Stiftung Tierärztliche Hochschule Hannover
University of Veterinary Medicine Hannover, Foundation

Nutrition of hedgehogs

http://www.aquatop-aachen.de/media/igel2.jpg

ECVNC Residency Class 2016

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Outline

- basal aspects
- physiology and anatomy (GIT)
- nutrition
  - wildliving hedgehogs
  - kept hedgehogs
    - legislative aspects
    - measures and care
    - return to the wild
- summary

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https://naturfotografen-forum.de/data/media/81/Igel-03::G%C3%B6tz_Nowack_igel.jpg

Basal aspects

- 12 species (Africa, Asia, Europe)
- "wild status" (African Pygmy hedgehog – pet in North America) FRY (2016)
- living in rural as well as in urban areas (sometimes high density in urban areas due to climatic conditions and extra food supply) HUBERT (2011)
- mammals, rogues, nocturnals
- duration of pregnancy: 31-42 d,
- parturition between June and August (mostly 4-6 hoglets/baby hedgehogs)
- body weight of newborns: 15-20 g
  adults: 700-1200 g
- expectation of life: 3-5 years (free living)

Basal aspects

- characteristics
  - protective spines, ability to roll in (defense)

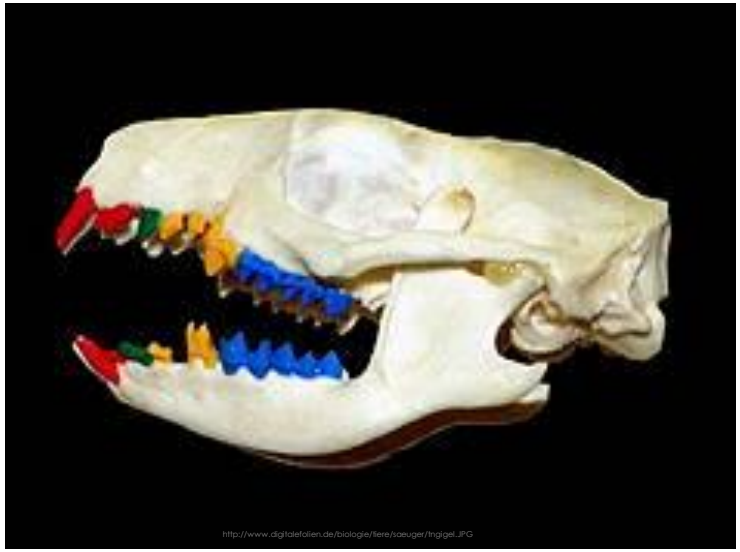
  - hibernation (winter sleep: about Novembre to March)
    - heart frequency: from 200-300 to 5 beats per minute
    - body temperature: from 35-36 °C to 1-8 °C depending on the ambient temperature

Physiology and anatomy of GIT

Dents

- features of carni- (P4 and M1 – scissor bite),
- omni- (blunter than dents of other insectivores),
- and insectivores (peaked molars for cracking chitinous exoskeleton) nutrition

REEVE (1994)



Cave:
development of dental calculus (in particular when offering diets low in fibre, e.g. canned diets for cats and dogs)

STRUCK and MEYER (1994)

Physiology and anatomy of GIT

GIT of hedgehog is low differentiated and short (archetypal)

- GIT weight –body weight ratio similar to other mammals
- stomach similar to humans and carnivores (particularity: chitinase, lack of lactase activity)
  STRUCK (1995), DIERENFELD (2009)
- low amylase activity in the pancreas (similar to cats) STRUCK (1995)
- marginally differentiated intestine (small intestine, slick colon, no caecum); macroscopically no difference in the outer side between small and large intestine)

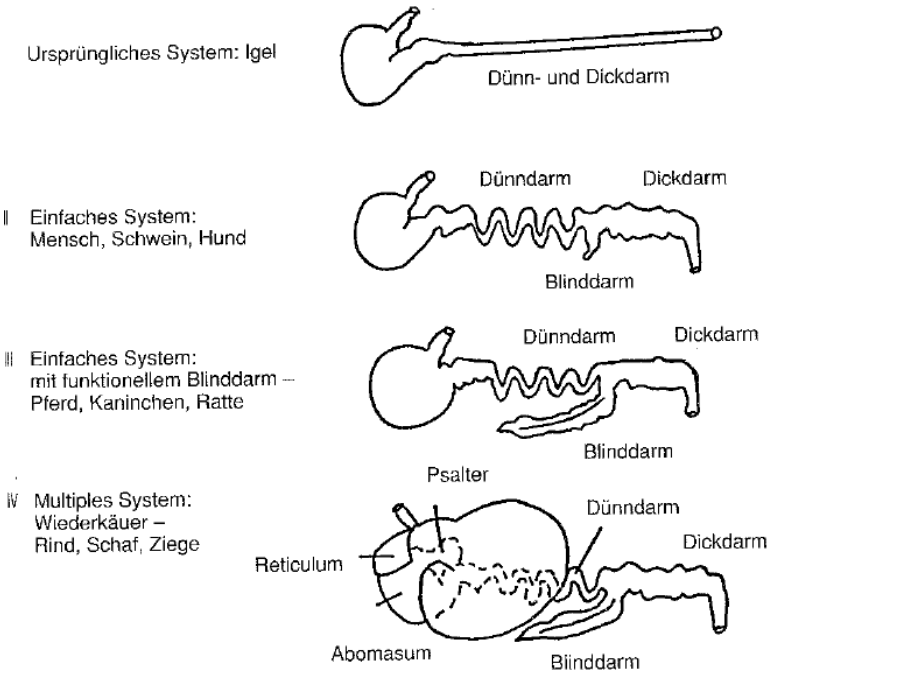


Abb. 8: Aufbau des Verdauungskanal bei verschiedenen Tierarten nach PÜSCHNER und SIMON (1988); Igel ergänzt.

STRUCK and MEYER (1998)

Nutrition in wildlife (babys)

- intake of milk until 42-44 d. p. n. (weaning)
- no or only small uterine transfer of antibodies
- directly post partum colostrum contains antibodies in concentrations similar to serum of mother
- antibody content of milk decreased rapidely to 25 % of serum until day 4-6 p.p.
- babys are able to resorb antibodies until weaning (about 40 d. p. n.)
- from about d 25 of life intake of solid feed and water

http://igel-in-bayern.br.de/wp-content/uploads/2015/03/COLOURBOX6142052_igelmutter_saeugt_junge.jpg

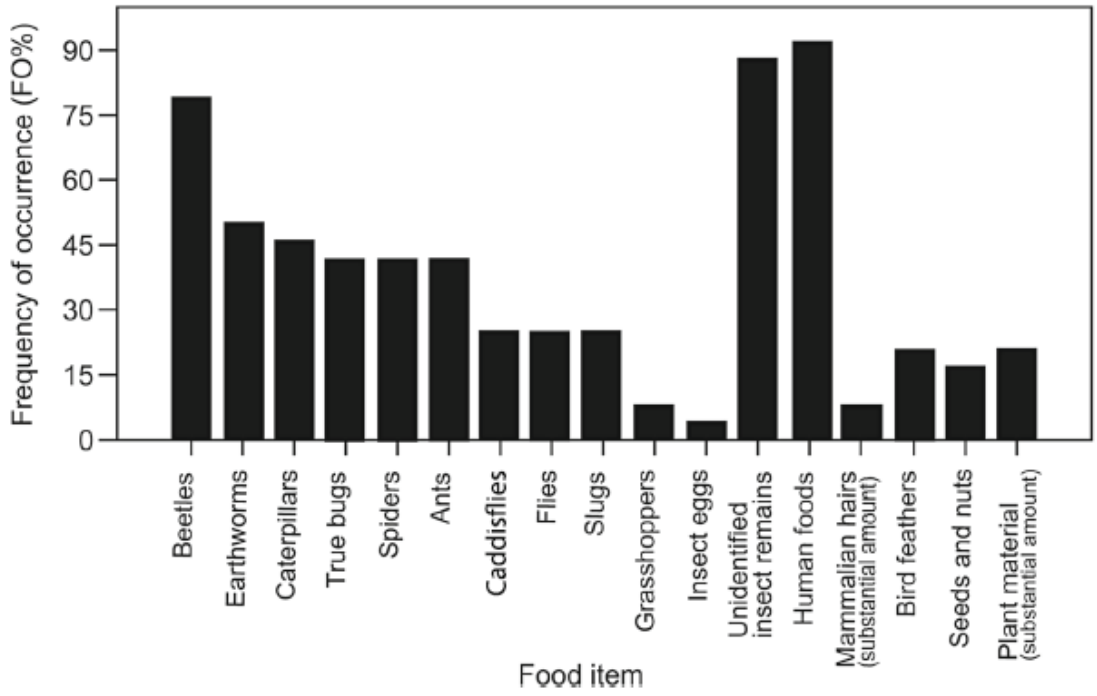
http://igel-hilfe.alternate-energy.de/bilder/Bilder%20Uwe%20Naeve/Europaeischer%20Igel%200018.jpg

MORRIS (1963), MORRIS and STEEL (1967), STRUCK and MEYER (1998)

Nutrition in wildlife (elder)

- finnish study (RAUTIO et al. 2016): analysis of stomach content of died hedgehogs

Fig. 2 Food items identified from the stomachs of hedgehogs ($n = 24$). Human foods include fish, milk, and unidentified meat. FO% = 100 × the number of stomachs containing a specific food item/total number of stomachs



Nutrition in wildlife (elder)

- JONES and NORBURY (2011, New Zealand, south island): analysis of droppings

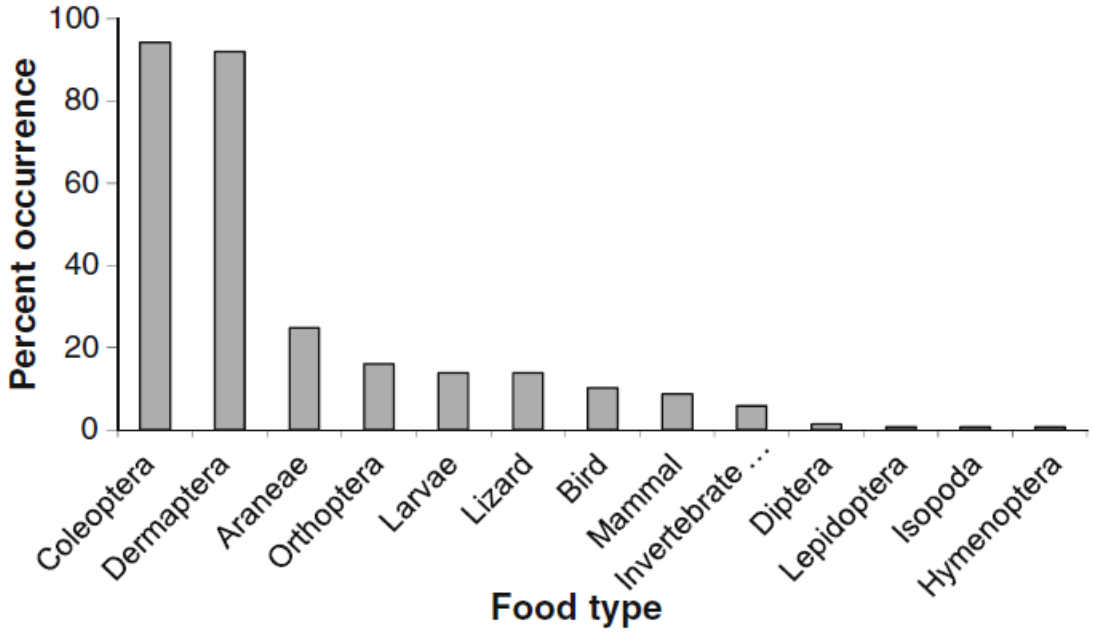


Fig. 1 Frequency of occurrence of food types in 177 hedgehog droppings from dryland habitat, South Island, New Zealand

Nutrition in wildlife (elder)

- REEVE (1994)

TABLE 3.3 *A comparison between four studies of diet in European hedgehogs which have used direct counts.*

	% dietary energy			
	Campbell (1973a)	*Yalden (1976)*	*Grosshans (1983)*	*Wroot (1984a)*
Beetles	56·3	41·2	30·0	27·9
Caterpillars	30·9	31·4	43·1	17·7
Earthworms	?	12·3	7·7	33·9
Earwigs	4·8	1·7	10·5	1·5
Slugs/snails	5·3	3·1	1·3	5·6
Diptera larvae	—	2·9	5·2	7·0
Beetle larvae	—	—	10·5	0·4
Millipedes	—	2·2	—	0·3
Woodlice	1·1	0·1	—	0·9
Sample size	230	137	57[a]	39

The counts have been converted to energy equivalents (using conversion factors derived from calorimetric determinations of sample species or near equivalents) and then expressed as a percentage of the total energy these prey represent. Comparability of the data for earthworms is marred by the fact that Campbell did not quantify them at all, Yalden used wet weights, Grosshans apparently combined an unspecified direct-count system with relative volume estimates and Wroot used counts of chaetae to estimate number of worm segments (the most bias-free method).

[a]Grosshans analysed just 57 samples (of the 125 total) in detail.
?Recorded but not quantified.
—Food category not used or none recorded in this category.
Source: based on Wroot (1984a).

Nutrition in wildlife (elder)

Supposed percentage of components of a hedgehog meal (STRUCK and MEYER 1998, modified)

component	% of total meal
beetles	30-65
orthoptera, dermaptera, hymenoptera	0-11
butterfly, orthoptera and celeoptera larvae	17-48
earthworms	0-34
snails	2-10
mammals	0-5
birds, eggs	0-10
plant material, fruits	0-9

Nutrition in wildlife (elder)

- free living: intake of beetles, grubs, rain worms, grasshoppers and snails but also of woodlice, spiders, eggs, plants, fruits, mammals (carrion), flies
- preys rich in energy and slow in motion were preferred
  (hunting based on olfactory and auditory sense primarily) WROOT (1984)
- natural diet crude protein rich (but e.g. in grasshoppers about 1/6 chitin) and energy rich

CORRIVEAU (2016)



Nutrition in wildlife (elder)

Supposed mean energy- and nutrient content of "natural" hedgehog diets (on a DM basis; 25-28 % DM):

GE: 21-24.5 MJ/kg
CA: 5-16 %
CP: 55-62 %
CF/Chitin: 7-12 %
CL: 12-20 %
NfE: 2-11%

http://www.schoepfung.eu

STRUCK and MEYER (1998)

Nutrition of kept hedgehogs (babys)

	hedgehog milk			dog milk	Esbilac+	self-made
Source	Ben Shaul 1962	Struck 1995*	Landes et al. 1997*	Heinze et al. 2014	Neumeier 1995	Landes et al. 1997
GE, MJ/kg	5.9	9.4/8.6	13.5	6,2	6.8	8.1
Water, %	79	63/57	55	78	74	69.5
Fat, %	10.1	14.7/13.1	25.5	9.2	9.8	14.2
Protein, %	7.2	15.6/14.9	16	8.4	11.7	10.4
Lactose, %	2 (NfE)	0.05/0.06	0.07	3.0	2.3 (NfE)	0.96
% of total energy						
fat	65	60/58	72	60	55**	68**
protein	29	40/42	28	31	39.4**	30**
lactose	6	0/0	0	9	5.6**	2.1**

*usage of oxitocin
**supposed: CP=23.9 kJ GE/g; CL=38 kJ GE/g; lactose=17.5 kJ GE/g

Nutrition of kept hedgehogs (babys)

- concentrated milk **rich in fat and protein** and extremely **low in lactose**
- milk with high energy density: 70 % of energy from fat, 30 % from protein
- aminoacid (AA) pattern: 6.4 g S-containing AA per 100 g AA (dog: 4.0 g, cattle 3.7 g)
- fine particular coagulation of proteins (similar to the dog milk)
- milkfat: about 98 % ≥ C16 (78 % unsaturated fatty acids; similar to dog milk but rich in linolic acid)
- uncommon high Fe- and Zn-content of milk: ~ 52 and 30 mg/kg (dog: 7.3 and 12 mg/kg; MEYER, 1990)
- higher Zn-requirement of hoglets due to development of Zn-rich spines?

LANDES et al. (1997), STRUCK (1995)

Nutrition of kept hedgehogs (babys)

- dog milk replacer for replacing hedgehog milk successfully used for decades despite the lower fat and the higher lactose content LANDES et al. 1997
- in case of lack of availability
  - self made milk replacer :
    - 15 % eggyolk
    - 8 % soyoil
    - 30 % scrambled eggs
    - 30 % low fat curd
    - 0.7 % mineral supplement (20 % Ca)
    - 0.5 % calciumcarbonate
    - 15.8 % fennel tea

    LANDES et al. (1997)
  - or glucose solution (5-10 % glucose, 36 °C) STRUCK and MEYER (1998)
- feeding concept:
  - each 3-4 hours at daytime, each 4-5 hours at nighttime
  - amount of the liquid diet: 15 % of the body weight per day (small syringes, 36 °C) LANDES et al. (1997)

http://www.gartenspaziergang.de/igel3_s.jpg

Nutrition of kept hedgehogs (elder)

LANDES et al. (1997)

- evaluation of commercial hedgehog feedstuffs compared to a self-made diet (based on beef and egg)

  individual differences in acceptance of diets (highest values for self-made diet)

  authors speculate about an increase in acceptance due to higher amount of components of animal origin

  - digestibility of organic matter: 70 - 90 %
  - high digestibility of protein (93 %) of the self-made ration, 73 - 77 % commercial diets
  - digestibility of crude fat: 80 – 94 %
  - digestibility of NfE: 67 – 86 (NfE-content of diets: 43 - 64 %; DM basis)
  - digestibility of crude fiber: 23 – 63 % (chitin: about 20 % digestibility; STRUCK 1995)

  negative correlation: fibre content of the diet and the digestibility of the organic matter (recommendation: max. 3 % CF on a DM basis)

  in spite of low amylase activity (STRUCK and MEYER, 1998), digestibility amounted to 67-86 %

STRUCK (1995) did digestibility studies with mealworms:

digestibility rates: CP 85 %; CL 98 %)

Nutrition of kept hedgehogs (elder)

Recommended nutrient contents in complete diets for hedgehogs (LANDES et al. 1997):

http://www.handtuchgarten.de

- 20-26 MJ GE/kg DM
- 30-60 % CP
- 20-30 % CL
- 2-3 % CF (during growth only 1-2 %)
- max. 40-50 % NfE
- per kg DM:
  - 4-9 g Ca
  - 2.5-6 g P (Ca:P relation between 1,3 and 2:1)
  - >1.5 g Mg
  - >1.5 g Na
  - >1.5 g K
- (during growth and reproduction: 24-26 MJ GE, 12 g Ca and 8 g P per kg DM)

Nutrition of kept hedgehogs (elder)

from week 3 of life:

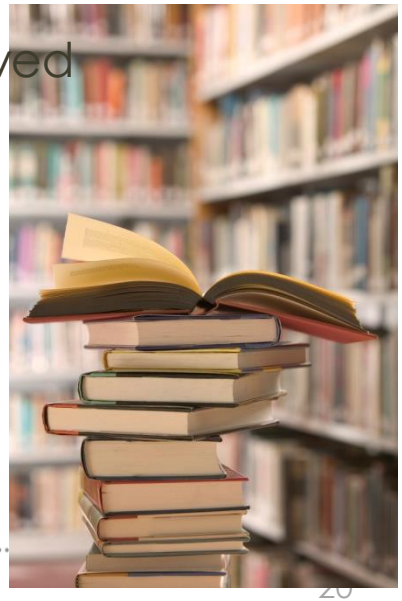
- open water source with water of appropriate quality ad libitum (safe against upset)
- change slowly to solid feeds
- e.g. canned (lateron also dry) petfood for hedgehogs,
- petfood for dogs or cats also suitable (higher palatability) but addition of fibre (e.g. 2 % wheat bran) recommended (STOCKER 1989) (GRAFFAM 1998)
- recipes for self-made diets (LANDES et al. 1997)
- meal worms, rain worms, insects (cave: parasites)
- from 200 g body weight onwards also sweet and soft fruits (banana, plum, peach), oat flakes, cooked poultry meat
- no milk
- prevent adipositas (frequent problem of pet trade hedgehogs)

http://www.hausfreund.at/files/pix/400x400/2010090.jpg

Kept hedgehogs

Legislative aspects (german legislation)

- German Civil Code: wild animals are “res nullius“, appropriation is forbidden
- Federal Nature Conversation Act: occupation of wild animals is forbidden
  - exception: ill, helpless, hurt wild animals
- in this case to take it and nurse it back to health is allowed
  - **but**
- after recovery: return to the wild is mandatory



Need for action?

- before picking up: feed outside and prepare a refuge for hibernation (pile of leaves, wood pile)
- situations in which help is necessary:
  - main onset: underweight young in late autumn/winter, risk due to missing energy reserves (<500-700 g body weight)
  - case of injury or illness
  - hedgehogs seen outside at day in times of snow and ice
  - orphaned hedgehog baby (cave 3-4 weeks old babys leave the nest for short time but find the way back alone!)

PLASS (2002)

http://static.lw-heute.de/tmp/14085_small.jpg

http://www.natur-server.de/Bilder/HWG/001/hwg000812.jpg

Measures and holding

- **Cave:**
  - parasites (ecto- as well as endoparasites)
  - zoonotic relevance (RAUTIO et al. 2016: Salmonella prevalence 57 %)
- **Babys:**
  - nest (basket, box) with heat source (max. 40 °C, from below, hot water bag), soft blanket
  - when crawling and walking: activity area (about 1 m^2)
- **Adults:**
  - sleep house (isolation of bottom) and run area (min. 2 m^2), nest material: pieces of newspaper, dry leaves
  - Individual housing (exception: young siblings)

PLASS (2002)

http://lernzentrum-stuttgart.de/wp-content/uploads/2013/08/Igel-300x171.jpg

Return to the wild

- in april/may at steady location (refuge), apart of traffic
- when young ones have a body weight of > 500 g and adults about 1000-1400 g
- offer feed in the first days at place of release

PLASS (2002)

http://www.schoepfung.eu/fileadmin/win/sc/dateien/6/saeugetiere/igel_jungtier.jpg

http://www.tierfotograf.com/media/600-600-76105-0-0/042500_igel.jpg

Summary

- usage of
  - milk replacer for dogs
  - canned food lateron also dry food for cats or dogs suitable (palatability↑, availability↑)
  - commercial hedgehog diets (palatablity↓)
- Cave: parasites, bacteria → zoonoses!
- best protection of hedgehogs: keep/left leaves and brushwood in the garden in the autumn for winter time

Thank you for your attention!

http://www.brandenburgs-wildtiere.de/images/insektenfresser-igel.jpg

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