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Reptile nutrition and nutritional disorders

A REVIEW

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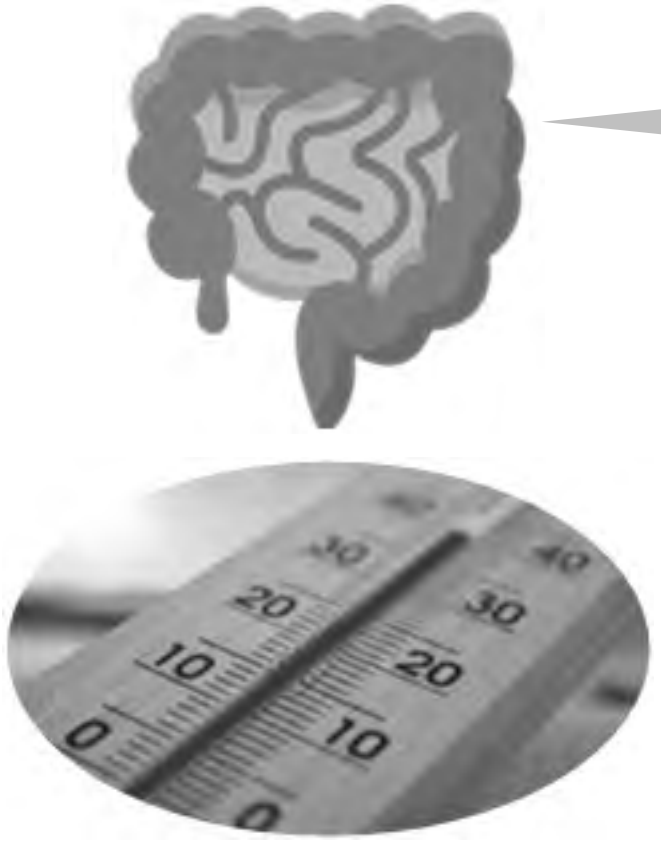
Special features

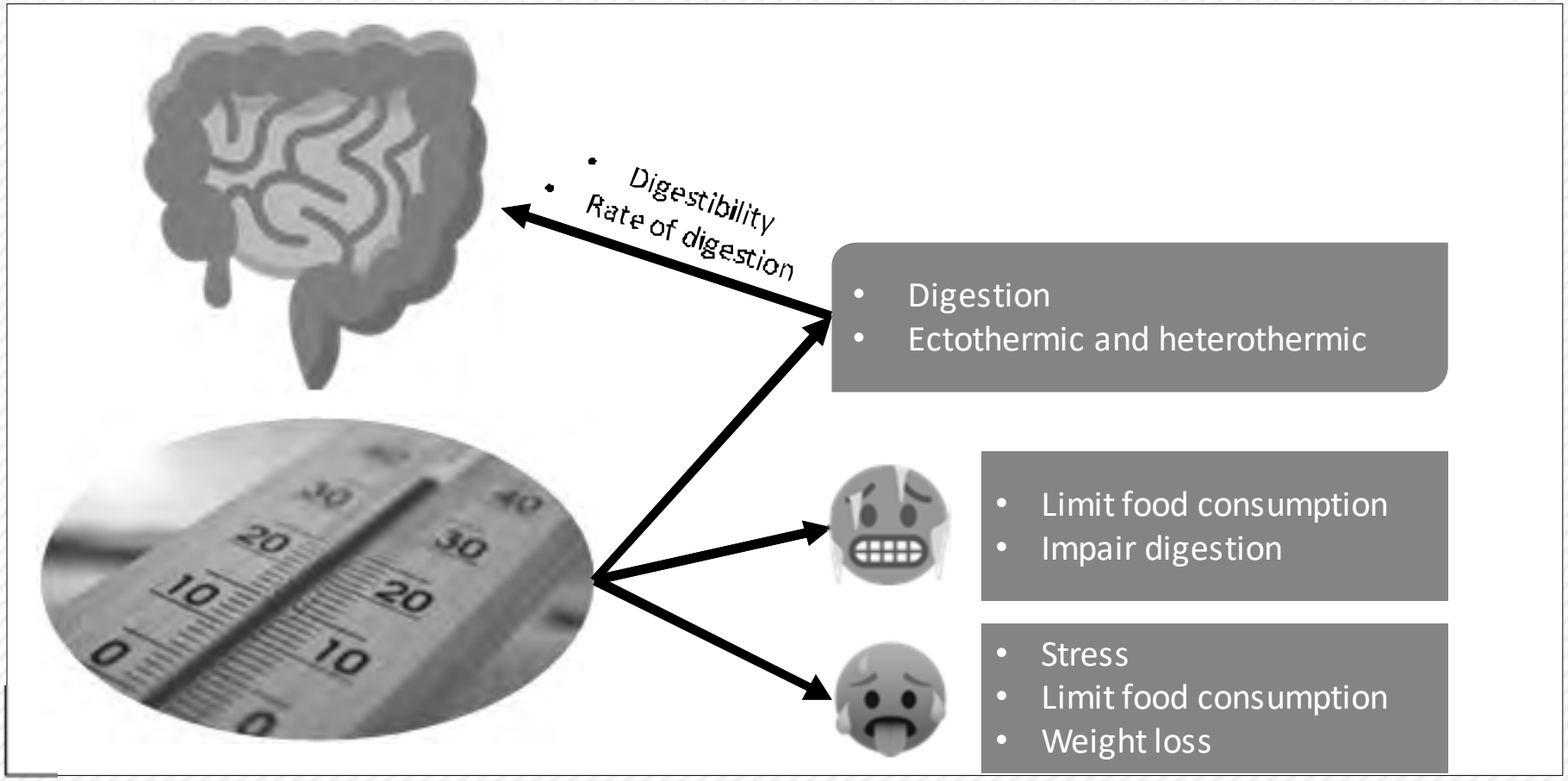


Species	Temperature (°C)	Food passage time
Chelonians		
Galapagos tortoise	NR	7–23 days
Lizards		
European wall lizard	NR	33–40 hours
Italian wall lizard	NR	35–40 hours
European green lizard	NR	32–45 hours
Green iguana	27.5	6–8 days
Whiptail lizard	NR	20–23 hours
Snakes		
Burmese python	NR	38 days
Yellow-bellied racer	NR	4 days
Eastern kingsnake	23	7 days
Eastern ribbon snake	21–26	4–5 days
Eurasian water snake	25	6–7 days
Speckled rattlesnake	NR	5–6 days
Tortuga Island rattlesnake	NR	9 days

3.1 Time required for food to pass through the gut in a variety of reptiles (*normal gut transit times*)
NR = not recorded (field data)

(Calvert, 2004a)

Special features



(Calvert, 2004a)

Special features

Energy Requirement

- Depends on:
  - Activity level
  - Environmental temperature
  - Stage of life
  - Disease
- Wild x Captive

(Donoghue, 1998; Calvert, 2004a; Girling, 2013)

Environment

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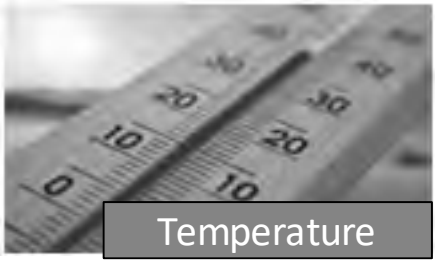
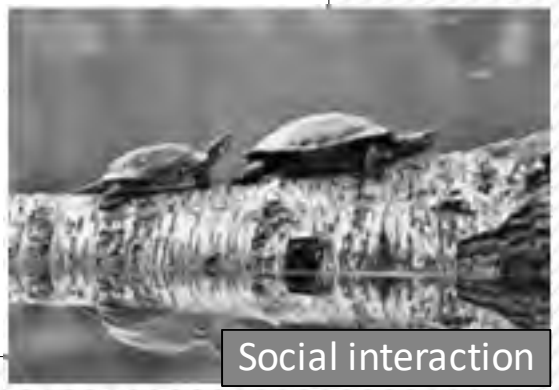
(Oonincx & Van Leeuwen, 2017)





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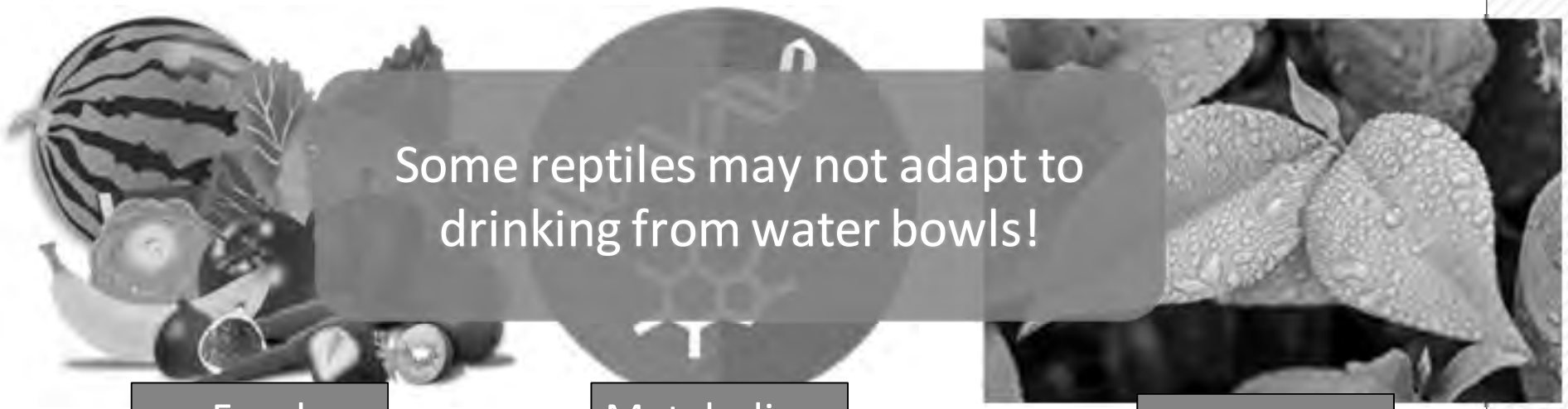
Water

10-15% of water loss is

LIFE THREATENING

Water requirement
= 20.6 x $BW^{0.84}$
20-30 ml/kg
(Minnich, 1982)



Some reptiles may not adapt to drinking from water bowls!

Food

Metabolism

Humidity

(Boyer, 2017)

Dehydration

❖ Nitrogen excretion

- Snakes and lizards: uric acid
- Aquatic crocodiles: ammonia
- Aquatic turtles: > ammonia
- Terrestrial tortoises: > uric acid

GOUT

- Deposition of urate crystals in soft tissues and joints
- Renal failure
- Multiple organ failure

(Schmidt-Nielsen, 1990; Girling, 2013)

(Donoghue, 1995; Calvert, 2004a)

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REPTILES

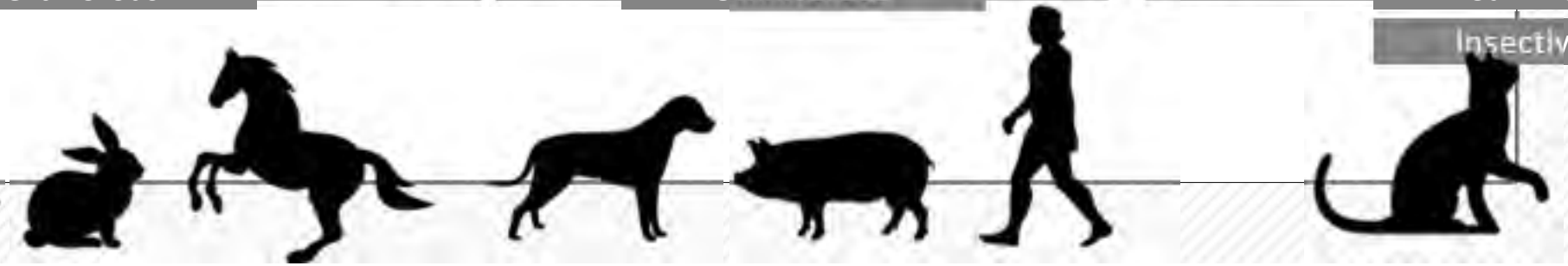
≈10.000 species

Herbivorous

Omnivorous

Carnivorous

Insectivorous



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(Donoghue, 1995; Calvert, 2004a)

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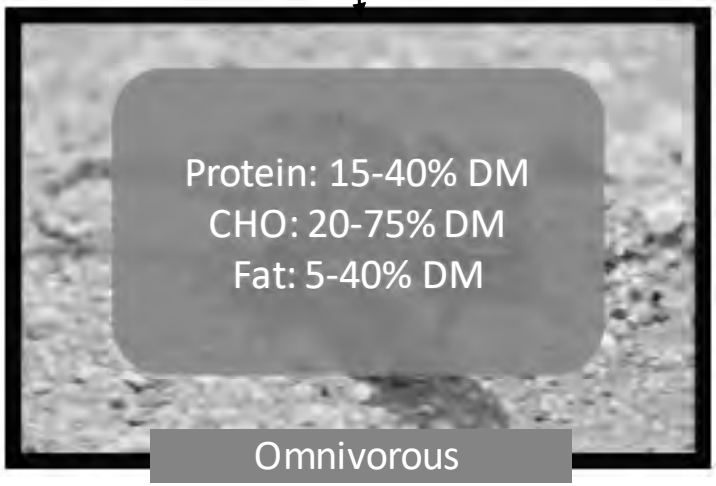
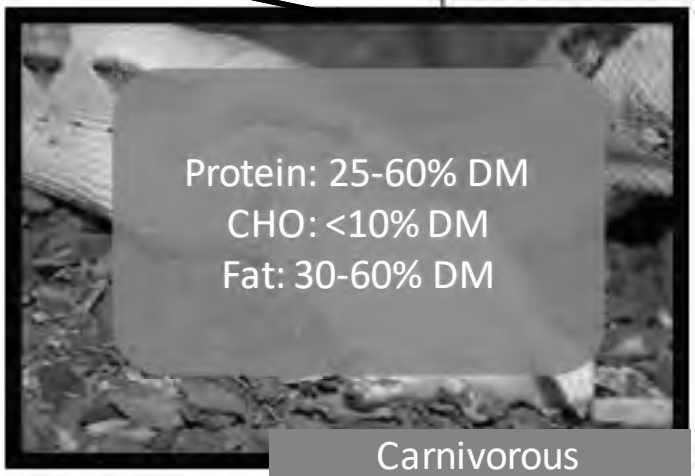
REPTILES

≈10.000 species

Herbivorous



Omnivorous



Carnivorous

Insectivorous

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Herbivorous

- High in slowly digestible CHOs, calcium and vit E.
- Appropriate amount of plant-based protein and appropriate energy density
- Low in quickly fermentable sugars (banana), fat (avocado), P

most tortoises, iguanas, *Uromastyx* spp.

(Donoghue, 1995; Calvert, 2004a)

Herbivorous

❖ Anti-nutritional factors:

- Oxalate: spinach, rhubarb, cabbage, peas, potatoes, and beet greens.
  http://www.guinealynx.info/diet_oxalic.html
- Goitrogens?: cabbage, kale, mustard, broccoli, cauliflower and other cruciferous plants
- Phytates: soy ingredients, cereals and legumes

(Donoghue, 1995; Calvert, 2004a; Boyer, 2017)

most tortoises, iguanas, *Uromastyx* spp.

Omnivorous

- May consume more animal tissue when juveniles
- Varied and well balanced diet
  - Invertebrate: cockroaches, mealworms, earthworms, spiders, isopods and others (Vosjoly & Mailoux, 1993)
- Careful monitoring

(Donoghue, 1995; Donoghue, 1998; Calvert, 2004a, Boyer, 2017)

box turtles, bearded dragons, day geckos, plated lizards, rock iguanas, veiled chamelon

Insectivorous and Carnivorous

- Fat-rich food (ex. Waxworms) should not form the majority form of the diet
- High gluconeogenesis

snakes, aquatic turtles, most monitors, tegus, most lizards, crocodilians

(Donoghue, 1995; Calvert, 2004a)

Herbivorous

- Fruits and vegetables from grocery stores x wild
- Fruits: high water, high fructose and low fiber
- Anti-nutritional factors

Insectivorous

- Invertebrate prey: lack of calcium and Vit A
- Wild x commercial insects
- Dusted invertebrates:
  - Supplementation of minerals
  - Nutrient toxicities or deficiencies
  - Palatability

Carnivorous

- Vertebrate prey: complete and balanced, BUT:
- Obese prey
- Neonatal prey: lack of calcium and fat soluble vitamins

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(Donoghue, 1995; Donoghue & Stahl, 2000)

"Because the class Reptilia is so **diverse** and reptiles have adapted to such a large **variety of climates, habitats, and natural diets**, making general applicable recommendations is **challenging**."

(Mans C & Braun, 2014)

Nutritional Disorders

Disease	Diet Evaluation	Diet Correction
Nutritional Secondary Hyperparathyroidism	Low Ca foods; no supplementation; no sun or UV-B	Add calcium carbonate up to 1.5% dry matter, house outside or use full-spectrum lights
Cachexia	Low intake of food; excess fruit	Increase ambient temperature, offer more calorie-dense food
Obesity	Excess food; low activity	Increase activity; offer low energy foods
Hypovitaminosis A	Muscle meat, lettuce	Replace with commercial turtle/trout/pet foods
Steatitis	Excess polyunsaturated fatty acids	Add Vit E, 100-400 IU/fish; low-fat fish
Thiamin Deficiency	Thiaminiases in fish	Add thiamin, 1mg/kg; vary fish species
Gout	Dehydration	Supply adequate water and humidity; low purine diet
Nutritional Secondary Hypothyroidism	Goitrogenic plants	Avoid goitrogenic plants in large quantities. Seaweed powder or tablets if diet offered is deficient in iodine

(Donoghue, 1998; Mans & Braun, 2014)

Nutritional Secondary Hyperparathyroidism

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- Deficiency of:
  - Ca
    - Insufficient intake
    - Inappropriate of Ca:P ratio (≤1:1)
  - Vit D3
    - Insufficient intake
    - Lack of UV-B radiation - HERBIVOROUS

- Natural diet: scrubs and grasses
- Insect prey species

Good sources of calcium:
- Phoenix worms
- Wood lice
- Terrestrial crustacean
- Earthworms

- Most common disease in captive reptiles:
  - Lizards and chelonians
  - Herbivorous and insectivorous – NOT IN CARNIVOROUS

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(Mans & Braun, 2014)

Nutritional Secondary Hyperparathyroidism

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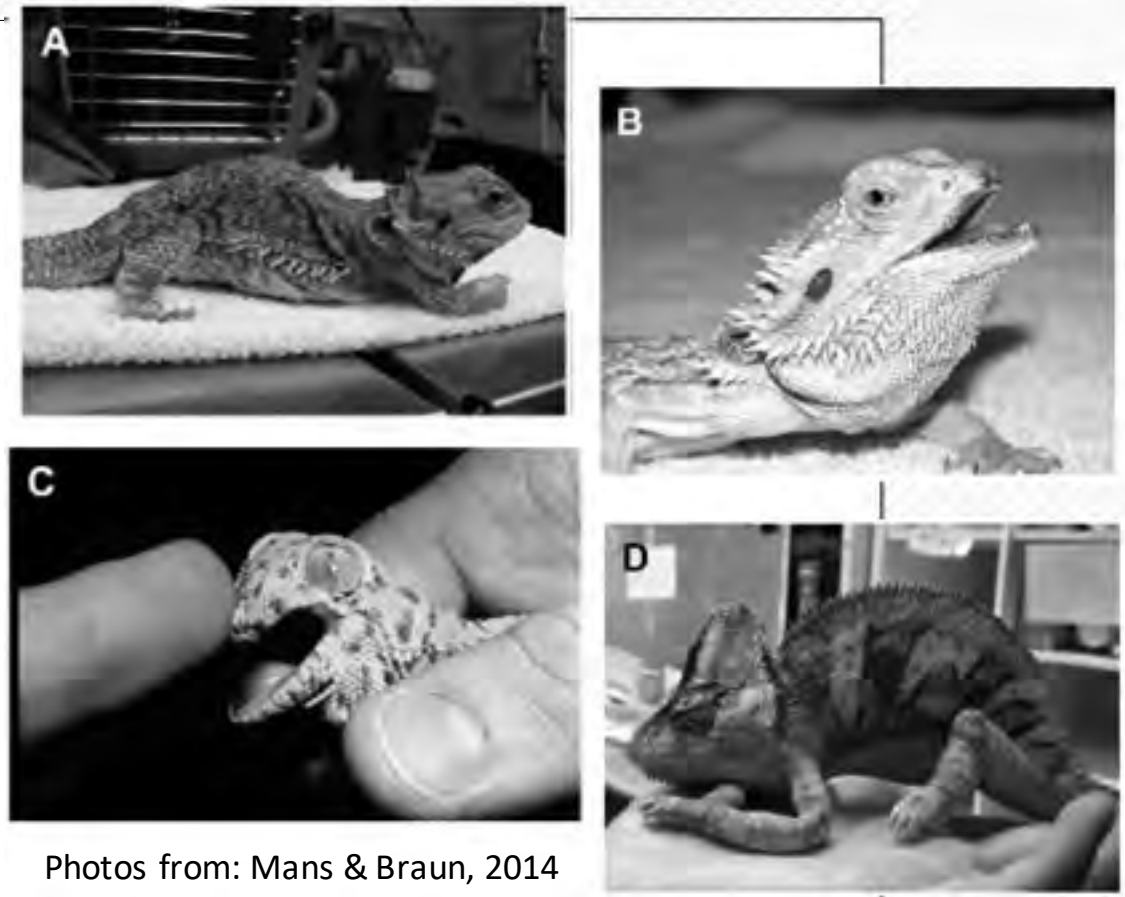
- Clinical Signs:
  - Skeletal deformities or fractures
  - Lizards: Fracture of limb and ribs
  - Chelonians: Shell -> poorly mineralized or deformed
  - Hypocalcemic crisis: muscle twitching, tremors, paresis, and neurologic signs
- Diagnosis:
  - History
  - X-Ray: changes detectable after 40-50% of bones mineralization depleted



Photos from: Mans & Braun, 2014

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(Mans & Braun, 2014)

Nutritional Secondary Hyperparathyroidism

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❖ Treatment:
- Calcium gluconate (50–100 mg/kg) – SC, IM, IV
- Calcium glubionate/carbonate 20-50mg/kg/SID - Oral
- Exposure to UV-B radiation

❖ Prevention:
- Appropriate Ca:P ratio in the diet (supplemented as powder or cattlefish bones)
- Avoid dietary Vit D3 supplementation:
  - Natural herbivorous diet does not contain Vit D3
- UV-B radiation

Ca: 1.8-3mg Ca/kcal ME or 1% DM
(Arnauld & Sanchez, 1990)

(Mans & Braun, 2014)

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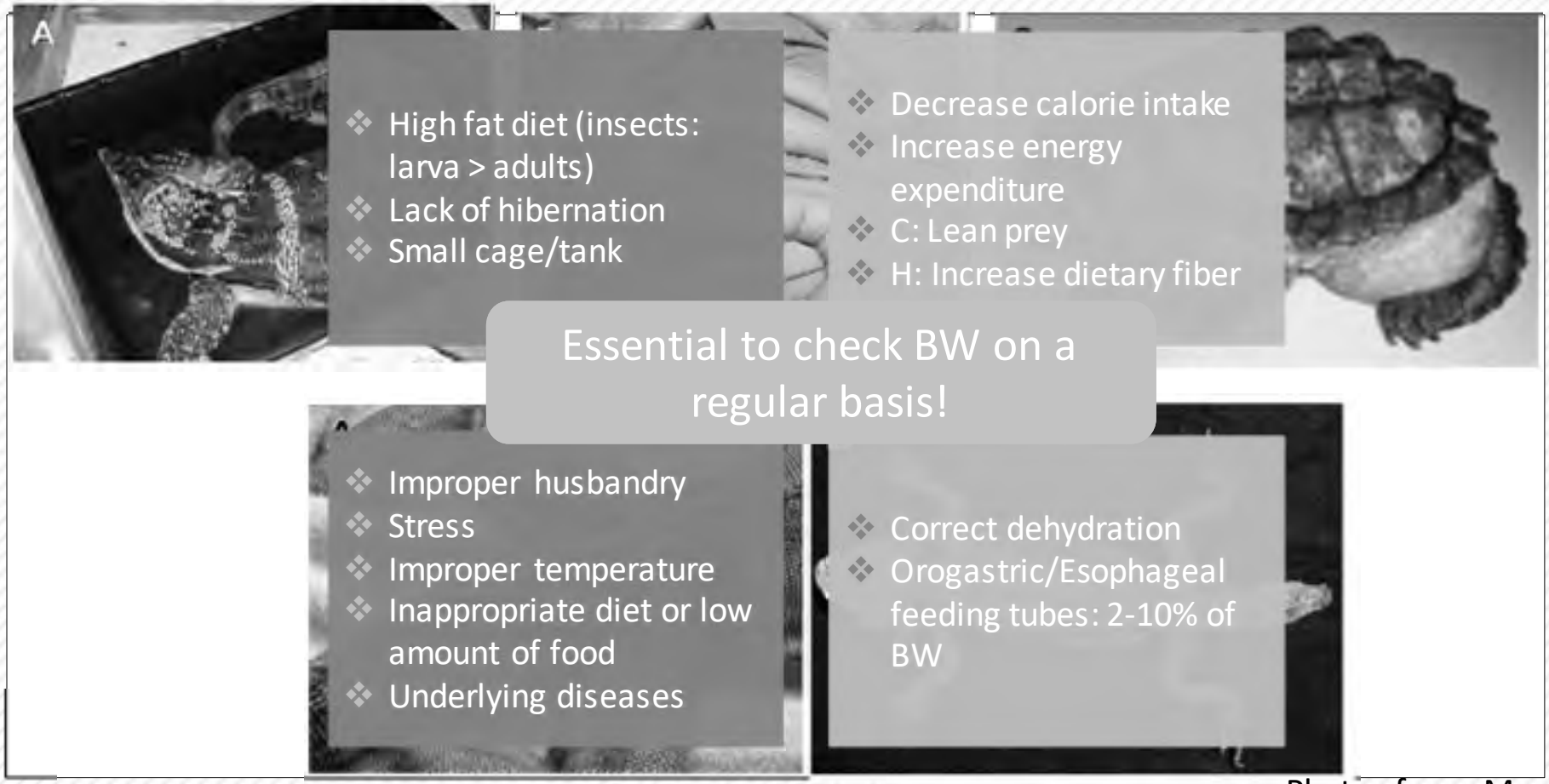
Obesity x Cachexia



Photos from: Mans & Braun, 2014
(Donoghue & Stahl, 2000; Mans & Braun, 2014)

Vitamin A–related Disorders

- Function: Maintain normal epithelial tissue
- Precursor: carotenoids
- Reptiles do not seem to absorb beta-carotenes well

- Concentration of carotenoids:
  - Green and yellow pigment
  - Geoghraphic location
  - Maturity
  - Duration and length of storage

- Herbivorous x **Carnivorous and Omnivorous**

(Mans & Braun, 2014)

Hypovitaminosis A

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Clinical Signs:

- Eye problems
- Respiratory infections
- Neurological dysfunction
- Spinal kinking
- Dysecdysis
- Increased formation of hemipenal plugs
- Multifocal squamous metaplasia
- Hyperkeratosis of epithelium

Treatment:

- Supplementation of Vit A
- Tortoises: avoid adm of retinols -> HIGH risk of intoxication
- H: Dietary carotenoids
- O, I and C: 500 to 5000 IU/kg IM every 7 to 14 days (max. 4x)

Prevention:

- C and O: Whole prey
- I: Insects gut loaded

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(Mans & Braun, 2014)

Hypervitaminosis A

- Only iatrogenic

Clinical Signs:

Weeks to months later
- Skin hyperemia
- Blisters
- Ulceration
- Skin sloughing

Treatment:

Only supportive care
- SC fluids
- Antibiotic – Secondary bacterial infections

Prevention:

When treating Hypovitaminosis A:
- Oral dosing is preferred

(Mans & Braun, 2014)

Thiamine Deficiency

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Dietary factors:

- Fish high in thiaminases
- Frozen thawed fish
- Frozen thawed vegetables -> phytothiaminases
- Storage of the supplement

Clinical signs:

- Torticollis
- Opisthotonus
- Muscle tremors
- Incoordination
- Blindness
- Jaw gaping
- Sudden death

Treatment:

- Thiamine (50–100 mg/kg) IM, SC, SID

Prevention:

- Avoid fishes with high thiaminase levels (gold fish, fathead minnows)
- Proper storage
- Rapid thawing process
- Supplementation of frozen thawed fish: 20mg thiamine/kg of fish

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(Mans & Braun, 2014)

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