



# Challenges in zoo animal nutrition



Marcus Clauss

*Clinic for Zoo Animals, Exotic Pets and Wildlife, Vetsuisse Faculty, University of Zurich, Switzerland  
Prague 2019*



**University of  
Zurich<sup>UZH</sup>**



**Clinic**  
of Zoo Animals, Exotic Pets and Wildlife



We feed zoo animals ...



# We feed zoo animals ...

1. ... and meet nutrient requirements or cause deficiencies



# We feed zoo animals ...

1. ... and meet nutrient requirements or cause deficiencies
2. ... and influence their behaviour



# We feed zoo animals ...

1. ... and meet nutrient requirements or cause deficiencies
2. ... and influence their behaviour
3. ... and we tell a story
  - to keepers and zoo personnel
  - to visitors



# What 's in an apple?



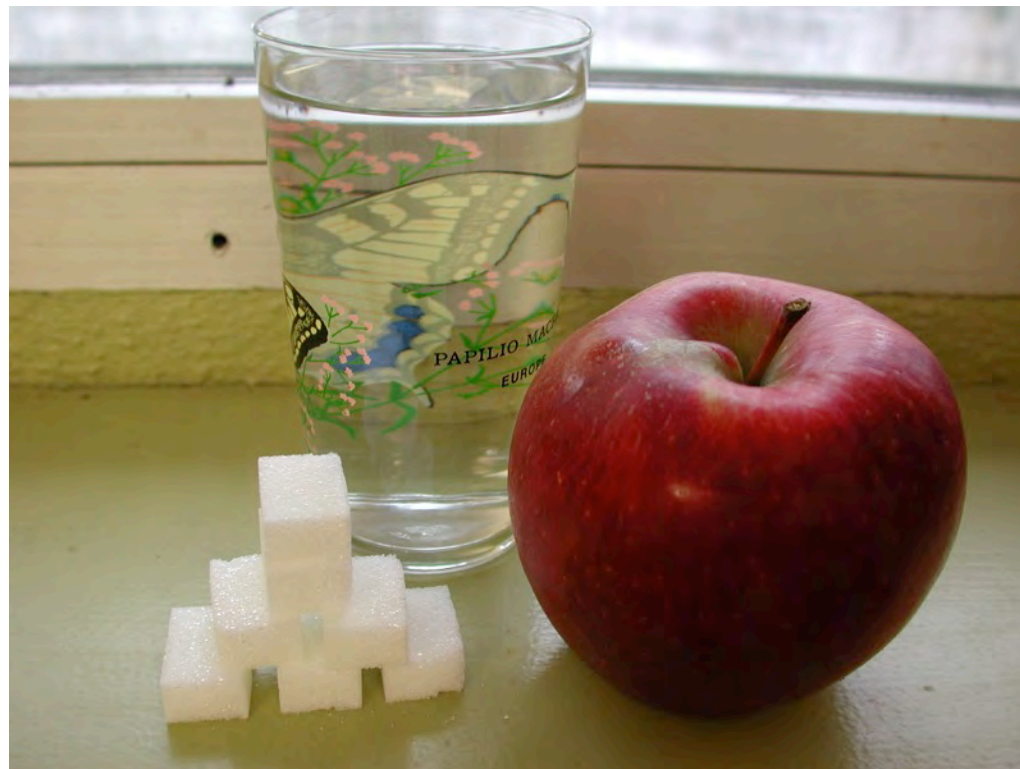
# What 's in an apple?

- 85 % water
- 10 % sugar



# What 's in an apple?

- 85 % water
- 10 % sugar







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

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

Fruits													Vegetables												
<b>Banana</b> <i>Musa acuminata</i>													<b>Carrot</b> <i>Daucus carota</i>												
 													 												
104 gram sugar													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	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	1.6	115	11.2	10.2	6.8	4	0.36	0.29	0.12	0.004	9170	5.5	0.02
<b>Apple</b> <i>Malus domestica</i>													<b>Sweet potato</b> <i>Ipomoea batatas</i>												
 													 												
86 gram sugar													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	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	3.0	197	39.4	9.7	8.3	11	0.45	0.47	0.15	0.009	3730	-	0.26
<b>Orange</b> <i>Citrus x sinensis</i>													<b>Celery</b> <i>Apium graveolens</i>												
 													 												
56 gram sugar													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	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	0.9	71	11.1	8.9	12.2	2.1	0.57	0.3	0.08	0.004	14.2	2	0.2
<b>Kiwi</b> <i>Actinidia deliciosa</i>													<b>Spinach</b> <i>Spinacia oleracea</i>												
 													 												
52 gram sugar													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	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	1.1	63	16.7	9.7	32.1	6.6	1.29	0.41	0.26	0.05	3490	29	0.52
<b>Papaya</b> <i>Carica papaya</i>													<b>Endive</b> <i>Cichorium endivia</i>												
 													 												
27 gram sugar													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	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	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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Contact:

Email:

Phone:

Tjalling Huisman

tjalling.huisman@wur.nl

+31-(0)58-2846311

courtesy Tjalling Huisman



*... is healthy?*



*... is healthier than ...*





*... is healthier than ...*



*... is healthier than ...*





Don 't believe names, think for yourself

- *'Frugivores' are adapted to **wild fruits** but **not to commercial produce** that has been bred for centuries to please the human palate!*



# Don 't believe names, think for yourself

- *'Frugivores' are adapted to **wild fruits** but **not to commercial produce** that has been bred for centuries to please the human palate!*
- *A large number of nutritional analyses document that '**wild fruit**' **contain more fibre and less sugar** than commercially available fruit (that is the product of selective breeding to please human taste).*

# The Feeding and Nutrition of Omnivores with Emphasis on Primates

OLAV T. OFTEDAL AND MARY E. ALLEN

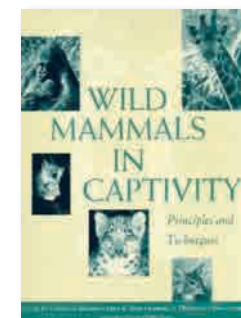


TABLE 14.5. Comparison of Some Foods Eaten by Primates in Zoos and in the Wild

Food type	Dry matter	Protein	Fiber fractions <sup>a</sup>			Ca	P
			NDF	ADF	AL		
Market produce used in primate diets <sup>b</sup>							
Apples	12.8	2.3	17.4	12.6	3.8	0.04	0.06
Green beans	10.7	17.9	28.0	25.1	2.2	0.57	0.44
Cabbage	8.9	14.7	20.6	21.9	1.7	0.64	0.38
Carrots	12.2	7.7	15.2	16.5	1.5	0.31	0.31
Kale	12.3	32.5	19.3	24.7	4.6	1.43	0.58
Foods eaten in the wild by red howler monkeys <sup>c</sup>							
Flowers	25.1	14.4	50.6	35.8	17.1	0.49	0.30
Fruits	23.7	7.0	53.8	35.2	16.6	0.64	0.16
Mature leaves	36.5	16.6	57.2	40.5	20.4	1.36	0.14
Young leaves	32.2	21.2	54.4	36.4	21.1	0.29	0.28



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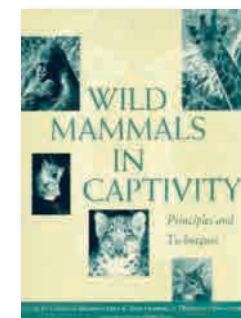


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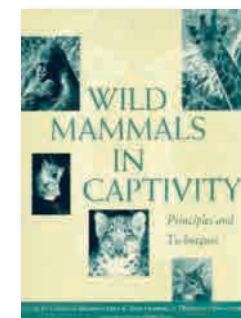


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if you want to 'copy' wild  
fruit, you have to feed green,  
leafy vegetables

**DWW**  
Dietary Welfare Working Group

**Sugars and other nutrients in produce (of fruits and vegetables)**  
All values represent average values, unless otherwise stated.

Fruits														Vegetables													
Protein	Moist	Starch	Sugar	Fiber	Cellulose	Ca	P	Mg	Na	K	Fe	Cu	Mn	Protein	Moist	Starch	Sugar	Fiber	Cellulose	Ca	P	Mg	Na	K	Fe	Cu	Mn
<b>Banana</b>  100 green sugar														<b>Carrot</b>  40 green sugar													
1.5	75	0	22	1.5	0	10	0.1	10	0	100	0.1	0.1	0.1	1.5	75	0	22	1.5	0	10	0.1	10	0	100	0.1	0.1	0.1
<b>Apple</b>  85 green sugar														<b>Spaghetti squash</b>  10 green sugar													
1.5	75	0	22	1.5	0	10	0.1	10	0	100	0.1	0.1	0.1	1.5	75	0	22	1.5	0	10	0.1	10	0	100	0.1	0.1	0.1
<b>Orange</b>  100 green sugar														<b>Celery</b>  10 green sugar													
1.5	75	0	22	1.5	0	10	0.1	10	0	100	0.1	0.1	0.1	1.5	75	0	22	1.5	0	10	0.1	10	0	100	0.1	0.1	0.1
<b>Avocado</b>  100 green sugar														<b>Spinach</b>  1 green sugar													
1.5	75	0	22	1.5	0	10	0.1	10	0	100	0.1	0.1	0.1	1.5	75	0	22	1.5	0	10	0.1	10	0	100	0.1	0.1	0.1
<b>Pumpkin</b>  100 green sugar														<b>Cucumber</b>  10 green sugar													
1.5	75	0	22	1.5	0	10	0.1	10	0	100	0.1	0.1	0.1	1.5	75	0	22	1.5	0	10	0.1	10	0	100	0.1	0.1	0.1

Protein and Starch: Source: NRC, 2005.  
Information used from Dietary Food Composition: Table and footnote at: (2005).

© The Animal Management / Animal Welfare Unit, 2005.  
Dietary Welfare Working Group  
Dietary Welfare Working Group  
Dietary Welfare Working Group





# What is your story ?





# What is your story ?

*“We show you that you can maintain wild animals in human care with diets that do not resemble the ones they eat in the wild.”*







# What is your story ?





# What is your story ?

*“We are concerned with conservation and welfare but we think it has nothing to do with feeding natural diets.”*







# What is your story ?





# What is your story ?

*“Nature sucks.  
Let us rather do  
something unnatural  
—  
it is much more fun.”*







# What is your story ?





What is your story ?

*“Hurray for Chiquita!”*





# What is your story ?





# What is your story ?







# What is your story ?



*At our zoo, we show you  
that it is ok to treat  
animals like cartoon  
characters.*

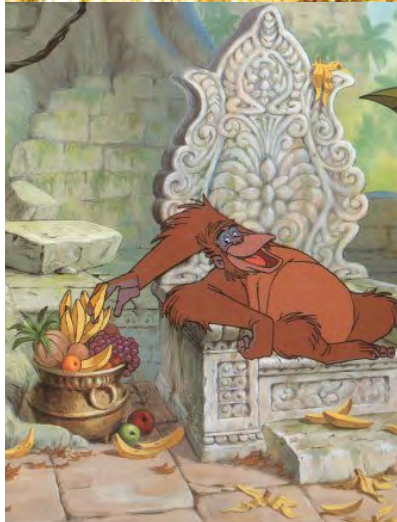




# What is your story ?



*At our zoo, we show you that it is ok to treat animals like cartoon characters.*



*And by the way, we justify it by saying conservation is important.*











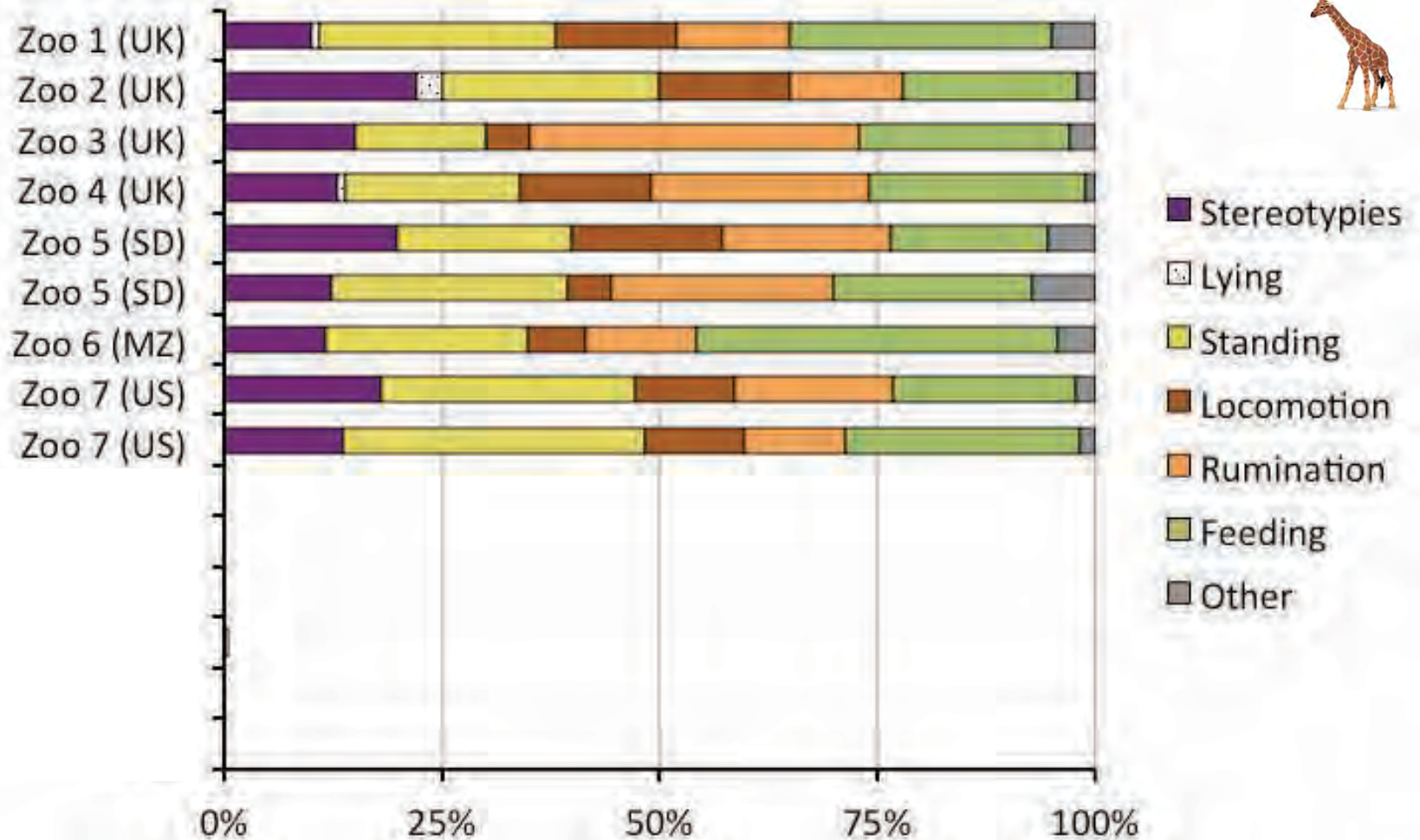
# What is your story ?







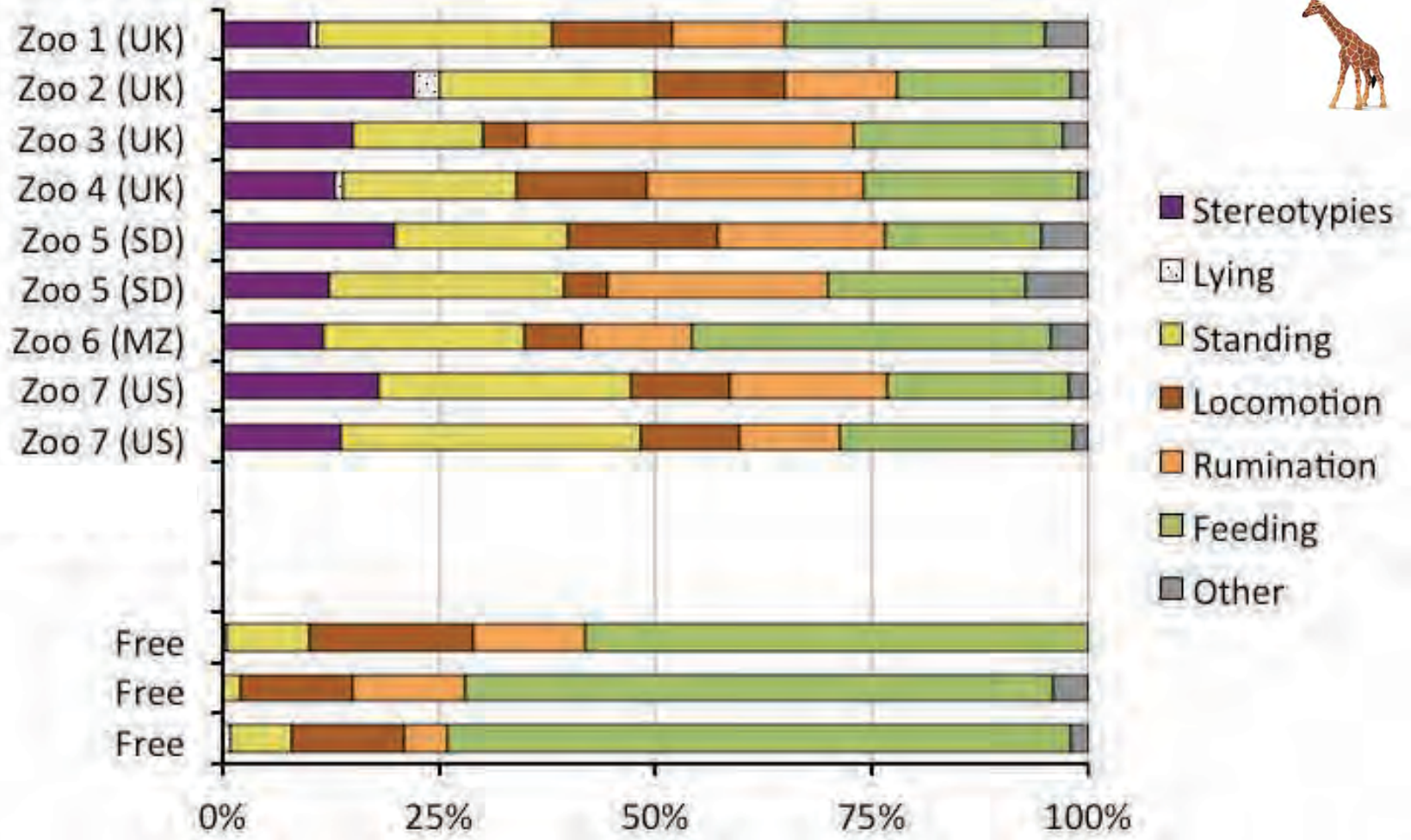
# Giraffe activity budgets



*Veasey et al. (1996), del Castillo et al. (2005), Bashaw (2011), Orban et al. (2016)*



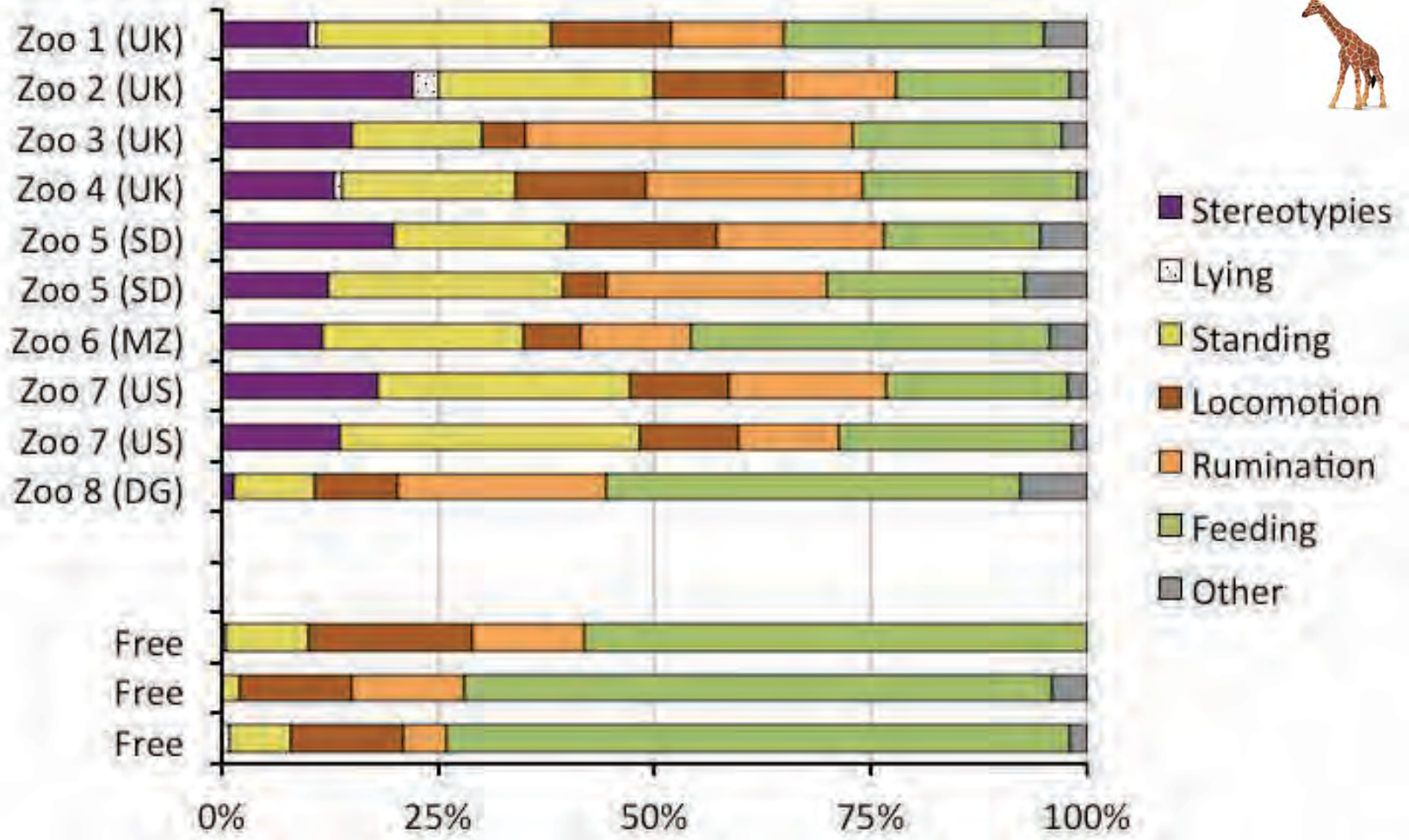
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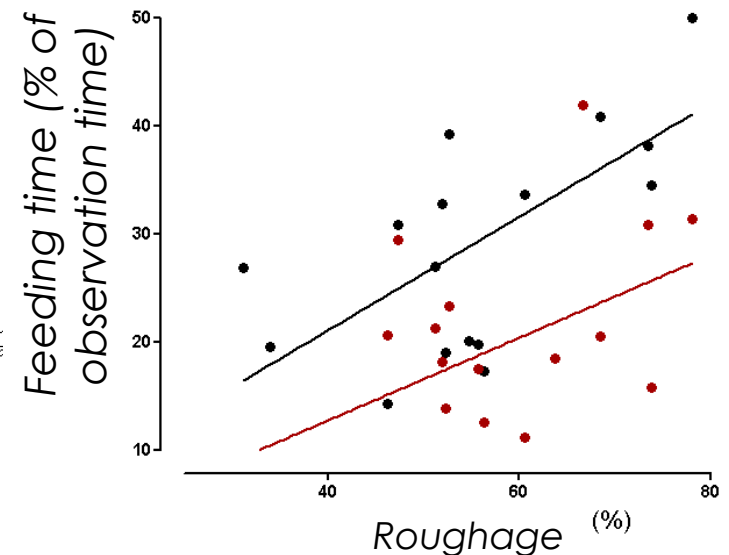
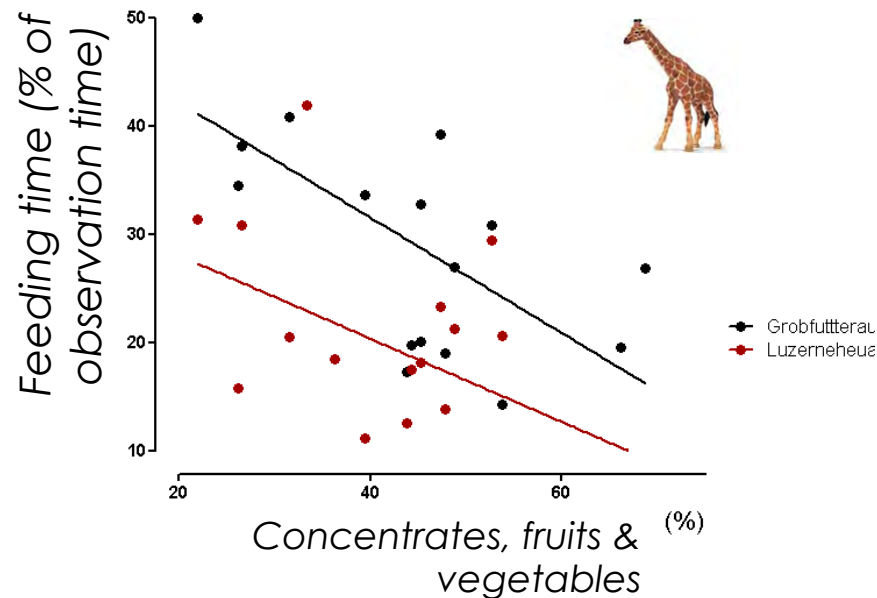




# Influence of ration composition on nutritive and digestive variables in captive giraffes (*Giraffa camelopardalis*) indicating the appropriateness of feeding practice

I. Gussek<sup>1</sup> | C. Große-Brinkhaus<sup>1</sup> | K.-H. Südekum<sup>1</sup>  | J. Hummel<sup>2</sup>

*J Anim Physiol Anim Nutr.* 2018;102:e513–e524.





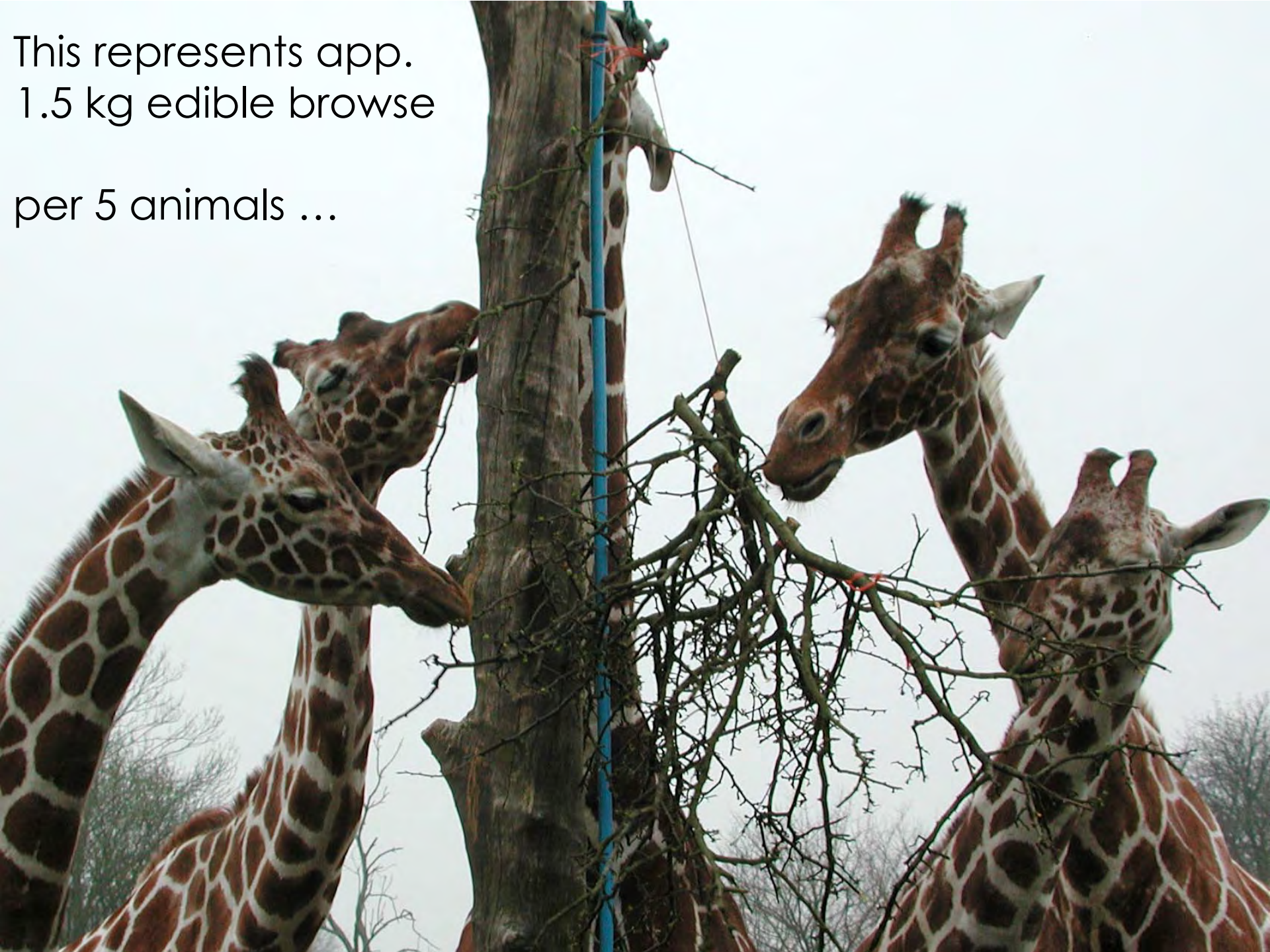




# What is your story ?

*“It is our aim to feed our animals a diet that consists of about 0.5 % natural diet items.”*

This represents app.  
1.5 kg edible browse  
per 5 animals ...





This represents app.  
1.5 kg edible browse  
(= 380 g dry matter)  
per 5 animals ...





This represents app.  
1.5 kg edible browse  
(= 380 g dry matter)  
per 5 animals ...

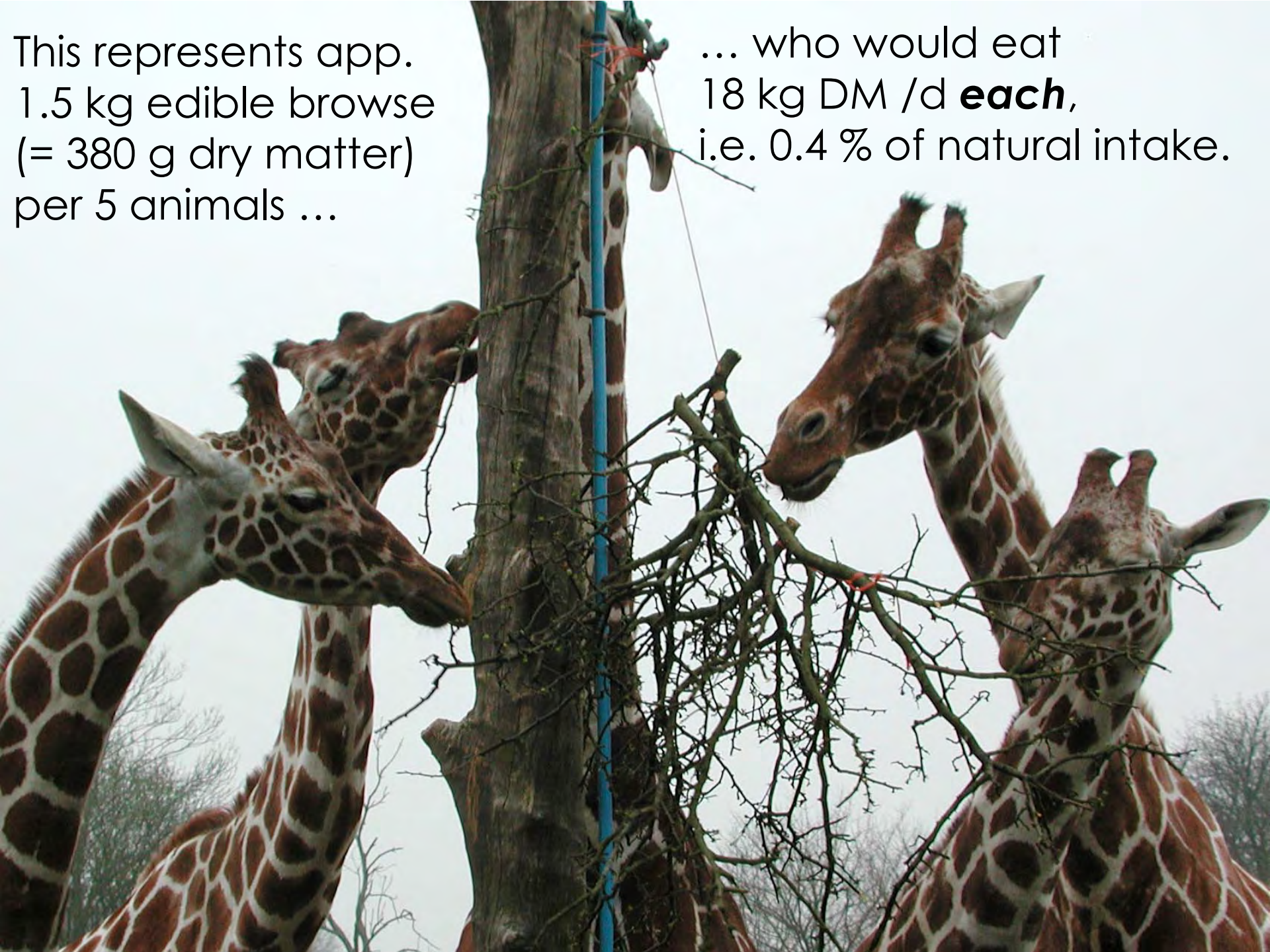
... who would eat  
18 kg DM /d **each**,





This represents app.  
1.5 kg edible browse  
(= 380 g dry matter)  
per 5 animals ...

... who would eat  
18 kg DM /d **each**,  
i.e. 0.4 % of natural intake.







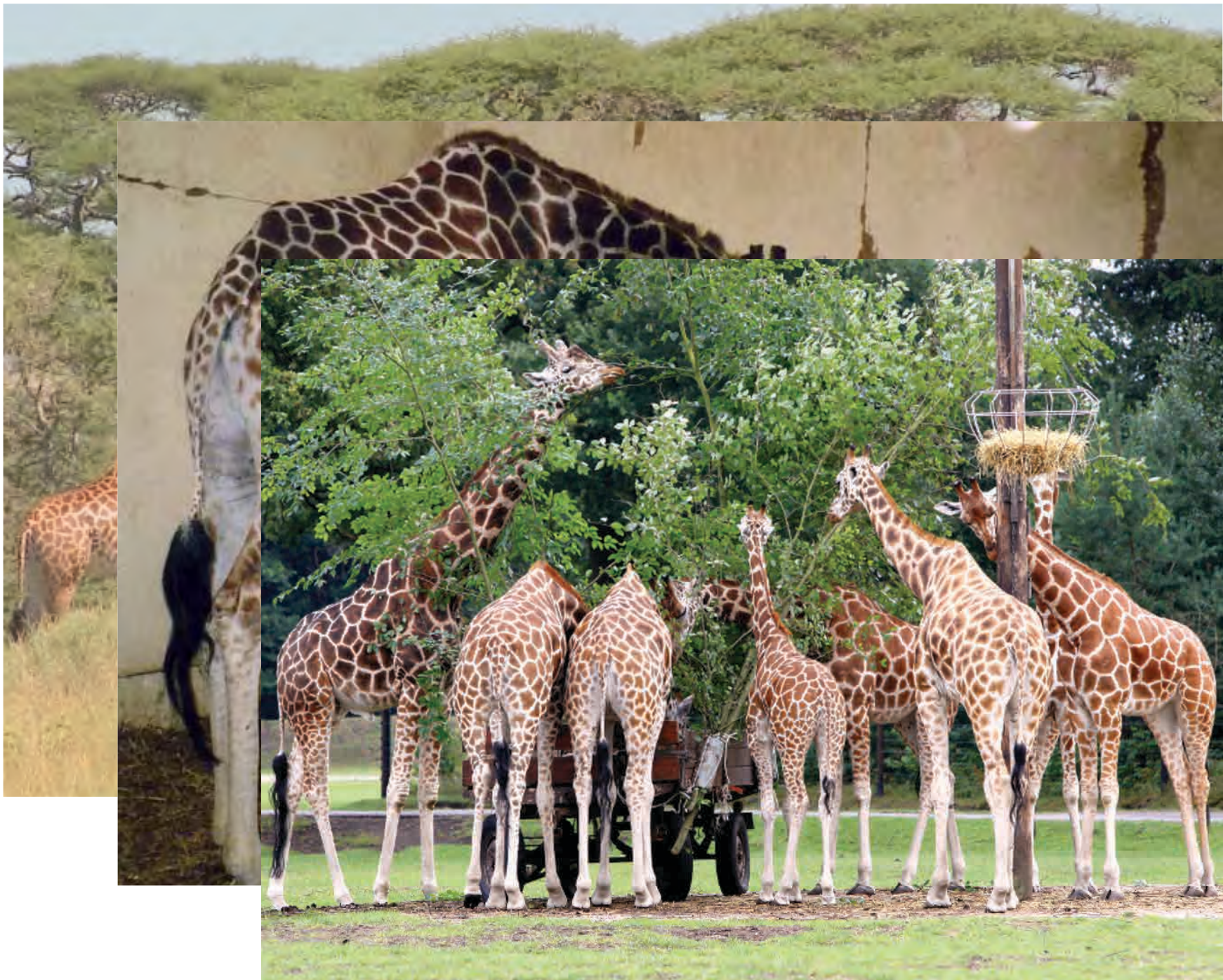














# What is your story ?







# *Chimpanzee R/R*





# An analysis of regurgitation and reingestion in captive chimpanzees

Kate C. Baker<sup>a,\*</sup>, Stephen Phillip Easley<sup>b</sup>

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.



# What is your story ?





# What is your story ?





# What is your story ?



*We get our  
animals hooked  
on sugar so they  
always come  
back to sugar  
daddy ...*





# Fatter animal are more difficult to kidnap





# A Survey of Diabetes Prevalence in Zoo-housed Primates

C. W. Kuhar,\* G. A. Fuller, and P. M. Dennis

Zoo Biology 32: 63–69 (2013)

Nearly 30% of responding institutions reported at least one diabetic primate in their current collection. Although the majority of reported cases were in Old World Monkeys (51%), all major taxonomic groups were represented. Females represented nearly 80% of the diagnosed cases. A wide variety of diagnosing, monitoring, and treatment techniques were reported. It is clear from these results diabetes should be considered prominently in decisions relating to diet, weight and activity levels in zoo-housed primates, as well as discussions surrounding animal health and welfare.

## Hypertension Increases With Aging and Obesity in Chimpanzees (*Pan troglodytes*)

John J. Ely,\* Tony Zavaskis, and Michael L. Lammey

Zoo Biology 32: 79–87 (2013)

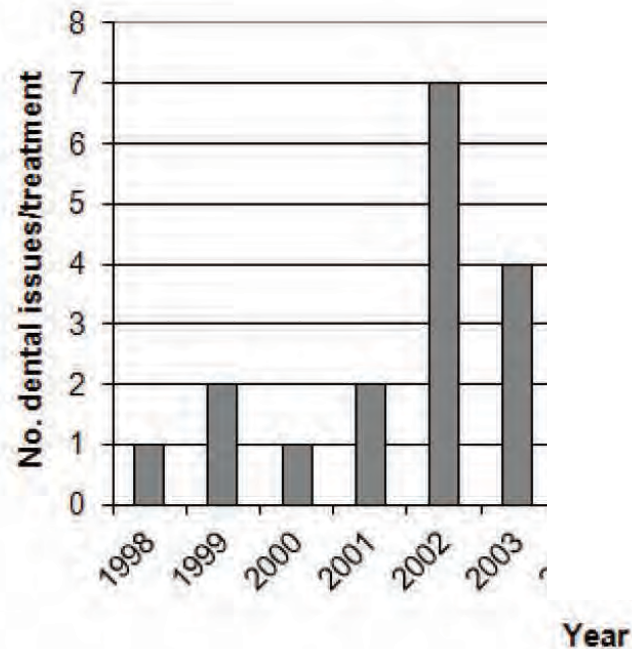
Cardiovascular disease is a primary cause of morbidity and mortality in captive chimpanzees. For females, obesity was a significant determinant of BP.



# Diet review and change for monkeys at Paignton Zoo Environmental Park

Journal of Zoo and Aquarium Research 1(2) 2013

Amy Plowman



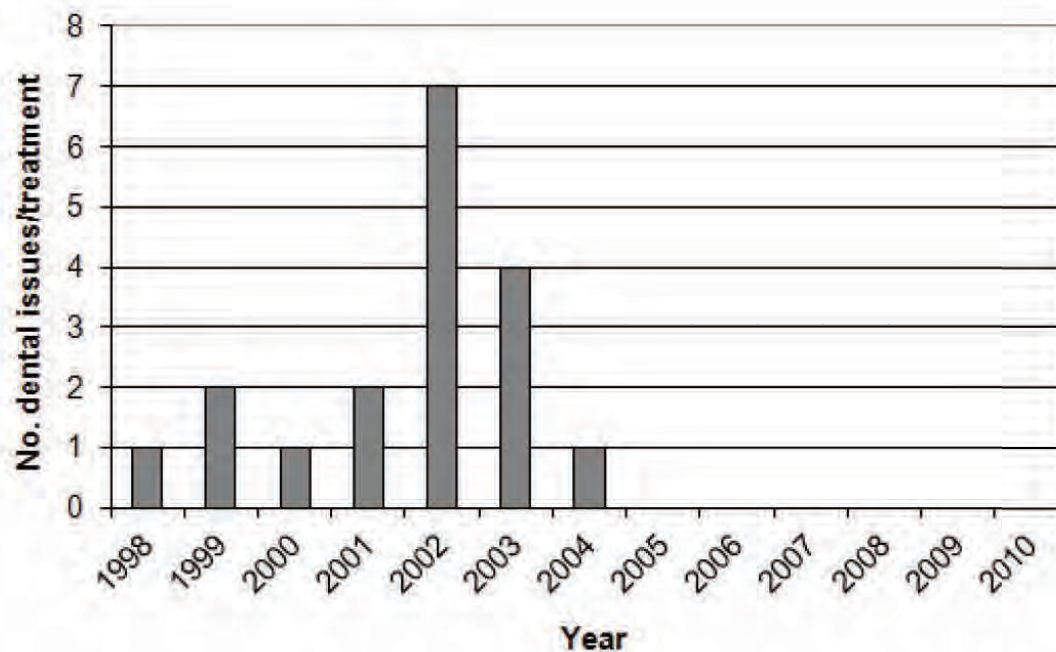
**Figure 1.** Frequency of dental issues identified or treatment required for six species of primate at Paignton Zoo Environmental Park before and after the initiation of diet improvements to reduce dietary sugar (March 2003).



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**Figure 1.** Frequency of dental issues identified or treatment required for six species of primate at Paignton Zoo Environmental Park before and after the initiation of diet improvements to reduce dietary sugar (March 2003).

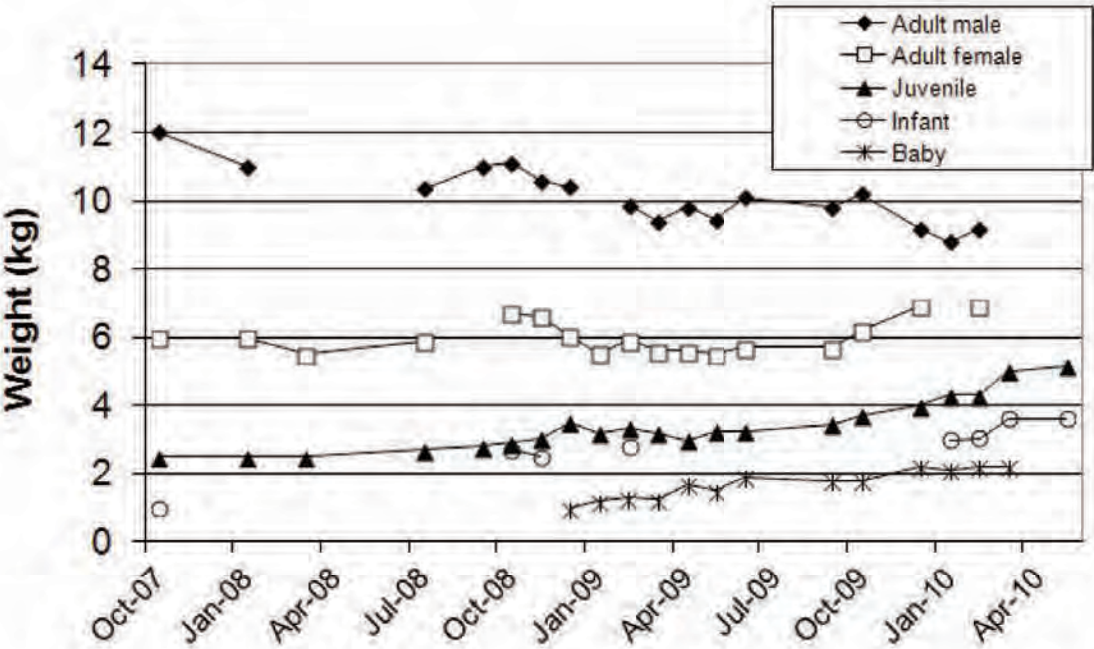




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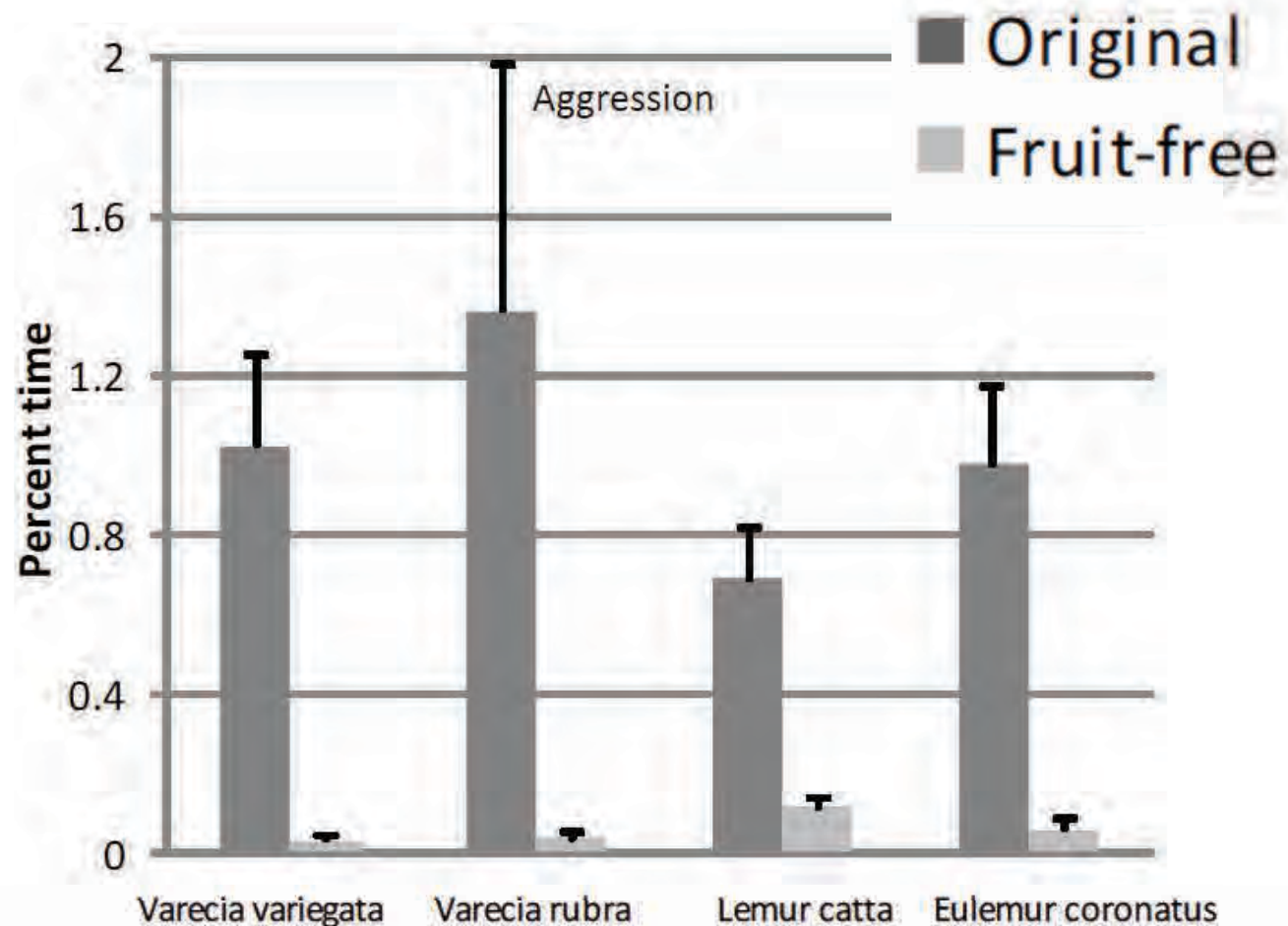
**Figure 2.** Body weights of a group of Diana monkeys at Paignton Zoo Environmental Park following a diet review that prompted a change from a fruit-based to a vegetable-based diet. The removal of all fruit occurred in April 2007; other changes were completed in September 2007 immediately before the first weights were obtained.



# Aggression and self-directed behaviour of captive lemurs (*Lemur catta*, *Varecia variegata*, *V. rubra* and *Eulemur coronatus*) is reduced by feeding fruit-free diets

Stephanie Britt<sup>1</sup>, Katherine Cowlard<sup>1</sup>, Kathy Baker<sup>2</sup> and Amy Plowman<sup>3\*</sup>

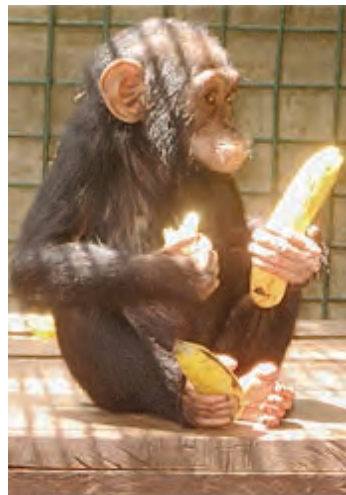
Journal of Zoo and Aquarium Research 3(2) 2015





# What is your story ?

*“We feed our monkeys fruit so that they have something to fight about.”*





# Development of zoo feeding regimes

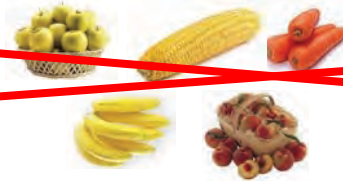
*concepts from agriculture*  
*(production animals – use **production** potential)*  
*human consumption habits*





# Development of zoo feeding regimes

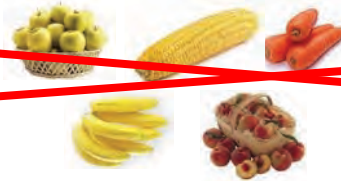
~~concepts from agriculture  
(production animals = use **production** potential)  
human consumption habits~~





# Development of zoo feeding regimes

~~concepts from agriculture  
(production animals = use **production** potential)  
human consumption habits~~



copying natural diets  
avoid diseases – use **adaptation** potential – teaching biological knowledge





## *Man-made diets: too little fibre*

- *Human nutrition*
- *Pigs*
- *Beef cattle/ Dairy cattle*
- *Riding horses*
- *Dogs/ Cats*
- *Zoo animals*



## *Man-made diets: too little fibre*

- *Human nutrition → gut health*
- *Pigs → piglet diarrhoea*
- *Beef cattle/ Dairy cattle*
- *Riding horses → crib biting*
- *Dogs/ Cats → faeces consistency*
- *Zoo animals → obesity*








## *Man-made diets: too little fibre*

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# *Fibre content depends on intended use*

<i>Use</i>		<i>Fibre content*</i>
<i>Beef cattle</i>		12 %DM
<i>Dairy cattle</i>		18 %DM
<hr/>		
<i>Feral cattle</i>		30 %DM

*\*historical recommendations for ration design*



## *Fibre content depends on intended use*

<i>Use</i>		<i>Fibre content*</i>	<i>Longevity</i>
<i>Beef cattle</i>		12 %DM	app. 2 years
<i>Dairy cattle</i>		18 %DM	app. 4 years
<hr/>			
<i>Feral cattle</i>		30 %DM	app. 25 years

*\*historical recommendations for ration design*



# *Zoo nutrition problems*

- *historical development*





# The classic problem repertoire

Carnivore



*Red meat*



?



# The classic problem repertoire

Carnivore



*Red meat*



*Calcium deficiency*



# The classic problem repertoire

Carnivore



*Red meat*



+



~~Calcium deficiency~~



# The classic problem repertoire

Carnivore



→ Red meat



+



→ ~~Calcium deficiency~~



# The classic problem repertoire

Carnivore



→ Red meat



+



→ ~~Calcium deficiency~~



→

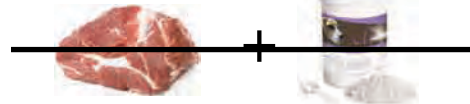
Dental calculus,  
obesity,  
behavioural  
deficiencies

# The classic problem repertoire

Carnivore



→ Red meat



→ ~~Calcium deficiency~~



→ ~~Dental calculus,  
obesity,  
behavioural  
deficiencies~~



# The classic problem repertoire

Carnivore



→ Red meat



→ ~~Calcium deficiency~~



--> ~~Dental calculus,  
obesity,  
behavioural  
deficiencies~~





# The classic problem repertoire

Carnivore



→ Red meat



→ ~~Calcium deficiency~~



→ ~~Dental calculus,~~  
~~obesity,~~  
~~behavioural~~  
~~deficiencies~~



+

adequate  
presentation

# The classic problem repertoire

Carnivore



→ Red meat



→ ~~Calcium deficiency~~



→ ~~Dental calculus,~~  
~~obesity,~~  
~~behavioural~~  
~~deficiencies~~



+

adequate  
presentation =  
**enrichment !!**



# The classic problem repertoire

*Primate*



*Fruits & vegetables*



*?*





# The classic problem repertoire

*Primate*

→ *Fruits & vegetables* → *Calcium deficiency*





# The classic problem repertoire

Primate

→ Fruits & vegetables → ~~Calcium deficiency~~



+



# The classic problem repertoire

Primate



→ Fruits & vegetables → ~~Calcium deficiency~~



+



Obesity, caries,  
aggression,  
abnormal  
behaviour

# The classic problem repertoire

Primate



→ Fruits & vegetables → ~~Calcium deficiency~~



~~Obesity, caries,  
aggression,  
abnormal  
behaviour~~



# The classic problem repertoire

Primate



→ Fruits & vegetables → ~~Calcium deficiency~~



~~Obesity, caries,  
aggression,  
abnormal  
behaviour~~



+

adequate  
presentation



# The classic problem repertoire

Primate



→ Fruits & vegetables → ~~Calcium deficiency~~



~~Obesity, caries,  
aggression,  
abnormal  
behaviour~~



+

adequate  
presentation =  
**enrichment !!**

# The classic problem repertoire

Herbivore



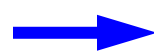
Hay, fruits & grains



?

# The classic problem repertoire

Herbivore



Hay, fruits & grains



Vitamin E- and calcium deficiency

# The classic problem repertoire

Herbivore



Hay, fruits & grains

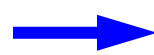


~~Vitamin E and calcium deficiency~~



# The classic problem repertoire

Herbivore



Hay, fruits & grains



~~Vitamin E and calcium deficiency~~

# The classic problem repertoire

Herbivore



Hay, fruits & grains



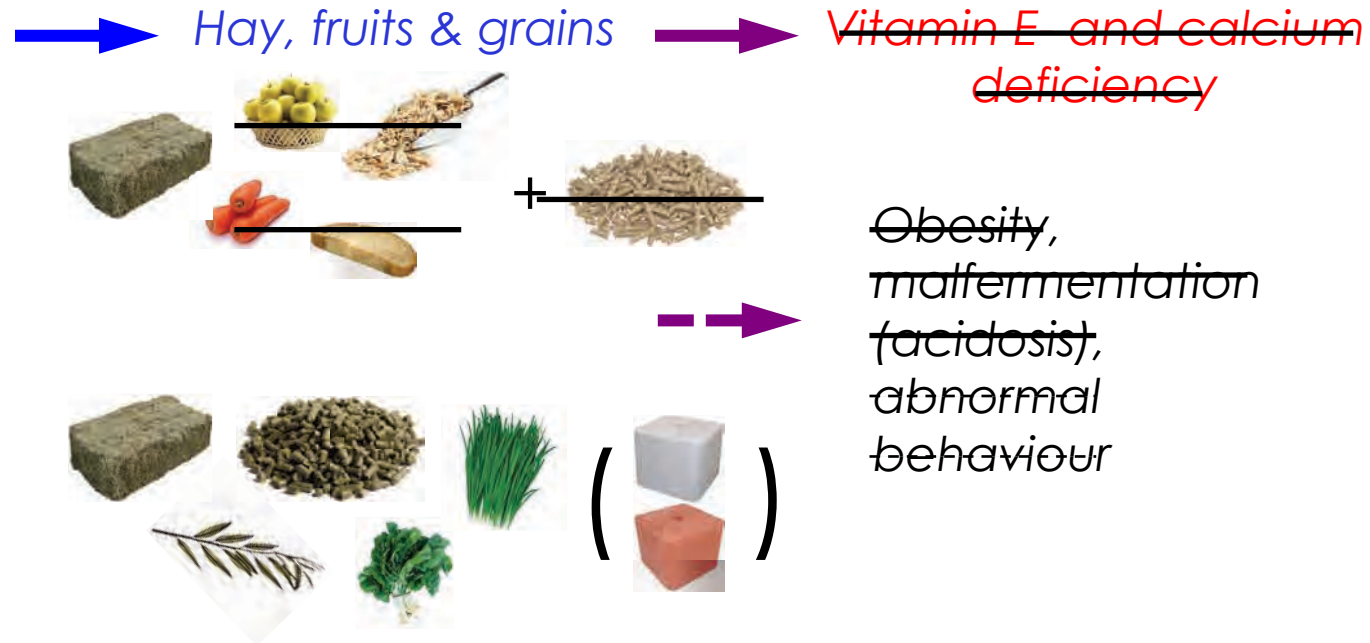
~~Vitamin E and calcium deficiency~~



Obesity,  
malfermentation,  
abnormal  
behaviour

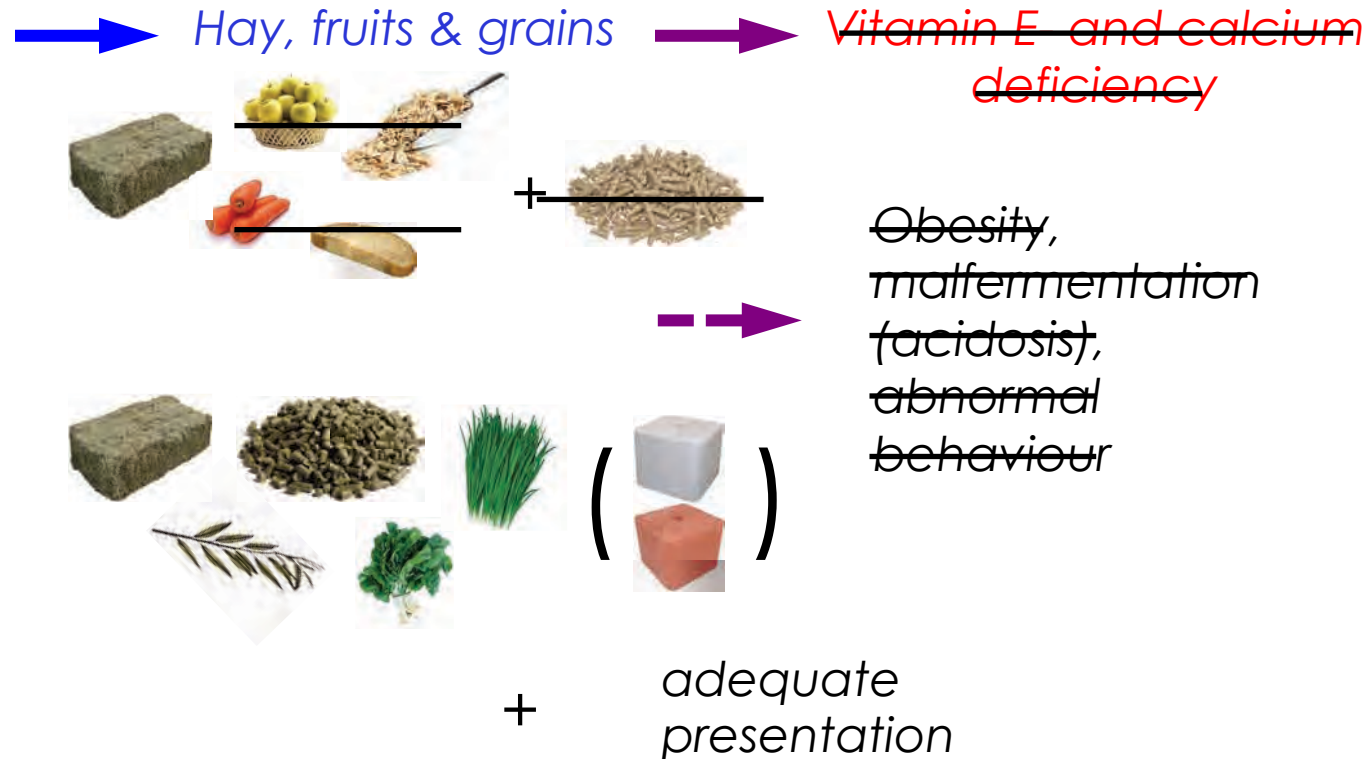
# The classic problem repertoire

Herbivore



# The classic problem repertoire

Herbivore





# The classic problem repertoire

Herbivore



→ Hay, fruits & grains



→ ~~Vitamin E and calcium deficiency~~

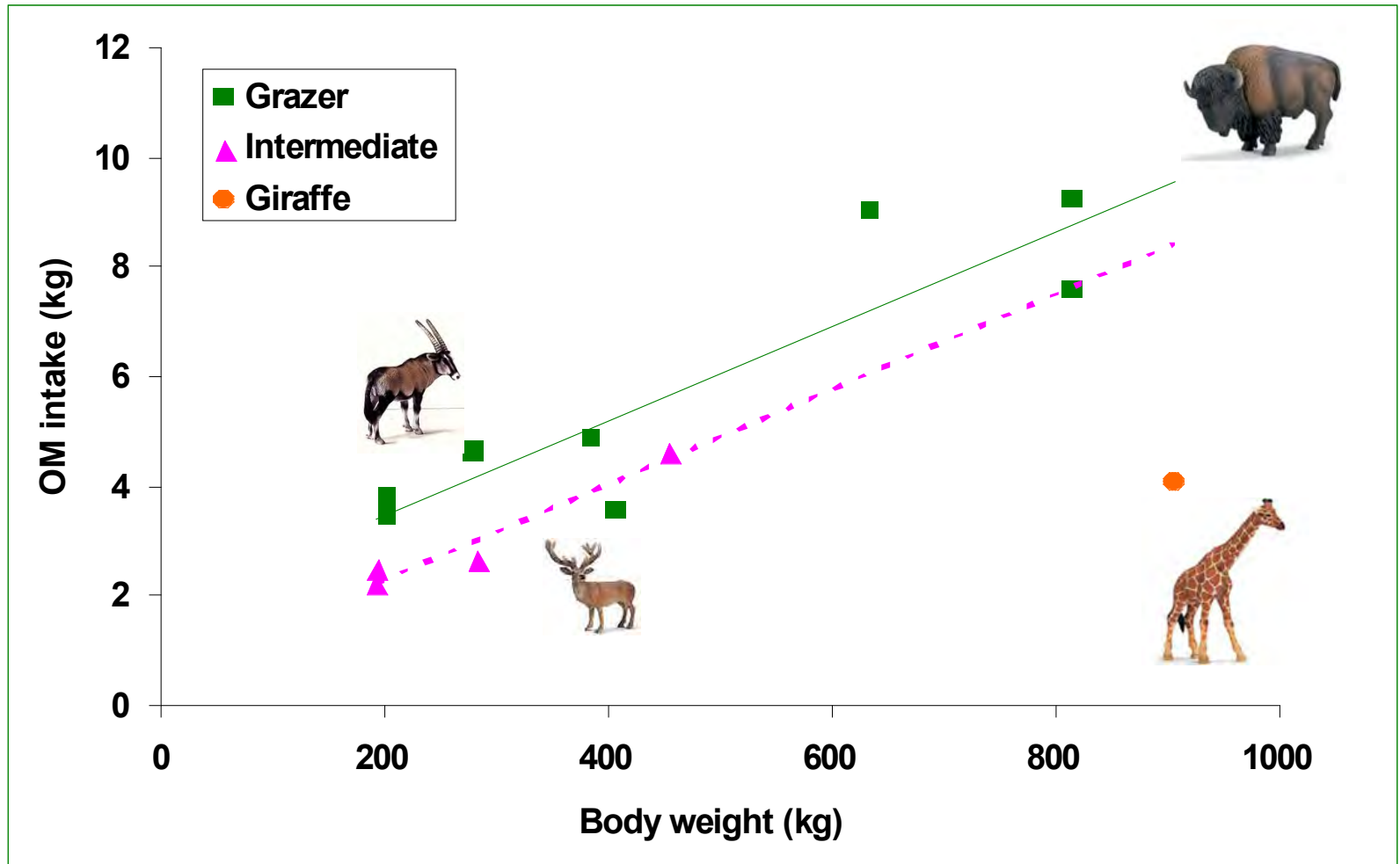
~~Obesity,  
malfermentation  
(acidosis),  
abnormal  
behaviour~~



+  
adequate  
presentation =  
**enrichment !!**



# Not every herbivore likes grass hay



from Foote (1982)



# Not every herbivore likes grass hay

**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)

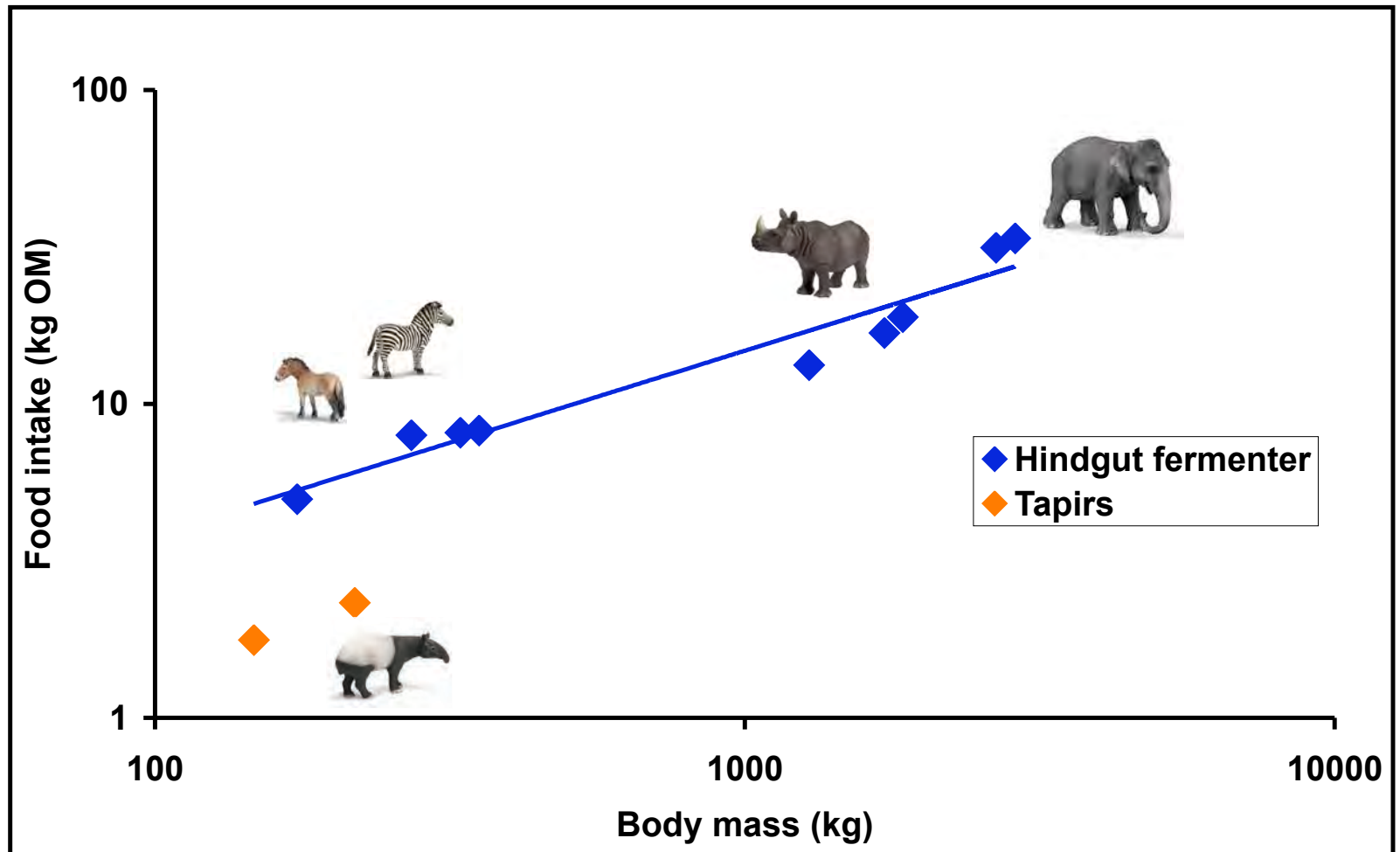
**Duiker** Cowan (1982), Luginbuhl et al. (1991), Van Soest et al. (1995)

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

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

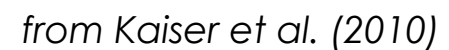
**Kudu** Miller et al. (2010)

# Not every herbivore likes grass hay



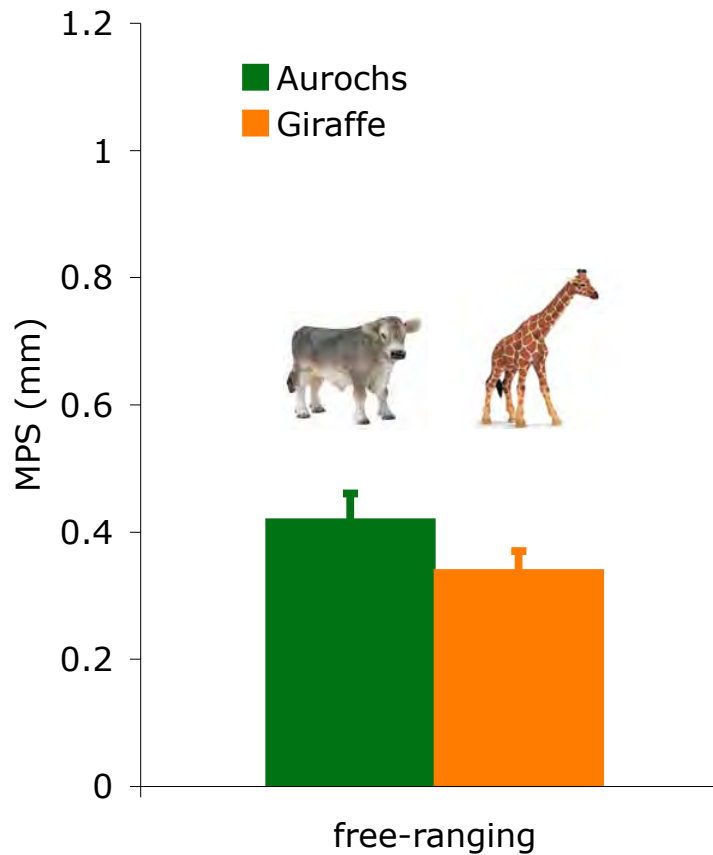
from Foote (1982)





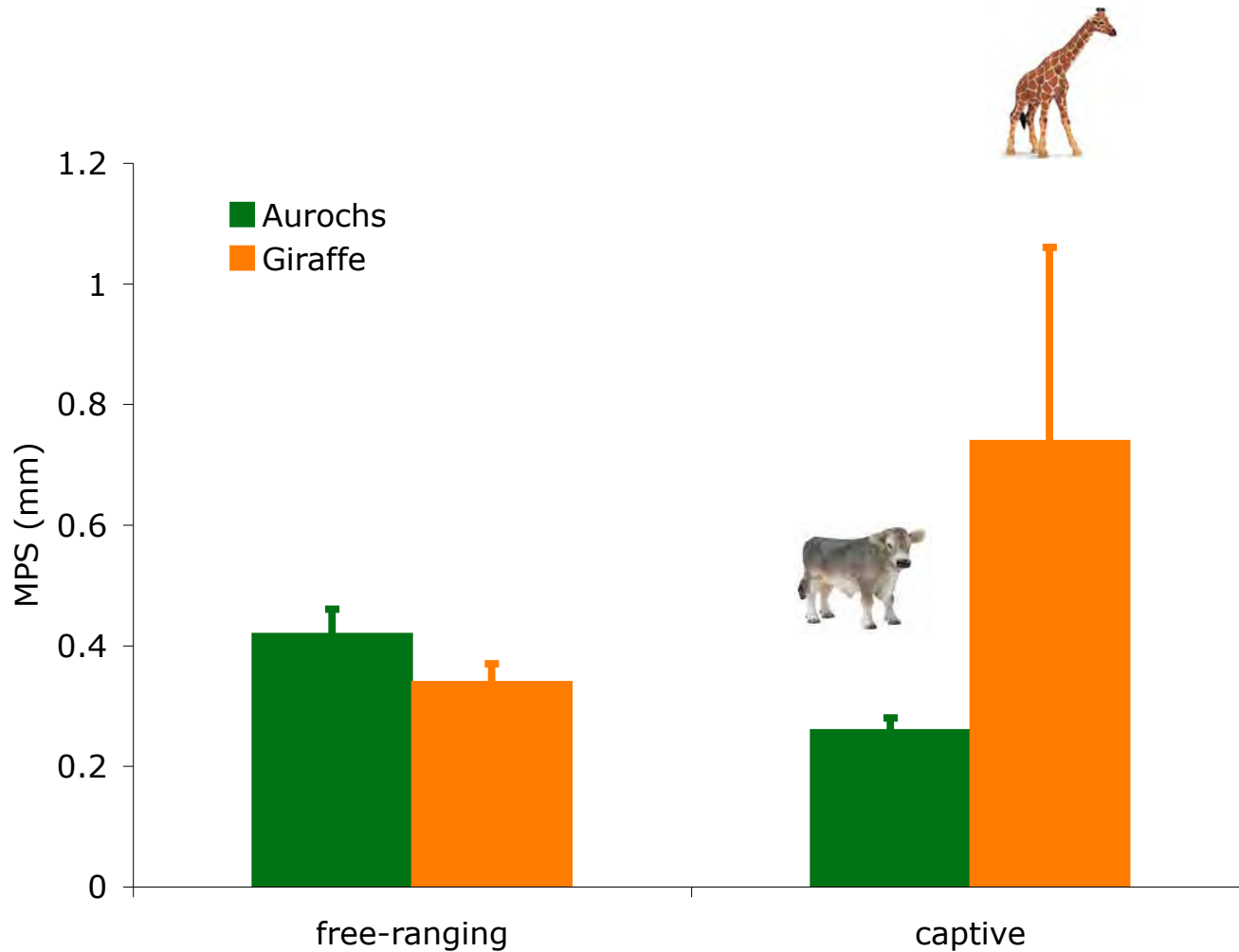


# Fecal particle size in herbivores



*from Hummel et al. (2008)*

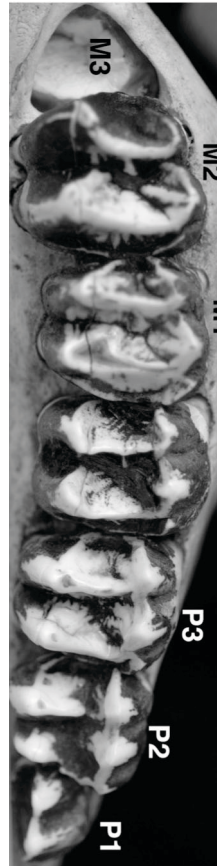
# Fecal particle size in herbivores



from Hummel et al. (2008)

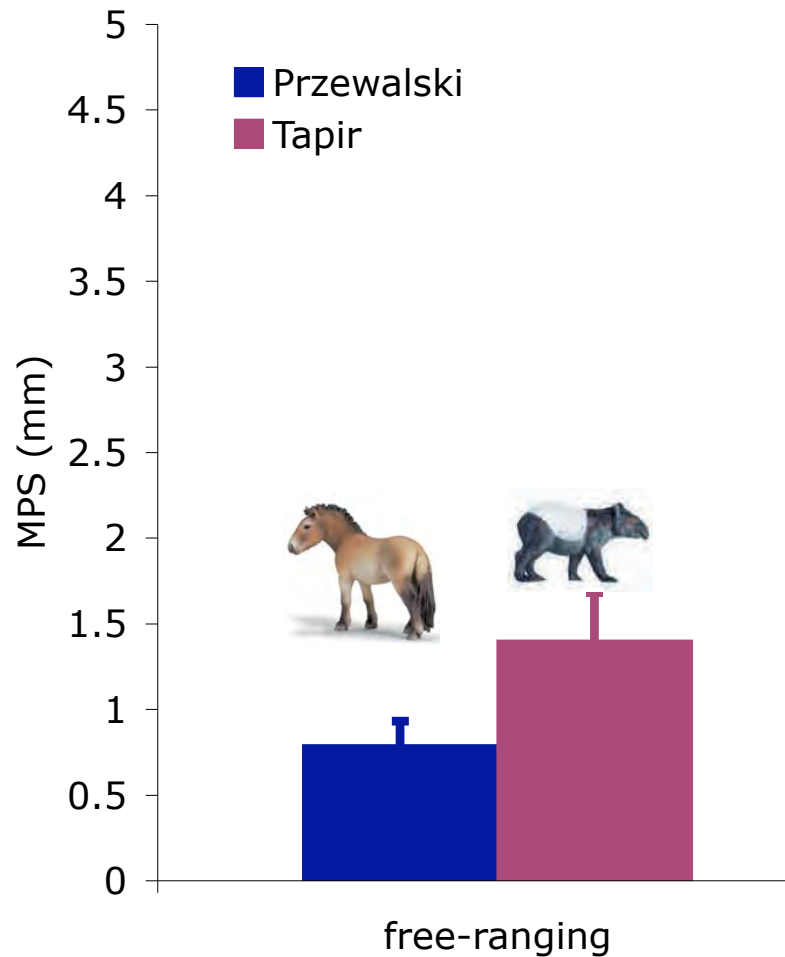


# *Molars in perissodactyls*





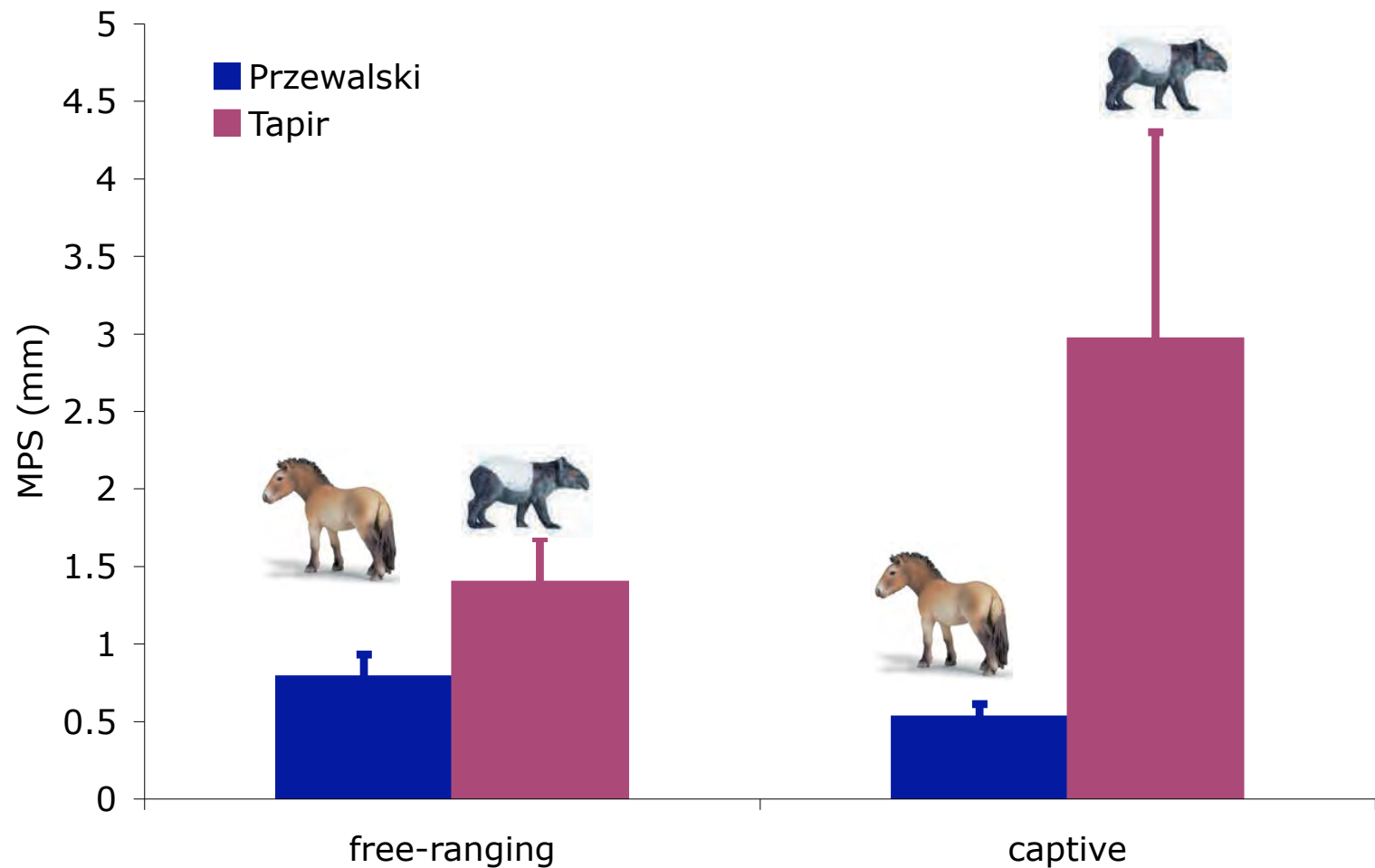
# Fecal particle size in herbivores



*from Hummel et al. (2008)*



# Fecal particle size in herbivores



from Hummel et al. (2008)



# Not every herbivore likes grass hay

- *Just because giraffes, tapirs or gorillas do not eat grass hay does not mean they do not need a high-fibre diet*
- *(they also do not eat fish and nevertheless require protein)*
- *it is a husbandry challenge to provide a roughage or high-fibre diet that these animals accept*








# Not every herbivore likes grass hay

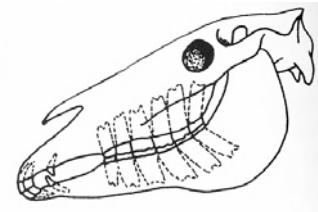
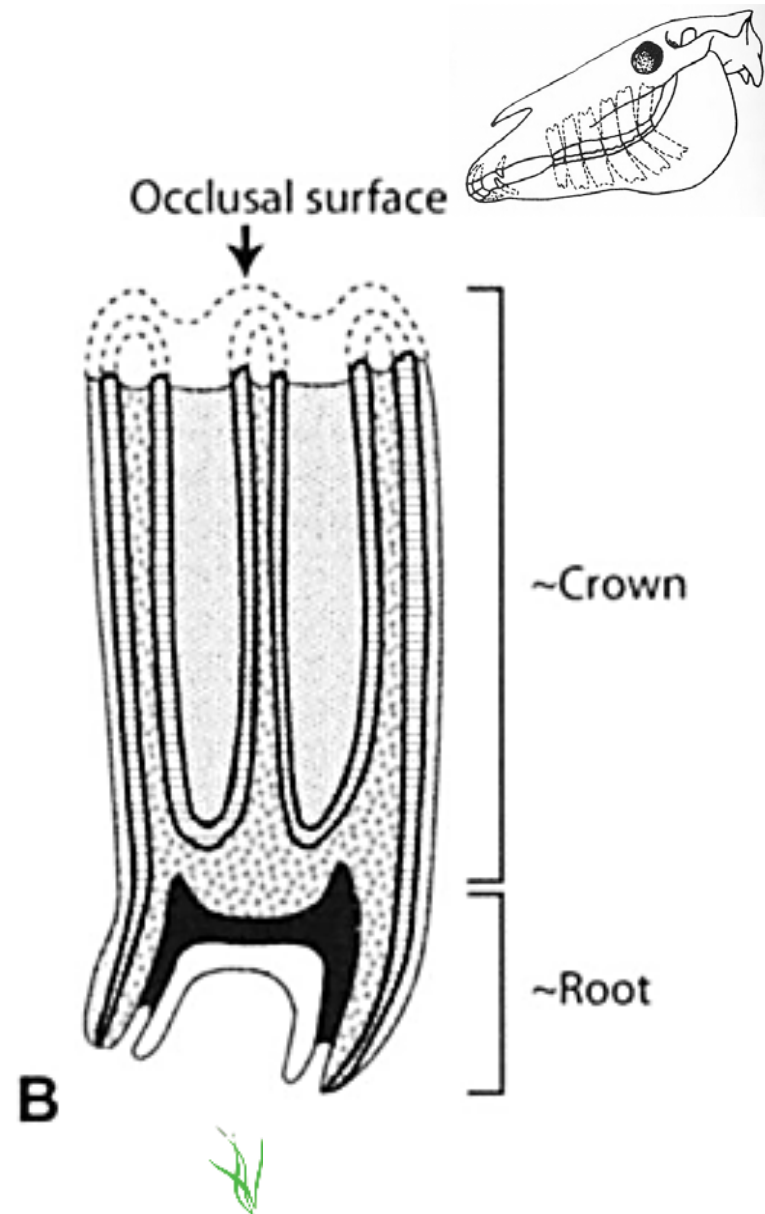
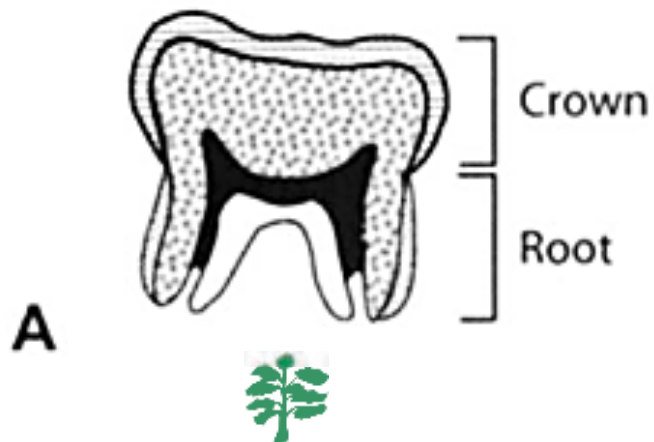






# Hypsodonty

-  Pulp cavity
-  Bone
-  Enamel
-  Dentine
-  Cementum





# Hypsodonty

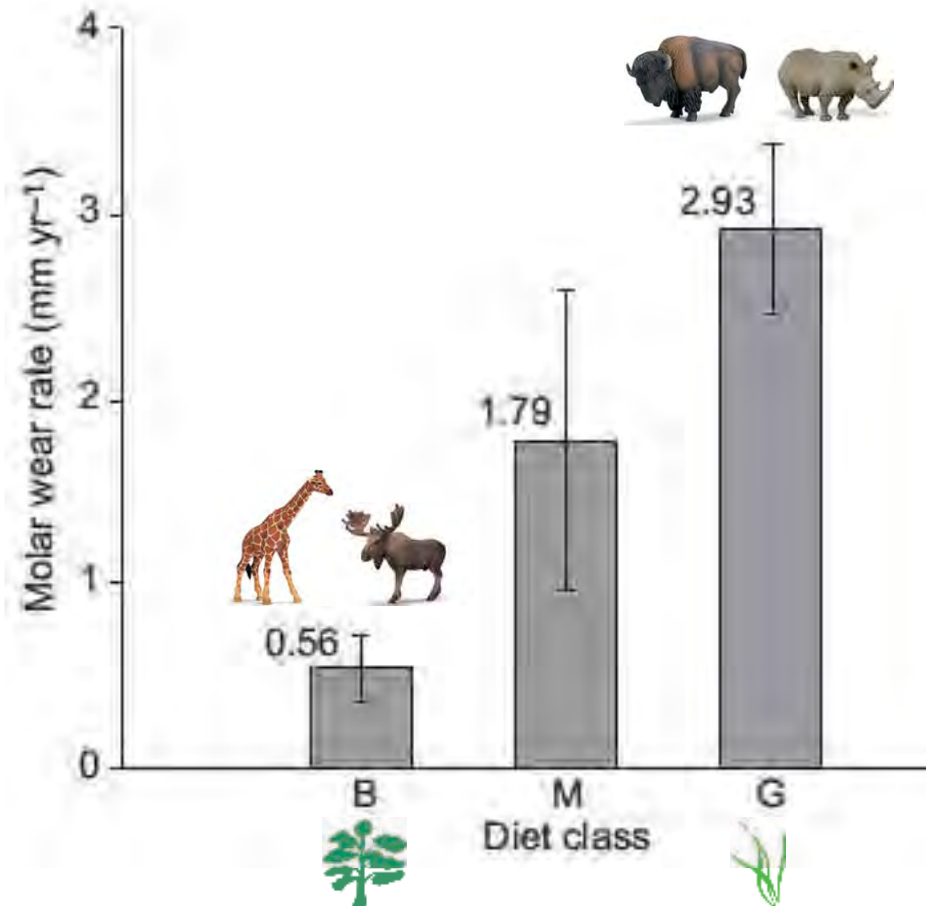




# A comparison of observed molar wear rates in extant herbivorous mammals

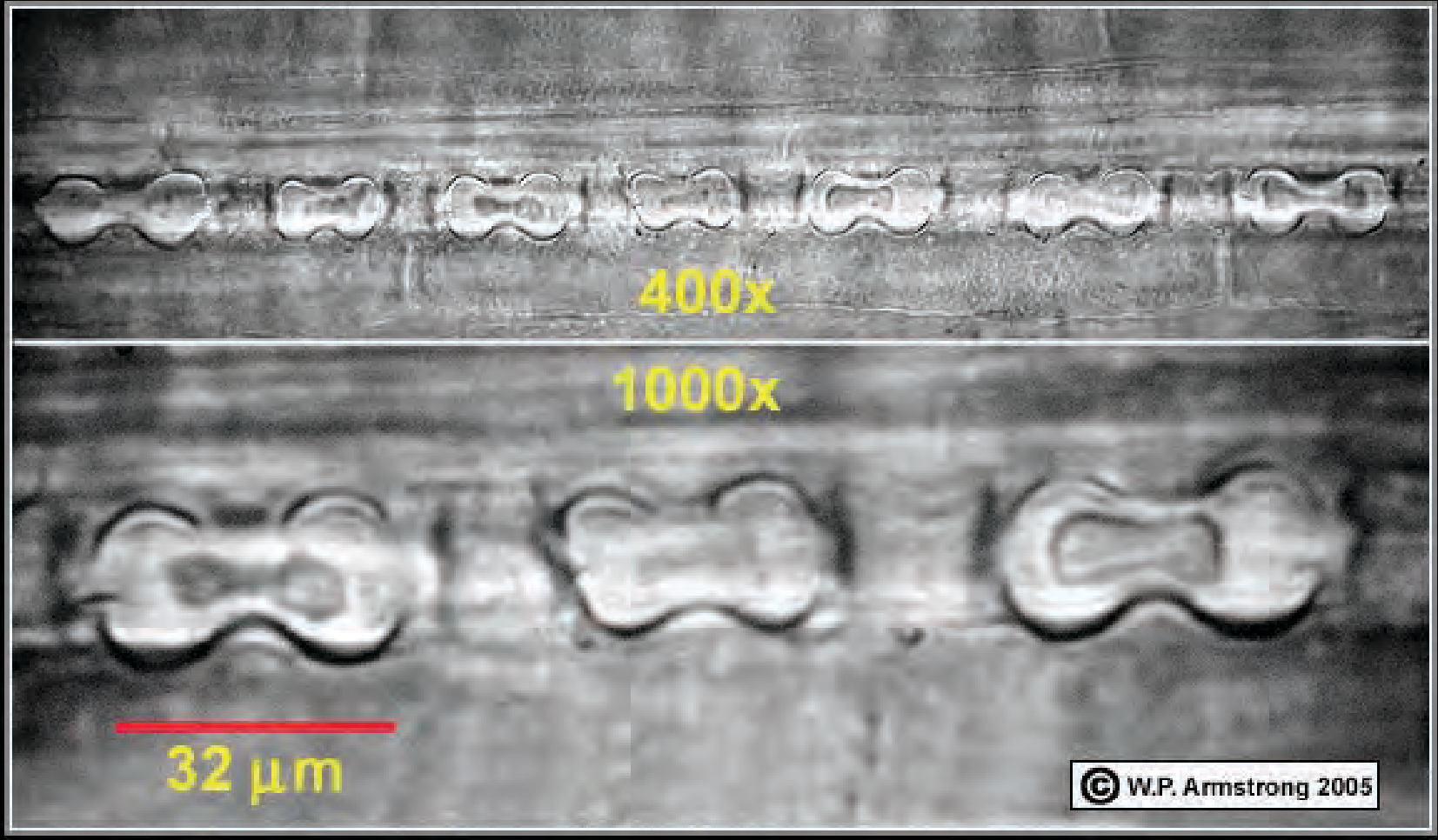
John Damuth<sup>1</sup> & Christine M. Janis<sup>2</sup>

*Ann. Zool. Fennici* 51: 188–200  
Helsinki 7 April 2014





# *Phytoliths*







# Free-ranging vs. captive giraffes



from Clauss et al. (2007)





# Basic feeding approach





# Basic feeding approach





# Basic feeding approach



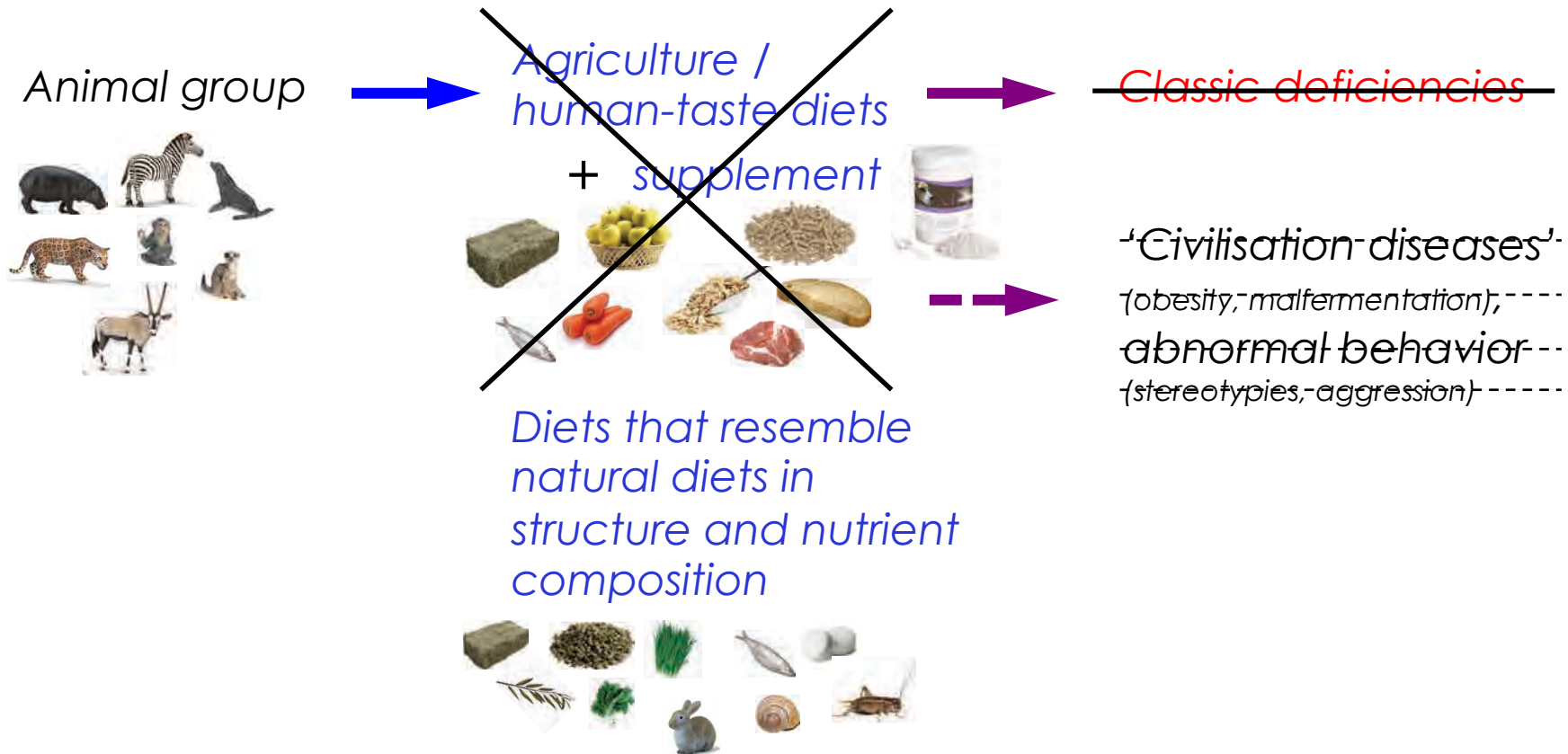


# Basic feeding approach





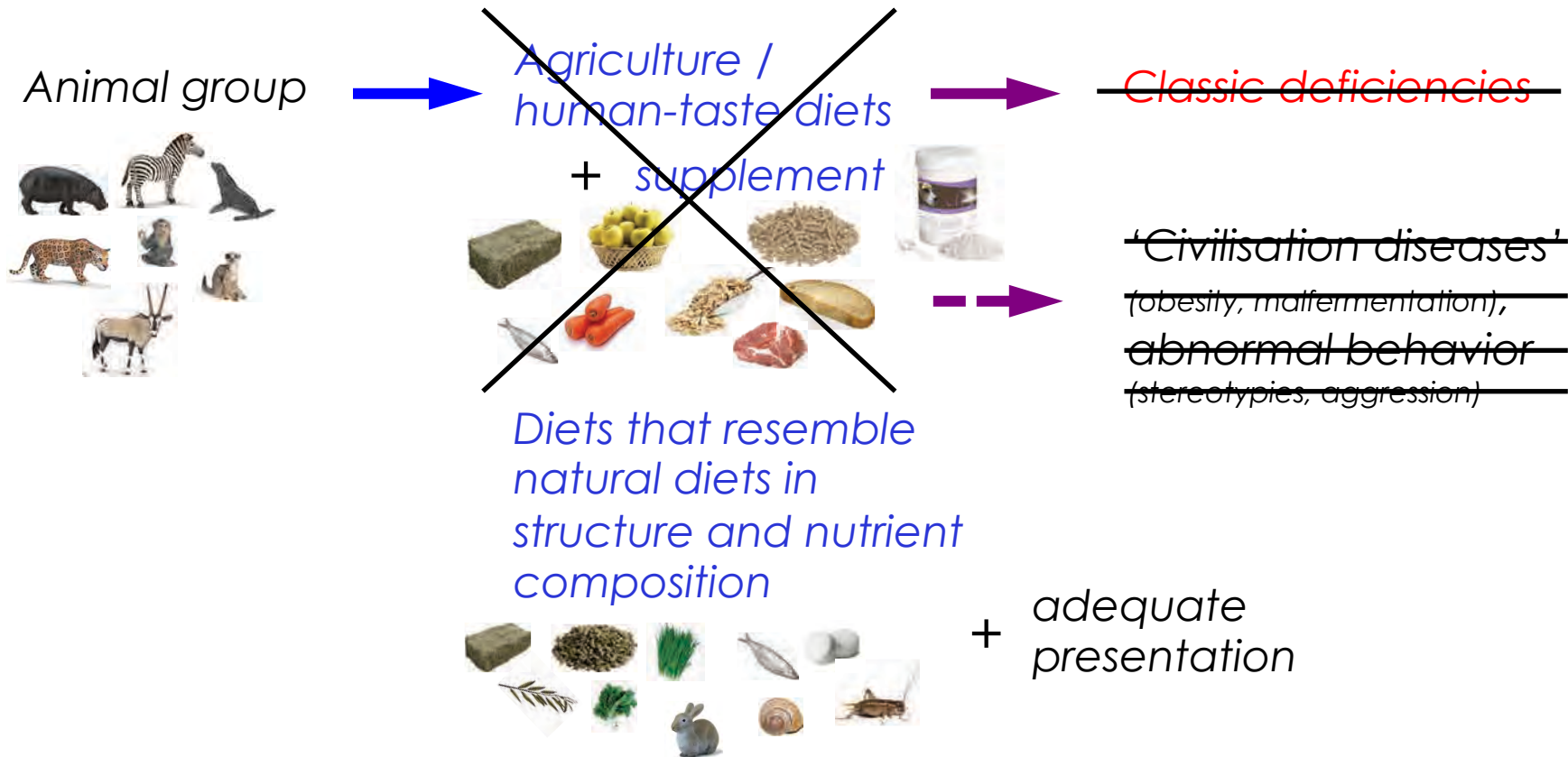
# Basic feeding approach





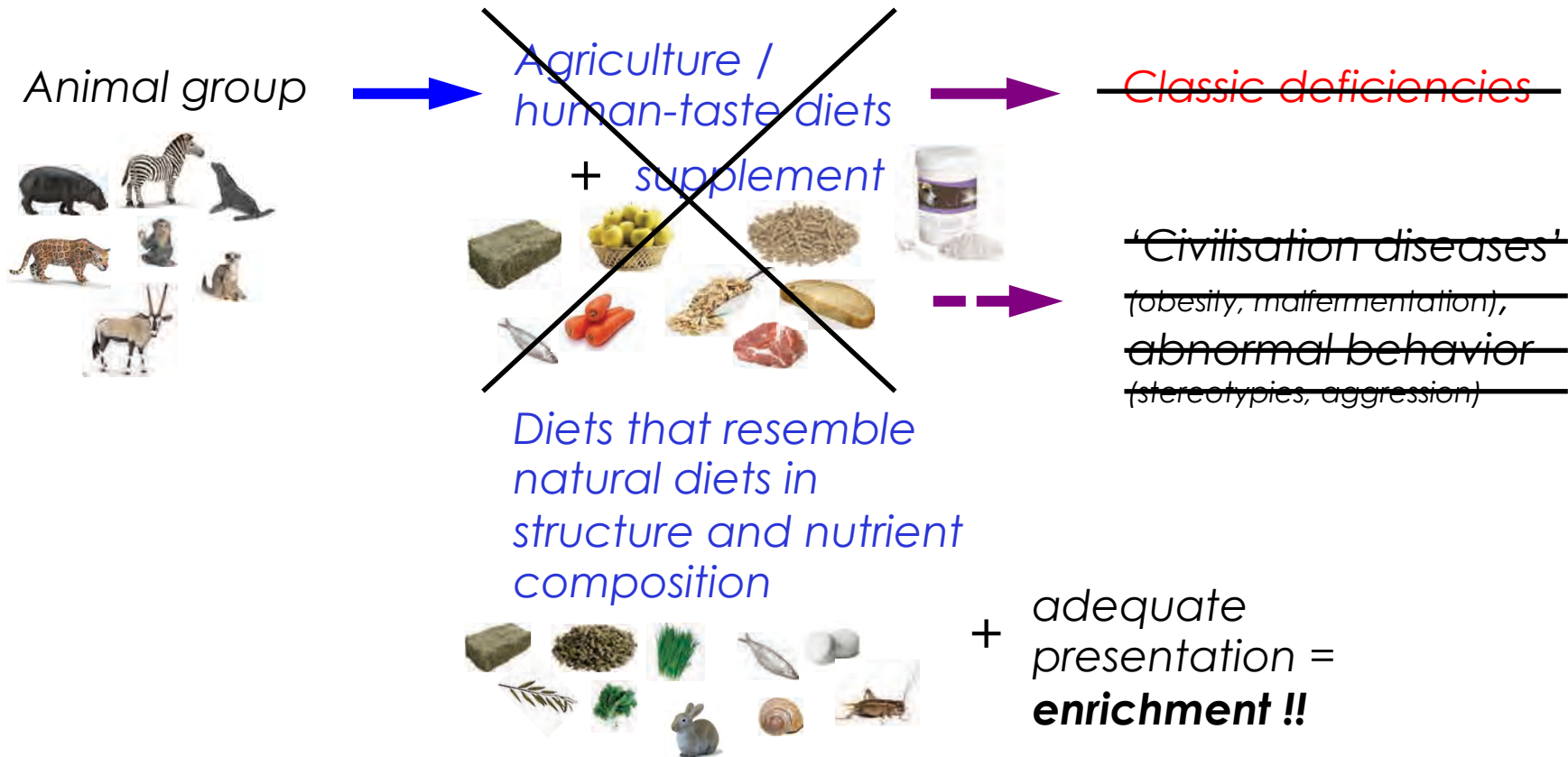


# Basic feeding approach



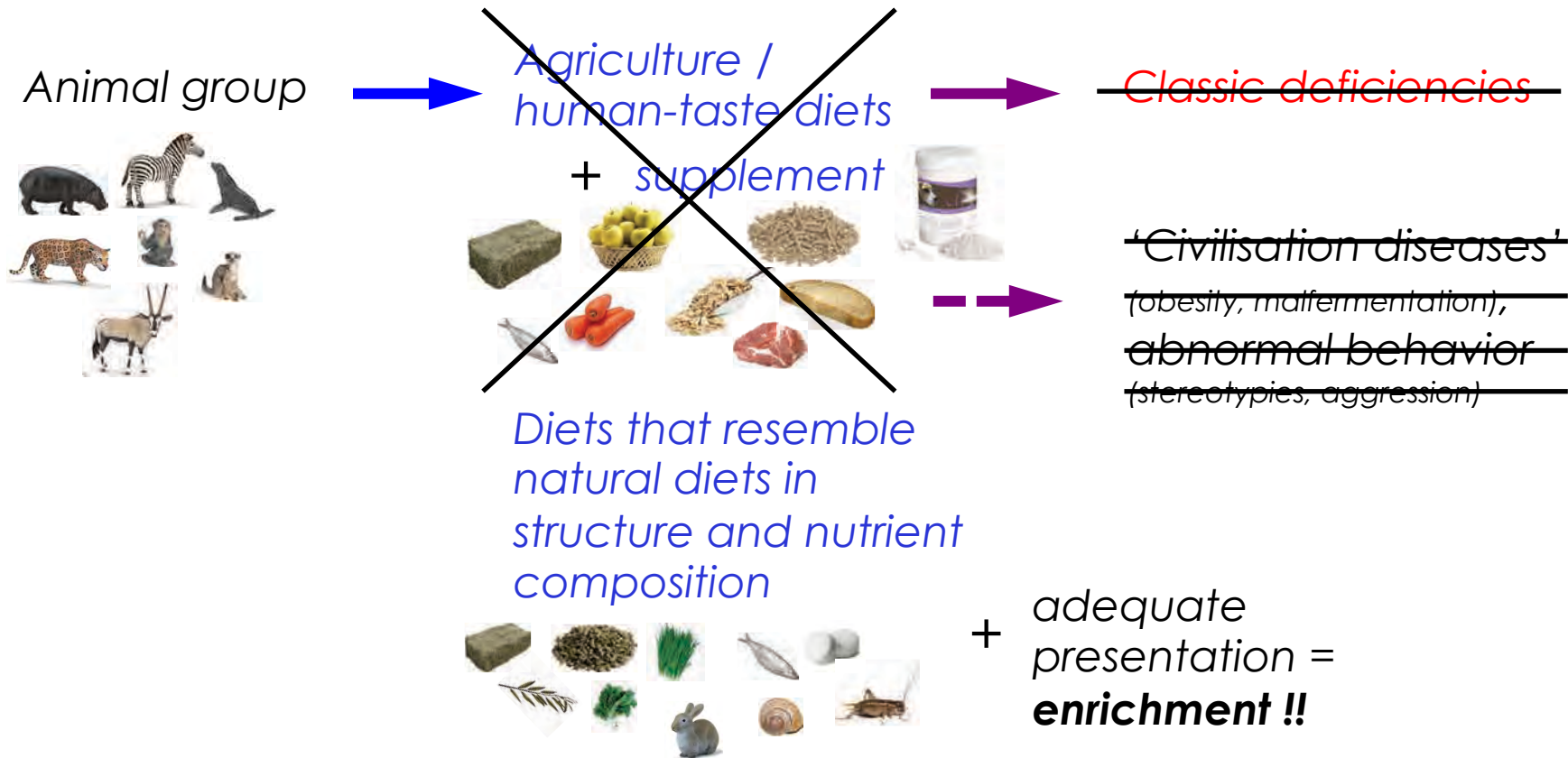


# Basic feeding approach





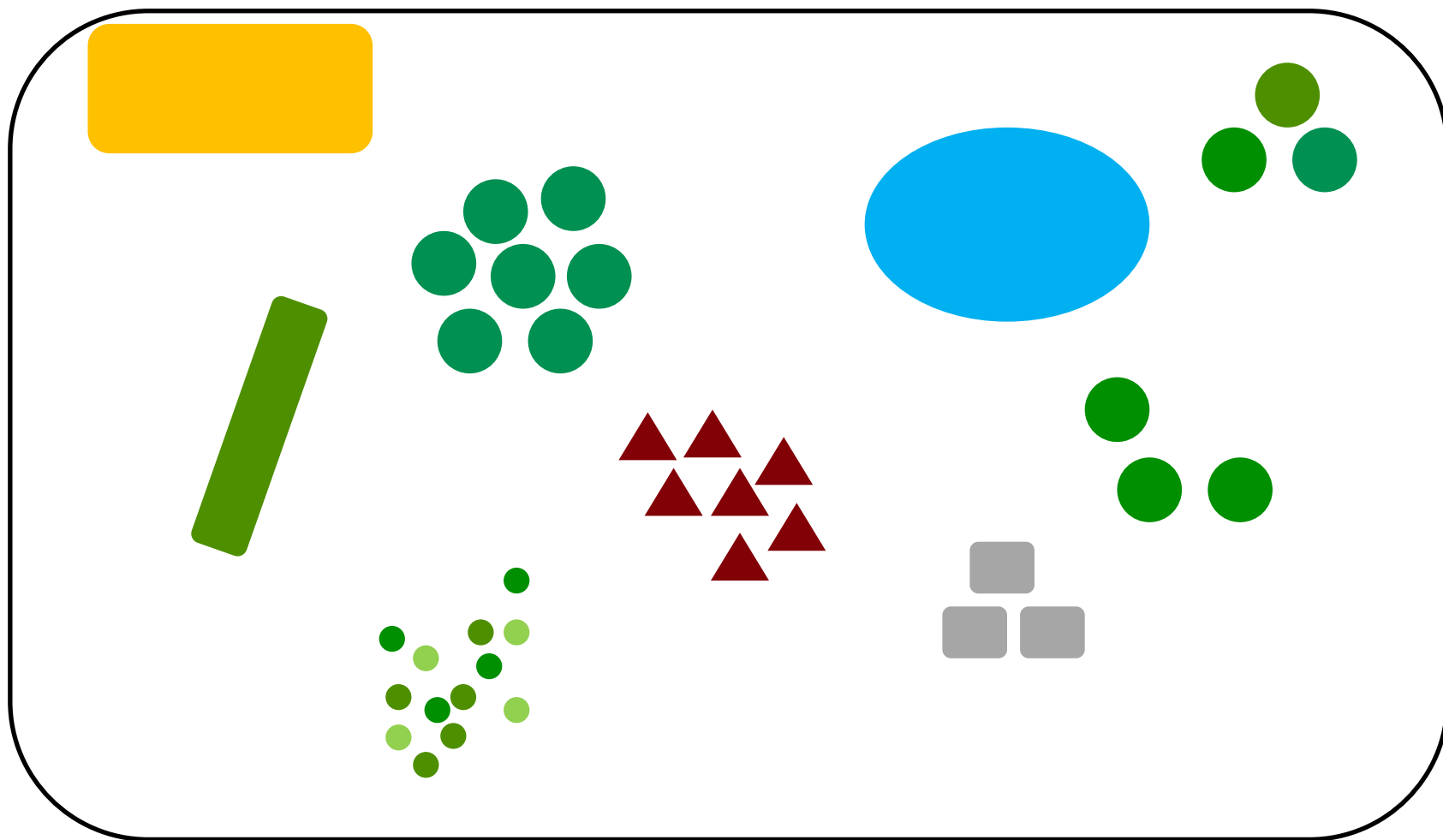
# Basic feeding approach



Enrichment should **not** be **the addition of something** (like human-taste items) but the presentation of the diet in a **challenging** and **meaningful way** !

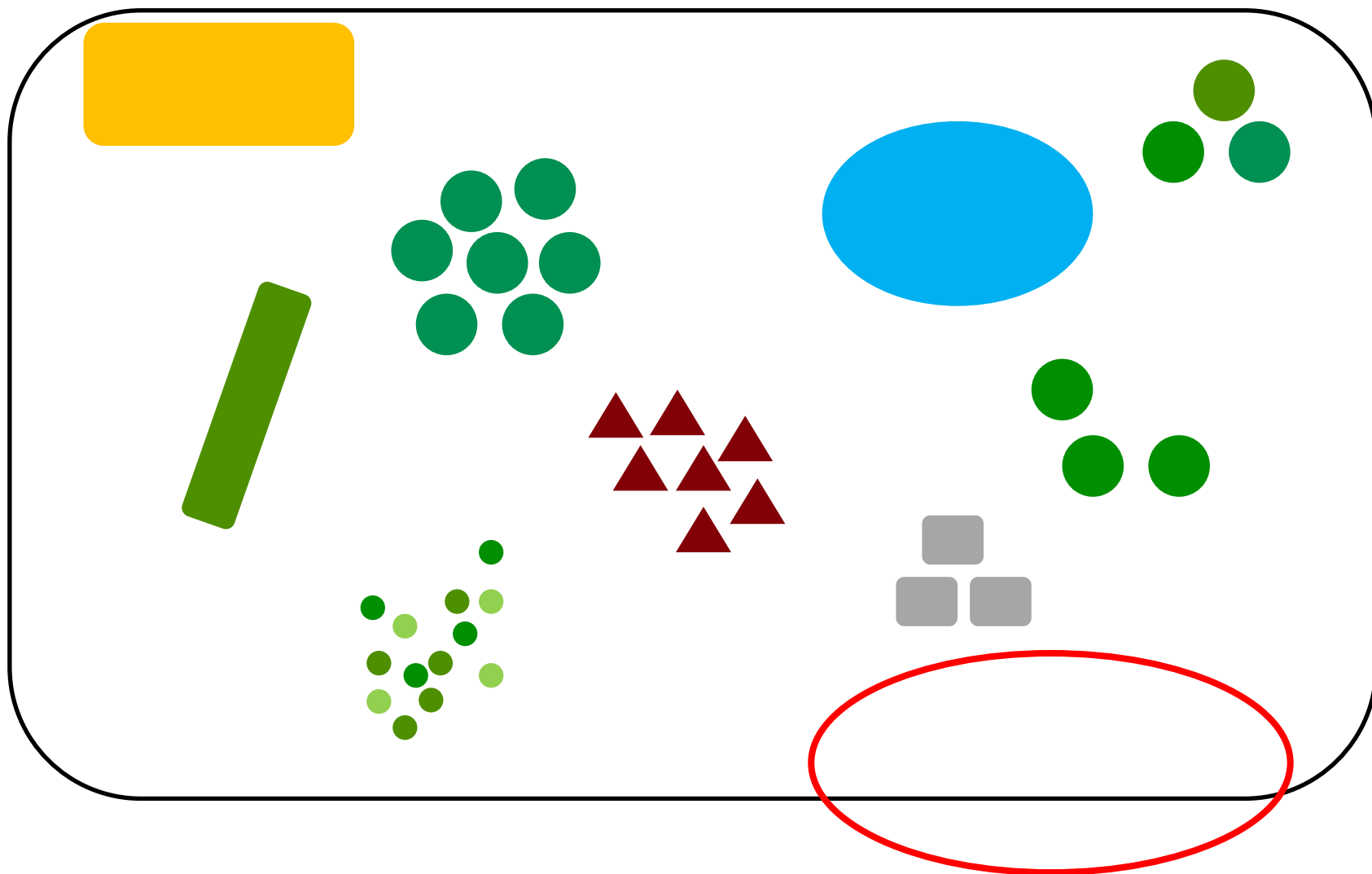


# Enclosure design





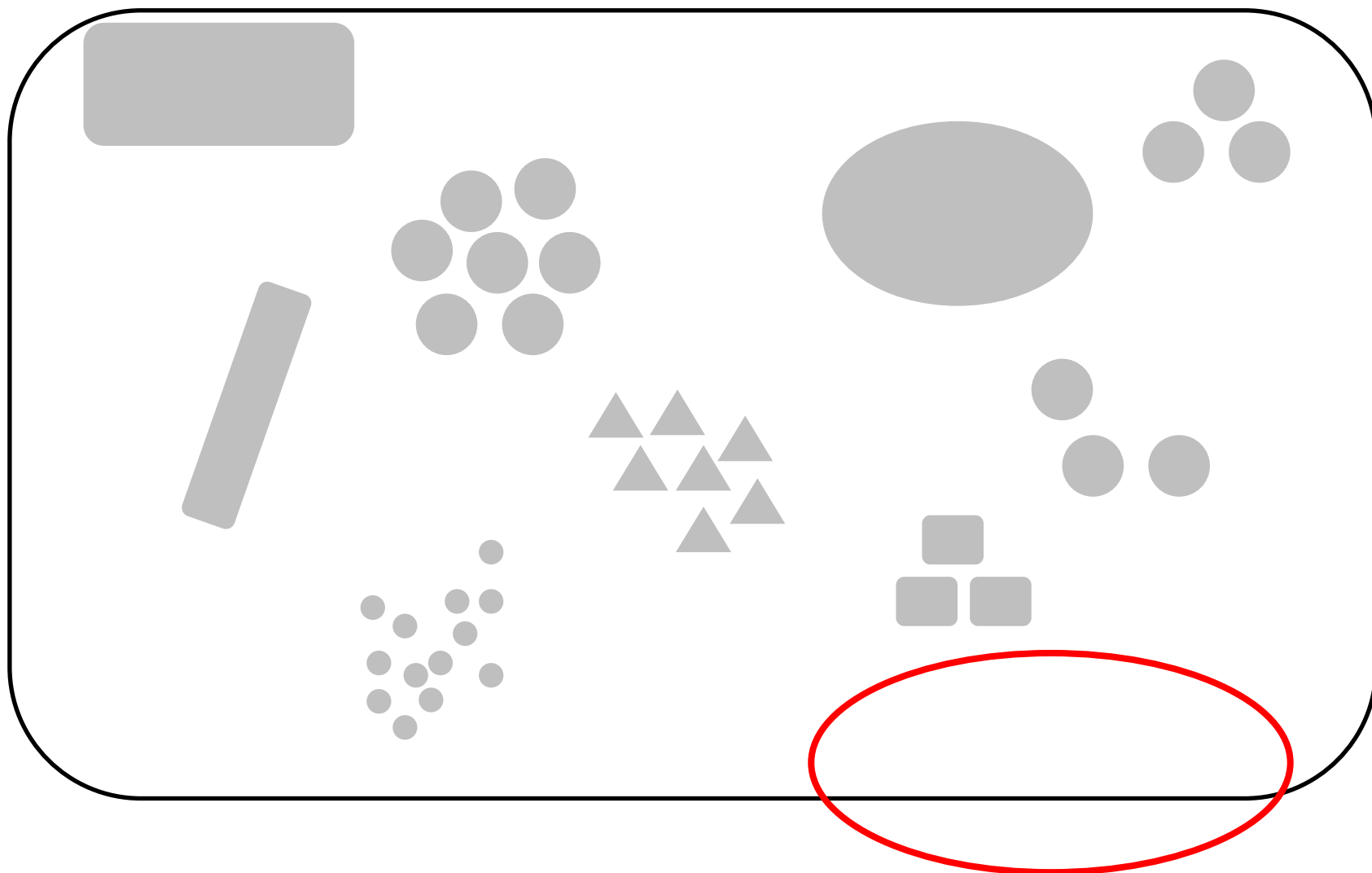
# Enclosure design and use





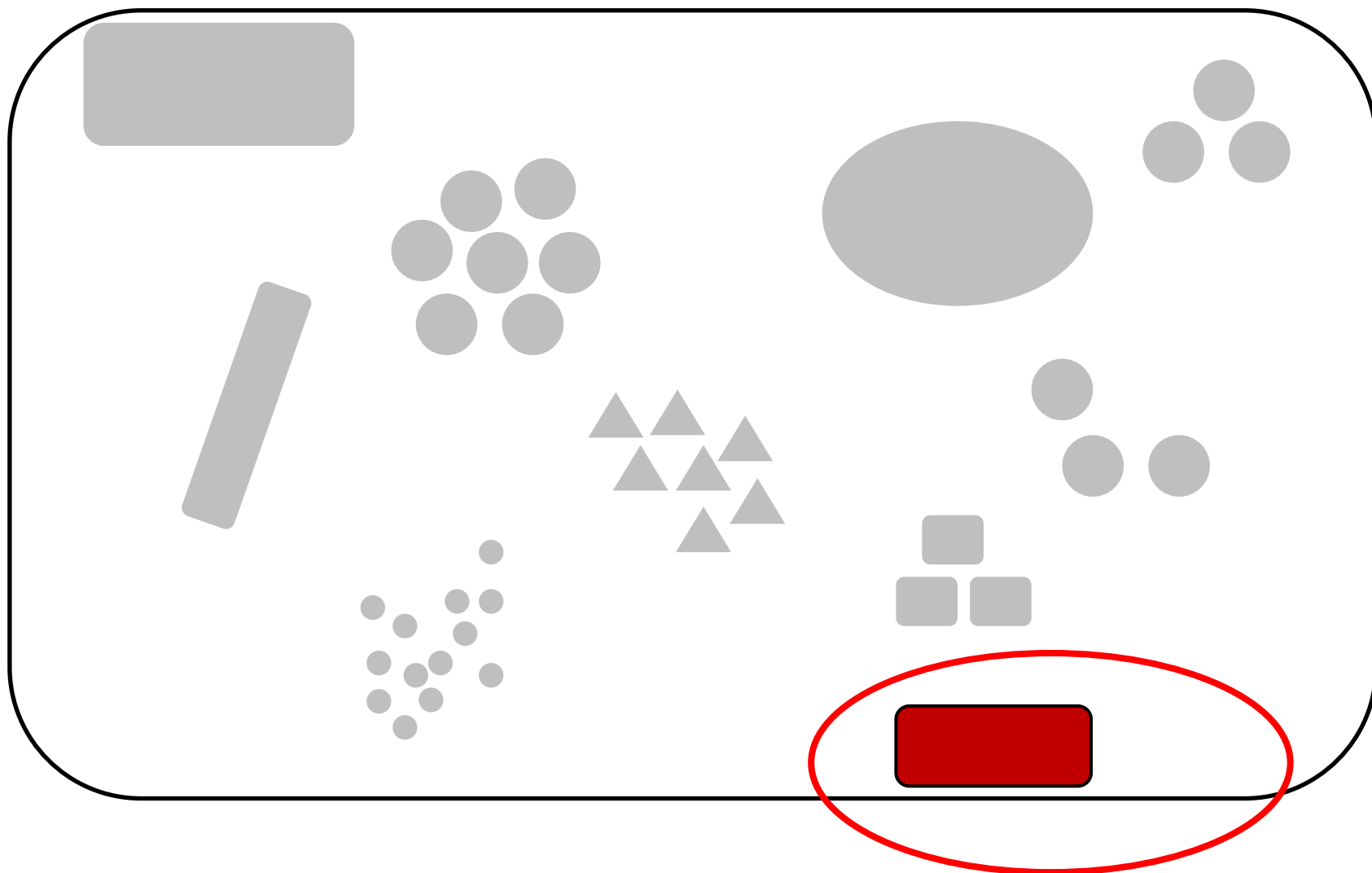


# Enclosure design and use



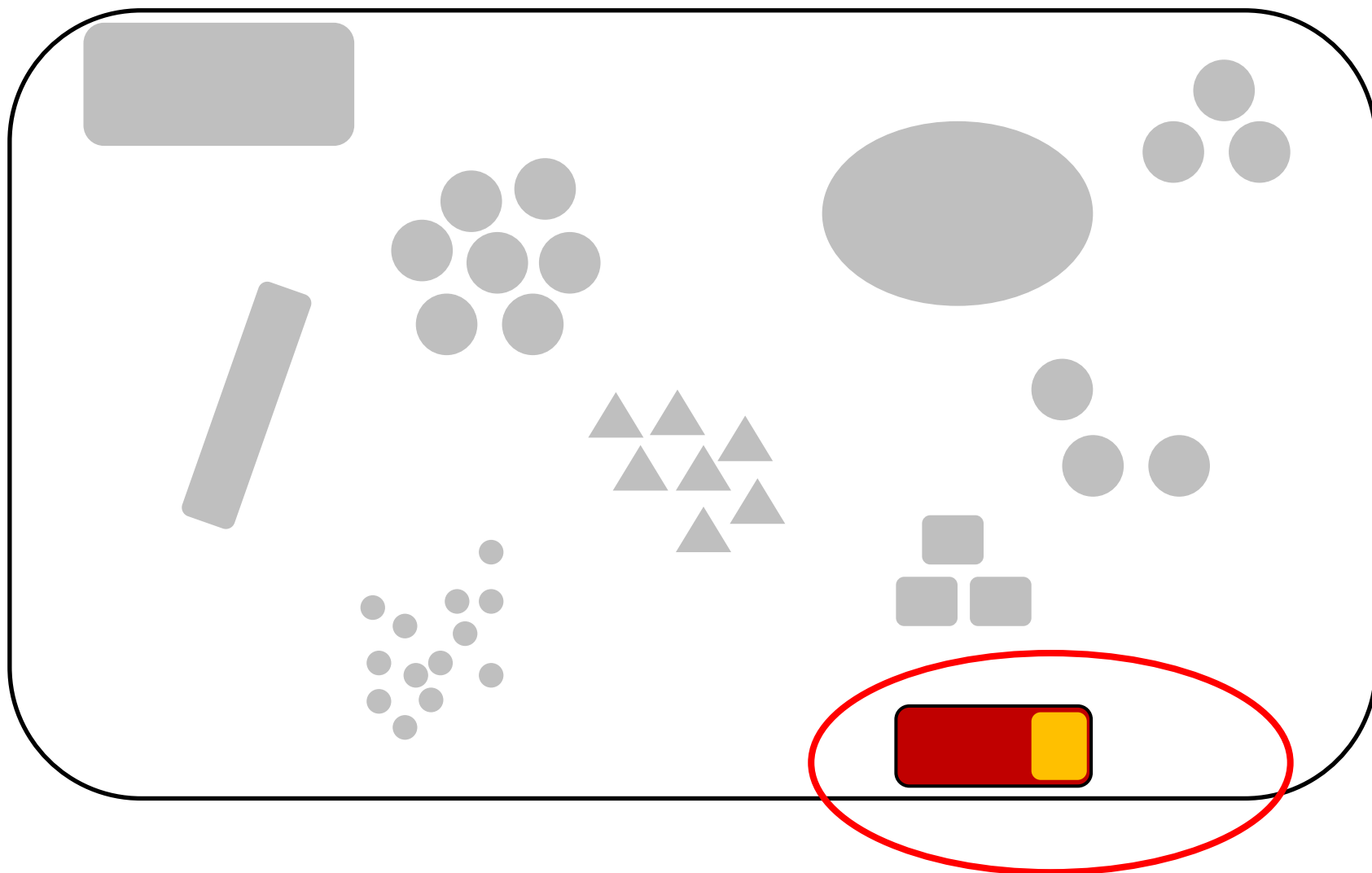


# Enclosure design and use



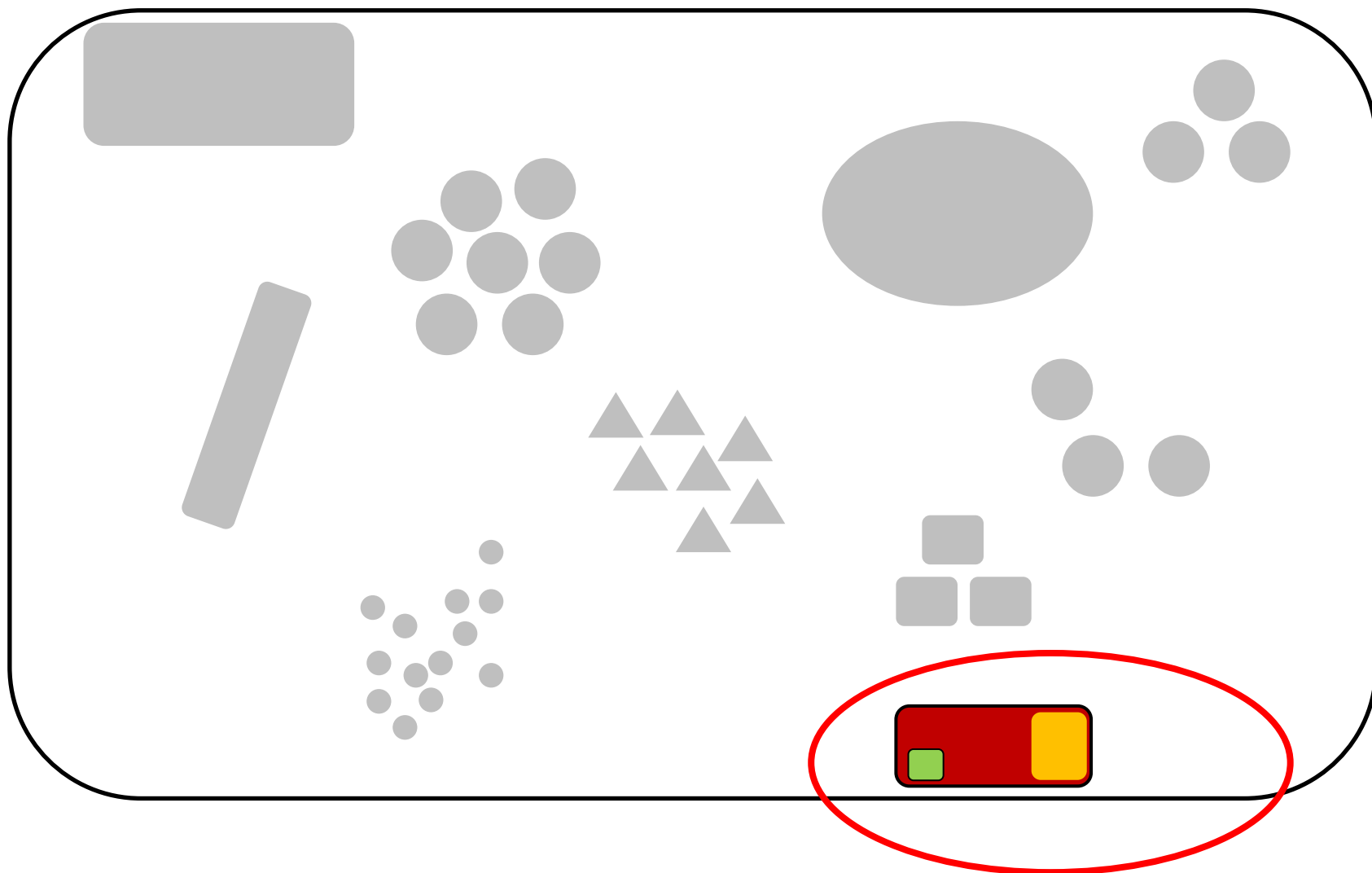


# Enclosure design and use



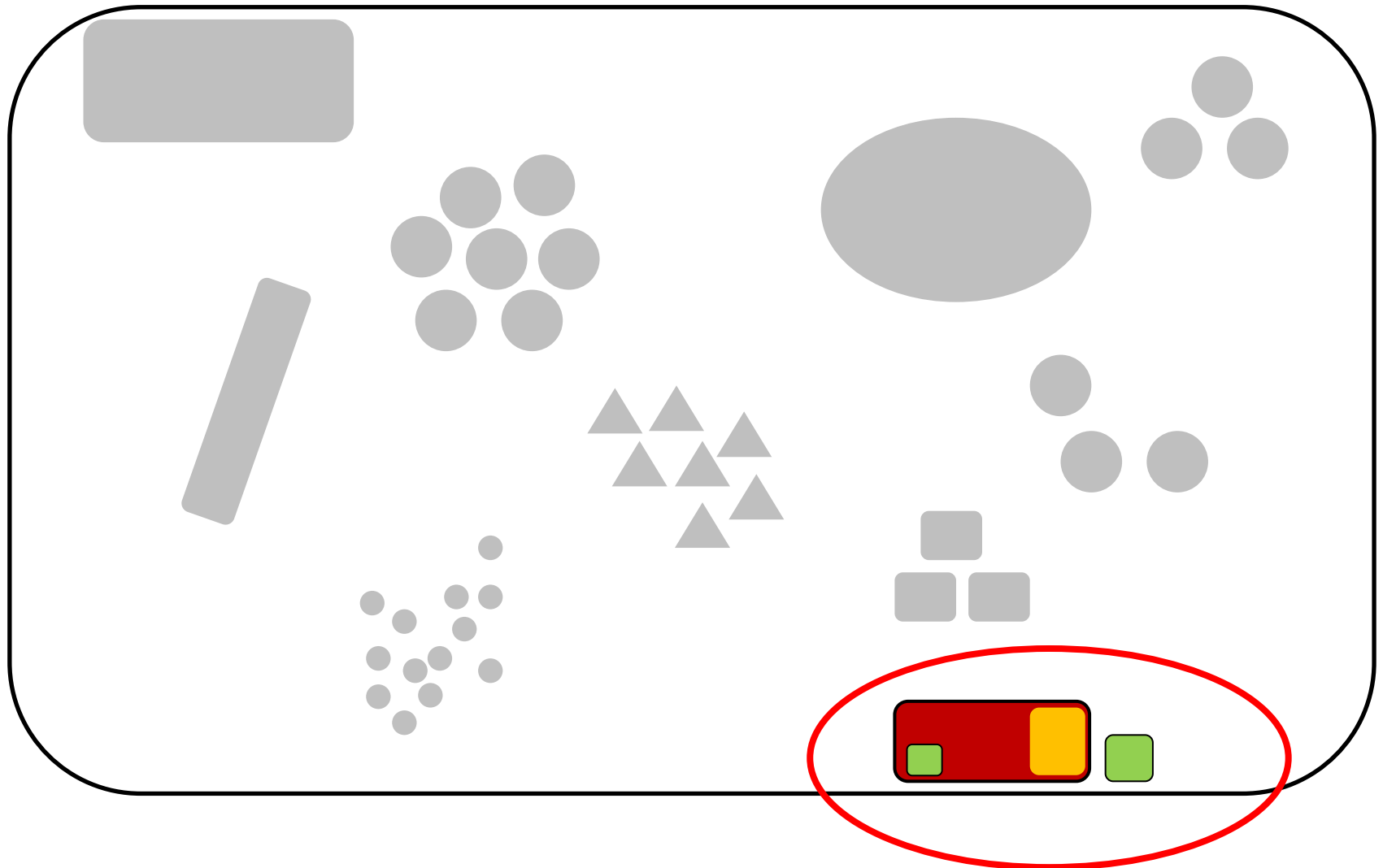


# Enclosure design and use





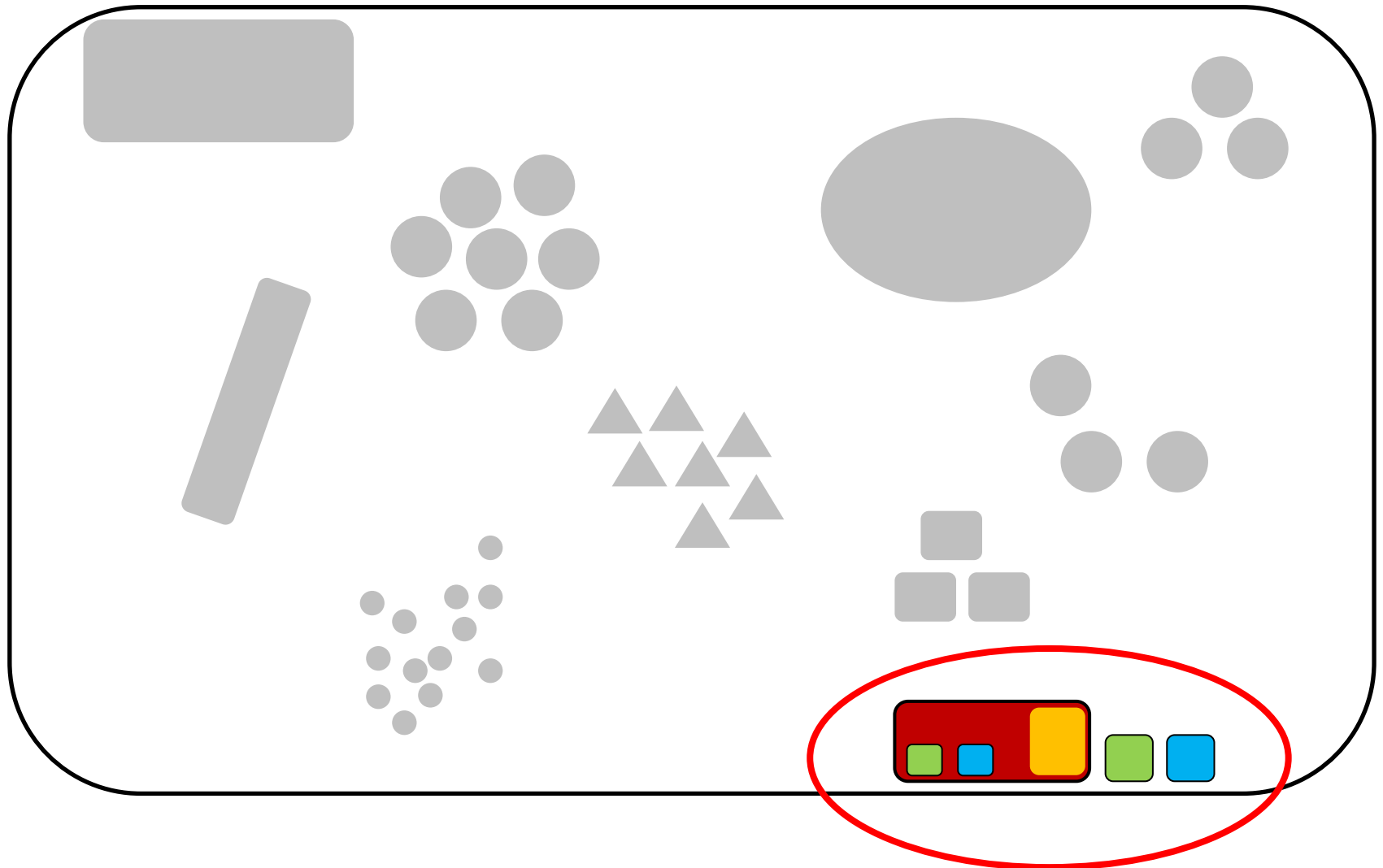
# Enclosure design and use





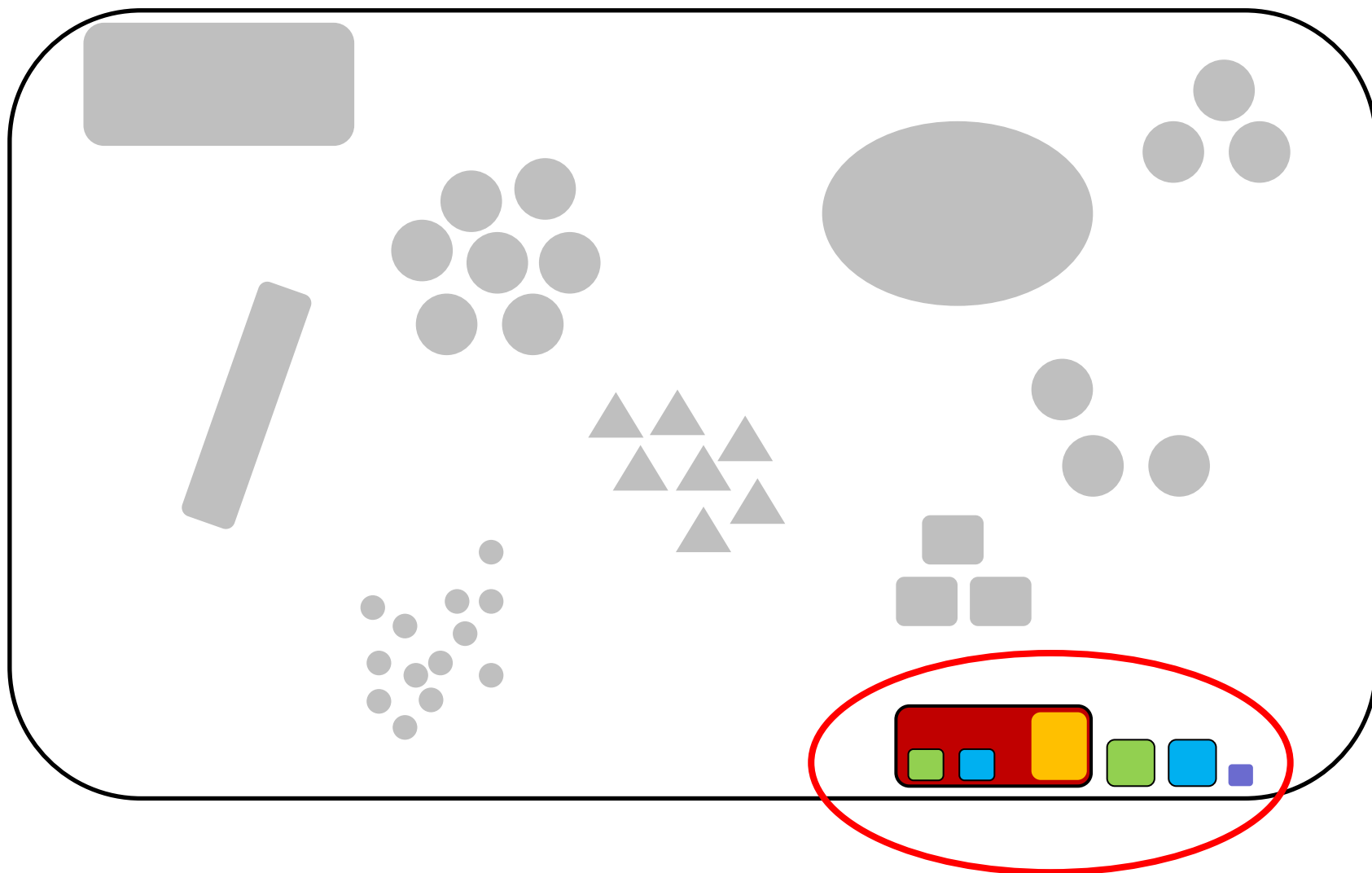


# Enclosure design and use



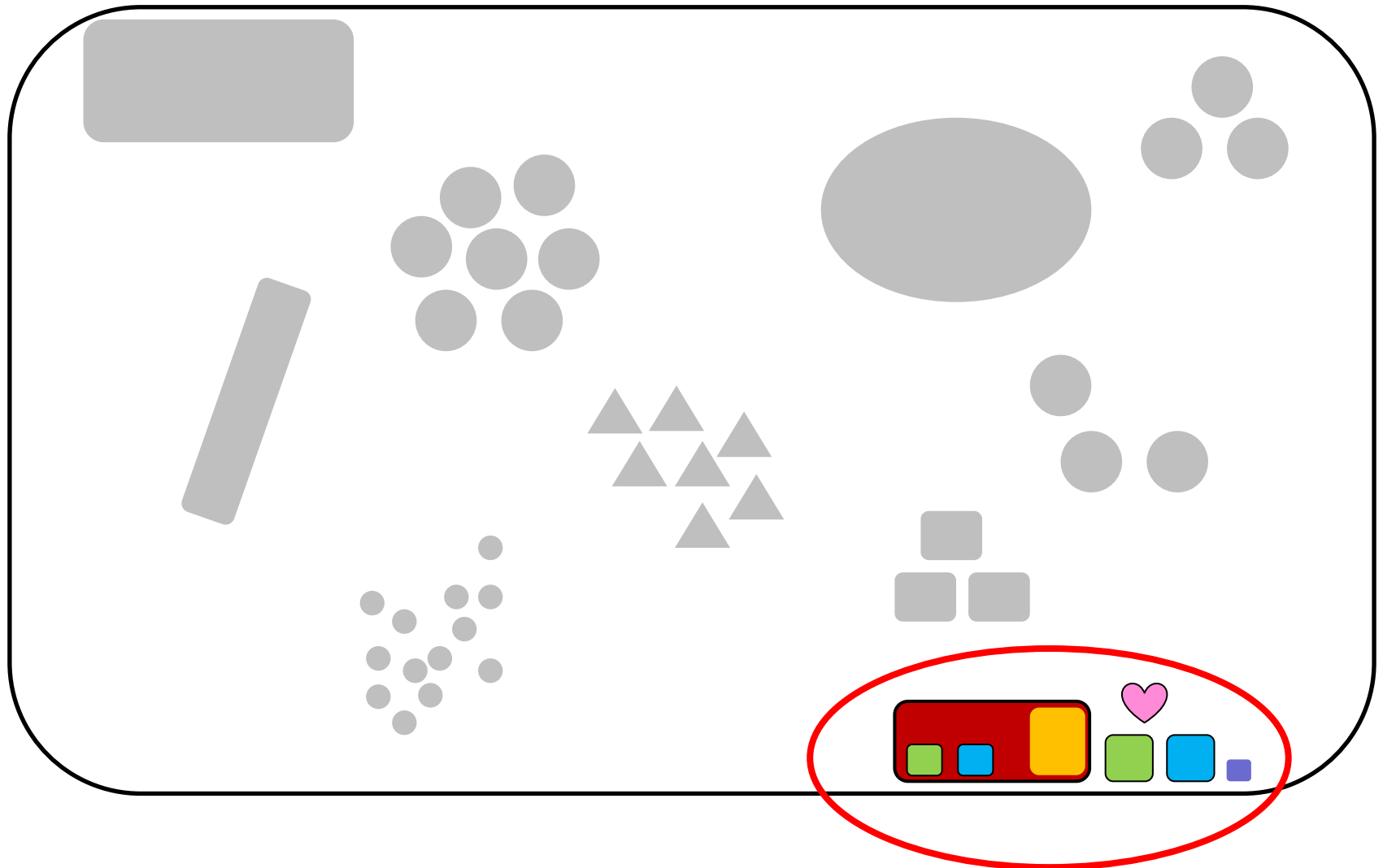


# Enclosure design and use



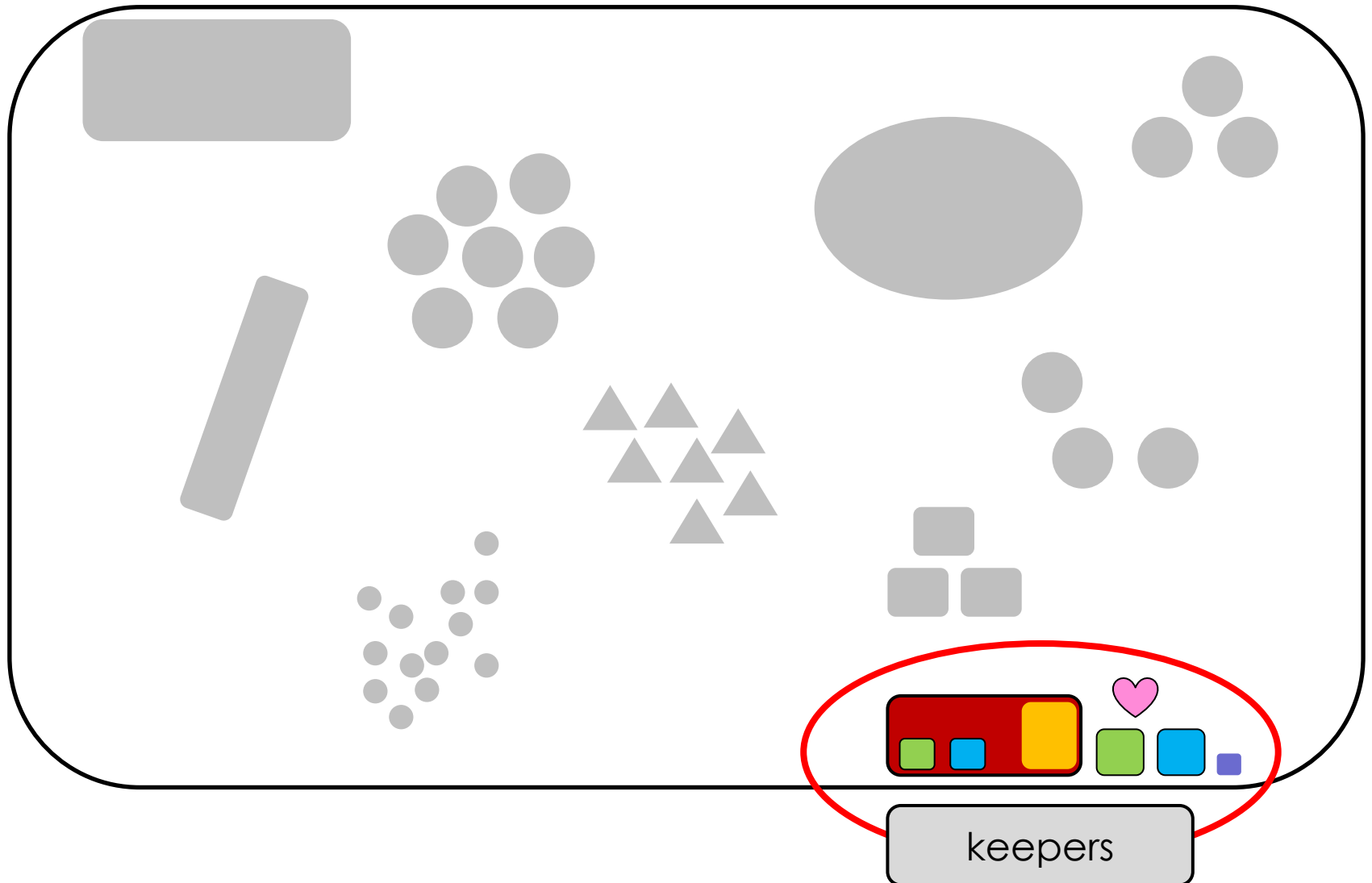


# Enclosure design and use



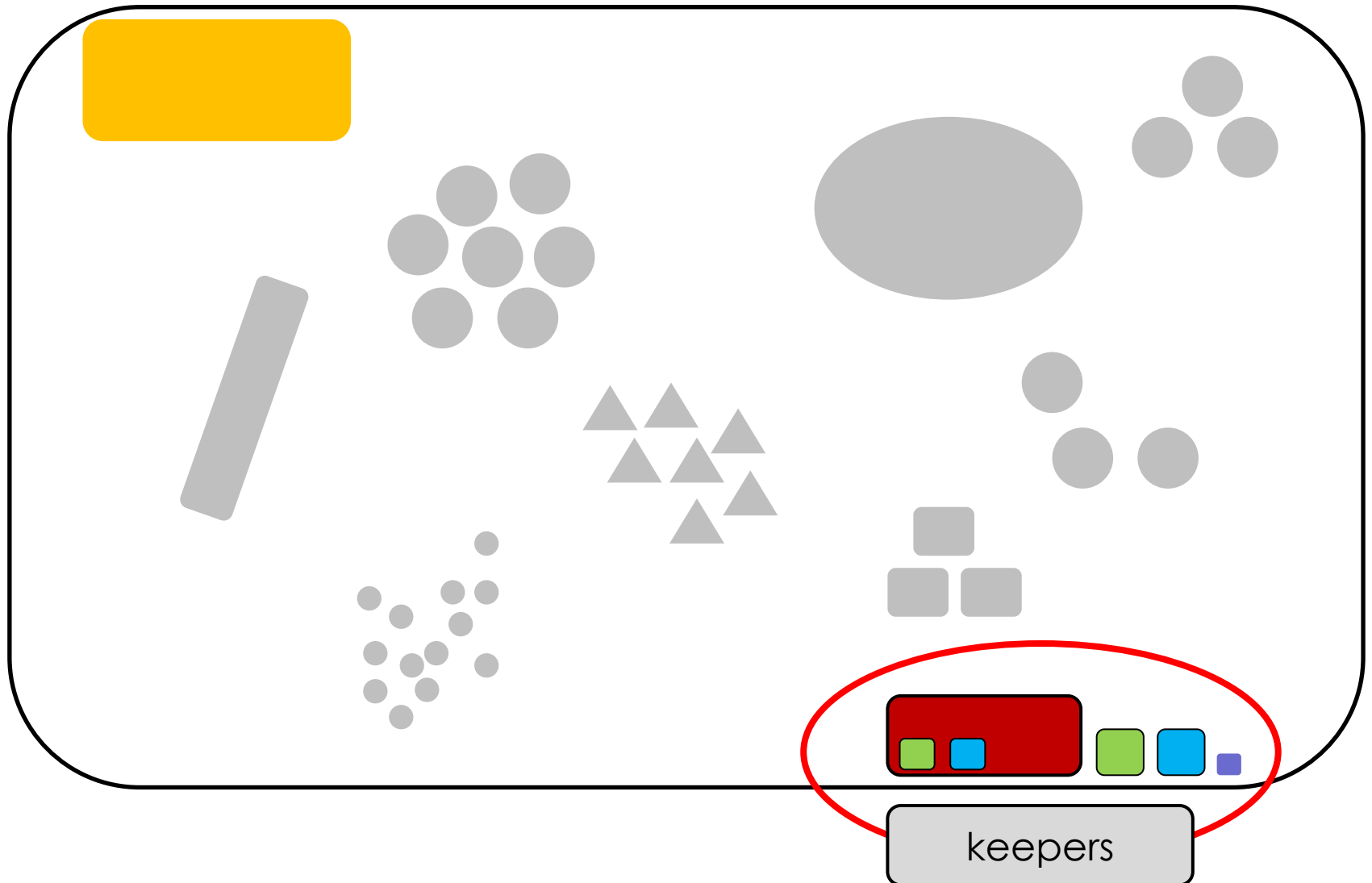


# Enclosure design and use





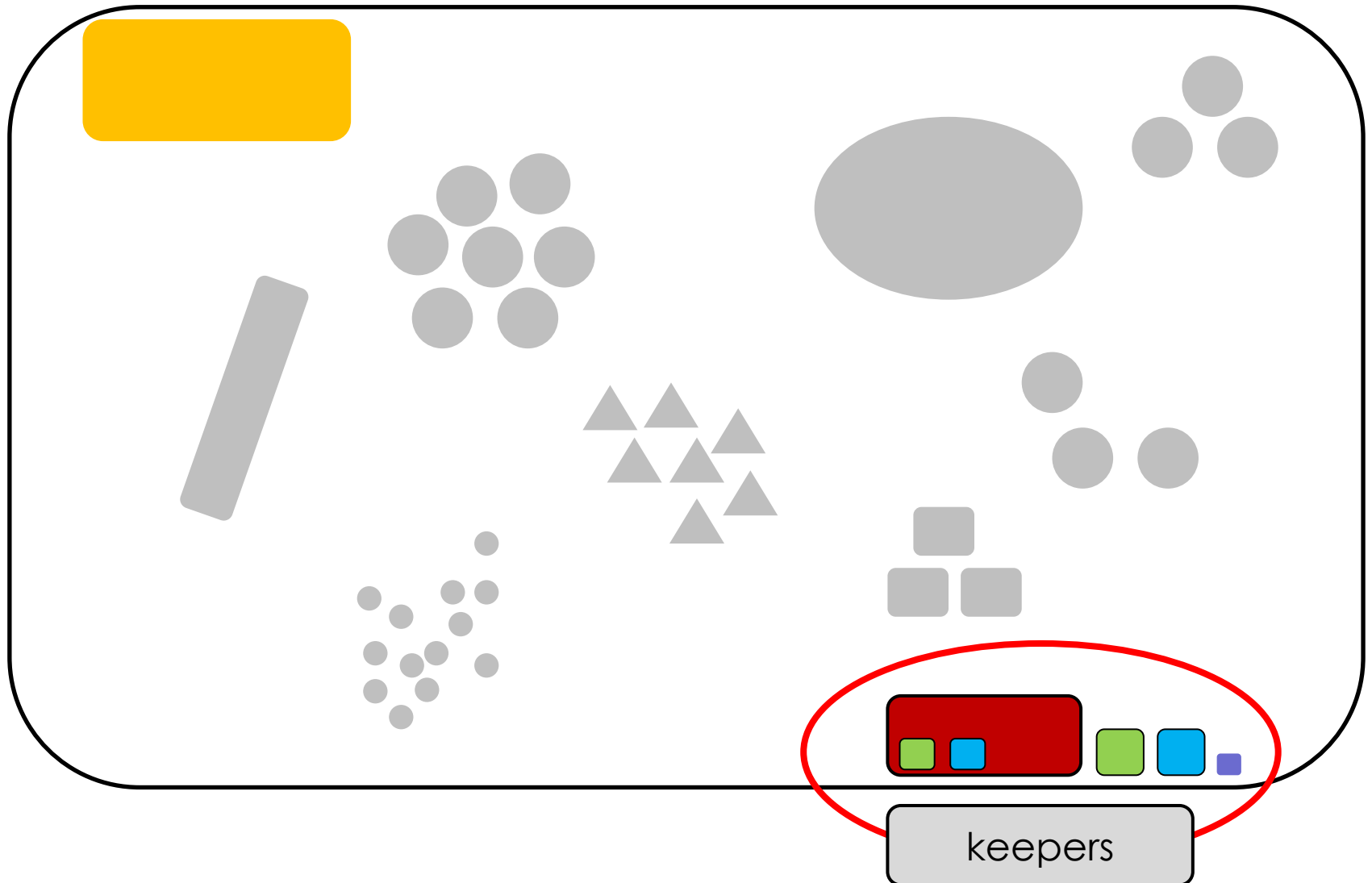
# Enclosure management





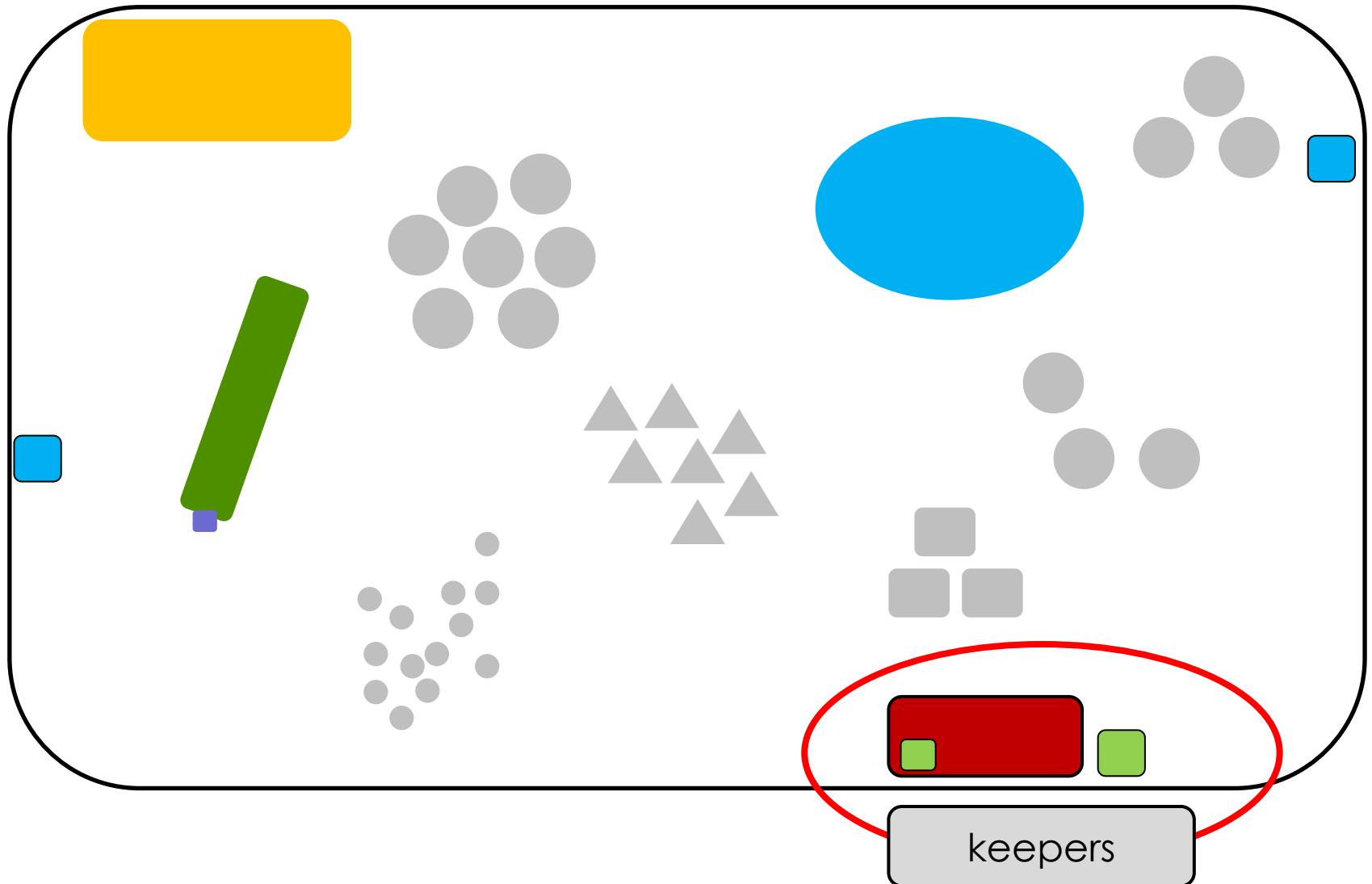


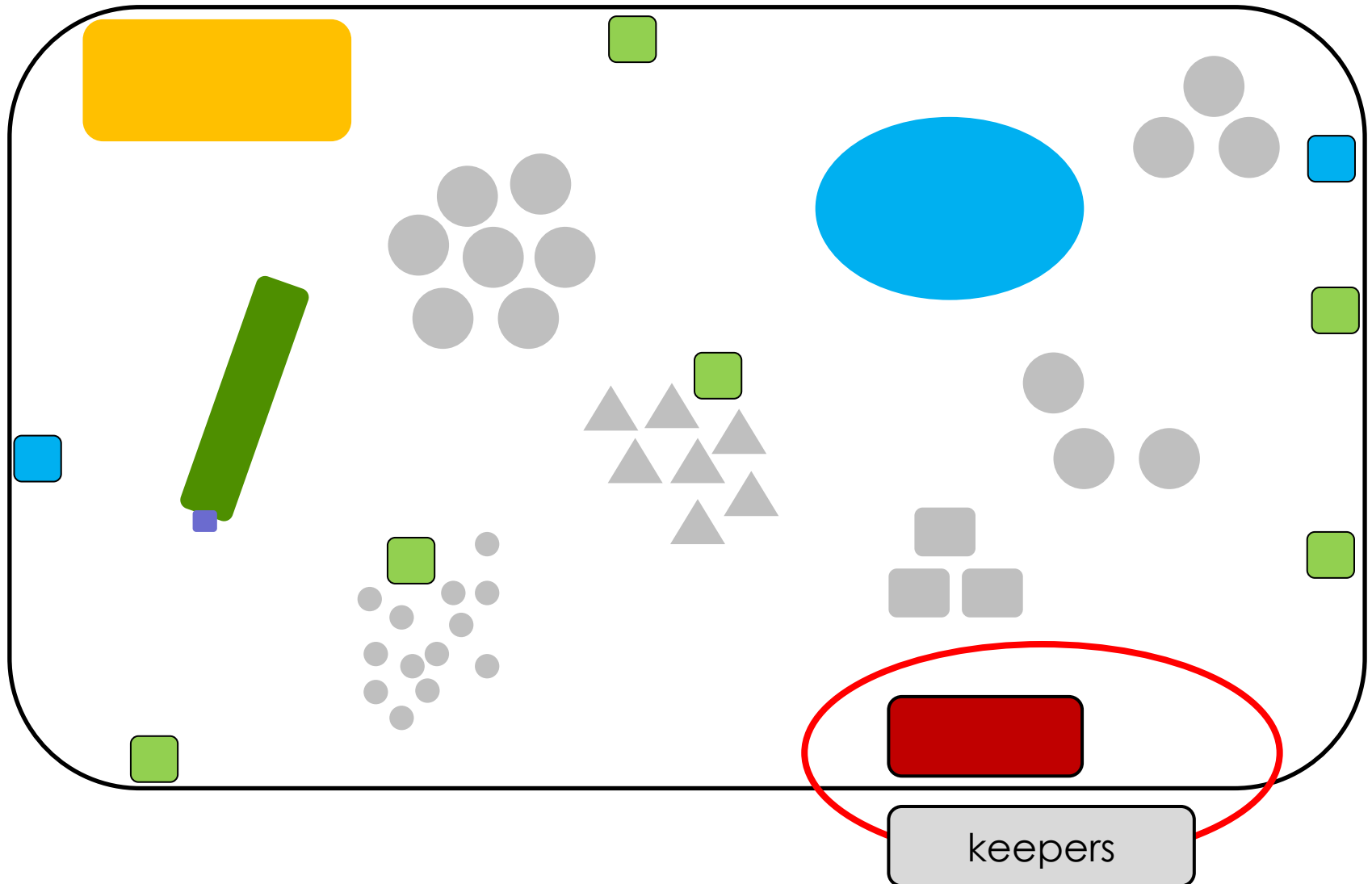
# Enclosure management

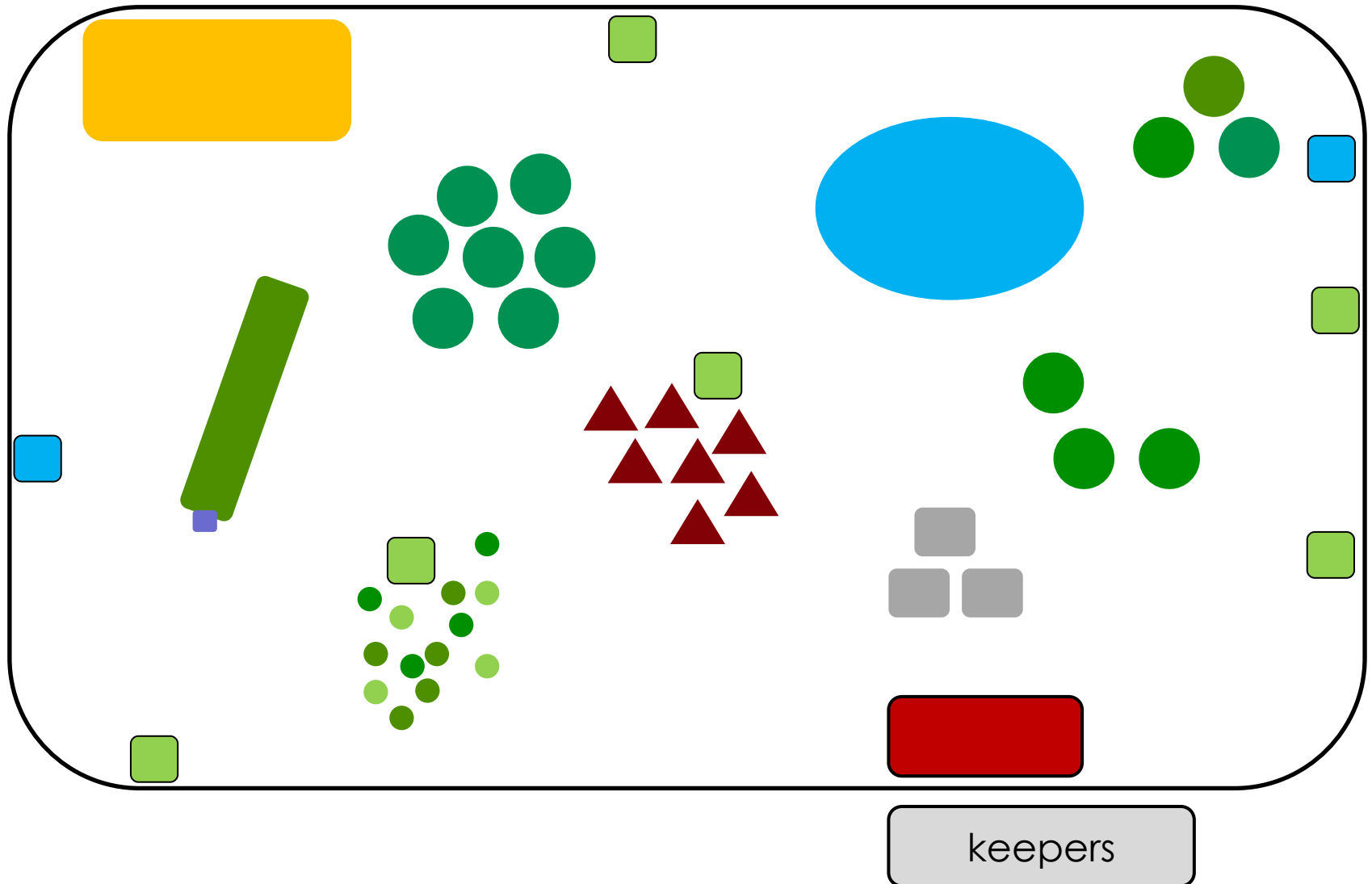


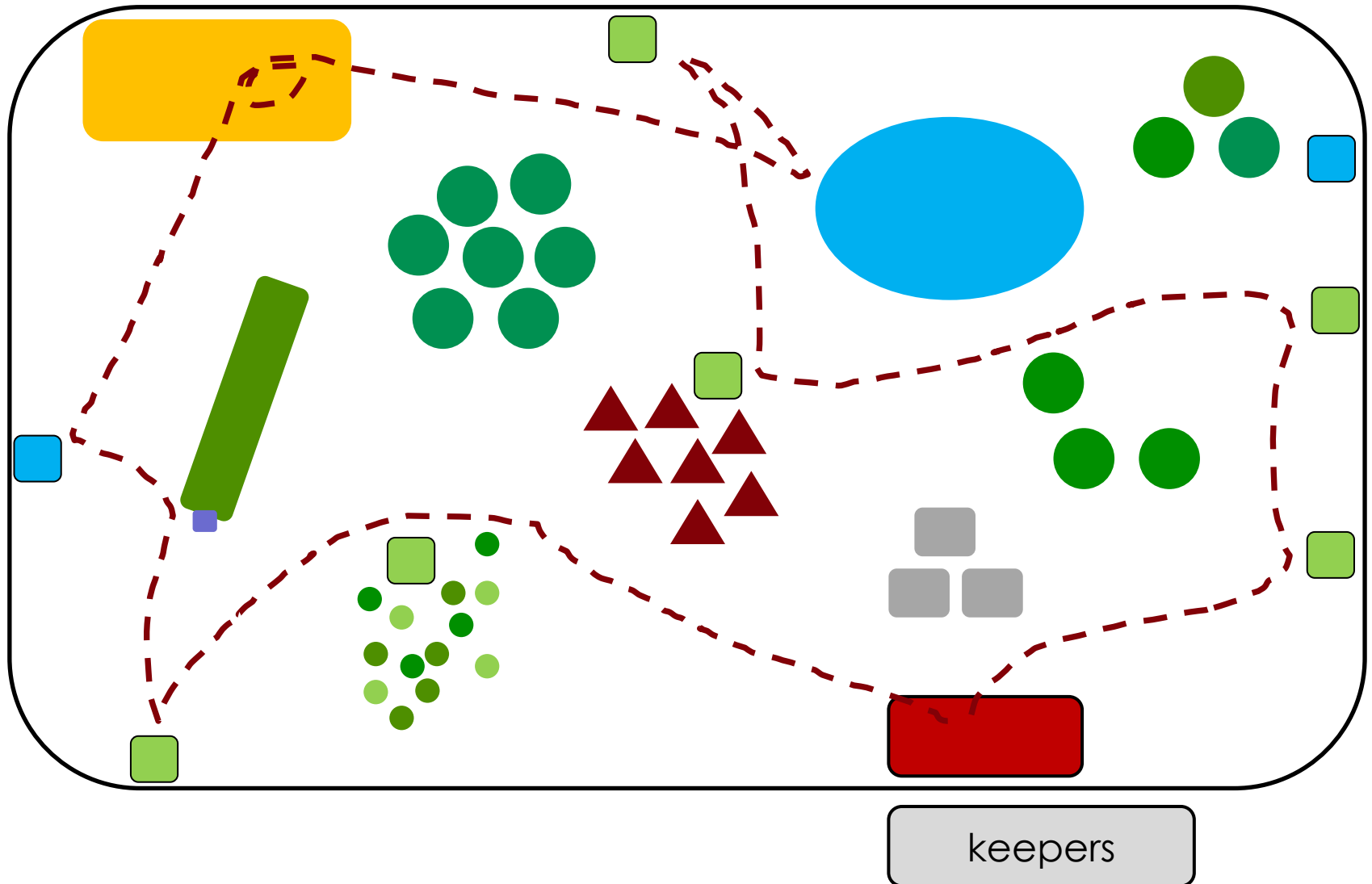


# Enclosure management













# Changing a bear diet





# Changing a bear diet

Bears at a Zoo were considered obese when compared to reported body mass for species (male: 180 vs. 140 kg, female: 115 vs. 75 kg)

Diet offered contained 2x the amount of ME (calculated as for dogs) compared to estimated requirements at ideal body weight.

***Challenge: feeding a group where some individuals should lose weight, some should keep weight, and one should continue to grow!***



# Changing a bear diet

Amount of food was reduced (to what was calculated as the total requirement on ideal body weight).

Bread was excluded, fruits reduced, additional vegetables introduced.

Regular weighing (every second week).



# Changing a bear diet

Amount of food was reduced (to what was calculated as the total requirement on ideal body weight).

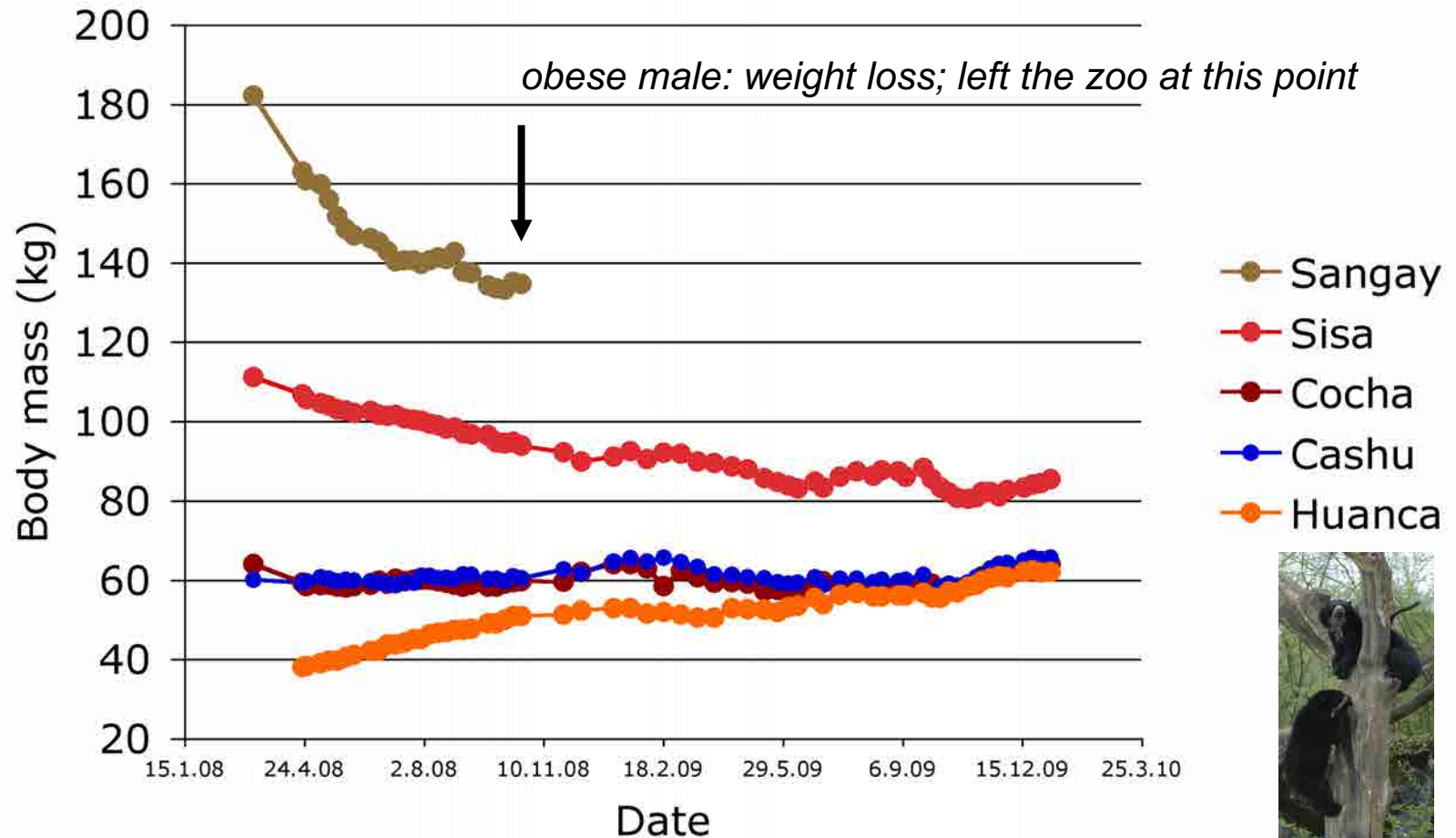
Bread was excluded, fruits reduced, additional vegetables introduced.

Regular weighing (every second week).

***The most important task was to have all personnel involved agree on goals of weight loss and diet change to a more 'natural' diet (in terms of nutrient composition).***



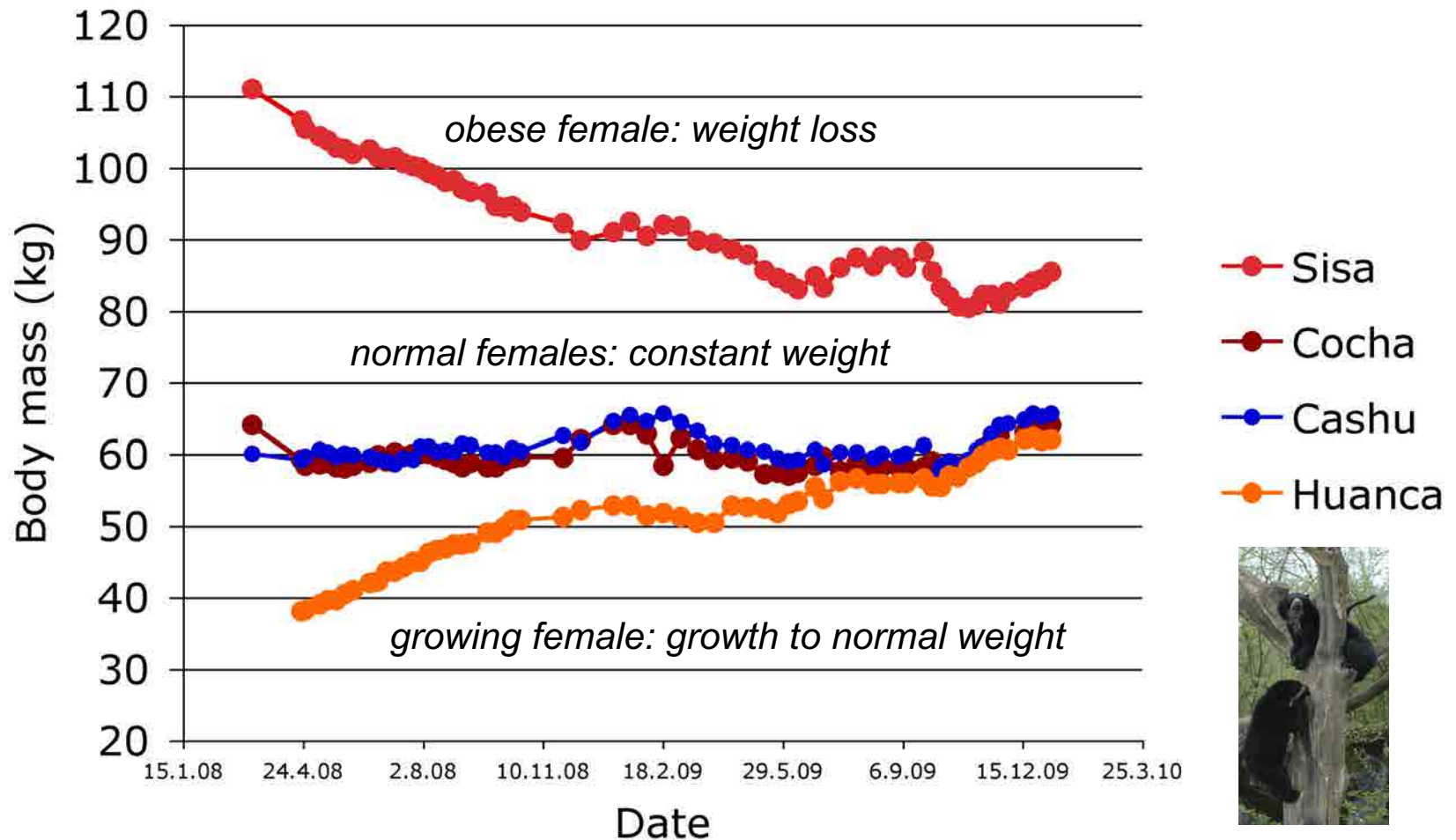
# Changing a bear diet







# Changing a bear diet





# Changing a bear diet

*The most important accomplishment is the creation of a situation where everyone involved now considers regular weighing, and constant adjustment of diet amounts based on the results of weighing, a normal procedure.*



# Seasonal body mass changes and feed intake in spectacled bears (*Tremarctos ornatus*) at Zurich Zoological Garden

Journal of Zoo and Aquarium Research 4(3) 2016

Kerstin Gerstner<sup>1</sup>, Annette Liesegang<sup>1</sup>, Jean-Michel Hatt<sup>2</sup>, Marcus Clauss<sup>2\*</sup> and Cordula Galeffi<sup>3</sup>

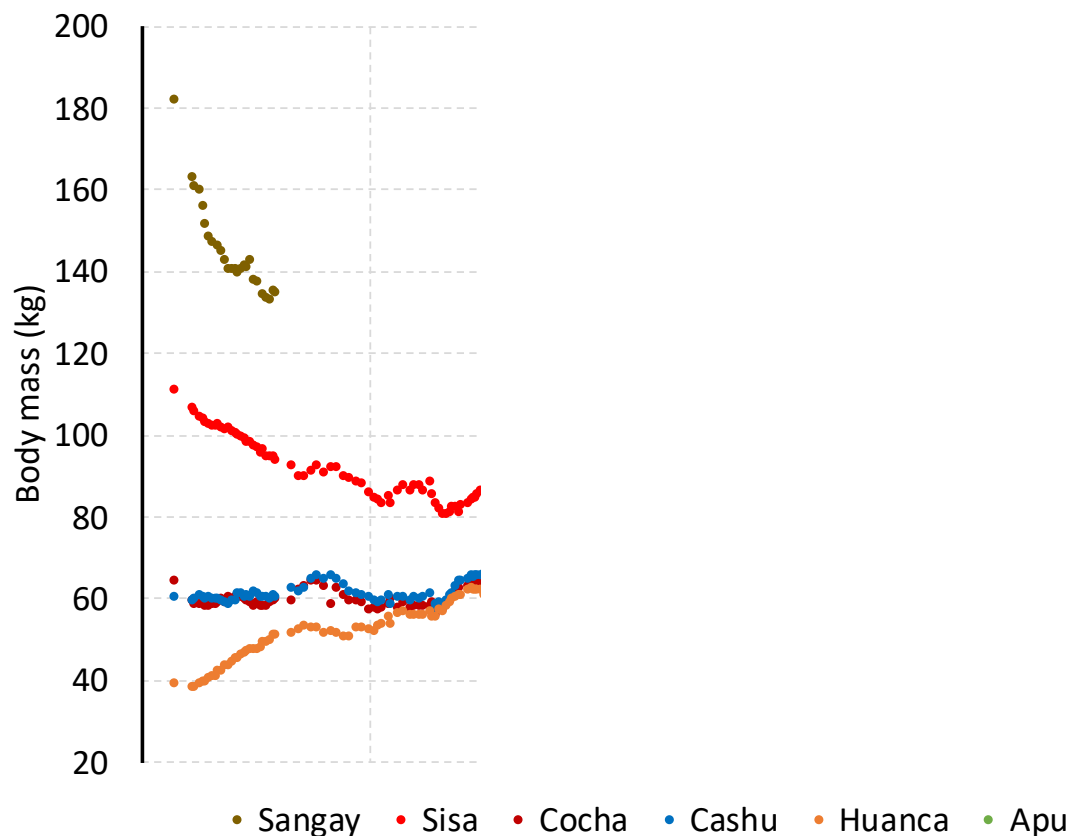




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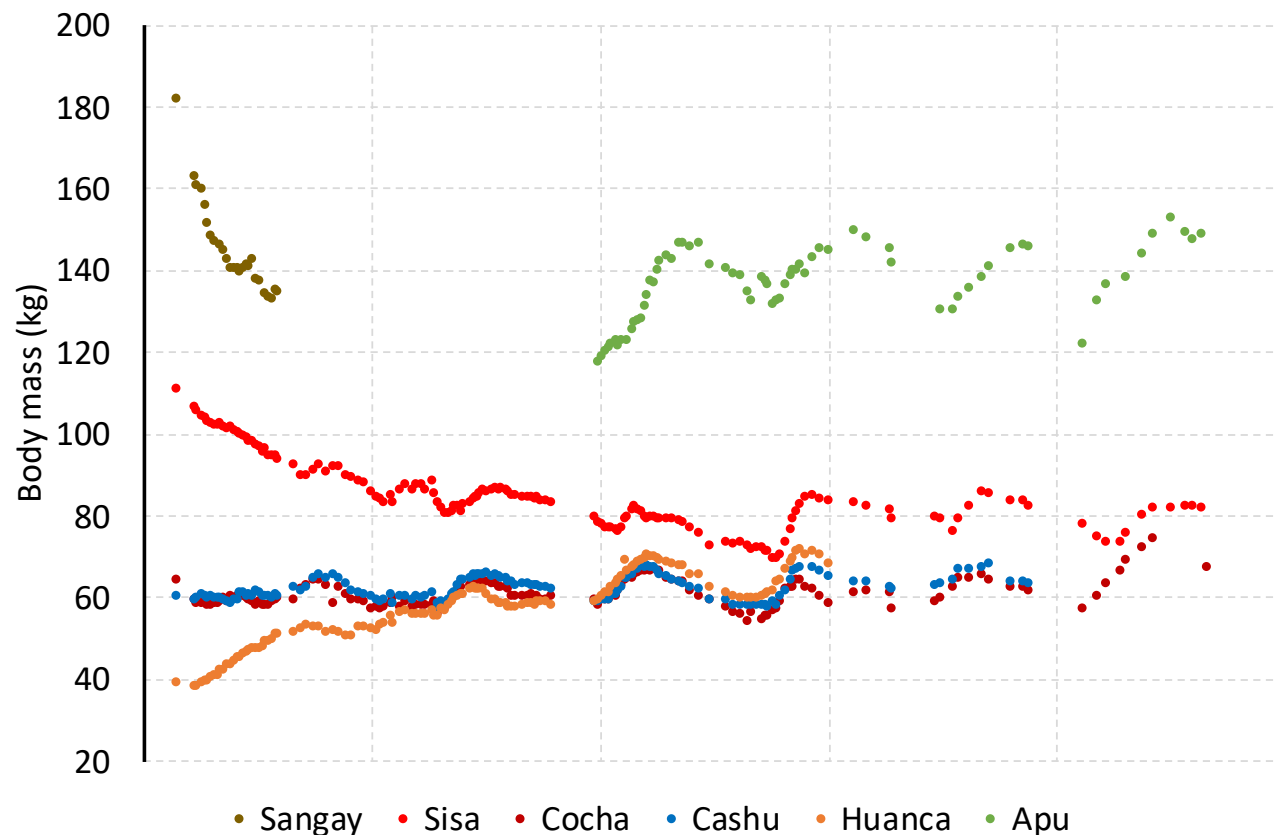




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***What is your story ?***