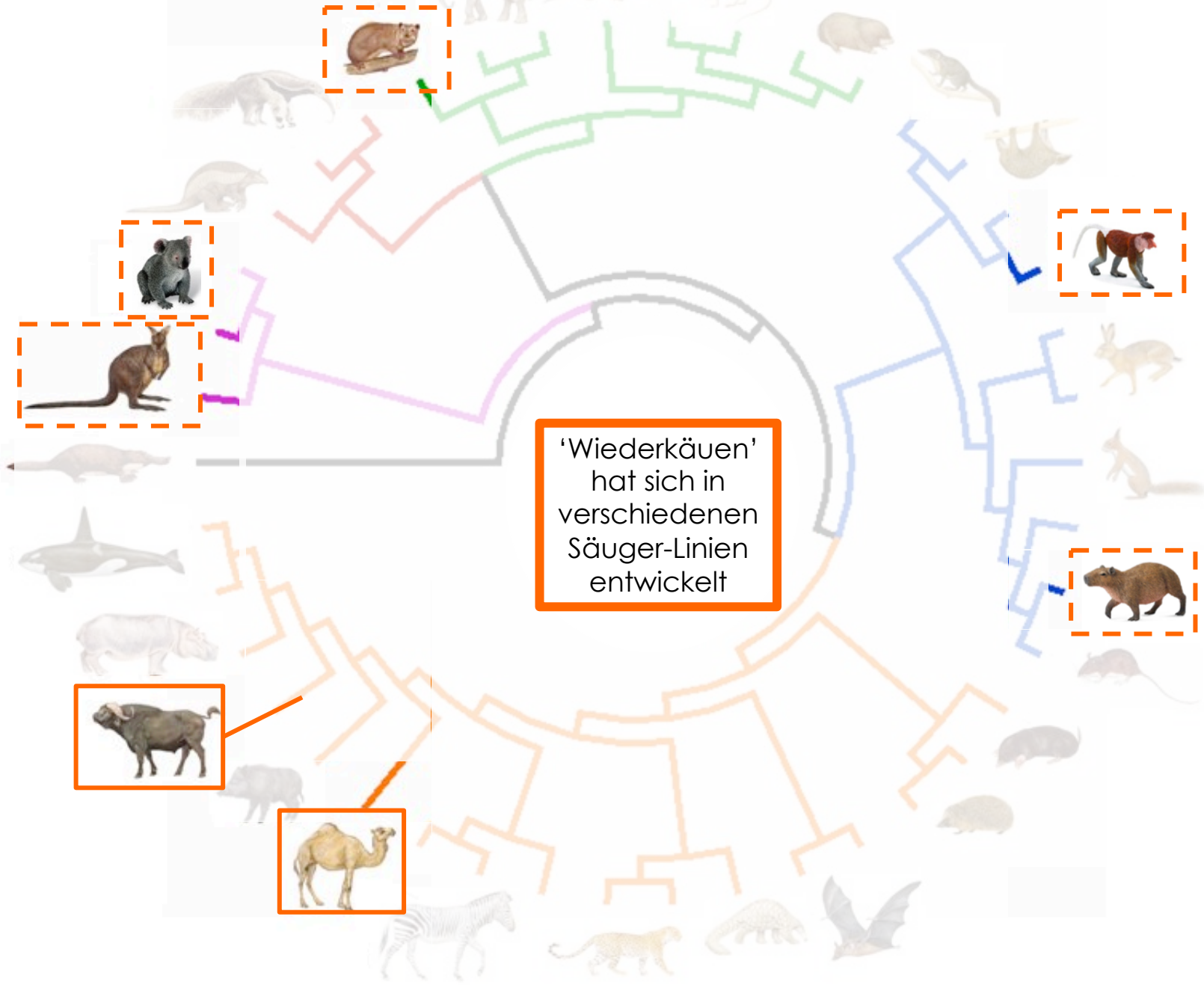








R/R als Verhaltens-störung scheinbar nur bei Menschen-affen / Menschen


'Wiederkäuen' hat sich in verschiedenen Säuger-Linien entwickelt

Wiederkäuen ist am effizientesten wenn mit einem Sortier-mechanismus gekoppelt … und optimiert die Futter-verwertung

vielen Dank für Ihre Aufmerksamkeit