NUTRITIONAL DISEASES: FROM BOTTLE FEEDING TO GERIATRIC ISSUES

Marcus Clauss & Jean-Michel Hatt

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EAZWV, Warschau 2014

University of Zurich[UZH]

Clinic of Zoo Animals, Exotic Pets and Wildlife


Child of the wilderness ...
... or potato couch?
Feeding herbivores in zoos
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Feeding ruminants
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Zoo animal nutrition - nutritional diseases

Approach to zoo animal nutrition

\+ **“do as we always did”** -

Historical approach

Variations in Eastern Bongo (*Tragelaphus eurycerus isaaci*) Feeding Practices in UK Zoological Collections

D. J. Wright,[1]* H. M. Omed,[1] C. M. Bishop,[1] and A. L. Fidgett[2]

Zoo Biology 30 : 149–164 (2011)

JZAR JOURNAL OF ZOO AND AQUARIUM RESEARCH
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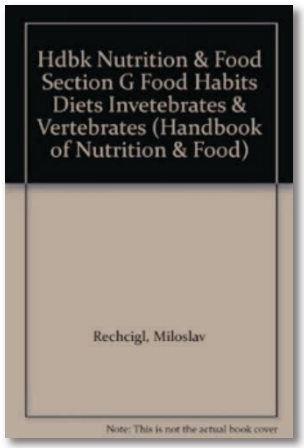
EAZA

Research Article

Feeding practices for captive greater kudus (*Tragelaphus strepsiceros*) in UK collections

Lucy A. Taylor[1,*], Christoph Schwitzer[1], Norman Owen-Smith[2], Michael Kreuzer[3] and Marcus Clauss[4]



Approach to zoo animal nutrition

"do as we always did"

+	-
based on experiences what has been working	sometimes 'experiences' are mistakes one has been making for long time

Approach to zoo animal nutrition

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“imitate the natural diet”

best approach

Approach to zoo animal nutrition

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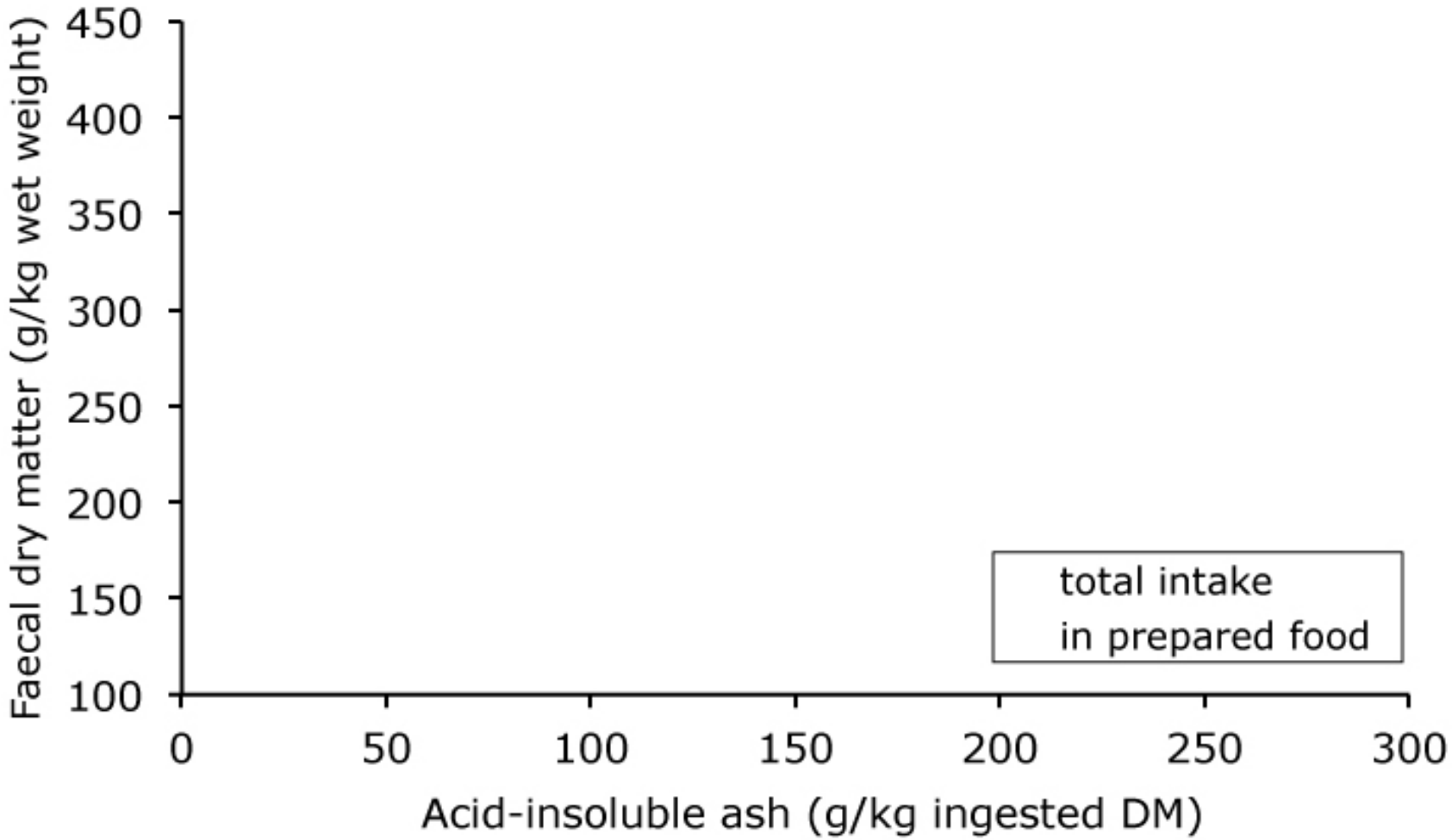
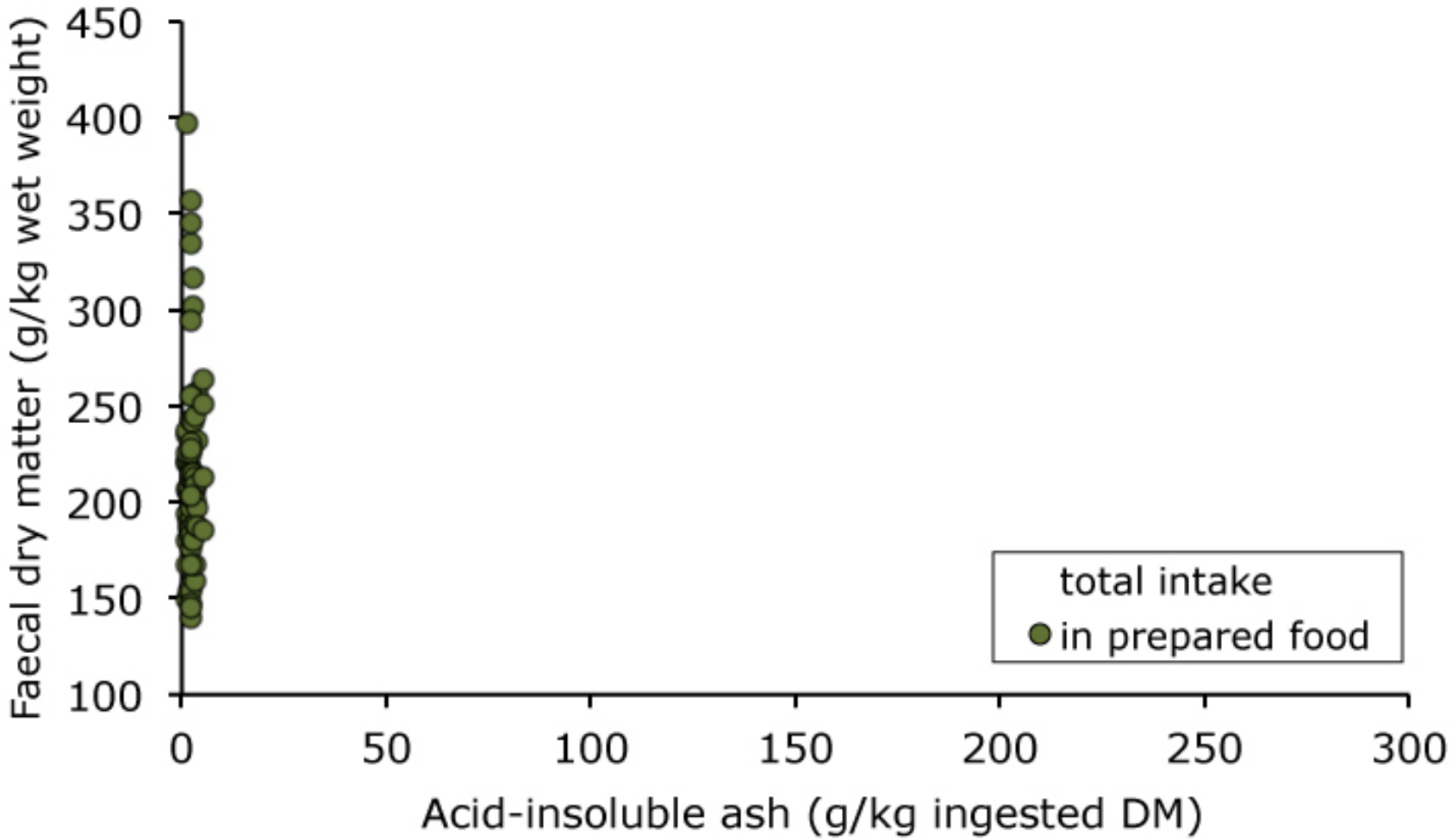
depends on what you know about the natural diet, and what feeds are available

Example: Giant anteater *(Myrmecophaga tridactyla)*



Gull et al. (subm.)

Example: Giant anteater *(Myrmecophaga tridactyla)*



Gull et al. (subm.)

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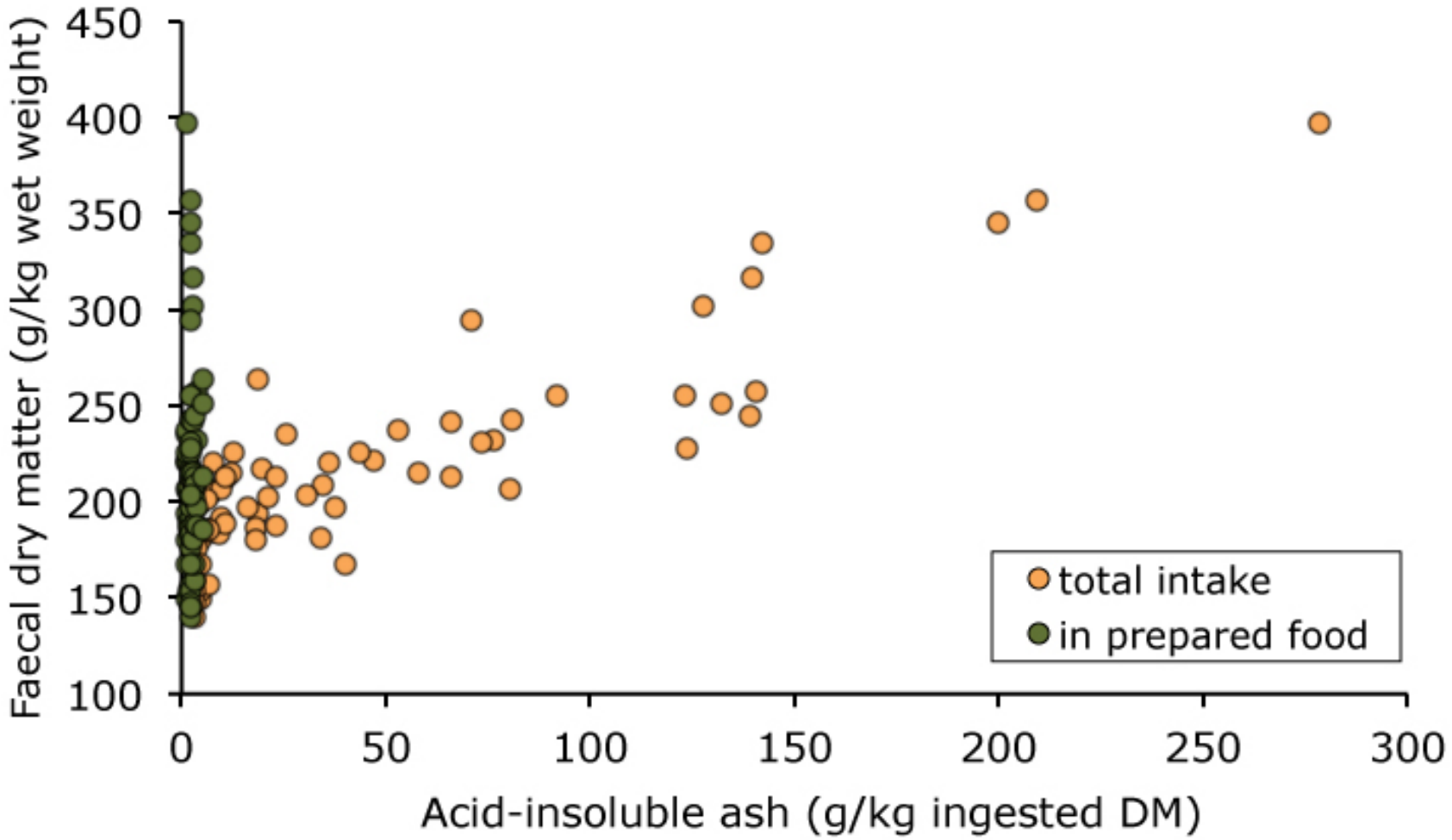
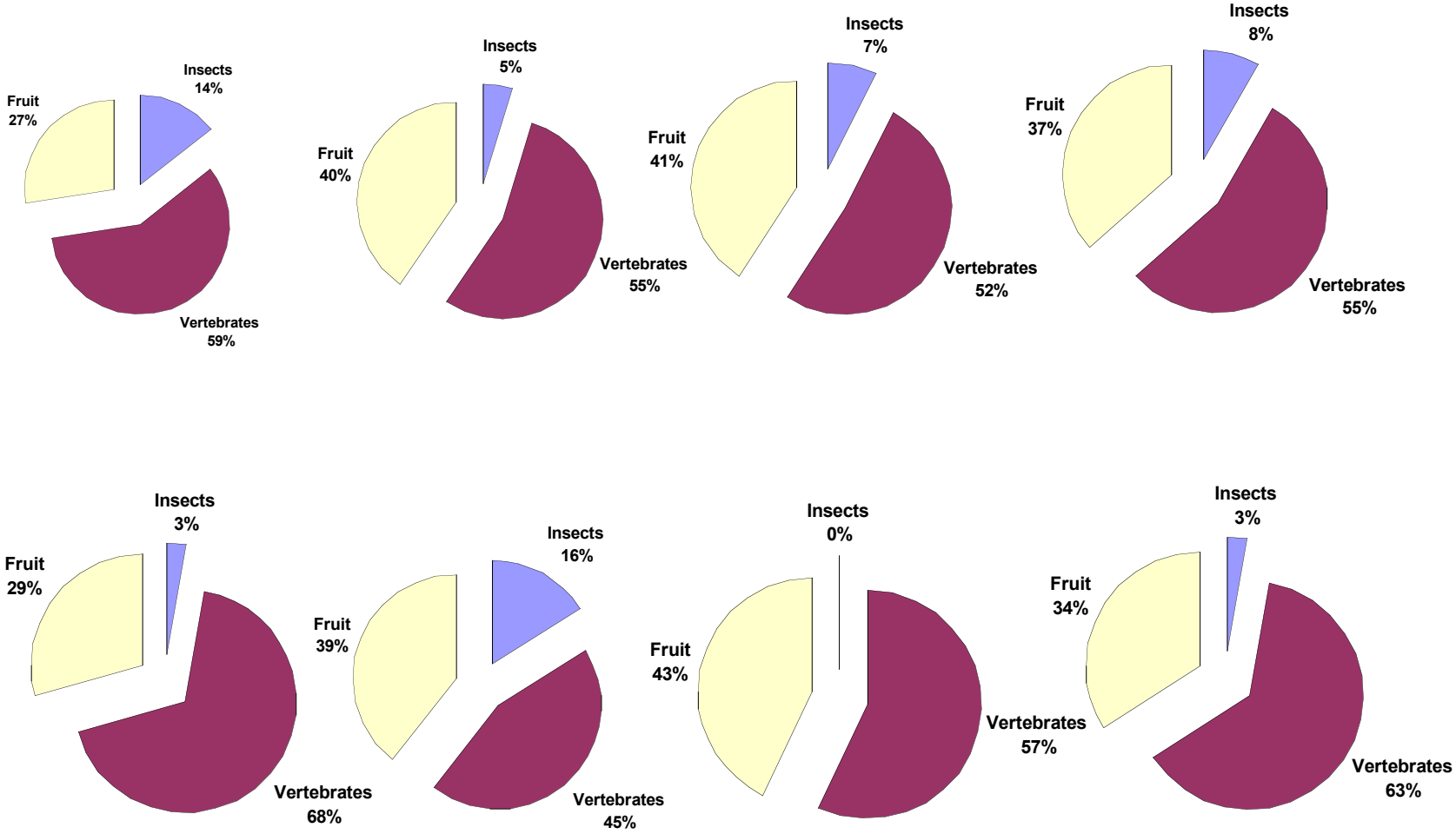


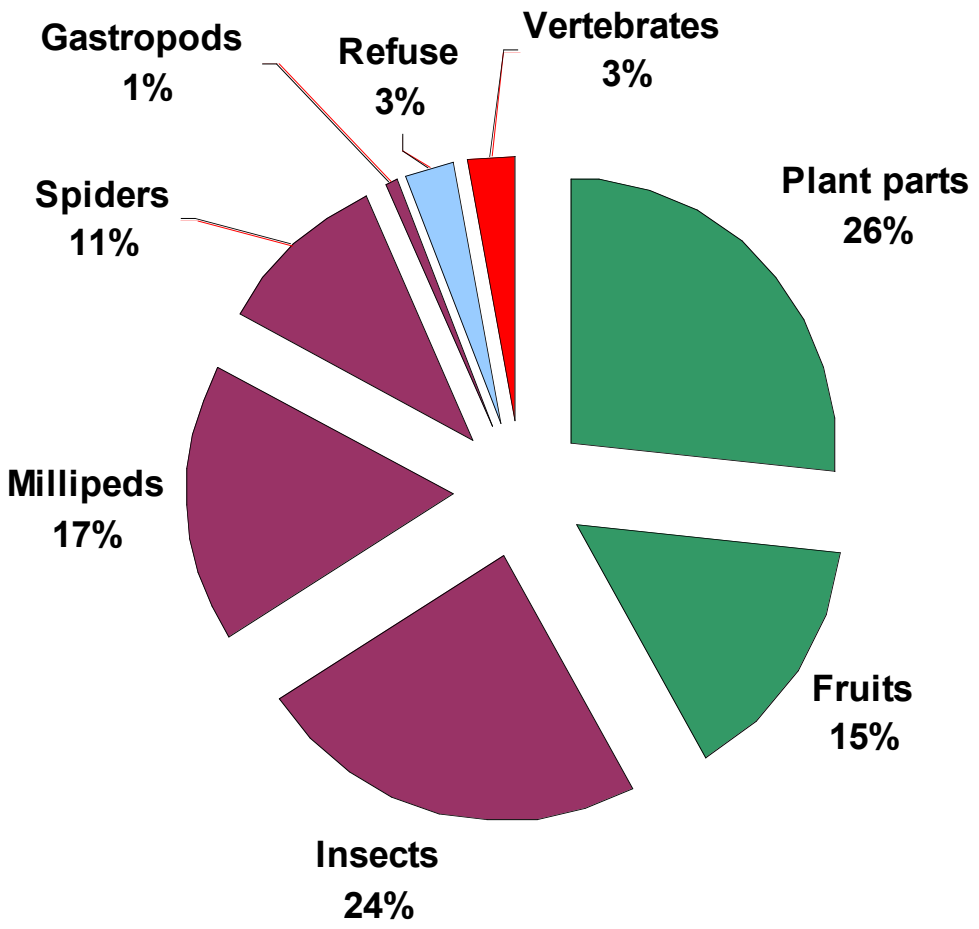
Gull et al. (subm.)

Example: Maned wolf *(Chrysocyon brachyurus)*



various studies, e.g. Bueno et al. (2004)

Example: Coati *(Nasua spp.)*



Alves-Costa et al. (2004)

Natural diets

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Research Article

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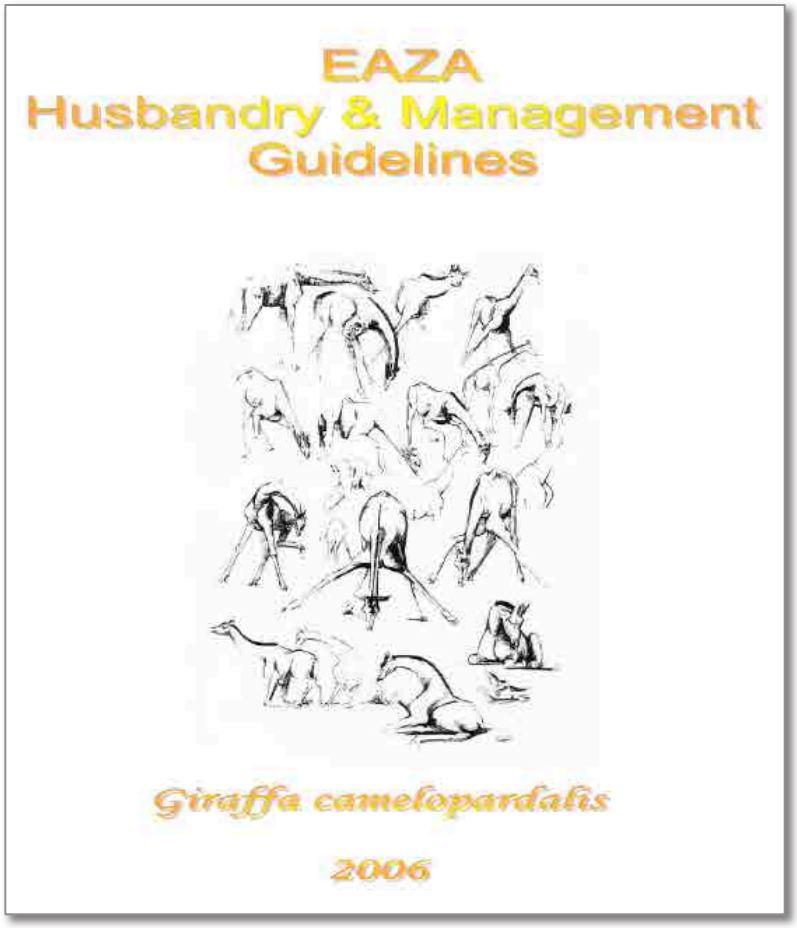
Research Article

Feeding practices for captive greater kudus (*Tragelaphus strepsiceros*) in UK collections as compared to diets of free-ranging specimens

Lucy A. Taylor[1,*], Christoph Schwitzer[1], Norman Owen-Smith[2], Michael Kreuzer[3] and Marcus Clauss[4]

Natural diets



2.2 Feeding

A. Knowledge of giraffe nutrition in the wild

It is important to know what giraffes are feeding on in the wild, when determining the proper diet in captivity

2.2.1 Selection of feeding plants

Hofmann (1973) classifies the giraffe as a browser. Tree or shrub browse are the dominant food plants (for a compilation of literature references see section 4, part D), leaves and shoots making up the most important items of the diet (Table 2-1). Selectivity of feeding behaviour is characterised by Van Soest (1994) to be of an intermediate degree. Due to its large body size, a giraffe just cannot afford to feed as selectively as smaller ruminant species.

Table 2-1: Description of feeding behaviour

Plant parts ingested	Importance to the diet	Reference
Leaves, small twigs	++	Leuthold and Leuthold (1972, 1978)
Some bark, flowers and fruits	+	
Leaves and shoots of trees and shrubs	++	Owen-Smith (1988)
Herbaceous material (climbers, vines, tall forbs)	Up to 7 %	
Shoot tips	78 %	Pellew (1984a+b)
Leaf whorls	14 %	
Flowers	5 %	
Pods	3 %	
Others	1 %	

If new growing shoots are available (including young leaves, twigs and thorns), they represent the favoured food resource according to Sauer et al. (1982). Older leaves are ingested when shoots are not available. Owen-Smith (1988) reports considerable amounts of woody material to be included in the diet (5 % in the rainy and 15 % in the dry season).

Natural diets

There are no secret, species-specific ingredients!

Formic acid in anteater formulas?

Natural diets

There is no single source of quantitative natural diet information on mammals.

Approach to zoo animal nutrition

“do as we always did”

+	-
based on experiences what has been working	sometimes ‘experiences’ are mistakes one has been making for long time

“imitate the natural diet”

best approach	depends on what you know about the natural diet, and what feeds are available

Two traditions in imitating natural diets

Ratcliffe and Wackernagel	*Hediger*
a complete feed for each animal (group) (pelleted)	*'natural' feeds (forages, fruits/vegetables), that resemble the natural diet*
atypcial physical structure *some nutrients difficult to limit* *behavioural deficits*	*selective feeding possible* ***available feeds differ from in nutrient content from the natural diet***

Frugivores don‘t eat supermarket fruit

DWW
AnimalWelfareWeb.nl

Sugars and other nutrients in produce (of fruits and vegetables)

All values expressed as g/kg wet weight, unless otherwise stated.

Fruits

Banana
Musa acuminata

104 gram sugar

Energy MJ	Dry Matter	NDF	ADF	Crude Protein	Fat	Ca	P	Mg	Fe	Vit. A RE	Vit. E α-TE	Vit. C
3.4	234	28.8	6.6	13.3	12.4	0.04	0.27	0.28	0.002	44.2	5.5	0.14

Apple
Malus domestica

86 gram sugar

Energy MJ	Dry Matter	NDF	ADF	Crude Protein	Fat	Ca	P	Mg	Fe	Vit. A RE	Vit. E α-TE	Vit. C
2.2	143	14.6	8.6	4.3	8.3	0.04	0.17	0.04	0.001	20.8	5.5	0.1

Orange
Citrus x sinensis

56 gram sugar

Energy MJ	Dry Matter	NDF	ADF	Crude Protein	Fat	Ca	P	Mg	Fe	Vit. A RE	Vit. E α-TE	Vit. C
2.2	130	14.3	9.2	7.8	4.9	0.35	0.22	0.1	0.001	40	5.5	0.5

Kiwi
Actinidia deliciosa

52 gram sugar

Energy MJ	Dry Matter	NDF	ADF	Crude Protein	Fat	Ca	P	Mg	Fe	Vit. A RE	Vit. E α-TE	Vit. C
2.5	156	25.3	19.7	12.9	8.3	0.32	0.33	0.13	0.003	31.4	5.5	0.65

Papaya
Carica papaya

27 gram sugar

Energy MJ	Dry Matter	NDF	ADF	Crude Protein	Fat	Ca	P	Mg	Fe	Vit. A RE	Vit. E α-TE	Vit. C
2.1	135	18.5	16.5	18.4	4.7	0.25	0.1	0.22	0.007	197	-	0.55

Vegetables

Carrot
Daucus caurota

45 gram sugar

Energy MJ	Dry Matter	NDF	ADF	Crude Protein	Fat	Ca	P	Mg	Fe	Vit. A RE	Vit. E α-TE	Vit. C
1.6	115	11.2	10.2	6.8	4	0.36	0.29	0.12	0.004	9170	5.5	0.02

Sweet potato
Ipomoea batatas

32 gram sugar

Energy MJ	Dry Matter	NDF	ADF	Crude Protein	Fat	Ca	P	Mg	Fe	Vit. A RE	Vit. E α-TE	Vit. C
3.0	197	39.4	9.7	8.3	11	0.45	0.47	0.15	0.009	3730	-	0.26

Celery
Apium graveolens

14 gram sugar

Energy MJ	Dry Matter	NDF	ADF	Crude Protein	Fat	Ca	P	Mg	Fe	Vit. A RE	Vit. E α-TE	Vit. C
0.9	71	11.1	8.9	12.2	2.1	0.57	0.3	0.08	0.004	14.2	2	0.2

Spinach
Spinacia oleracea

1 gram sugar

Energy MJ	Dry Matter	NDF	ADF	Crude Protein	Fat	Ca	P	Mg	Fe	Vit. A RE	Vit. E α-TE	Vit. C
1.1	83	16.7	9.7	32.1	6.6	1.29	0.41	0.26	0.05	3490	29	0.52

Endive
Cichorium endivia

0 gram sugar

Energy MJ	Dry Matter	NDF	ADF	Crude Protein	Fat	Ca	P	Mg	Fe	Vit. A RE	Vit. E α-TE	Vit. C
0.6	62	11	8.9	13	2	0.52	0.28	0.15	0.008	1030	-	0.07

Photos and design, Emile Prins, 2012.
Information used from Danish Food Composition Table and Schmidt *et al.*, (2005).

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Phone: +31-(0)58-2846311

courtesy Tjalling Huisman

Traditions in imitating natural diets

Traditions in imitating natural diets

J. Zoo An. Med. 15: 142-146, 1984

Diet and Oral Health in Captive Amur Tigers (*Panthera tigris altaica*)

L. I. Haberstroh, D.V.M.*
D. E. Ullrey, Ph.D.**
J. G. Sikarski, D.V.M., M.S.*
N. A. Richter, D.V.M.***
B. H. Colmery, D.V.M.*
T. D. Myers, D.D.S.****

J. Zoo An. Med. 13: 104-107, 1982

A SOFT VERSUS HARD DIET AND ORAL HEALTH IN CAPTIVE TIMBER WOLVES *(Canis lupus)*

K.M. Vosburgh, B.S.*
R.B. Barbiers, B.S.*
J.G. Sikarskie, D.V.M., M.S.*
D.E. Ullrey, Ph.D.**

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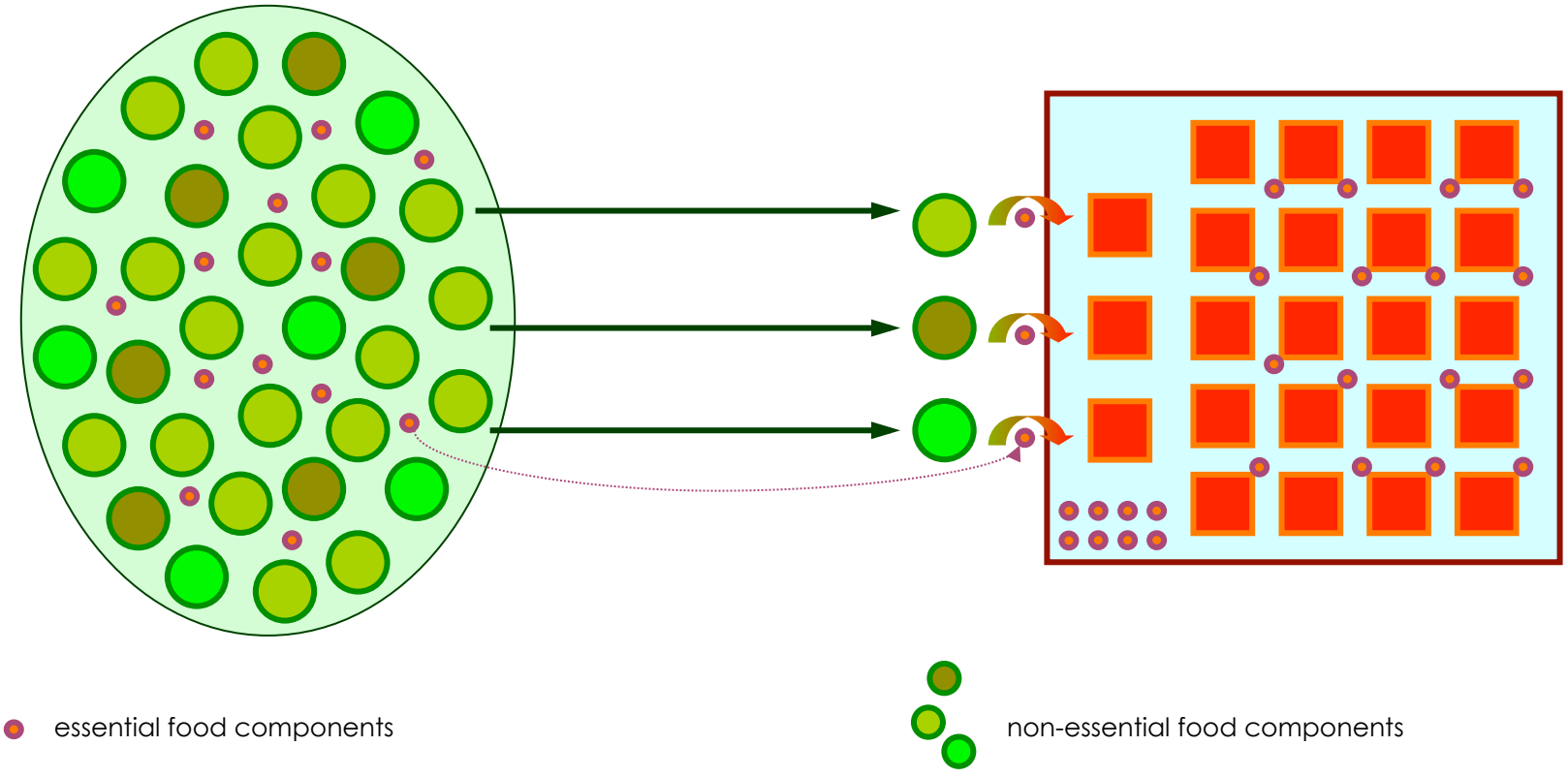
	"imitate the natural diet"	
best approach		depends on what you know about the natural diet, and what feeds are available
	"use a suitable domestic species as model"	
'scientific compromise' huge amount of knowledge		species-specific peculiarities are easily overlooked

Nutrition Research Reviews (2002), **15**, 153–168
DOI: 10.1079/NRR200238

Idiosyncratic nutrient requirements of cats appear to be diet-induced evolutionary adaptations*

James G. Morris



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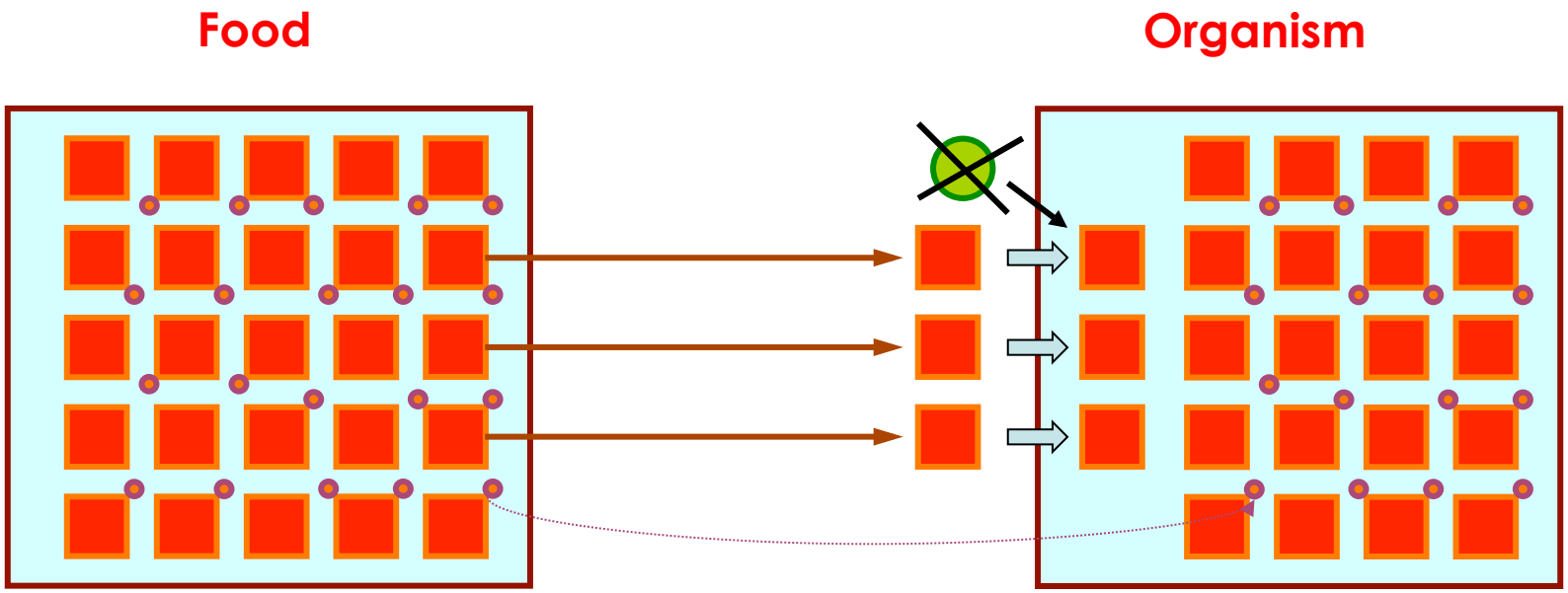

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DOI: 10.1079/NRR200238

Idiosyncratic nutrient requirements of cats appear to be diet-induced evolutionary adaptations*

James G. Morris

not essential for dogs ⟷ essential nutrients:

- high protein requirement
- amino acids taurine and arginine
- arachidonic acid
- vitamin A (β-carotine useless)
- vitamin D
- niacine

Nutrition Research Reviews (2002), **15**, 153–168
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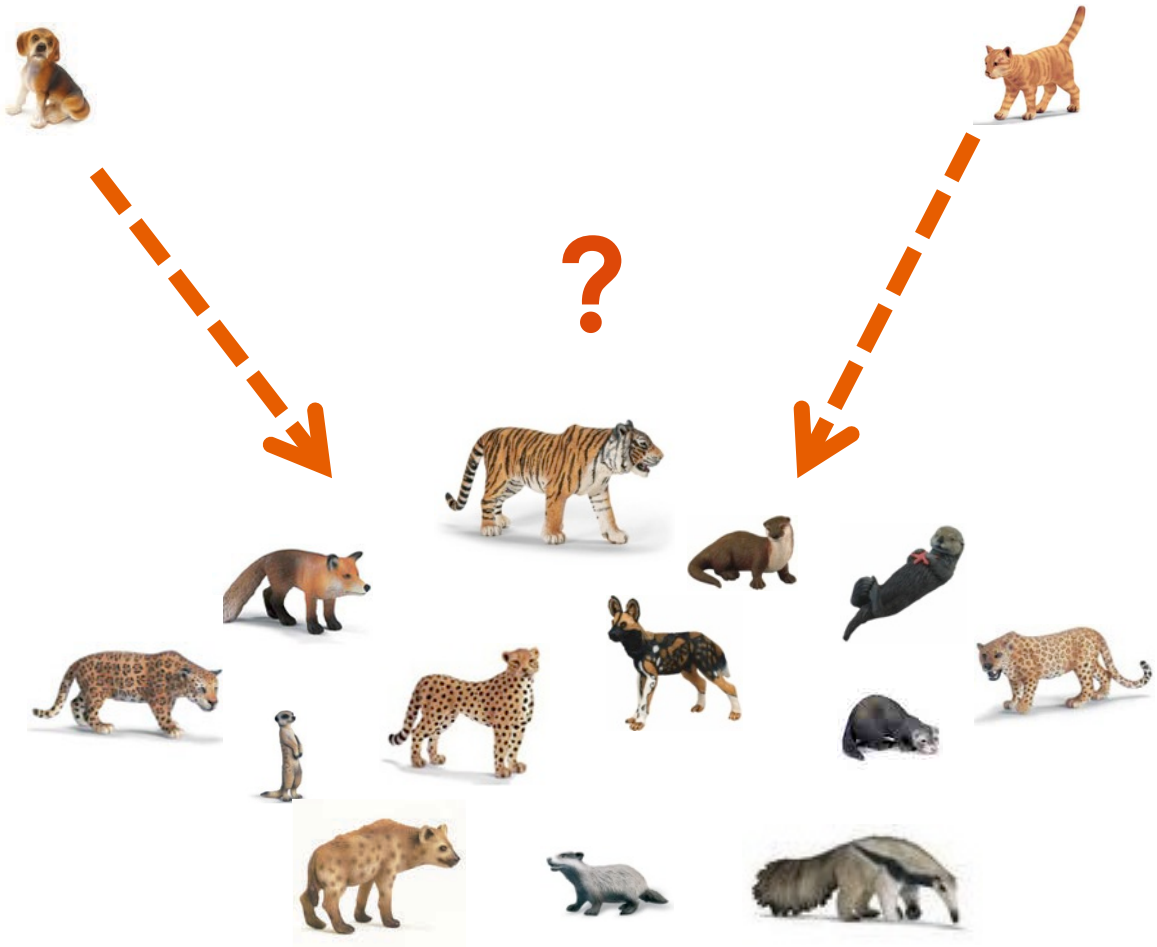

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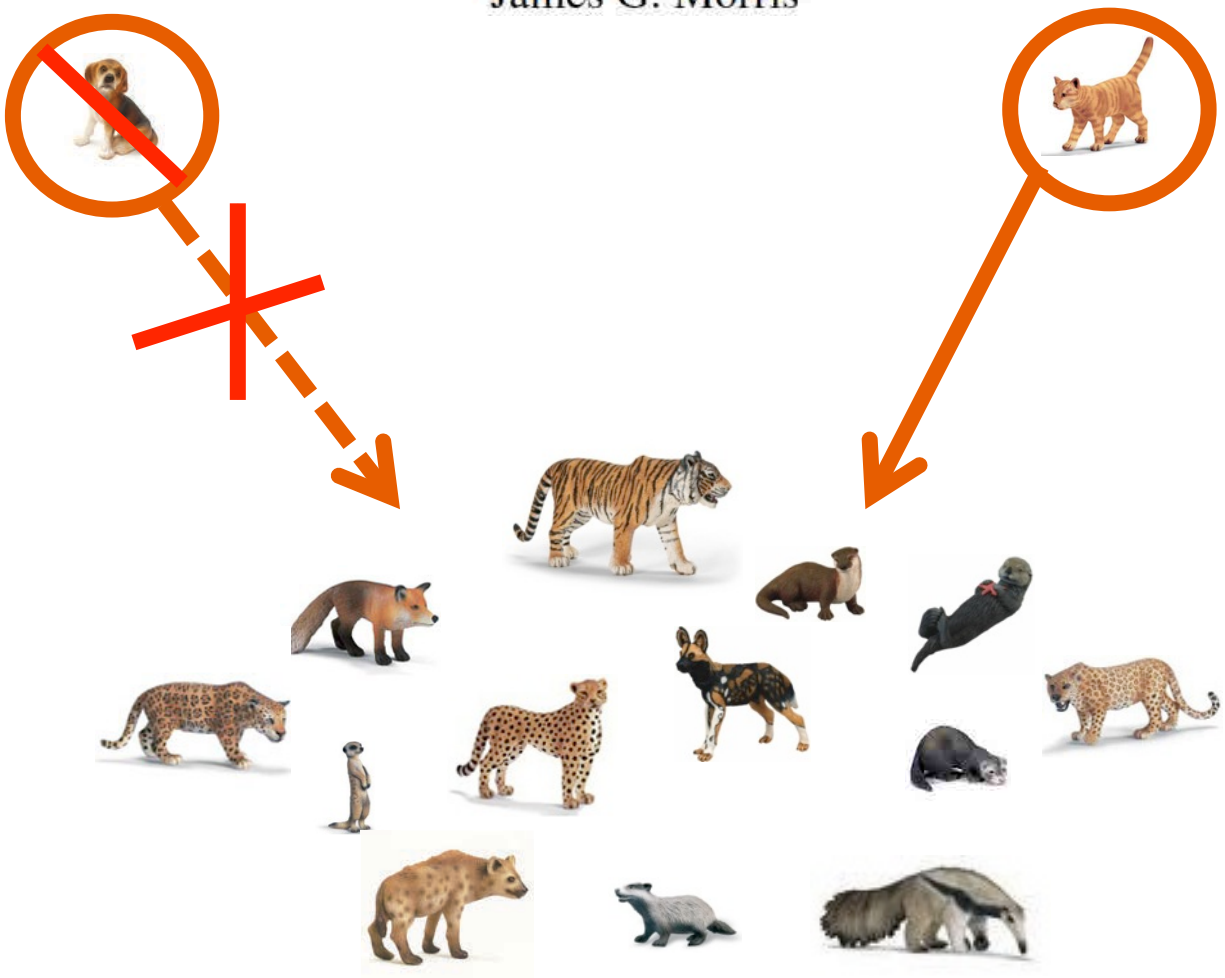

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	"use a suitable domestic species as model"	
'scientific compromise' huge amount of knowledge		species-specific peculiarities are easily overlooked
	"based on studies in zoo animals"	
'scientific approach'		financially and logistically challenging, difficulty in summarizing knowledge

Studies in zoo animals

- Case reports / case series
- Inventories of diets, pathological states, husbandry success
- Differences between free-range and zoo
- Epidemiological / controlled studies

Examples: case studies

DIETARY TAURINE SUPPLEMENTATION AND CARDIAC FUNCTION IN THE GIANT ANTEATER (*Myrmecophaga tridactyla*): PRELIMINARY FINDINGS

J. Andrew Teare, DVM, MS,[1] Alan D. Weldon, DVM, Dipl AVCIM,[2] and Nikolay Kapustin, DVM[1]*

2009 PROCEEDINGS AAZV AAWV JOINT CONFERENCE

TAURINE DEFICIENCY IN MANED WOLVES (*Chrysocyon brachyurus*) MAINTAINED ON TWO DIETS MANUFACTURED FOR PREVENTION OF CYSTINE UROLITHIASIS

Sara E. Childs-Sanford, DVM[1] and C. Roselina Angel, PhD[2]*

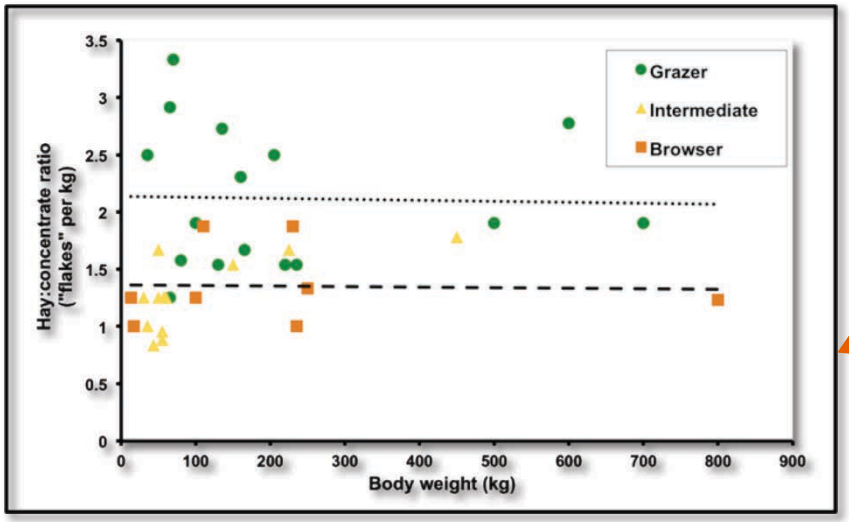
2004 PROCEEDINGS AAZV, AAWV, WDA JOINT CONFERENCE

no control group

The classic problem repertoire

Carnivore	→	*Red meat*	→	*Calcium deficiency*
Primate	→	*Fruits & vegetables*	→	*Calcium deficiency*
Fish-Eater	→	*Thawed fish*	→	*Sodium- and vitamin B deficiency*
Herbivore	→	*Hay & grains*	→	*Acidosis, vitamin E- and calcium deficiency*

Examples: inventories

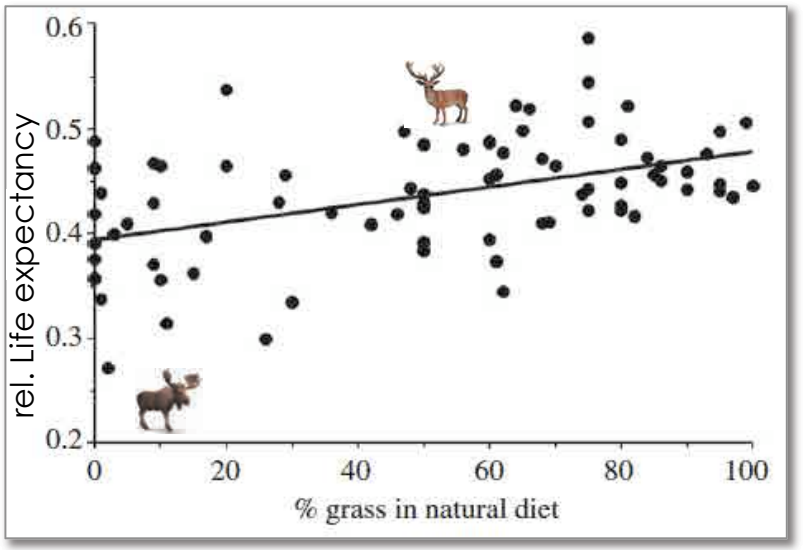


Grisham and Savage (1990)

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

Marholdt (1991)

no direct association



Müller et al. (2011)

Examples: differences wild - zoo

+	fibre in herbivore diets	-
-	iron deposits in organs	+
+	unsaturated (n-3) fatty acids in diets and body tissues	-
-	tooth wear (browsers, bears)	+
+	dental calculus	++

e.g. Taylor et al. (2013), Clauss & Paglia (2012), Clauss et al. (2007), Wenker et al. (1999), Kaiser et al. (2009), Taylor et al. (2014), Clarke & Cameron (1998)

Dental calculus

Relationship between diet, dental calculus and periodontal disease in domestic and feral cats in Australia

DE CLARKE[a] and A CAMERON[b]

Aust Vet J 1998;76:690-693.

Results Dental calculus scores were significantly higher in domestic cats than in feral cats. There was no statistical difference in the prevalence of periodontal disease between the two groups.

Conclusion It can be inferred that diet may play a role in the accumulation of calculus, but a diet based on live prey does not protect cats against periodontal disease.

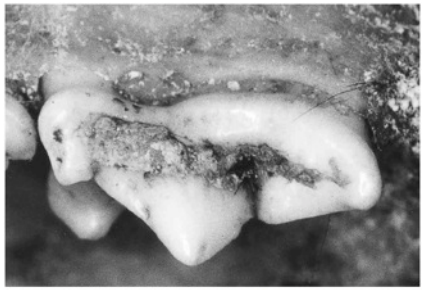


Figure 1. Calculus on the buccal surface of the upper fourth premolar tooth in a feral cat.

Examples: differences wild - zoo

+	fibre in herbivore diets	-
-	iron deposits in organs	+
+	unsaturated (n-3) fatty acids in diets and body tissues	-
-	tooth wear (browsers, bears)	+
+	dental calculus	++
-	undesired GIT bacteria	+
-	feeding-related dysbehaviour	+

e.g. Taylor et al. (2013), Clauss & Paglia (2012), Clauss et al. (2007), Wenker et al. (1999), Kaiser et al. (2009), Taylor et al. (2014), Clarke & Cameron (1998), Fujita & Kageyama (2007)

Great ape R/R

Great ape R/R

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)

0196-206X/86/0705-0314$02.00/0
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.

Examples: differences wild - zoo

+	fibre in herbivore diets	-
-	iron deposits in organs	+
+	unsaturated (n-3) fatty acids in diets and body tissues	-
-	tooth wear (browsers, bears)	+
+	dental calculus	++
-	undesired GIT bacteria	+
-	feeding-related dysbehaviour	+
-	***obesity***	++

e.g. Taylor et al. (2013), Clauss & Paglia (2012), Clauss et al. (2007), Wenker et al. (1999), Kaiser et al. (2009), Taylor et al. (2014), Clarke & Cameron (1998), Fujita & Kageyama (2007), Schwitzer & Kaumanns (2001)

Examples: differences wild - zoo

obesity

Examples: **epidemiological**/controlled studies

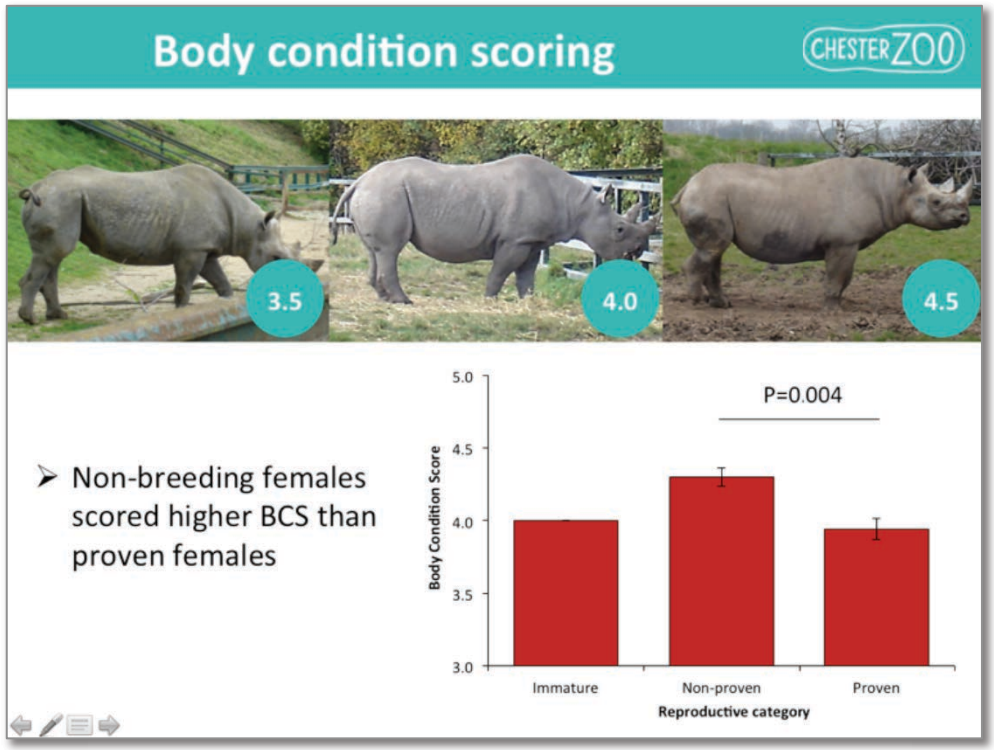
Social Factors Influence Ovarian Acyclicity in Captive African Elephants (*Loxodonta africana*)

Elizabeth W. Freeman,[1,2]* Greg Guagnano,[2] Deborah Olson,[3] Mike Keele,[4] and Janine L. Brown[1]

Zoo Biology 28:1–15 (2009)

Females more likely to be acyclic had a larger body mass index and had resided longer at a facility with the same herdmates. Results suggest that controlling the weight of an elephant might be a first step to helping mitigate estrous cycle problems.

Examples: **epidemiological**/controlled studies



courtesy Christoph Schwitzer

Examples: epidemiological/**controlled** studies

Nutritional Metabolic Bone Disease in Juvenile Veiled Chameleons (*Chamaeleo calyptratus*) and Its Prevention[1–3]

J. Nutr. 140: 1923–1931, 2010.

Stefan Hoby,[4,5] Christian Wenker,[5] Nadia Robert,[4] Thomas Jermann,[5] Sonja Hartnack,[6] Helmut Segner,[4] Claude-P. Aebischer,[8] and Annette Liesegang[7]*

Effects of starch and fibre in pelleted diets on nutritional status of mule deer (*Odocoileus hemionus*) fawns

S. McCusker[1], L. A. Shipley[1], T. N. Tollefson[1,2], M. Griffin[3,4] and E. A. Koutsos[4]

Journal of Animal Physiology and Animal Nutrition **95** (2011) 489–498

Examples: epidemiological/**controlled** studies

Nutritional Metabolic Bone Disease in Juvenile Veiled Chameleons (*Chamaeleo calyptratus*) and Its Prevention[1–3]

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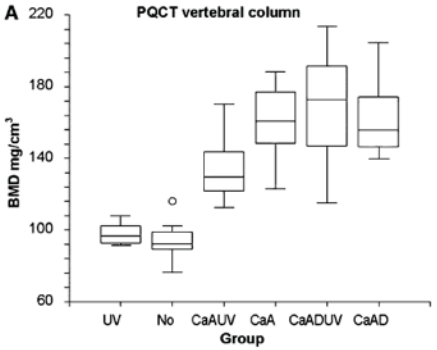
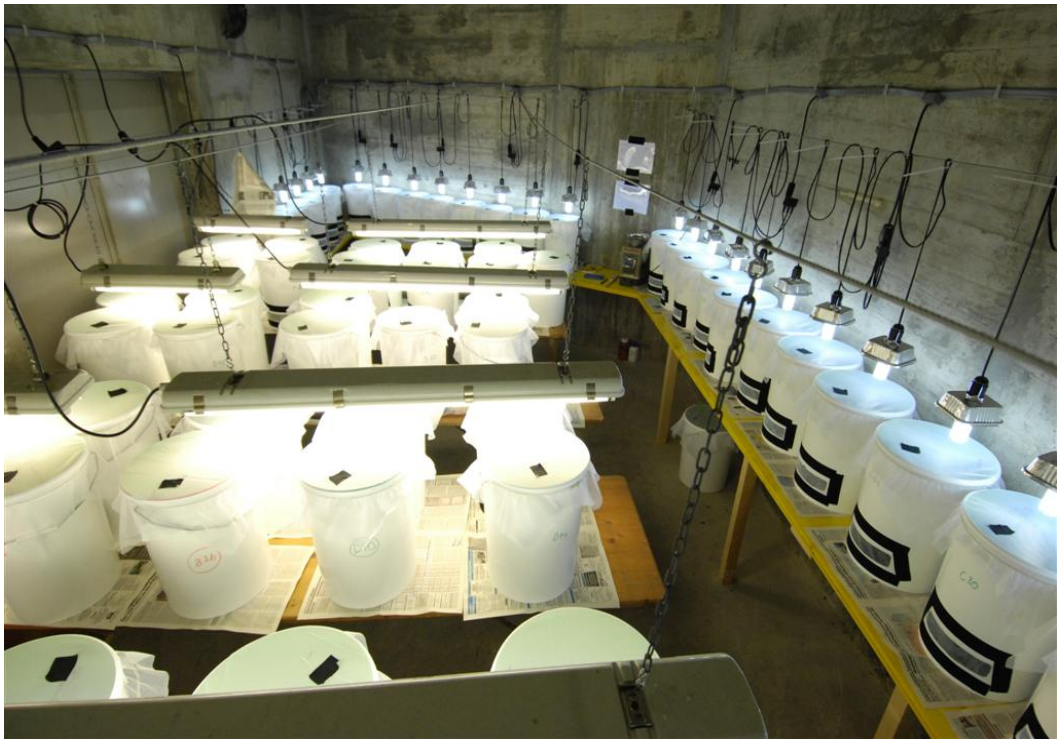
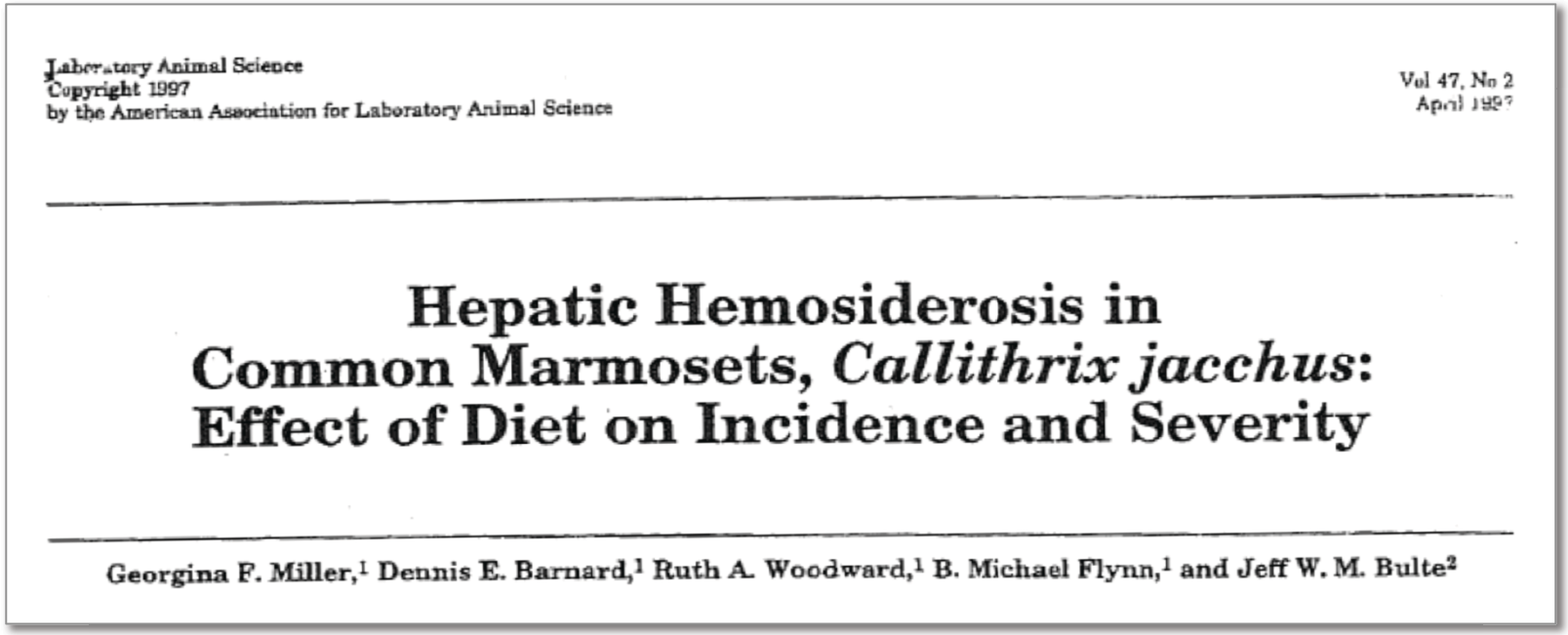
Group	*n*	Body dimensions	
		Weight	SVL
		g	*mm*
UV	10	26.7 (19.2–34.2)	100.1 (90.4–109.8)
No	10	13.5 (11.3–15.7)	74.4 (69.1–79.7)
CaAUV	9	58.2 (47.3–69.2)	144.2 (133.8–154.6)
CaA	9	60.5 (52.1–68.9)	144.2 (133.4–155.1)
CaADUV	9	54.3 (38.1–70.5)	138.2 (117.6–158.8)
CaAD	9	57.9 (38.2–77.6)	136.8 (117.8–155.7)





Examples: epidemiological/**controlled** studies



Laboratory Animal Science

Vol 47, No 2
April 1997

Hepatic Hemosiderosis in Common Marmosets, *Callithrix jacchus*: Effect of Diet on Incidence and Severity

Georgina F. Miller,[1] Dennis E. Barnard,[1] Ruth A. Woodward,[1] B. Michael Flynn,[1] and Jeff W. M. Bulte[2]

=> Fe ≥ 350 ppm DM leads to massive liver damage

Examples: epidemiological/**controlled** studies

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Hepatic Hemosi
Common Marmosets, C
Effect of Diet on Incide

Georgina F. Miller,[1] Dennis E. Barnard,[1] Ruth A. Woodwar

Marmoset

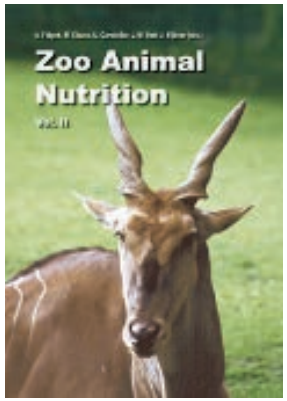
Crude Oil	%	7.50
Crude Protein	%	25.40
Crude Fibre	%	3.70
Ash	%	10.50
N.F.E.	%	42.90
Starches	%	27.80
Sugars	%	7.80
Gross Energy	MJ/Kg	15.80
Dig. Energy	MJ/Kg	13.30
Met. Energy	MJ/Kg	12.00
Linoleic Acid	%	2.12
Linolenic Acid	%	0.27
Calcium	%	2.16
Phosphorus	%	1.46
Phytate Phosphorus	%	0.18
Sodium	%	0.33
Chlorine	%	0.45
Potassium	%	0.81
Magnesium	%	0.09
Iron	mg/Kg	358.00
Copper	mg/Kg	19.00
Manganese	mg/Kg	85.00
Zinc	mg/Kg	71.00
Cobalt	µg/Kg	2018.00
Iodine	µg/Kg	3379.00
Selenium	µg/Kg	232.00
Fluorine	mg/Kg	54.00
Vitamin A	IU/Kg	30142.00
Vitamin D_3	IU/Kg	11640.00
Vitamin E	mg/Kg	105.60
Vitamin B_1	mg/Kg	27.70
Vitamin B_2	mg/Kg	18.20
Vitamin B_6	mg/Kg	14.10
Vitamin B_{12}	µg/Kg	39.40
Vitamin C	mg/Kg	2966.00
Vitamin K_3	mg/Kg	5.30
Folic Acid	mg/Kg	10.20
Nicotinic Acid	mg/Kg	92.70
Pantothenic Acid	mg/Kg	37.30
Choline	mg/Kg	1951.00
Inositol	mg/Kg	1649.00
Biotin	µg/Kg	398.00

=> Fe ≥ 350 ppm DM leads to massive liver damage

Approach to zoo animal nutrition

+		−
	"do as we always did"	
based on experiences what has been working		sometimes 'experiences' are mistakes one has been making for long time
	"imitate the natural diet"	
best approach		depends on what you know about the natural diet, and what feeds are available
	"use a suitable domestic species as model"	
'scientific compromise' huge amount of knowledge		species-specific peculiarities are easily overlooked
	"based on studies in zoo animals"	
'scientific approach'		financially and logistically challenging, **difficulty in summarizing knowledge**

Where is the information?



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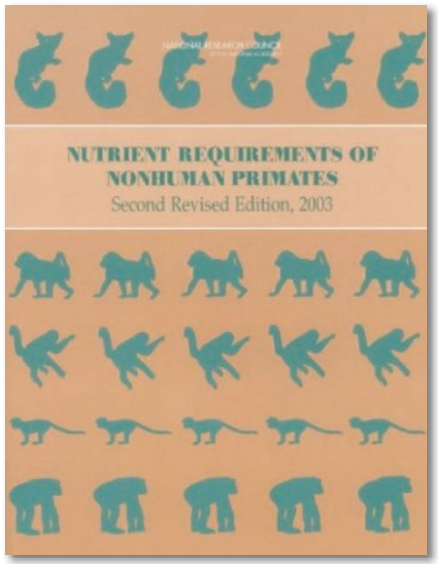

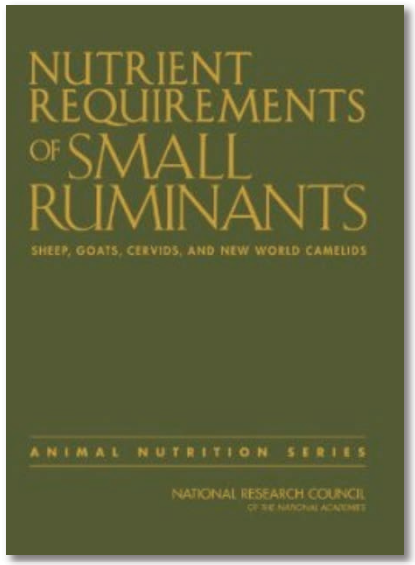

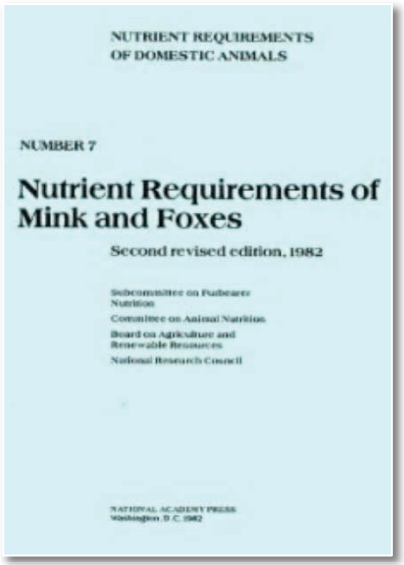

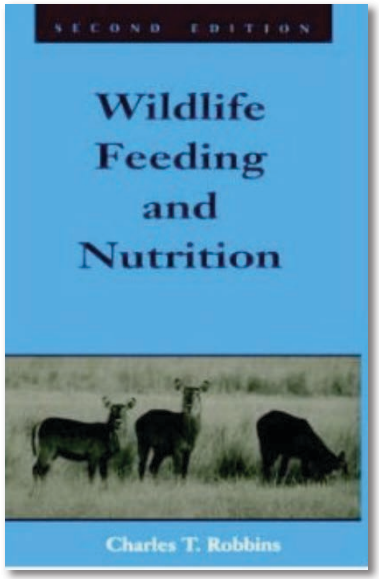

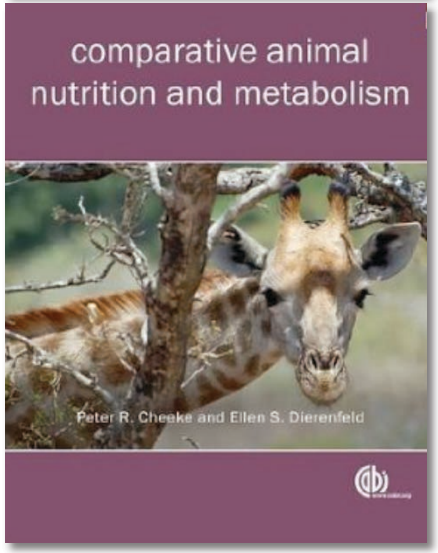

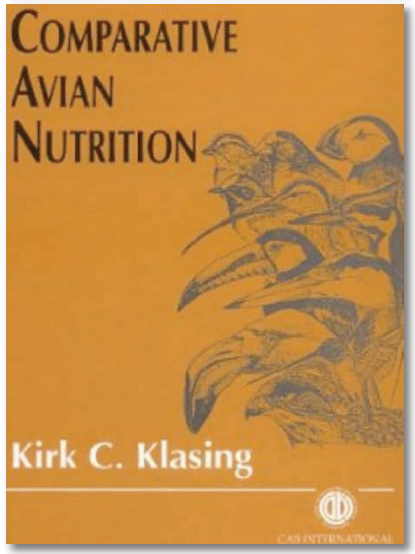

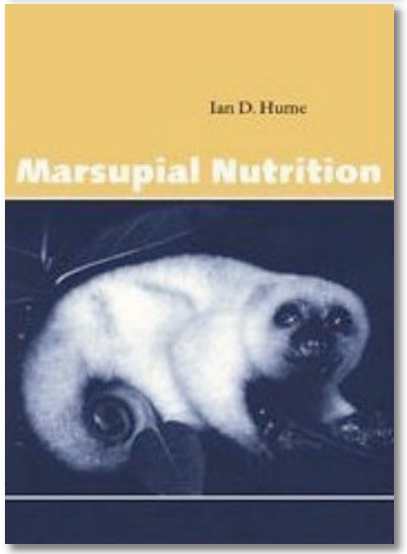

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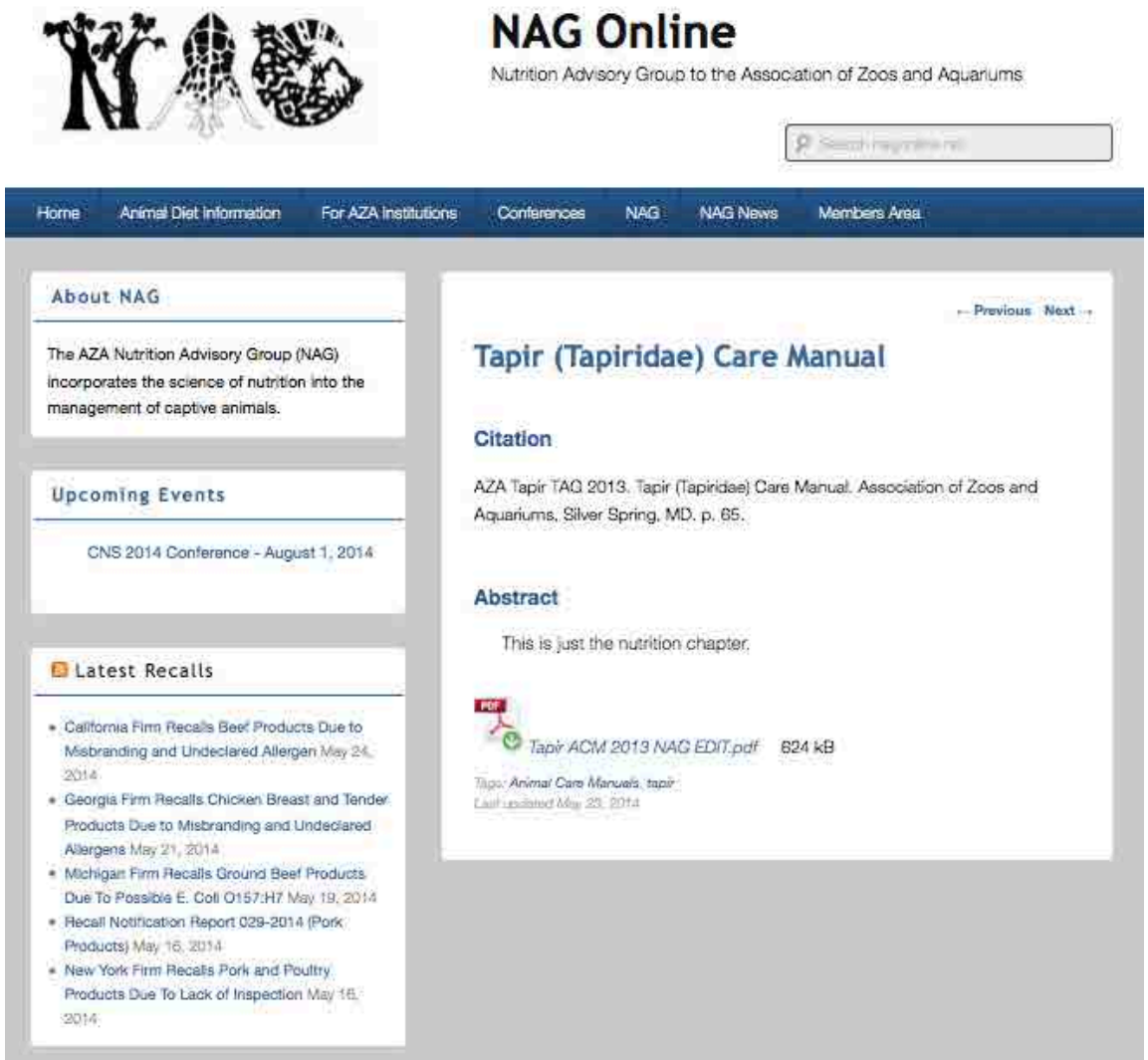

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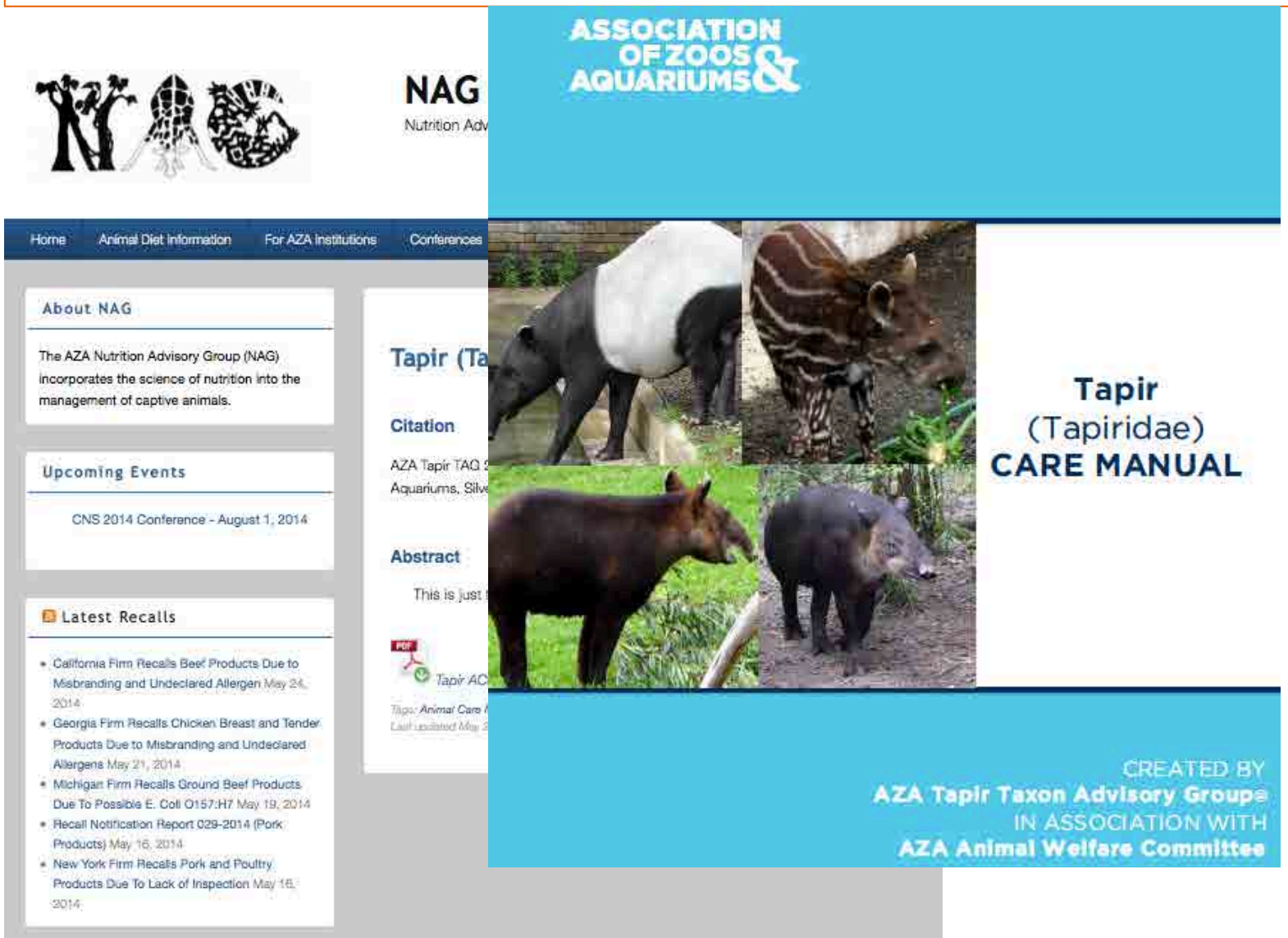

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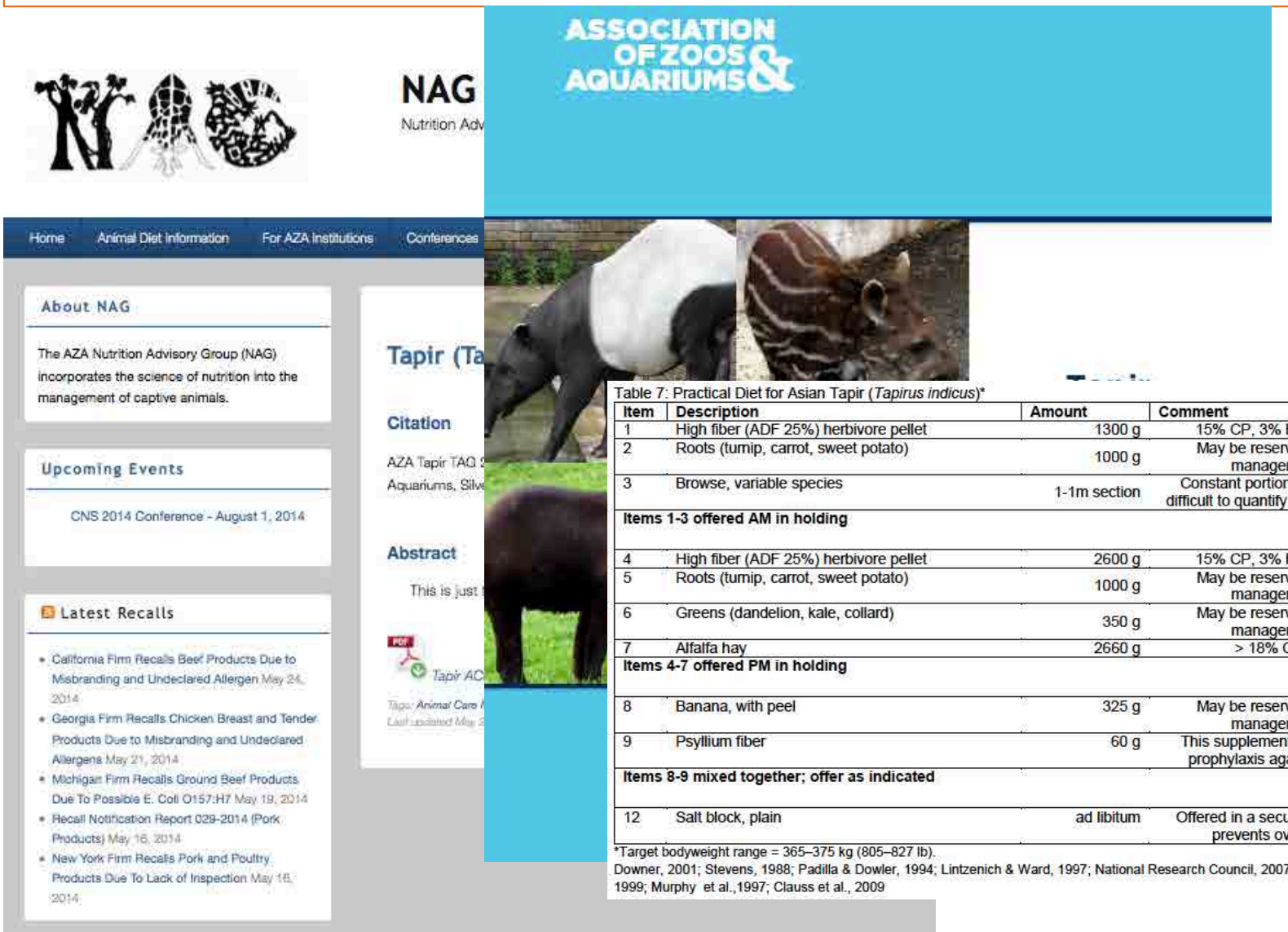

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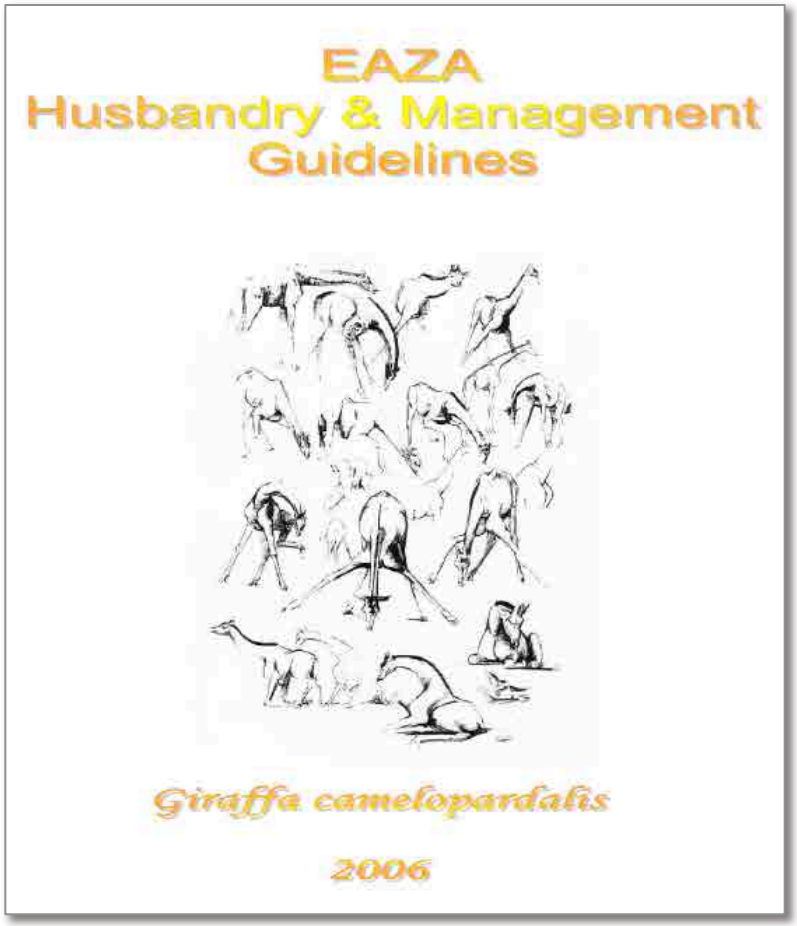

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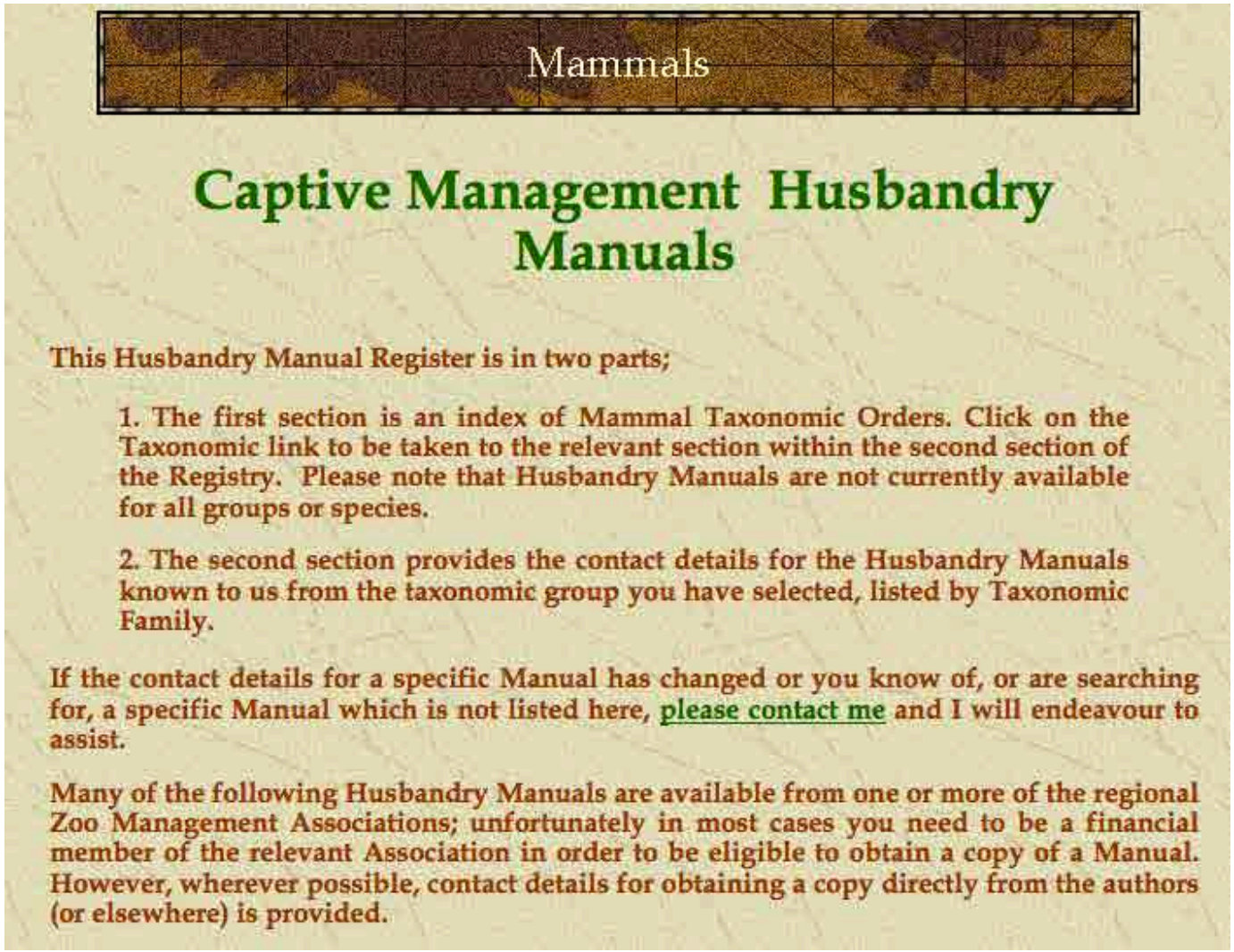

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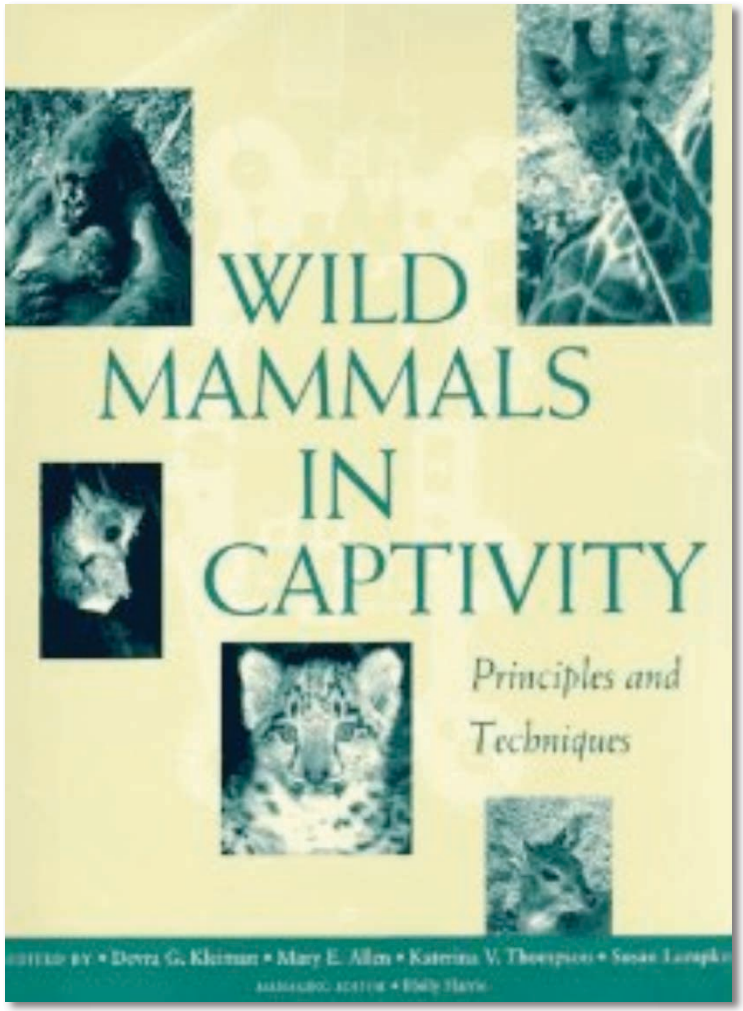


The Feeding and Nutrition of Herbivores

Olav T. Oftedal, David J. Baer, and Mary E. Allen

The Feeding and Nutrition of Carnivores

Mary E. Allen, Olav T. Oftedal, and David J. Baer

The Feeding and Nutrition of Omnivores with Emphasis on Primates

Olav T. Oftedal and Mary E. Allen

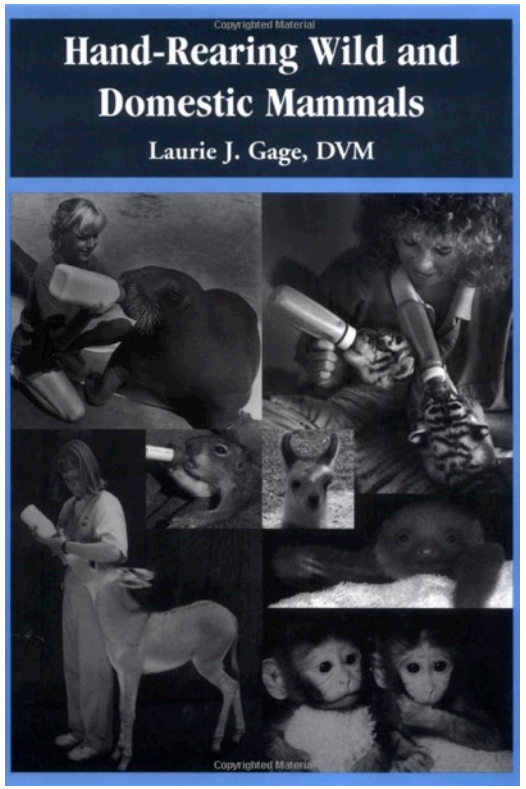
Where is the information?

not in any one place

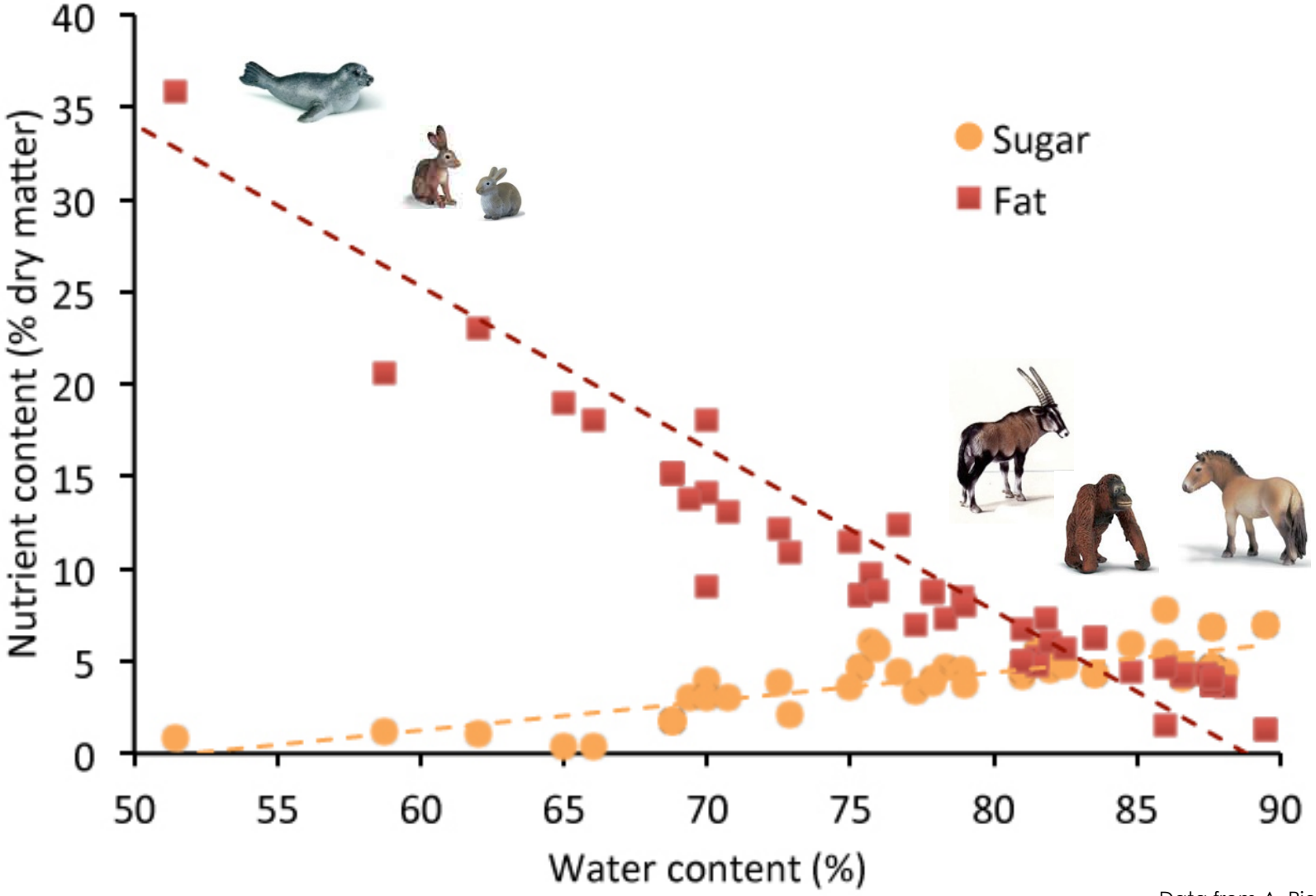
... from bottle feeding to geriatric issues ...

Bottle feeding

- *… is it reasonable?*
- *… is it feasible (in terms of logistics)?*
- *… do you have a recipe and a dosage scheme?*

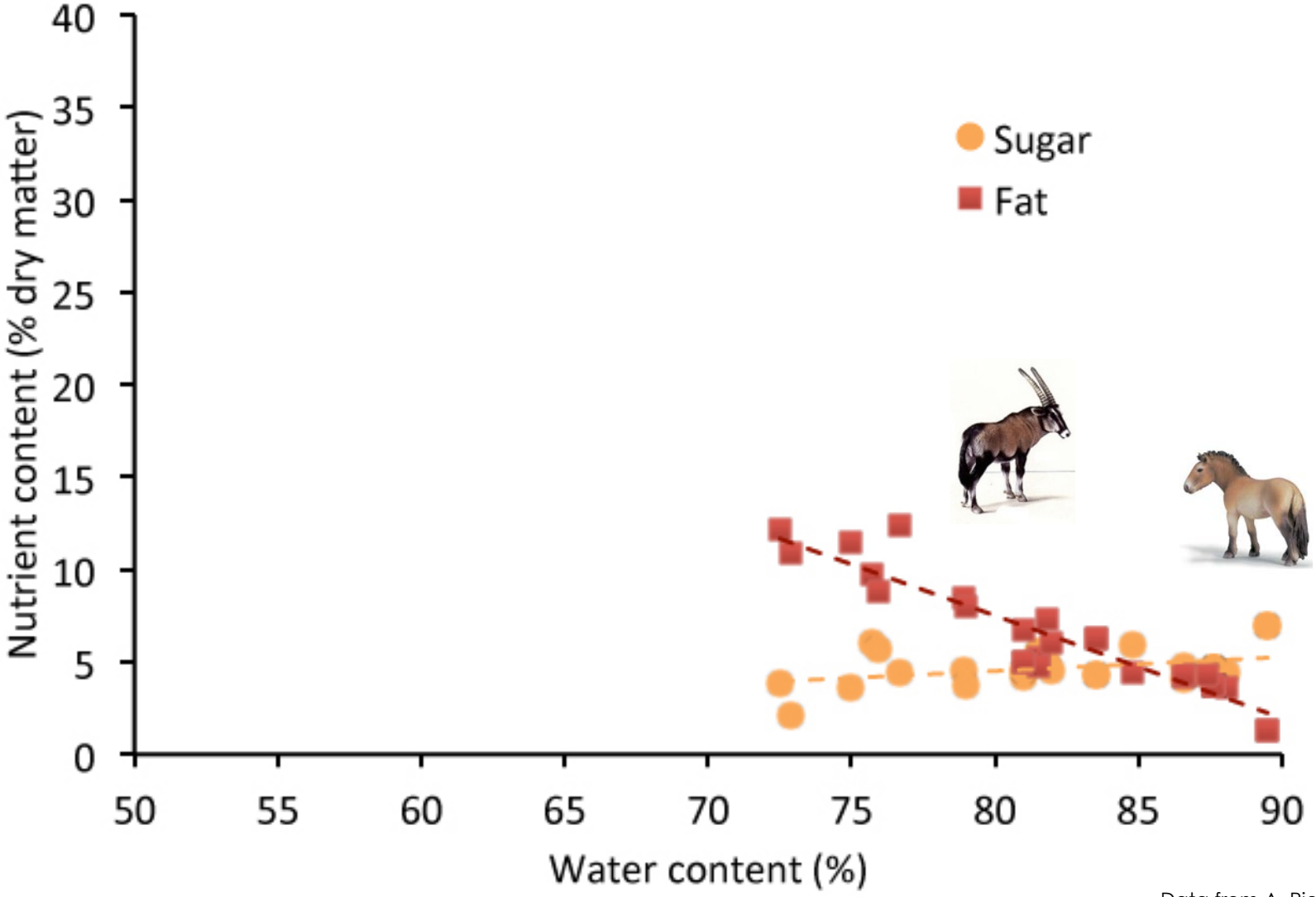


Mammal milk composition



Data from A. Riek (2008)

Mammal milk composition



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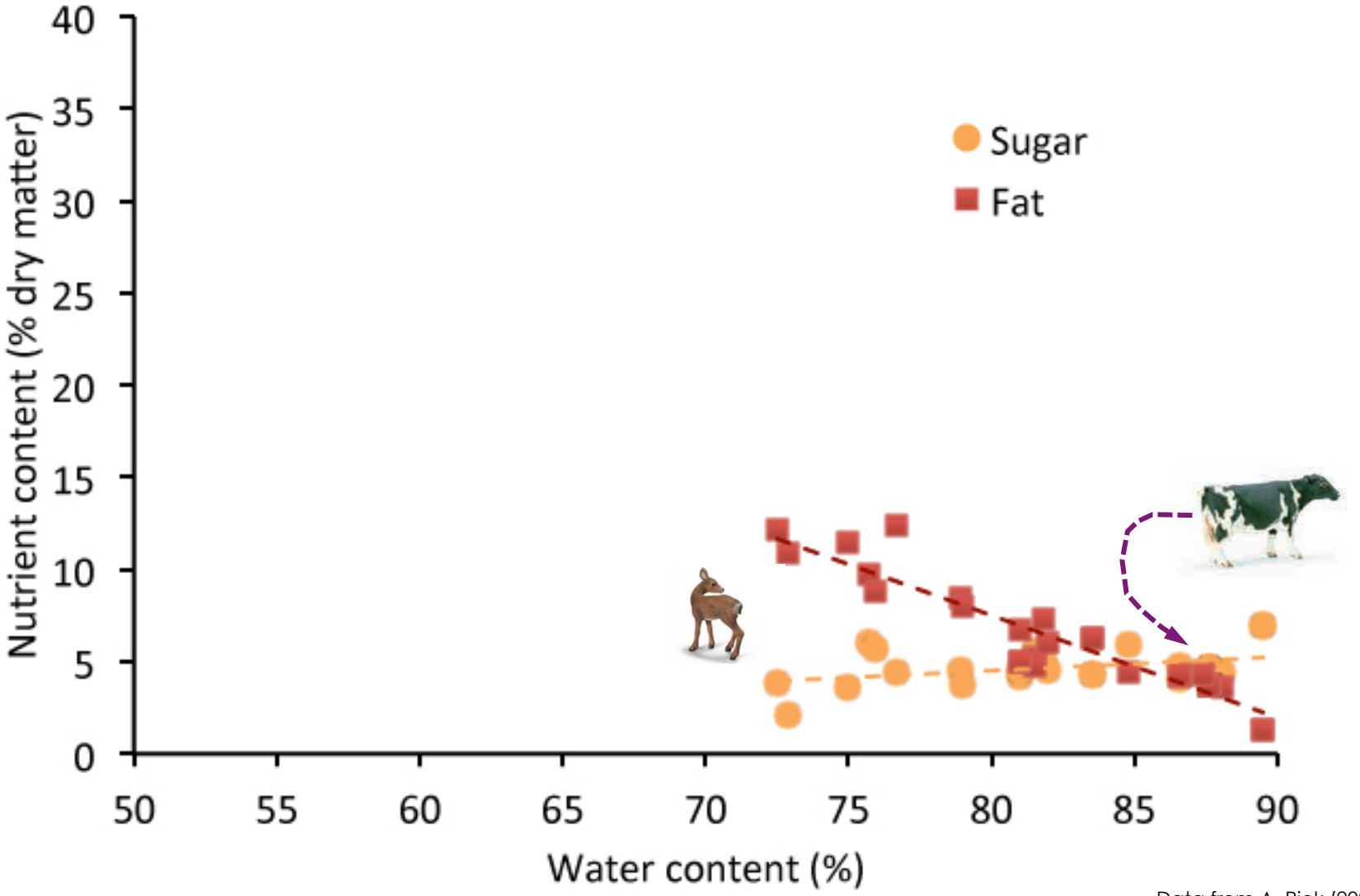


Data from A. Riek (2008)

Mammal milk recipes

Tabelle 1: Rezepte für hausgemachte Milchaustauscher für verschiedene Species

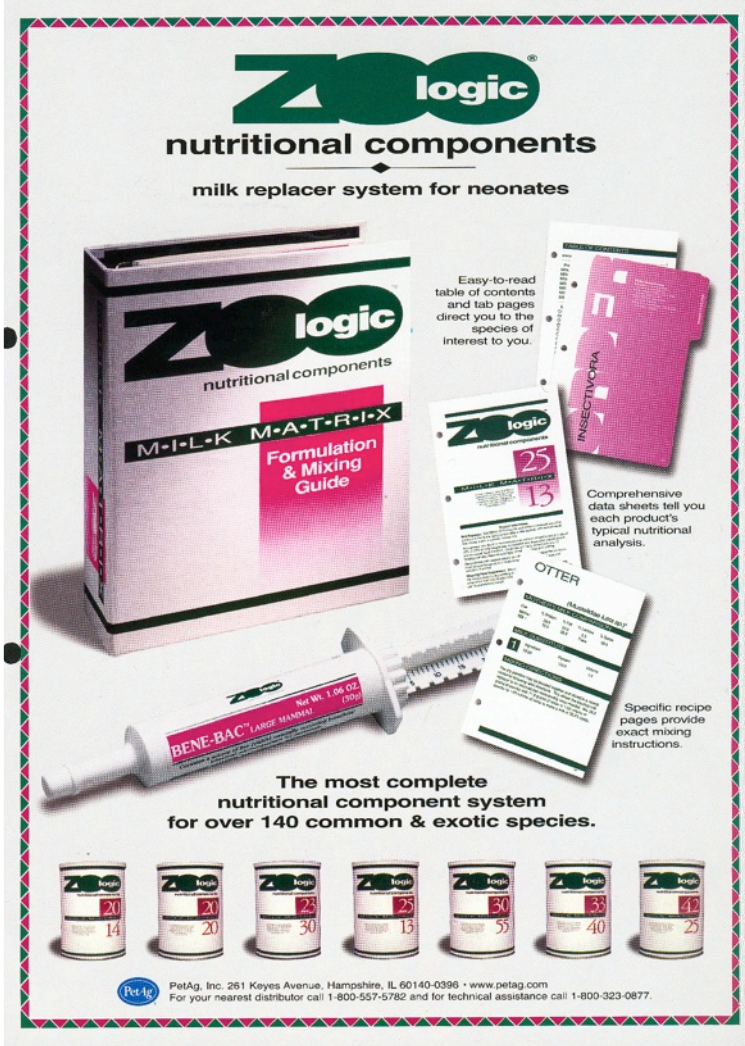
Futtermittel / Anteil in %	für Hund	Katze	Katze[1])	Rotwild	Rehkitz	Hase	Igel	Schweinchen	Hamster	Chinchilla	Seehunde
Magerquark	40	15	15	5	36	65	60	38	40	28	7
Rinderhack, fettarm	–	8	–	–	–	–	–	–	–	–	–
Heringsfilet	–	–	–	–	–	–	–	–	–	–	24
Eigelb	10	4	5	–	–	3	12	4	4	5	14
Magermilch	43	68,2	76	66	–	–	–	–	42	33	–
Rahm (30 % Fett)	–	–	–	27	28	25	–	7	11	20	–
Wasser	–	–	–	–	–	–	–	–	–	10	40
Fencheltee	–	–	–	–	–	–	18	–	–	–	–
Vollmilch	–	–	–	–	36,5	–	–	48	–	–	–
Lactose	–	0,8	–	–	–	–	–	–	–	–	–
Speiseöl	6	3	3	–	–	5	8	1	1	2	–
Fischöl[2])	–	–	–	–	–	–	–	–	–	–	14
Mineralfutter[3])	1	1	1	2	1,5	2	2	2	2	2	1

[1]) Diesem Rezept müssen bei langfristiger Verwendung 40 mg Taurin und 300 mg Nachtkerzenöl pro 100 ml zugesetzt werden.
[2]) unbehandelt, sonst geringe Verdaulichkeit des Fetts – > Verschmutzung des Schwimmbeckens (MEYER und WIESE-TWELE, unveröffentl.)
[3]) Mit ca. 20 % Calcium, 5–8 % Phosphor, für Seehunde sind 10 % Calcium günstiger.

Die Rezepte für Hund und Katze sind unter Praxisbedingungen erprobt und bewährt (KIENZLE, 1991).
Das Rezept für die Rehkitze ist der von TREICHLER et al. (1974) in der Praxis erprobten Mischung vergleichbar, lediglich das etwas mühsam zu besorgende Casein wurde gegen Magerquark ausgetauscht, Wasserzusatz ist dann nicht mehr nötig.
Das Rezept für die Seehunde ist in Anlehnung an eine von MEYER und WIESE-TWELE (unveröffentl.) bei der Heuleraufzucht überprüfte Mischung berechnet. Im Originalrezept ist ein milchreiches Alleinfutter für Hunde enthalten, das nicht mehr im Handel ist, daher wurde es durch andere Komponenten ersetzt.
Alle übrigen Rezepte sind entsprechend der Milchzusammensetzung berechnet, jedoch nicht praktisch erprobt.

from Kienzle & Landes (1995)

Mammal milk recipes



TAPIR

(Tapiridae tapirus indicus)4

MOTHER'S MILK COMPARISON

Diet	% Protein	%Fat	%Lactose	% Solids
Mother	36.3	21.7	42.0	15.7
Milk 1	33.3	20.3	35.0	

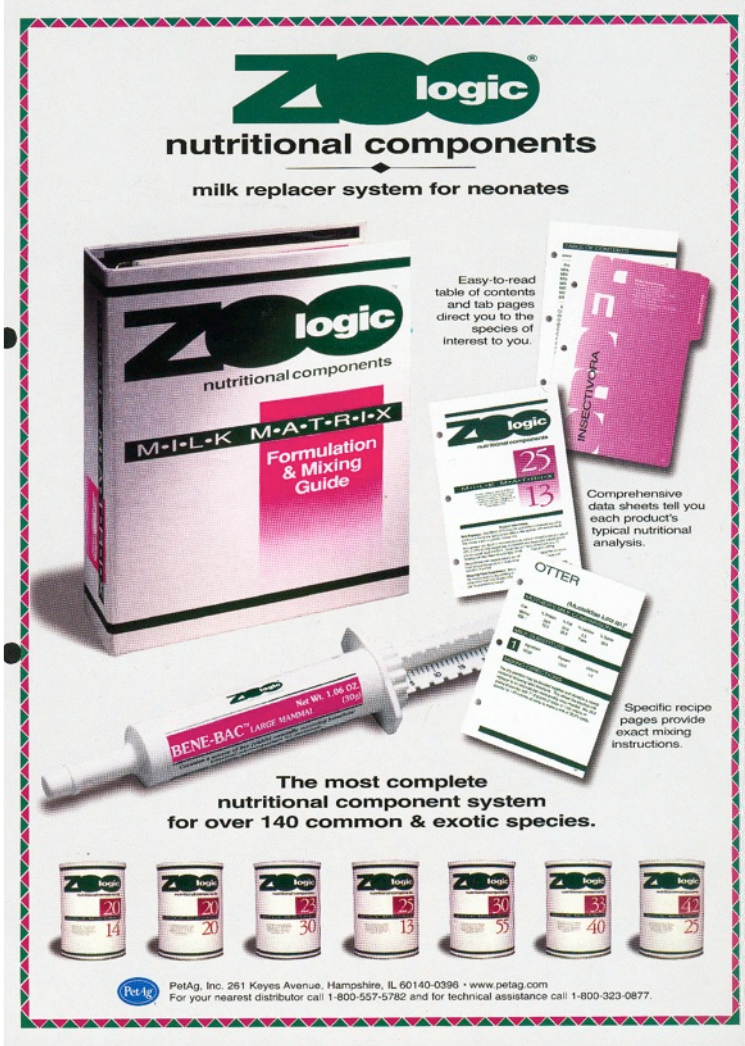
MILK SUBSTITUTE

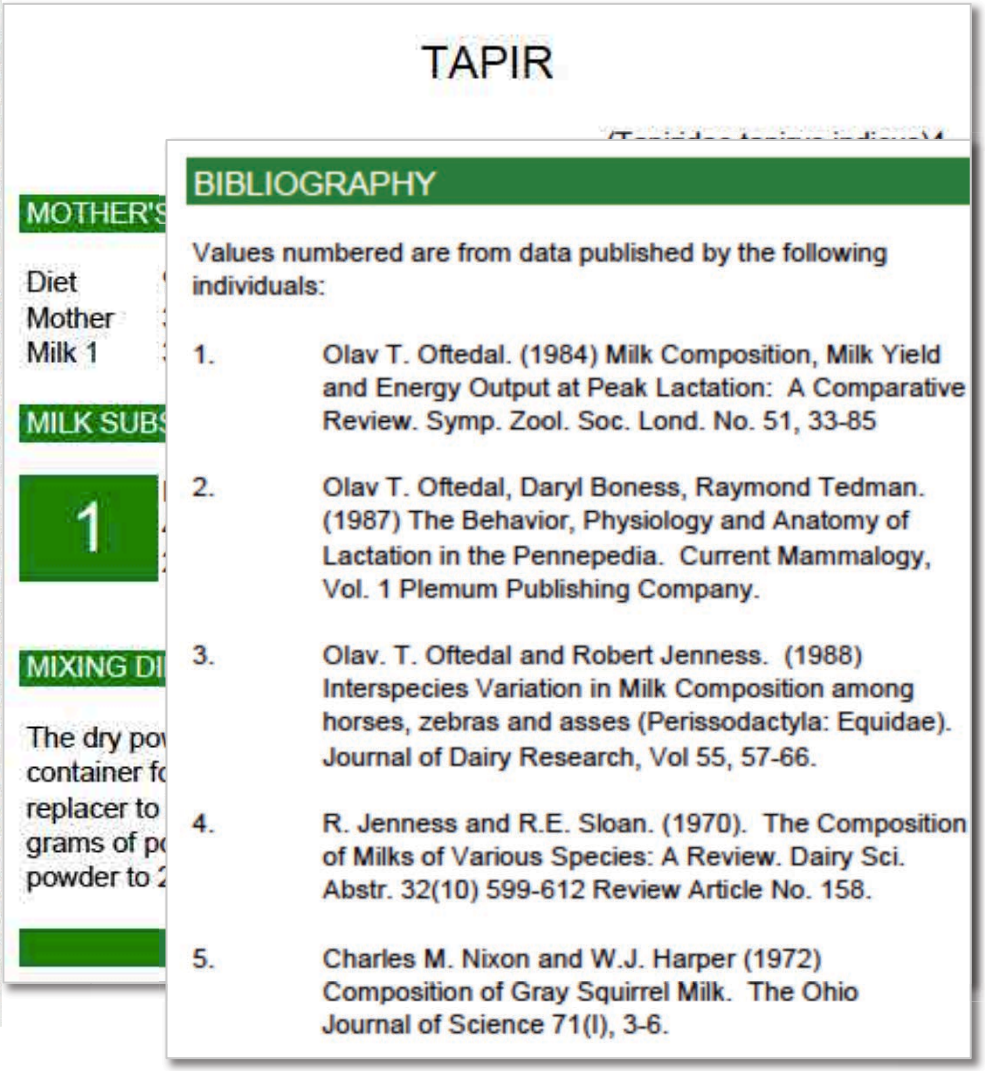
	Ingredient	Percent	Volume
1	42/25	57.0	1.3
	20/14	43.0	1.0

MIXING DIRECTIONS

The dry powders may be blended together and stored in a closed container following label directions. This allows the blended milk replacer to be reconstituted more quickly when needed. Mix 15.7 grams of powder with 84.3 grams of water or 1.0 volume of powder to 2.5 volumes of water to make a milk of 15.7% solids.

Mammal milk recipes





Milk replacer calculations

WildAgain Wildlife Rehabilitation, Inc.

Wild mammal nutrition resources	Online	Download (PDF) click below
Insolubility Issues with Milk Replacer Powders: An Easy Fix NEW Wildlife rehabilitators caring for young mammals prepare milk replacement formulas. Most rehabilitators, over the years, have dutifully followed the mixing instructions indicated on product labeling. Instructions generally say to add water, gently stir, and the liquid formula is ready to use. This paper discusses issues related to these products lack of complete solubility, laboratory tests performed to measure insolubility and minor adjustments to formula preparation that easily address these issues.		Click Here
Powdered milk replacer product tests - March, 2012 Discussion of test results on 8 recent lots of commercial powdered milk replacement products, including Fox Valley (6 products), PetAg (1 product), and GNC (1 product). Presents new information on solubility, mineral levels, adherence to Guaranteed Analysis, physical characteristics and labeling issues, as well as trends. Tests on additional recent lots expected in April, 2012.	Click Here	
Milk Replacer update - January, 2011 This update discusses research on commercial powdered milk replacer products and issues in wildlife rehabilitation from 2010 though January 2011, as well as a few of the broader issues about milk replacers that have prompted a variety of results and opinions. It also reviews an example of a newly developed 'recipe' that squirrel rehabilitators have found to be effective during 2010, including possible reasons for its success and implications for other 'recipes.'	Click Here	Click Here
Nutrition calculator - ***newly expanded functionality (May 31, 2013)*** NEW This expanded WildAgain Nutrition Calculator provides a tool to calculate the nutritional composition and kcal value for milk replacer powders used by wildlife rehabilitators. The dropdown list allows the user to select from and compare commonly used milk replacer powders from multiple manufactures as well as compose 'recipes' -- and then compare that information to research studies of the mother's milk for several common species of mammals rehabilitated in North America. The calculator also allows the user to add other other products or research studies for other species that are not on the provided lists. It's user-friendly and easy to use. The Calculator does not suggest or endorse a specific or mix of product(s) for individual species; recipes or amounts of formula to be fed; or specific feeding frequencies. Those decisions	Click here ***Updated May 31, 2013***	Click here **(Excel spreadsheet)**

Milk replacer calculations

WildAgain Wildlife Rehabilitation, Inc.

home > mammal nutrition > calculator

home
training
homeopathy
nutrition
regulations
501c3
colorado
recruiting
publications
wildlifeemergency
WildAgain
contactus

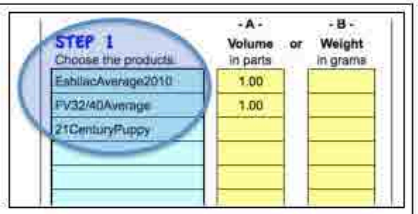
WildAgain's Nutrition Calculator (Updated 3/30/12)

The calculator is a series of worksheets that provide the nutritional component analysis for various powdered milk replacer products when mixed with water. The calculator is in the form of a Microsoft Excel Spreadsheet, so you do need to have a copy of Excel on your computer. When you click on the link below to the calculator, your browser will likely begin the download process, or it may bring up the calculator in Excel automatically. Either way, the calculator is easy to use and fairly self-explanatory. If you download the calculator, please check back periodically, as new products and lots will be added from time to time.

The Calculator has newly expanded functionality as described below!

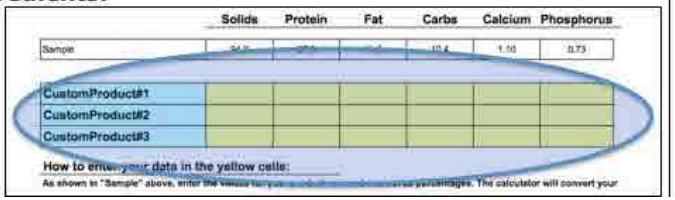
1.) Multiple manufacturers, products, individual lots and ingredients.

Previously limited to just a handful of milk replacers produced by one manufacturer, the calculator now provides a selection of over 50 products, individual lots and supplemental ingredients. The user may select up to 6 products or ingredients concurrently from an easy to use drop-down menu when evaluating a formula. The detailed Typical Nutritional Analysis is also provided for each of the individual products and ingredients. The input may be either in volume (parts) or by weight (in grams). Some users prefer to enter the values in grams to alleviate creating inaccurate results because of measurement error.

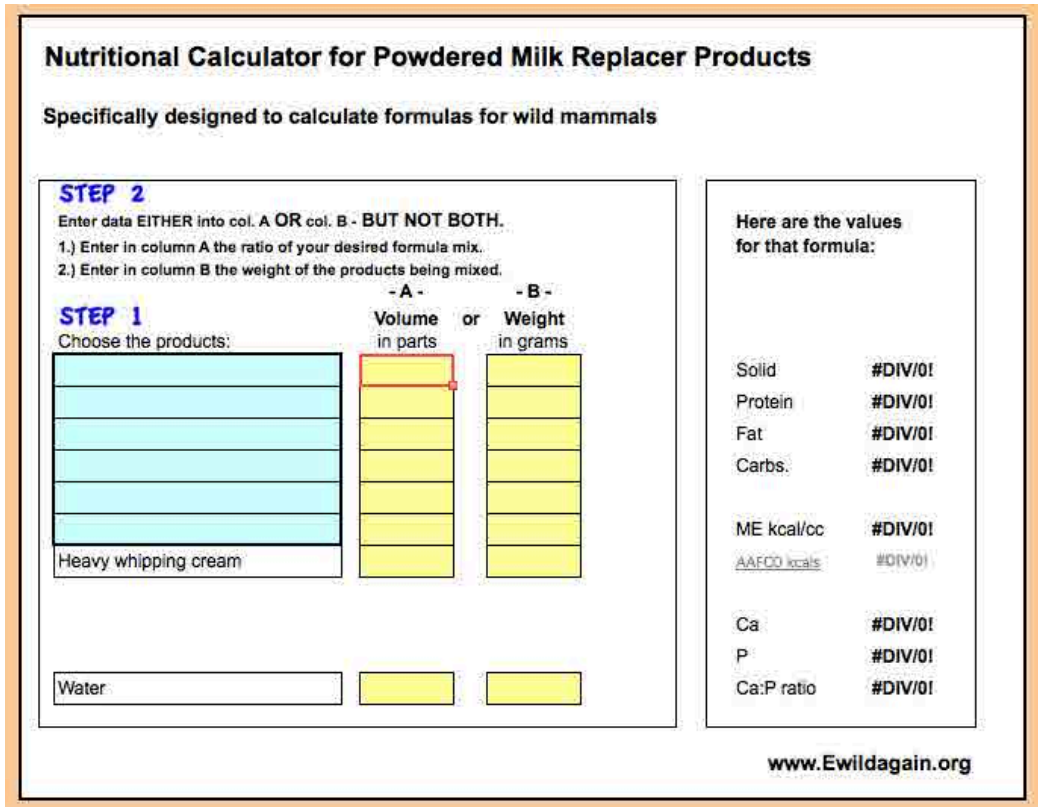


2.) Allows user to input up to 3 custom products or ingredients.

If the calculator does not already include a specific product, the user has the option to input up to three custom products. The user will need to have certain data about the composition of the product or ingredient (such as % solids, % protein, etc.) as well as the weight in grams of 1 tablespoon of the product or ingredient.



Milk replacer calculations



Nutritional Calculator for Powdered Milk Replacer Products

Specifically designed to calculate formulas for wild mammals

STEP 2

Enter data EITHER into col. A OR col. B - BUT NOT BOTH.

1.) Enter in column A the ratio of your desired formula mix.

2.) Enter in column B the weight of the products being mixed.

STEP 1

Choose the products:

	- A - Volume in parts	or	- B - Weight in grams
Heavy whipping cream			
Water			

Here are the values for that formula:

Solid	#DIV/0!
Protein	#DIV/0!
Fat	#DIV/0!
Carbs.	#DIV/0!
ME kcal/cc	#DIV/0!
AAFCO kcals	#DIV/0!
Ca	#DIV/0!
P	#DIV/0!
Ca:P ratio	#DIV/0!

www.Ewildagain.org

Click on any of the blue cells to select a product or ingredient from the drop-down list (up & down arrows).

How does this formula compare to mother's milk?

STEP 3

Choose a species (and research study):

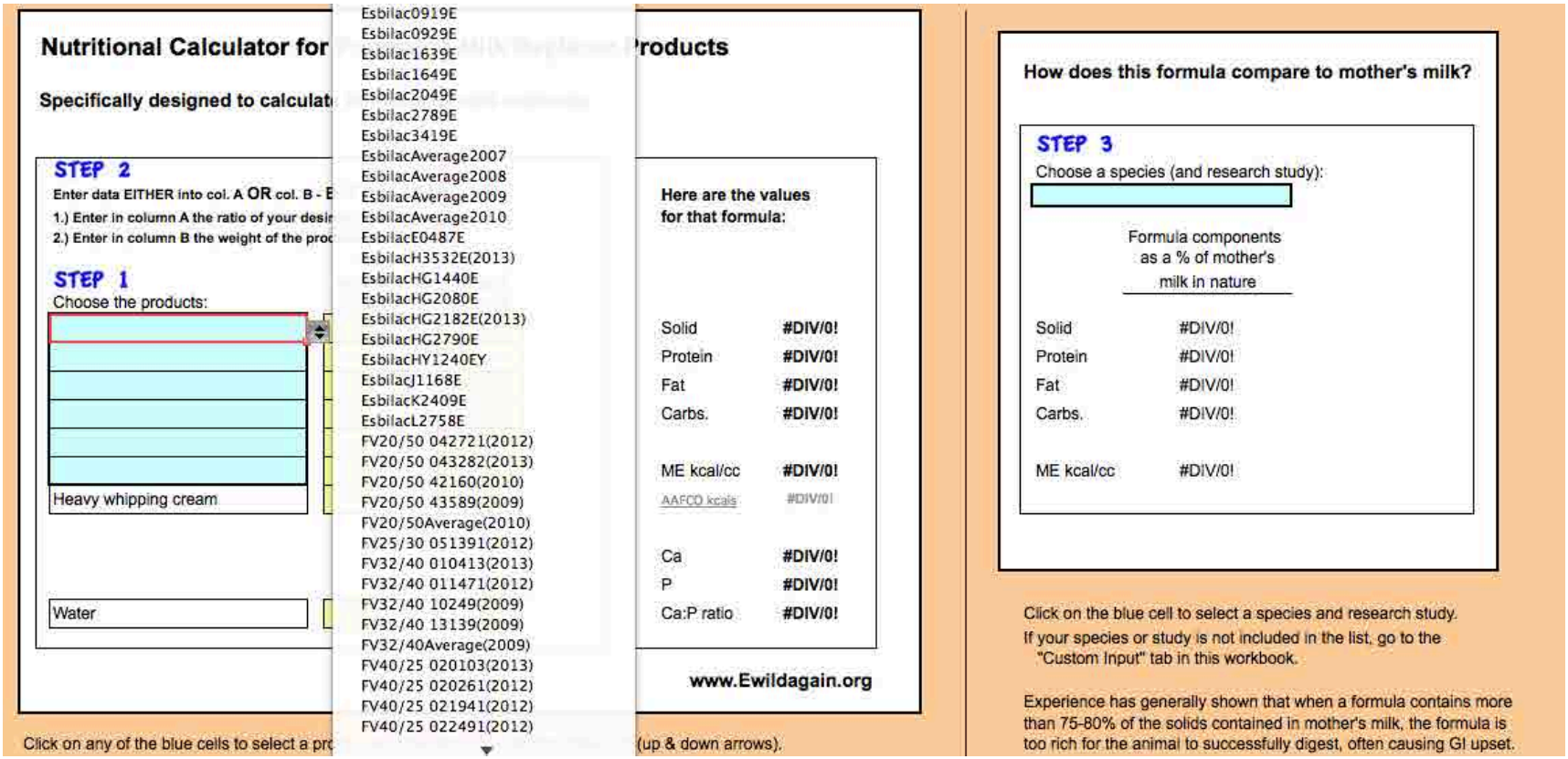
	Formula components as a % of mother's milk in nature
Solid	#DIV/0!
Protein	#DIV/0!
Fat	#DIV/0!
Carbs.	#DIV/0!
ME kcal/cc	#DIV/0!

Click on the blue cell to select a species and research study.

If your species or study is not included in the list, go to the "Custom Input" tab in this workbook.

Experience has generally shown that when a formula contains more than 75-80% of the solids contained in mother's milk, the formula is too rich for the animal to successfully digest, often causing GI upset.

Milk replacer calculations



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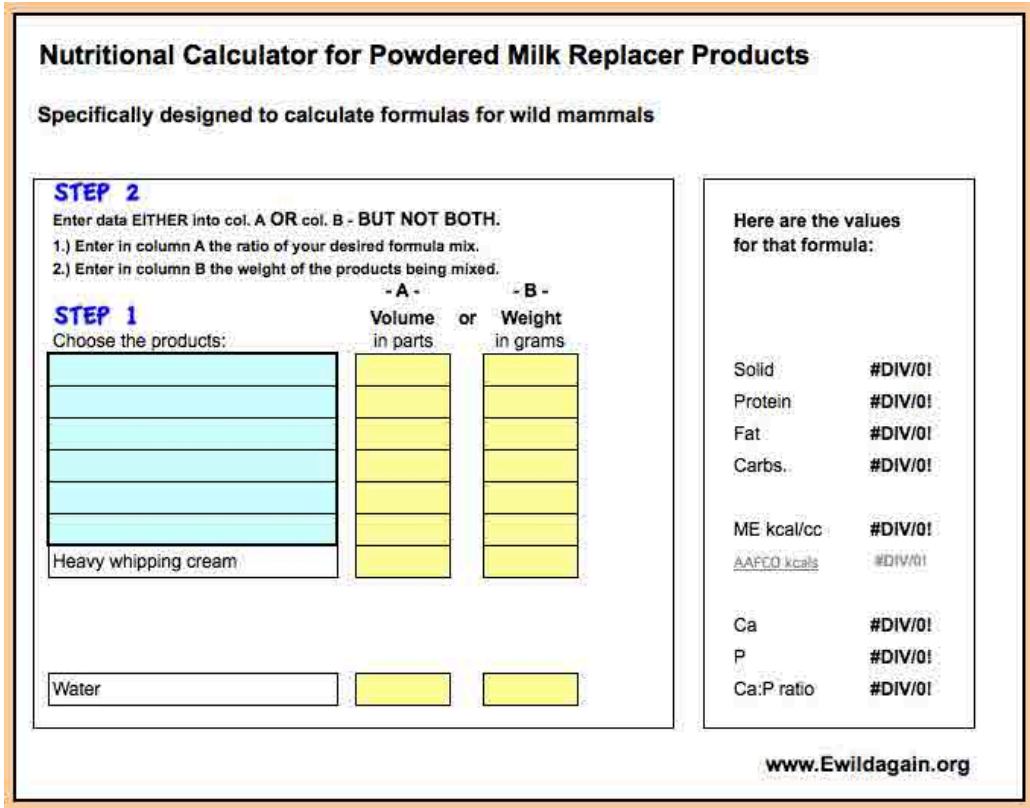

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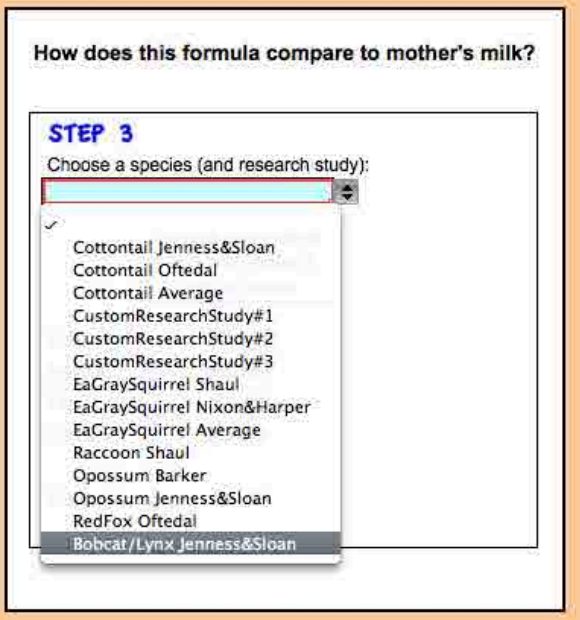

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Milk replacer: mixing problems

WildAgain Wildlife Rehabilitation, Inc.

Wild mammal nutrition resources	Online	Download (PDF) click below
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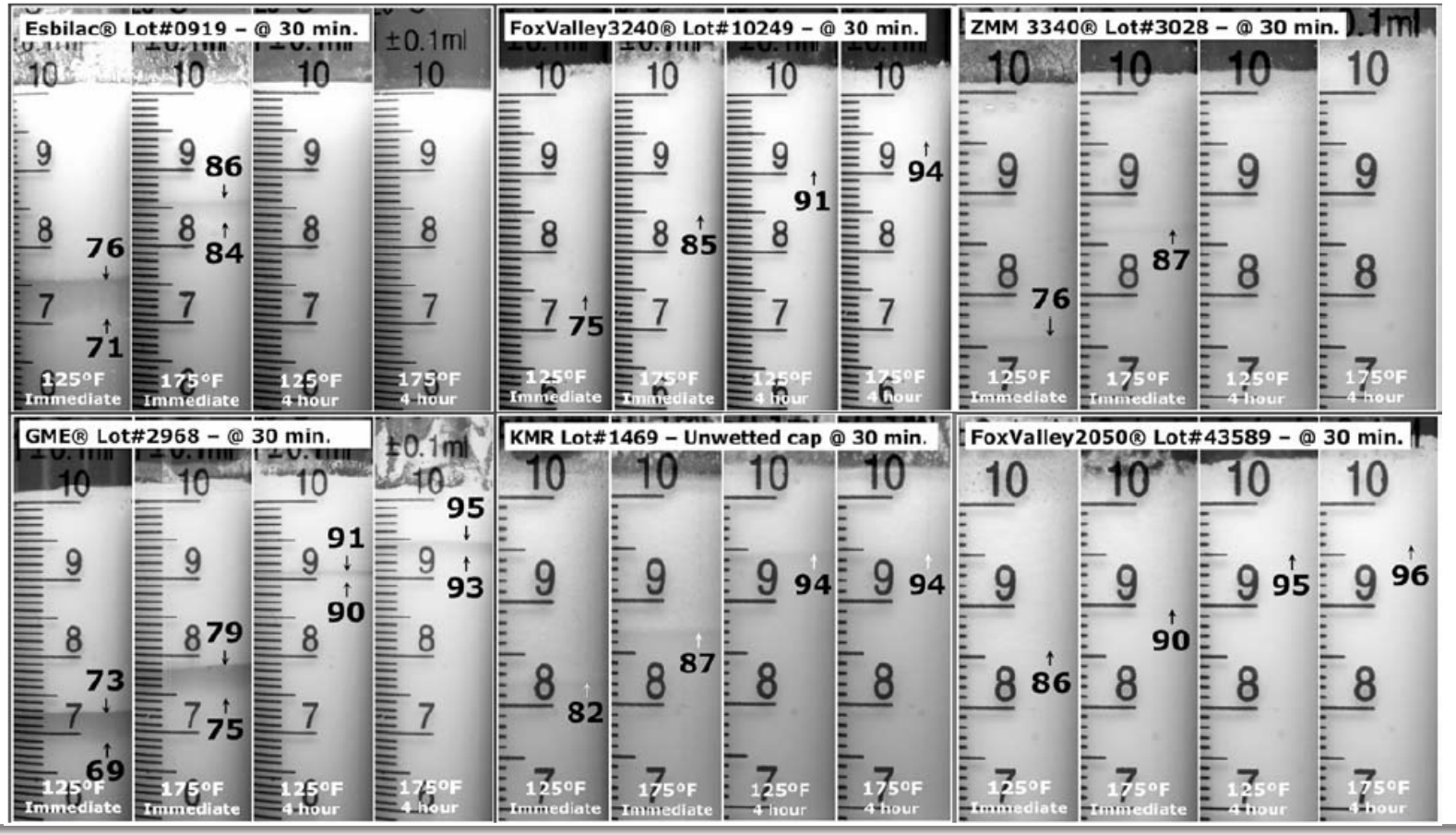
Powdered milk replacer product tests - March, 2012 Discussion of test results on 8 recent lots of commercial powdered milk replacement products, including Fox Valley (6 products), PetAg (1 product), and GNC (1 product). Presents new information on solubility, mineral levels, adherence to Guaranteed Analysis, physical characteristics and labeling issues, as well as trends. Tests on additional recent lots expected in April, 2012.	Click Here	
Milk Replacer update - January, 2011 This update discusses research on commercial powdered milk replacer products and issues in wildlife rehabilitation from 2010 though January 2011, as well as a few of the broader issues about milk replacers that have prompted a variety of results and opinions. It also reviews an example of a newly developed 'recipe' that squirrel rehabilitators have found to be effective during 2010, including possible reasons for its success and implications for other 'recipes.'	Click Here	Click Here
Nutrition calculator - ***newly expanded functionality (May 31, 2013)*** NEW This expanded WildAgain Nutrition Calculator provides a tool to calculate the nutritional composition and kcal value for milk replacer powders used by wildlife rehabilitators. The dropdown list allows the user to select from and compare commonly used milk replacer powders from multiple manufactures as well as compose 'recipes' -- and then compare that information to research studies of the mother's milk for several common species of mammals rehabilitated in North America. The calculator also allows the user to add other other products or research studies for other species that are not on the provided lists. It's user-friendly and easy to use. The Calculator does not suggest or endorse a specific or mix of product(s) for individual species; recipes or amounts of formula to be fed; or specific feeding frequencies. Those decisions	Click here ***Updated May 31, 2013***	Click here **(Excel spreadsheet)**

Milk replacer: mixing problems

Solubility Issues with Milk Replacer Powders—An Easy Fix

Allan M. Casey, III and Shirley J, Casey
WildAgain Wildlife Rehabilitation, Inc.



Milk replacer: mixing problems

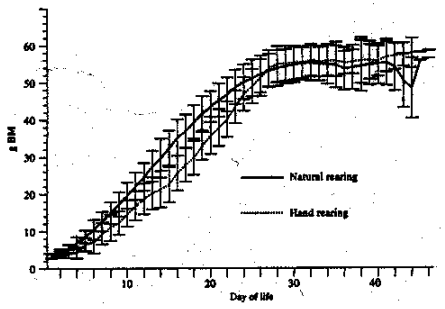
Solubility Issues with Milk Replacer Powders—An Easy Fix

ALLAN M. CASEY, III AND SHIRLEY J, CASEY
WILDAGAIN WILDLIFE REHABILITATION, INC.

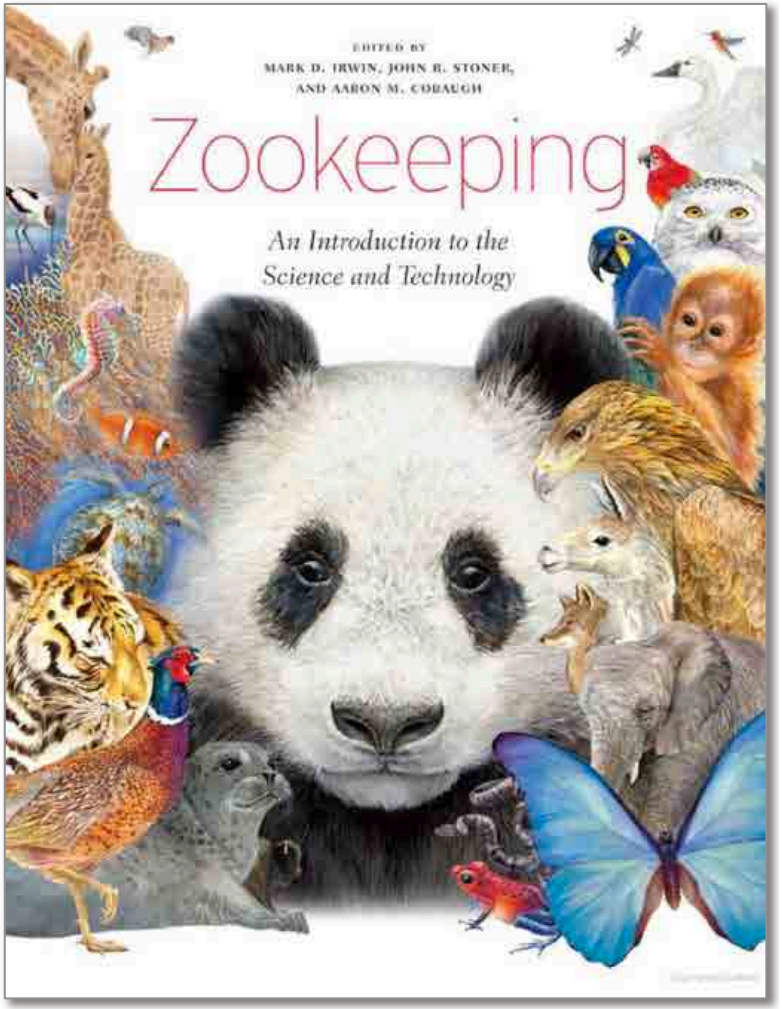
A SIMPLE SOLUTION

As demonstrated by the laboratory tests and clearly shown in Table 1, an easy remedial action was developed and tested. Guided by the laboratory test results, simply using the hotter water temperature, premixing four hours prior to use, and storing in the refrigerator, the amount of unwetted powder is reduced by 76 percent, on average, between the 23 products/lots tested, as shown comparing Group 1 and Group 4 in Table 1. Some products resulted in zero percent unwetted powder using this preparation method.

Bottle feeding – weight control



Geriatric issues



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Management of Geriatric Animals

Cynthia E. Stringfield

INTRODUCTION

With the increasing knowledge and implementation of proper husbandry and medical care for zoo and aquarium species, many animals in captivity now live well past their average life expectancy in the wild. Many facilities may have a number of animals that are considered geriatric (aged). Animal keepers should know the longevity data for the species they care for, so that they know when that species becomes geriatric. They should also be aware of the accurate age of the individual animals they are responsible for. Old age itself is not a disease or diagnosis; however, geriatric animals have special care requirements due to changes that occur in the body due to aging and medical conditions that are commonly seen, and so they often require more time and attention than young healthy animals. Gerontology is the study of aging and geriatrics; human physicians have this formal specialty, but veterinarians do not. Zoo veterinarians, however, are usually very skilled and experienced in geriatric medicine, due to the high numbers of geriatric animals they care for. Proper husbandry throughout an animal's life can not only extend its life but prevent or delay some common geriatric diseases. Additionally, the most difficult of decisions, euthanasia, must often be made when assessing quality of life for an animal that has a terminal disease. Animal keepers that are emotionally and professionally bonded to an animal need to manage the grief, loss, and sense of responsibility they feel when an animal dies.

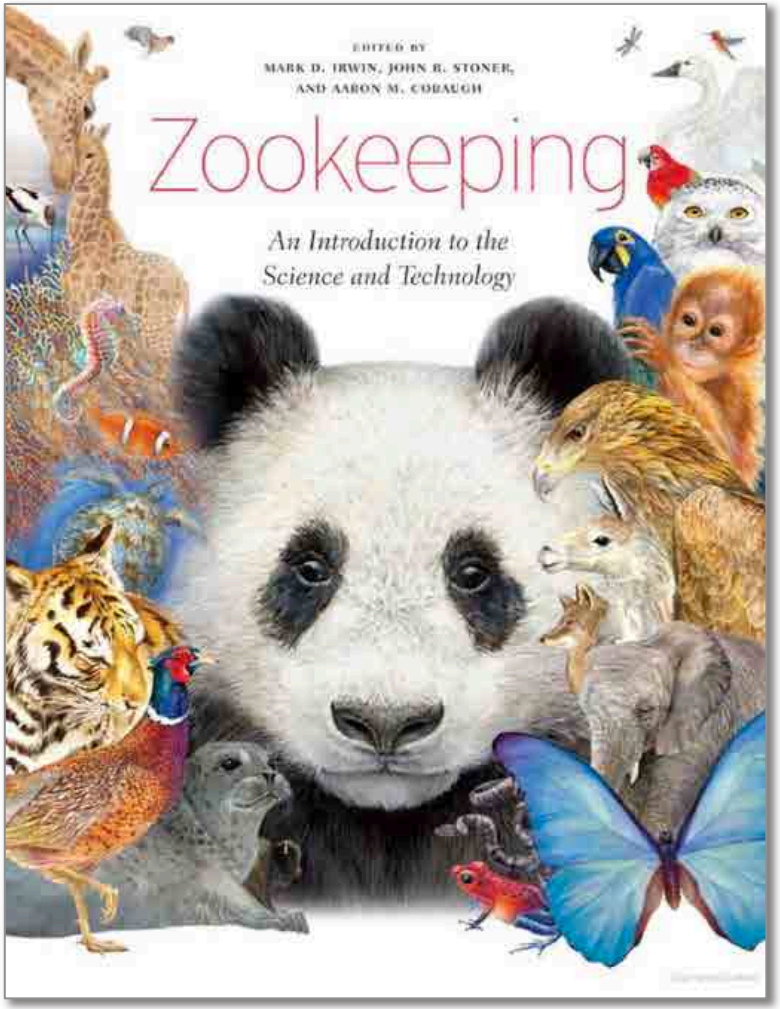
This chapter will provide basic information about geriatric animals and the care they need from their keepers. After studying this chapter, the reader will understand

- the importance of the keeper knowing the typical longevity of the species and age of the individual animal
- common health concerns of geriatric animals
- the effect of proper husbandry in preventing or managing common geriatric diseases
- the current care requirements of geriatric animals in zoo settings
- nutrition and feeding changes of geriatric animals
- the importance of diagnosis in determining treatment, palliative care, or euthanasia for a geriatric animal
- the what, when, who, how, and ethics of euthanasia of geriatric animals
- grief management and help resources for the animal keeper.

AGING AND LIFE SPAN

When evaluating an animal's life span, resources should include species-specific books and articles, and studbook or husbandry managers. Species-specific longevity data is available in many cases (Weigl 2005). Information exists on the internet, but it must be scrutinized carefully and its origin must be determined. Often differing information or age ranges will be found. For some species, information about life span in the wild and/or in captivity may not be well known. It is important to realize the differences between life span in the wild, life span in captivity, and longevity records. Depending on the species, animals may typically live either longer or shorter lives in captivity; however, in modern facilities with proper animal management (husbandry), nutrition, and veterinary care, the majority of species live longer (and may breed longer) in captivity. For example, camels used to be considered old in their late teens, but now they frequently live past the age of thirty. A longevity record refers to the age of the oldest individual of a species ever documented. For example, the Guinness world record (Guinness World Records 2009) for the oldest human is a French woman who died at 122 years of age; however, the United Nations reports that the average life expectancy for a woman in France is 84. In the United States it is 81 for women and 76 for men. In Swaziland it is 32. Animal managers and keepers may unrealistically expect their animals to reach the same age as the "record holder," but it is important to be realistic about an individual's life span. It will vary between individuals and can be heavily influenced by environmental factors.

Geriatric issues



NUTRITION AND FEEDING CONSIDERATIONS

As animals age, they may need modifications to their daily rations due to decreased metabolism and/or decreased activity. Depending on the species, they may benefit from changes in the composition of their diet based on recommendations by veterinarians and zoo nutritionists. For an animal with a certain disease, prescription diets may be used. Prescription diets made for dogs and cats may be used in similar nondomestic patients. These diets must be prescribed by a veterinarian, just as medication is. Also, the diets can be specially formulated by animal nutritionists to provide the proper nutrients that geriatric animals require. Dietary supplements (or nutraceuticals) can also assist in the treatment of many chronic diseases. One example is the previously mentioned use of nutraceutical chondroprotectives for arthritis (Stringfield 1999). Finally, diets may need to be presented differently for animals with chronic disease. Some adjustments might include the softening of hard food for an animal with missing teeth, addition of extra water for an animal in CRF, improvement of flavor to encourage an animal to eat, and so on. For example, a geriatric fox in chronic renal failure that has lost molars due to previous tooth disease may benefit from having its prescription dog chow soaked or ground up, or may be switched to the canned version of the diet. Sometimes, as animals in decline become picky eaters, keepers may be challenged to provide diet items they will eat while still maintaining a balanced diet for them.

Geriatric issues

European Association of Zoo- and Wildlife Veterinarians (EAZWV)
5th scientific meeting, May 19 - 23 - 2004, Ebeltoft. Denmark.

DIETARY AND VETERINARY MANAGEMENT OF A LINGUAL ABSCESS IN A GERIATRIC CAPTIVE BLACK RHINO (*Diceros bicornis*) WITH IRON STORAGE DISEASE

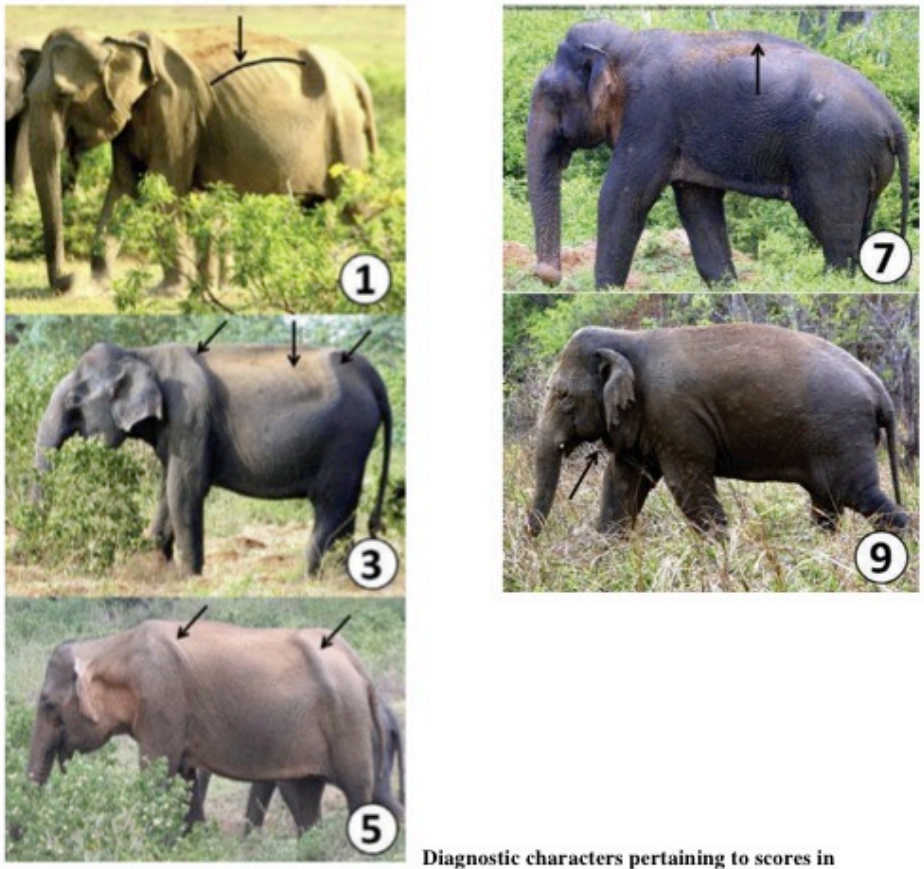
J-M. HATT[1], C. WENKER[2], J. CASTELL[3] and M. CLAUSS[3]

Geriatric issues

- typical sign: loss of condition
  - monitoring

Condition monitoring

Body Condition Index Scores



Diagnostic characters pertaining to scores in photographic scale.

1	All ribs (shoulder to pelvis) visible, some ribs prominent (spaces in between sunken in)
3	Some ribs visible (spaces in between not sunken in), shoulder and pelvic girdles prominent
5	Ribs not visible, shoulder and pelvic girdles visible
7	Backbone visible as a ridge, shoulder and pelvic girdles not visible
9	Back rounded, thick rolls of fat under neck

If it is difficult to decide between two points on the scale, as the scale is composed of odd numbers, the score represented by the intervening even number is assigned.

Geriatric issues

- typical sign: loss of condition
  - monitoring
- tooth wear – adjust physical form of diet (roughage/pellets; whole prey/minced meat)
- reduced digestive ability – adjust energy content ('concentrates')

Geriatric issues

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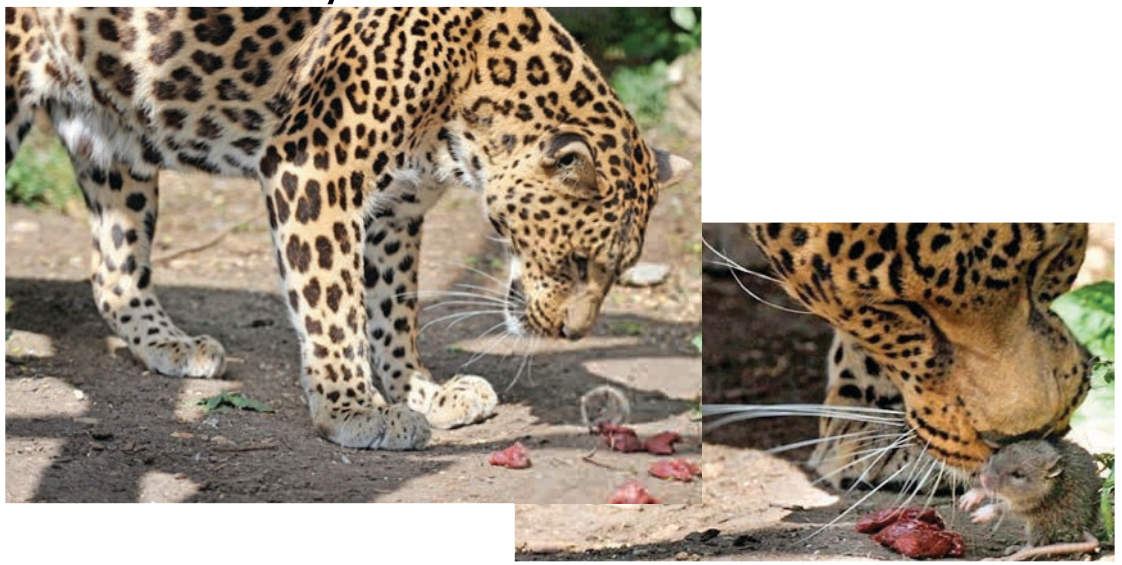

Announcements

- Nutrition software

Introducing...

FAUNA

Zoo Diet Management Software

Announcements

- Nutrition software

- Next zoo nutrition conference

European Zoo Nutrition Conference

Feeding zoo animals for health, welfare and conservation

22-25 January 2015
Burgers Zoo, The Netherlands

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