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Obesity in *Chamaeleo calyptratus* DUMÉRIL & DUMÉRIL, 1851 (Reptilia: Chamaeleonidae) successfully treated with a diet. A Practice Report.

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ABSTRACT

In general, obesity is one of the most frequent health disorders found in captive chameleons, particularly the Yemen chameleon, *Chamaeleo calyptratus*. The main cause of obesity is incorrect husbandry and overfeeding. We present here the insight into the reasons and mechanisms of fat storage of chameleons in captivity; including the principles of assessment of the nutritional state and principles of treatment for obesity, documented by a real case study.

Key words: Chameleons, captive, diet, chameleonoculture, obesity, *Chamaeleo calyptratus*

INTRODUCTION

Obesity is one of the most problematic and frequent diseases and physiological disorders found in chameleons. Almost every single captive chameleon is overweight, by "wild standards"—the number of heavily obese chameleons (weighing double, even triple their standard weight) in captivity is alarming. Even Veterinary Doctors are many times misled by the standard of how a healthy chameleon should look; wild observations are scarce and in captivity, unfortunately obesity has become the norm (M. SLOBODA, IN LITT.). Obesity is the root cause of many diseases, leading to the degradation of homeostasis, both physically and biochemically causing the failure of many internal organs (especially the liver and kidneys). It is the most frequent cause of egg binding; often combined with gout, leading to starvation and eventually death. In general, obesity cuts the life expectancy of a chameleon, both directly and indirectly, by less than a half—the longer living chameleons are never obese (P. NECAS, PERS. OBS.; NECAS & MANCHEN, IN PREP.).

In the wild, chameleons' ecosystems are so well balanced that they practically have no need to store fat; and if they do so, it is in minute amounts. Obesity is a phenomenon not reported from the natural habitat of chameleons (TOLLEY & HERREL 2016); it very rarely occurs in heavily man-modified landscapes, when food with very high nutritive value can become over-abundant. Other species tolerate the cultural landscape such as in Nosy Be—e.g. *Furcifer pardalis* (CUVIER, 1829), living around municipality garbage dumps or manure deposits (P. NECAS, PERS. OBS.; P. NECAS 2019).

There is a unique logic to how chameleons store fat and it takes place in phases (the first two of which are not so easily visible):

1. Development of Pelvic fat bodies
2. Fat bodies fill the majority of the body cavity; the liver hypertrophies by fat degeneration, simultaneously doubling to quadrupling its typical physiological volume
3. Fat deposits develop in muscles, best visible in the extremities, tail and along the spine
4. Fat deposits swell the casque and cheeks

As the chameleon starts to exhibit oedematic extremities, the state of obesity has reached its peak. Once the casque and cheeks start to become puffy, the situation is critical (NECAS, 2019a).

Ethically, it is wrong and irresponsible to allow chameleons in captivity to become overweight; obesity causes health problems, leading to suffering and in some cases death. An overweight chameleon must be the subject of dietary program, with the purpose of

reducing its overall weight, depleting fat reserves.

Reasons of obesity

The most obvious and common cause of obesity in captive chameleons is the higher-than-necessary consumption of nutrients, which in turn are not utilized in metabolic processes and the excess energy is stored in the form of fat. While chameleons continually grow until they reach maturity, there is no risk of obesity, as all the energy intake is invested into development and growth. The problem arises once the chameleon reaches its maximum size (maturity) and begins to gain weight only. It is at this moment and beyond, obesity is driven mainly by the following factors:

Fig 1: Captive Yemen Chameleon *Chamaeleo calyptratus* with typical signs of heavy obesity: puffy cheeks and casque and swollen legs, Photo: Petr Nečas

Overfeeding with too much food. The nutritional demand of an adult fully grown male Yemen chameleon, under proper care conditions, on average does not exceed the volume of one large sized cricket per day. In this species, evolution did not build any preventive measures to inhibit overfeeding: once the animals reach adulthood, they immediately begin to reproduce; afterwards the dry season starts, bringing more limited food resources. The animals are therefore programmed from the young age to feed as much as possible to win the race of time, and to grow enough to reproduce at end of the rainy season. This has instilled an innate programing to feed as much as possible, building up reserves for the long, cold, harsh dry season. Virtually no keeper imitates these natural seasons in captivity; they—as a rule—continue feeding ad-libitum, resulting in mild or heavy obesity in only a few short months.

Overfeeding with too high nutritional value food. In captivity, chameleons are often fed fatty foods, commercially produced and widely available, containing immensely high amounts of fat and proteins (such as moth and beetle larvae, and roaches). Feeding food with such high nutritional values quickly results in the development of fat reserves.

Overheating. Chameleons are heterothermal animals, heavily dependent on their body temperature and the surrounding environment to stimulate their metabolism; this is especially so in the ambient temperatures of the air and infrared rays contained in the wild within natural sunlight (simulated in captivity with various kinds of electric bulbs). The speed of their metabolism is directly proportionally dependent on temperature. Higher temperatures require a more intense metabolism and higher food consumption, stimulating the animal to increase its overall food intake. Reducing temperatures only and not food consumption inevitably leads to obesity.

Wrong supplementation. Improper supplementation in chameleons may also contribute to the building of fat reserves, especially in the absence of their most vital natural supplement: bee pollen.

Wrong hydration regimen. In captivity chameleons are often subject to completely incorrect, even inverted, hydration schedules as compared to their natural environment. The lack of knowledge and attention often leads to keeping chameleons in moist, hot days and dry, warm nights - instead of the naturally correct gradient of warm, dry days and cold, humid nights. This unnatural imbalance of water intake destroys homeostasis, contributing to the increase of fat storage.

Disease. Some diseases, such as Metabolic Bone Disease (MBD), can destroy the natural equilibrium of the chameleon organism, leading to excess fat storage.

Assessing the nutritional state

In captivity, one of the most crucial factors is keeping the chameleon in a similar state as to what one would find them in the wild - "athletic", except when in periods of drought and/or hunger. The common mistreatment in captivity is to heavily overfeed them.

It is practical to use the following terms to address the nutritional state of a chameleon (After Necas 2020a,b):

Skinny:	suboptimal weight
Athletic:	optimal weight
Well-Fed:	above optimal weight to 150% the optimal weight
Fat:	between 150% and 200% of the optimal weight
Extremely Fat	above 200% of the optimal weight

For an average adult Yemen male chameleon reaching around 40cm in total length, the optimal weight is around 120g. Males exceeding 45cm in total length, the optimal weight is around 150g, considering its constitution - slim or heavily built (P. Necas, pers. obs.).

For assessment, the following guiding factors can be considered:

Useful Factors:

- Total constitution (heavy bodied or thin)
- Belly form (Belly content, emptiness)
- Skin texture (firm or relaxed)
- Casque side (flat or bulged)
- Cheek (flat or bulged)
- Extremities (thin vs. thick, muscles or bones visible)
- Fingers (parallel or fat and divergent)
- Tail base (muscles or bones visible or solid)
- Area along the spine (with or without swelling)
- Bite and casque interactions (when biting, muscle actions visible or whole area bulging outside cranial crest)

Misleading factors:

- Body form (inflated, gravid)
- Belly content (gut full or fat body?)
- Rib visibility (low fat content under skin, even well fed chameleons have visible ribs)
- Age (elasticity of skin deteriorates with age, muscles and bones become more visible)

The story of Buddha, the Yemen Chameleon

Farrah Harris (pers.obs.): "When my husband & I purchased Buddha on June 7th, 2017, our journey started as most new chameleon keepers do: extremely excited & terribly misinformed by the local pet store we adopted him from. He was about 6 months old when we first took him home – Buddha's enclosure began as an 18x18x24" glass terrarium with the dual heat lamp & coil UVB light fixture. We started him on gut loaded crickets & superworms, dusting with Calcium (with D3) every feeding & Reptivite twice monthly. As most chameleons are, Buddha was very food motivated; it was easy to instill positive associations between us as the food providers & Buddha, the perpetually hungry chameleon. By July, he would willingly climb out onto us with no visible signs of stress.

After joining a couple Facebook groups concerning chameleons, I quickly learned our current set up was doomed to fail Buddha in the long run – by early August 2017 we moved him into a proper 2x2x4' mesh enclosure with T5HO UVB lighting, a 65 watt flood lighting for basking, live plants, a MistKing & a custom drainage system. Overall, Buddha was a very charming chameleon in his youth & didn't seem as "feisty" as I've heard Veileds could be.

As we dove deeper into the Chameleon world, I wanted to start diversifying his diet from solely gut loaded crickets. After finding a reptile store that sold hornworms, silkworms & dubia roaches we began to experiment with different feeders. Upon introducing Buddha to hornworms & silkworms, he quickly began to refuse crickets, superworms & dubias in favor of these juicier morsels. Looking back now, I believe this was the beginning of Buddha's weight gain – He would protest every feeder other than hornworms, so we felt we had no other choice…We would eventually cave after a few days of his mutiny, returning to feeding his beloved hornworms (they were more readily available than silk worms & kept longer). We probably fed Buddha exclusively hornworms (& the occasional batch of silkworms) *every day,* for a little over a year. By May 2018, Buddha tipped the scales from overfed to an obese chameleon. We started to call him "Big Buddha" & in hindsight, he became less active the more weight he gained. Additionally, we had bought into the myth that "chameleons store water & energy in their casques" – we thought Buddha was a super healthy boy because he had such a large "supply" stored up.

By the beginning on 2019, we had done enough research to warrant a complete diet change – hornworms should be a treat, not a staple. We finally broke the hornworm binge after about a week of resistance, & Buddha became hungry enough to eat crickets & dubia roaches again. Unfortunately, Buddha was already vastly overweight by this time & we continued to feed him daily unknowingly. It wasn't until I joined "Life with Chameleons," I learned chameleons could even be overweight. Once I knew the signs (puffy casque, puffy cheeks, etc.) we noticed Buddha exhibited these symptoms & immediate changes needed to be made. After posting a cry

Fig 2: Top Photo: Buddha after 8 months of strict dieting, taken February 2020 (approx. 200g)
Bottom Photo: Buddha before he started his diet, taken April 2019 (approx. 250g) Photo: JACOB HARRIS

for help, Petr & the admins at "Life with Chameleons" helped us establish a strict food regimen to get Buddha back on the right track – his diet officially started on August 10th, 2019; he weighed close to 250g.

Buddha's Monthly feeding schedule was immediately reduced to the following: 1-2 gut loaded crickets every other day for 3 weeks, 1 week of fasting; we continued the usual supplementation schedule of 1:1 Calcium (no D3) / Bee Pollen for every feeding & 1:1 Reptivite / Bee Pollen twice monthly. Overall, it took about 8 months of consistent dieting for Buddha to reach a healthier weight of ~200g (last weighed on April 9th, 2020). He took to the diet pretty well – I believe the drastic reduction in food intake increased his drive to hunt for food & he became more active; he took any food offered with ease & we ignored all subsequent begging for more. It was a long road, but worth it.

Physically, the improvements are visible - his puffy casque & cheeks have drastically slimmed down. The muscles in his legs & feet are visible again. We can see his shoulder blades & ribs move lithely beneath the skin. The puffy band that used to run down his spine has diminished to where we can see the vertebrae under the skin at certain angles. Buddha has certainly become more agile & active upon losing about 50g of weight. His overall colors & posture has improved as well – he does less laying around & perches upright on his branches. His demeanor has largely stayed the same, though perhaps he's a bit more "feisty" like a Veiled Chameleon should be."

Principles of reduction diet

Once obesity is diagnosed in chameleons, the only ethical approach is to reduce the weight, down close to physiological norm; otherwise, the health and life of the animal is under extreme risk. The specific dieting process is to be designed by a competent veterinary doctor, experienced keeper or breeder. The process should adhere to the following principles and steps (after Necas 2020b):

Reduce

- Reduce the amount of food
- Reduce the size of the feeders
- Change the type of food
- Implement fasting periods

Support

- Hydrate, manage water regimens
- Supplement correctly, provide bee pollen
- Provide correct temperature gradients
- Provide correct lighting, including UV

Measure

- Weigh regularly
- Keep a record of progress, or lack thereof
- Adjust if necessary

Share

- Provide evidence
- Ask questions
- Consult

The best approach of all is of course prevention, which is based on correct and naturalistic chameleon husbandry from the start: proper caging, no overheating, no overfeeding, correct supplementation and accurate hydration methodology.

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Archaius tigris (KUHL, 1820) Quest for the Seychelles Tiger Chameleon, A Snapshot

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The island of Silhouette is the third largest island of Seychelles with 20 km². It is of volcanic origin, with the 753m high Mont Plaisir. The main town is La Passe on the northeast coast with a five-star resort as the only possible accommodation at its north end, the second village is Grand Barbe on the southwest coast. Tropical temperatures prevail in the Seychelles due to the proximity of the equator.

Seven *Archaius tigris* specimens (5 males and 2 females) were spotted during a full-day hike from an altitude of 100m a.s.l. in dense vegetation, both near the ground, but also at heights of up to approx. 3m.

The animals have a greenish base color, with the black pattern typical for *Archaius tigris*, same as the animals on the neighboring island Mahé. Yellow-orange or white lateral spots and a yellow-brown dorsal area are striking. The eyes and temples of the animals found on the hike were turquoise blue. This turquoise-blue and white can also be found around the mouth area.

Tab 1. *Archaius tigris*, Silhouette, Seychelles. Photo G. FRITZSCHE

Archaius tigris (KUHL, 1820) Suche nach dem Tigerchamäleon der Seychellen

GERD FRITZSCHE

Die Insel Silhouette ist mit 20 km² die drittgrößte Seychellen-Insel. Sie ist vulkanischen Ursprungs, mit dem 753m hohen Mont Plaisir. Der Hauptort ist La Passe an der Nordostküste mit einem Fünf-Sterne-Resort als einzig mögliche Unterkunft an dessen nördlichen Ende, das zweite Dorf ist Grand Barbe an der Südwestküste. Auf den Seychellen herrschen aufgrund der Äquatornähe tropische Temperaturen.

Sieben *Archaius tigris* Exemplare (5 Männchen und 2 Weibchen) wurden während einer Ganztagswanderung ab einer Seehöhe von 100m in der dichten Vegetation gespottet, sowohl in Bodennähe, aber auch in Höhen bis zu ca. 3m.

Die Tiere zeigen eine grünliche Grundfarbe, mit der für *Archaius tigris* typische schwarze Musterung, wie auch die Tiere auf der Nachbarinsel Mahé. Auffällig sind gelborange oder weiße laterale Tupfen sowie ein gelbbrauner dorsaler Bereich. Augen und Schläfen der auf der Wanderung gefundenen Tiere waren Türkisblau. Dieses Türkisblau und Weiß findet sich auch um die Mundpartie.

Tab 2. *Archaius tigris*, Silhouette, Seychelles. Photo G. FRITZSCHE

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A Myth about longevity of chameleons unleashed: Chameleons live long!

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ABSTRACT

An overview of the history of published and collected longevity records in chameleons is presented. Despite of the common belief, that chameleons live very short lives, counting in single-digit numbers in years, many Chamaeleon species, obviously exceed a decade or even more. The key for the longevity in captivity is the proper captive care based on the principles of the naturalistic approach and "Wild Re-Creation".

Key words: Chameleons, wild, captive, chameleonoculture, longevity

INTRODUCTION

Chameleons are surrounded by so many myths that almost no other animal in the world can exceed them in this aspect. By expanding their presence in captivity, new myths appear very frequently.

One myth is that chameleons live extremely short lives. People tend to believe that chameleons die within maximum 2-3 years. (P. NECAS, PERS.OBS.)

EVIDENCE FROM THE WILD

Looking into published data, it is obvious, that in the wild, indeed some species are extremely short living and do not even reach one-year age. It was clearly demonstrated by KARSTEN & AL. (2008) for *Furcifer labordi* (GRANDIDIER, 1872) that in Ranobe, SW Madagascar, they spend most of their lives as an embryo in the egg, to hatch at the beginning of the rainy season, becoming sexually mature at 2-months of age, reproducing and then dying at age of 4-5 months due to the harsh climatic conditions of the dry season.

A very similar pattern was recorded for *Chamaeleo calyptratus* (DUMÉRIL & DUMÉRIL, 1851) by the first author (P. NECAS PERS OBS.): Yemen Chameleons hatch in April, get sexually mature in July, reproduce and die due to predation in the dry season not later than in December, at age of 9 months only. Their disappearing is also tied with the onset of the dry season and wintertime, when low temperatures fall to the freezing point on some days and all the trees and bushes stay leafless. The real reason of their deaths is lack of hiding possibilities and predation (P. NECAS PERS.OBS.), though some specimens might survive hidden under leaves and debris, as indicated by the observation of M. BAILEY (PERS. OBS.) from wintertime in Florida. He observed *Chamaeleo calyptratus* descending to the ground and burying themselves at the base of tree trunks in dead leaves and soil.

EKHARDT & AL. (2017) relativized the fantastically presented data of KARSTEN & AL. (2008) clearly demonstrating that the extinction does not necessarily take place in other localities the same way. If exposed to less harsh conditions, the animals live in the wild substantially longer.

Same is true for the Yemen Chameleon. While even FRITZ & SCHÜTTE (1986) found an old specimen that was older than one year, the experience with longevity of *Chamaeleo calyptratus* from captivity shows they can live 14 years and possibly more.

Literature sources bring also longevity reports such as 12 years for *Trioceros melleri* (GRAY, 1865) (NECAS 1999; Tolley & Herrel 2016); for *Trioceros jacksonii* (BOULENGER, 1896) 8-10 years (DAVIDSON 2020) or 13 years (CHAMELEON FORUMS 2020A). TESSAAC & AL. (2017) used skeletochronology in museum specimens of

Calumma parsonii (CUVIER, 1824) and found the preserved animals were of maximum age of 8-10 years. It needs to be noted that the specimens were collected in the wild and euthanized and preserved for scientific purposes, so not necessarily dying, but in full strength. JENKINS & AL. (2011) estimates for the purpose of IUCN the longevity of *Calumma parsonii* in the wild to be 10-12 years, report about a captive specimen that died at age of 14 by incident (could live longer) and estimate the captive longevity maximum at 20 years. TOLLEY & HERREL (2016) handles the longevity field weakly with mentioning longevity of *Trioceros montium* 9yrs, and giving comments on dubious calculated longevity data in *Trioceros jacksonii* (6,6yrs for females and 2,2yrs for males) and *Trioceros hoehnelii* (4,5yrs) and skeletochronological investigation of *Furcifer pardalis* giving as longevity 1 year only.

Tab.1: Captive *Chamaeleo calyptratus*, 11 years old. Photo M. MAAS

CHAMAELEO CALYPTRATUS EXAMPLE

As an example of the most widespread species in captivity, *Chamaeleo calyptratus*, the sources give a very inconsistent picture. The Care-sheet deliver the following data: CHAMELEON FORUMS (2020b) 5-7 years, with the reasoning: this is how the chameleons live on average (ANONYMUS IN LITT.). MONGE (2020) gives 6-8yrs, THE REPTILIAN CO UK (ANONYMUS 2020) 4-8yrs; ZOOMED (ANONYMUS 2020) Males: 6-8 yrs, Females: 4-6 yrs. Only NECAS & STRAND (2018) and NECAS (2019) give much higher life expectancy: 14years. The inconsistency of this data is caused by the fact that a vast majority of chameleons die in captivity much sooner than they could, either because of accidents and diseases or (mainly) because of improper care. If cared for properly, they can exceed the highest given numbers: 16 was already reported (ANONYMUS from Germany, IN LITT.).

So, the Yemen Chameleons instead of living 3 to 5 years on average and if they reach seven we applaud, they can live up to 14 or even 16 years: PETR NECAS (PERS. OBS.) reports on 8 specimens exceeding the age of 12yrs, KISHAN PATEL (IN LITT.) from England recently reported on a male, which died at 14yrs.

CALUMMA PARSONII EXAMPLE

The life expectancy of the giant Parson's Chameleon is up to 20years by IUCN (JENKINS ET AL. 2011); O. PRONK (IN MEMORIAM, IN LITT.) reported about a male of *Calumma p. parsonii* from Ranomafana, the age of which was estimated at 30years minimum.

CHUCK GOCHNOUR/HEROIC CHAMELEONS (IN LITT.) is keeping an adult female of *Calumma p. parsonii* obtained as a subadult in 2006. The clutch was captive bred or hatched, imported to the United States, and sold by a well-known commercial chameleon breeder.

KENT MANCHEN (PERS. OBS.) owns a male that was purchased from the same clutch as CHUCK GOCHNOUR (IN LITT.). This animal has been kept outside in a large, well-planted terrarium year-round in Southern California, except in the most extreme cold conditions. He experiences seasonal changes in temperature, daylight length, and humidity levels. During the winter he assumes very dark colors, rarely moves, and refuses most prey items until Spring. At approximately 15 years old he actively courts females with head-bobbing displays and assumes offensive, territorial posturing when he sees rival males. He is approximately 24 inches in length and 525 grams currently.

Tab.2: Captive *Calumma p. parsonii*, 15 years old. Photo K. MANCHEN

HERPETOCULTURE RECORDS

Besides of the mentioned two species examples (above), herpetoculture is the only realistic source of longevity data for chameleons, as the calculation and skeletochronological methods as demonstrated by TOLLEY

& HERREL (2016) lead to hardly usable data and the literature is quite scarce in reliable records. The IUCN allows the specialists to estimate the longevity, which is sometimes based on data, sometimes on the imagination of the authors. The data presented here were compiled from private sources and double-checked as far as possible. Even if the reliability of some could be questioned, in general, they show a clear pattern: the chameleons can reach in captivity under controlled environment age, that exceed the longevity records from the wild in general and exceed the average mentioned and believed lifespan data while multiplying it by 2, sometimes more. It is absolutely obvious, that chameleons are not to be labeled as short-living lizards, as they reach longevities that are normal in other groups of lizards.

Species/subspecies	Sex	Yrs	Autor	Note
Bradypodion thamnobates	m	9	GERD FRITZSCHE	IN LITT.
Calumma globifer	m	15	MARIO JUNGMANN	IN LITT.
Calumma parsonii parsonii	m	15	JÜRGEN VAN OVERBEKE	IN LITT.
Calumma parsonii parsonii	m	30	OLAF PRONK	IN LITT.
Calumma parsonii parsonii	m	17	GRANT TAYLOR	IN LITT.
Calumma parsonii parsonii	m	10,5	CRAIG DURBIN	IN LITT.
Calumma parsonii parsonii	m	18	NICKY VIOLA	IN LITT.
Calumma parsonii parsonii	m	18	ARDI ABATE	IN VERB.
Calumma parsonii parsonii	m	15	KENT MANCHEN	PERS. OBS.
Calumma parsonii parsonii	f	15	RALF MOUTH	IN LITT.
Chamaeleo calyptratus	m	12	PETR NECAS	PERS. OBS.
Chamaeleo calyptratus	m	14	KISHAN PATEL	IN LITT.
Chamaeleo calyptratus	m	14	SABRINA CASH	IN LITT.
Chamaeleo calyptratus	m	8	TÄTII FELK	IN LITT.
Chamaeleo calyptratus	m	9	JUSTIN CONNORS	IN LITT.
Chamaeleo calyptratus	m	10	ALEX RO	IN LITT.
Chamaeleo calyptratus	m	11	MONYA MAAS	IN LITT.
Chamaeleo calyptratus	m	10	SUZANNE BLAD	IN LITT.
Chamaeleo senegalensis	m	8,5	NICOLAS PELEGRIN	IN LITT.
Furcifer lateralis	m	5	KATRIN PAWLIK	IN LITT.
Furcifer lateralis	m	6	JÜRGEN VAN OVERBEKE	IN LITT.
Furcifer pardalis	m	9,5	KATRIN PAWLIK	IN LITT.
Furcifer pardalis	m	12	PETER POWER	IN LITT.
Furcifer pardalis	m	8	LISA GIBBS	IN LITT.
Furcifer pardalis	m	8,5	KATHRIN RUDOLPH	IN LITT.
Furcifer pardalis	m	9	TJEU VAN LIN	IN LITT.
Furcifer pardalis	m	9	CRAIG DURBIN	IN LITT.
Furcifer pardalis	m	8,5	TYLENE DUNCAN	IN LITT.
Furcifer pardalis	m	8	KRISTINA GRACE RED	IN LITT.
Furcifer viridis	m	5,25	PHILIP-S. GEHRING	IN LITT.
Furcifer willsii	m	10	ARDI ABATE	IN VERB.
Kinyongia multituberculata	m	10	MARIO JUNGMANN	IN LITT.
Rhampholeon acuminatus	m	5,5	KATRIN PAWLIK	IN LITT.
Rieppeleon brevicaudatus	m	6	PETER DVORAK	IN LITT.
Rieppeleon brevicaudatus	m	5	JERRY DAVIS	IN LITT.
Trioceros deremensis	m	10	JÜRGEN VAN OVERBEKE	IN LITT.
Trioceros deremensis	m	9	BILL STRAND	IN LITT.
Trioceros deremensis	m	10,5	TYLENE DUNCAN	IN LITT.
Trioceros deremensis	m	11	MARIO JUNGMANN	IN LITT.
Trioceros j. jacksonii	m	7	CRAIG DURBIN	IN LITT.
Trioceros j. xantholophus	m	10	CRAIG DURBIN	IN LITT.
Trioceros j. xantholophus	m	15	SEBASTIAN HEINECKE	IN LITT.
Trioceros j. xantholophus	m	12	MARIO JUNGMANN	IN LITT.
Trioceros melleri	f	10	JOAN GENTILE	IN LITT.
Trioceros melleri	m	9	JÜRGEN VAN OVERBEKE	IN LITT.
Trioceros pfefferi	m	6	JÜRGEN VAN OVERBEKE	IN LITT.
Trioceros q. gracilior	f	6	JANE ANNE JEANPIERRE	IN LITT.
Trioceros q. quadricornis	m	7	JÜRGEN VAN OVERBEKE	IN LITT.
Trioceros q. quadricornis	f	5	JÜRGEN VAN OVERBEKE	IN LITT.
Trioceros q. quadricornis	m	8	TYLENE DUNCAN	IN LITT.
Trioceros werneri	m	9	PETR NECAS	PERS. OBS.

Tab.3: Overview of captive longevity records and sources

REASONS FOR SHORTER LIFESPAN IN THE WILD

In the nature, the chameleons might live quite short lives, because they die due to their interactions with the following factors:

- weather, climate (esp. harsh conditions of the winter-time and/or dry season),
- predation (mainly by birds, big lizards, snakes, carnivores, monkeys, big insects such as mantis in juvenile age),
- diseases and parasite infestations (especially in combination with some discomfort),
- habitat loss and environmental pollution as result of human activities (urbanization, deforestation, agricultural use of land, climate change).

Nothing like that is necessary in captivity, where we can control most of these factors.

REASONS FOR SHORTER LIFESPAN IN CAPTIVITY

The short life of chameleons in captivity is not due to their normal life expectancy but because of improper care practice, very often executed based on recommendations by many of the above mentioned free internet sources:

- too high temperatures
- food containing too much phosphorus (e.g. locusts and *Zophobas morio* larvae)
- food containing too much of uric acid (high-protein-diet-fed roaches)
- lack of proper supplementation - refusal of feeding pollen as a natural part of the diet
- reverting the humidity cycles from the natural cold and moist nights and dry and warm days into hot and moist days and dry and warm nights,
- absence of natural fogging/inadequate hydration
- use of poisonous and dangerous fake plants instead of living ones.

All of these are the main reasons for tremendous shortening of the lives of chameleons in captivity.

Tab.4: Captive *Kinyongia multituberculata*, 10 years old in care of MARIO JUNGMANN. Photo P. NEČAS

Tab.5: Captive *Calumma p. parsonii*, 15 years old. Photo K. MANCHEN (upper male) and C. GOCHNOUR (lower female)

LONG LIFE IN CAPTIVITY

There are two basic approaches on how to keep chameleons alive for long lifespans:

1. **Outdoor caging**: chameleons can be very successfully kept in climates similar to their home country if kept fully or partly outside. The slight differences of the climates are to be compensated. Often, as such territories, regions like Florida, California,
2. **Indoor caging**: if kept indoors, principles of the naturalistic approach defined by JOHN COURTENEY-SMITH (2018) "Wild Re-Creation" are to be applied.

If the husbandry is done respecting the real needs of the animals, only in *Furcifer pardalis* and *Chamaeleo calyptratus* were observed long-term (one to two years prior to death) aging effects, like immobility, inability to feed, lowered skin elasticity, loose eyelids, warty scales on the cranial crests, loss of weight. In all others, the animals die in principle due to injury or disease or the process of aging is evident for about a month before the actual death only. The phenomenon of "sudden death", often mentioned by breeders, is usually either due to long–term unrecognized disease, malnutrition, wrong supplementation, lack of UV insolation, wrong caging and parasitic infestation, applicable mainly in wild-caught specimens (J. CONNORS, IN LITT.; M. JUNGMANN IN LITT.; P. NECAS PERS. OBS.).

What we really hope, is that, when buying a chameleon, people begin to realize that this is not a novelty, but a long-term commitment.

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Tab.6: Captive *Calumma p. parsonii*, male, 15 years old. Photo K. MANCHEN

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Fluorescence predicts survival of chameleon eggs

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Key words: Chameleons, *Furcifer pardalis*, captive, eggs, fluorescence, UV examination, fertility

Fluorescence is the emission of light by a substance, which has absorbed an electromagnetic radiation (incl. light). It has been reported from many organisms such as fungi, plants, invertebrates and vertebrates. These organisms utilize proteins, pigments, chitin, lymph and gland secretion for this purpose. The evolution and function of fluorescence is yet little known but basically can be divided in physiological use (e.g. for photosynthesis, photo protection, prey attraction) and communication (e.g. sex and species recognition). In chameleons, the fluorescence has been described just recently and it is hypothesized, they use it for sex- and species recognition. (Prötzel et al. 2018)

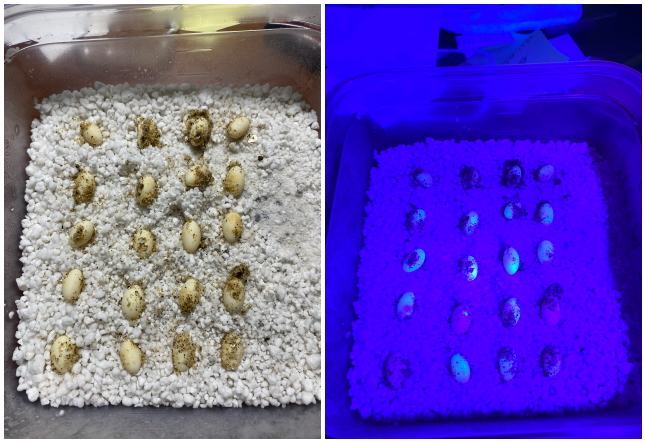

Fig.1: Fluorescence in *Furcifer pardalis* eggs infested with fungus
Photo: ADAM GREENBERG

UV light can be one of the electromagnetic radiation, causing immediate response in fluorescence. It has been used biologists for search for scorpions in the wild (YOND 2011) and dermatologists to detect fungus on human skin (ELSTON 2001).

Fungal infection of reptile eggs is a major cause of loss of embryos and is proven to be a consequence of eggs being infertile (MOREIRA & BARATA 2005).

UV light was tried on captive *Furcifer pardalis* (CUVIER 1826) eggs. Five separate clutches of this species were laid and incubated at room temperature (74° to 76°F / 23° to 24°C), and under exactly the same conditions on water saturated perlite in a snap lid plastic container. UV examination was carried out with UV flashlight (WINDFIRE Underwater UV Light 10W 395nm 3 X Cree LED Diving UV Ultra Violet Scuba Diving Blacklight Flashight Torch with Magnetic Control 100m Waterproof Lamp Light) intended to see the possible reaction. In every case where all eggs fluoresced they became visibly infested by fungi within 4 weeks, then shriveled and died.

Early detection should enable anti fungal treatment early in some cases and allocation of resources to viable eggs in others, aiding breeders in husbandry. It isn't clear whether this may apply to eggs of all kinds.

CONCLUSIONS: UV offers very early detection of fungal infection and viability of chameleon eggs. This should help breeders either treat fungus or identify bad batches of eggs early so the keeper/breeder can allocate resources early.

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Fig.2: Fluorescence in *Heterometrus laoticus* COUZIJN, 1981. Photo PETR NEČAS

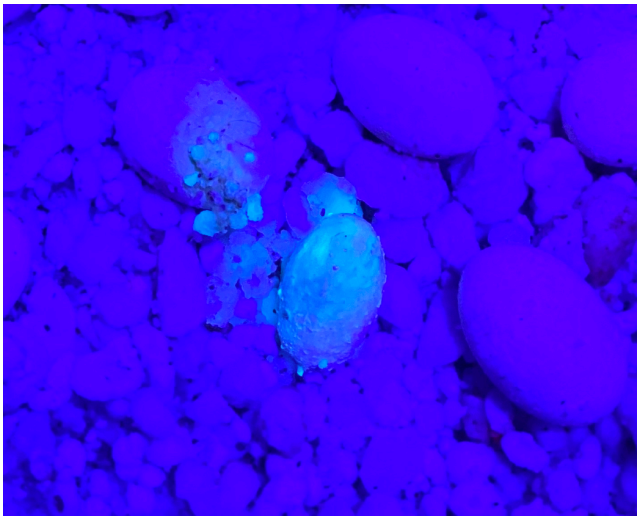

Fig.3: Fluorescence in *Furcifer pardalis* eggs infested with fungus Photo: ADAM GREENBERG

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A Panther Chameleon, *Furcifer pardalis* (CUVIER, 1826) (Reptilia: Chamaeleonidae) with eyes on the roof of mouth cavity

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Key words: Chameleons, *Furcifer pardalis*, captive, mutation, macromutation, eyes in mouth

Mutations happen in the nature on regular basis, they are obviously one of the engines of evolution. About most, we never get to know, as they disappear as unviable or indifferent. Only some come to expression. Some happen at the molecular level in the DNA and express in a modification of enzymes, but some, called macromutations, are visible as macroscopic modifications of organs or parts of the body. Macromutations are known for example as deformities of wings and heads in the flies of the genus *Drosophila* FALLÉN, 1823 (ANONYMUS 2020) or as polydactylia in domestic cats (LANGE & AL. 2013).

From the mutations a big part happens naturally, but many are induced by human influence, especially by pollution or through special (unethical) practices such as inbreeding. In chameleons, this phenomenon was recently well documented by NECAS & DVORAK (2020) on the case of *Chamaleo calyptratus* DUMÉRIL & DUMÉRIL, 1851. In some cases, we know exactly the reason for the mutation and the principles, how the mutagenous factors work, in many, we have still no clue, especially in those, which are extremely rare.

The subject of this short communication is a unique and sensational case of a macromutation, which has never been observed neither in chameleons, nor in reptiles and which is the second historical record of such mutation in all vertebrates. The observation is presented and commented further.

On 24th April 2019, a captive female of *Furcifer pardalis* deposited 19 eggs in the breeding facilities of the first author. Within a week, 16 of them appeared to be infertile and then disposed. Only two eggs remained developing after seven month; at that then they were due to hatch (NECAS, 1999). On 17th April 2020, almost one year after the egg was laid, it shrank significantly, as is typical for eggs to hatch, but it was not cut. The egg was opened and inside, a dead mutant juvenile was found, with deformed head, with eyes positioned on the roof of the mouth cavity, directed both forward, watching out of the opened mouth. The eyes were partly fused, as were the eyelid turrets, leaving one opening for both eyes open. The pupils were two, each on the own, medially fused eyeballs. SO, this case also represents the first case of (incomplete) cyclopia in chameleons.

Fig.1: Mutant of *Furcifer pardalis* with eyes on the roof of mouth cavity. Photo MAXIM SAVONCHIK

Historically, only one similar case is known of eyes developing on the roof of the mouth cavity: a case of *Anaxyrus hemiophrys* (COPE, 1886), which was found alive (DAWKINS 2006; CREW 2014). The reason for it has never been found.

Fig.2: Mutant of *Furcifer pardalis* with eyes on the roof of mouth cavity. Photo MAXIM SAVONCHIK

Same in the case of our chameleon with eyes in the mouth; it is hard to speculate about the reasons of this phenomenon, as neither parasitic infections (captive animal), nor inbreeding (few generations in captivity only), nor any evident chemical pollution has been noted. The only feasible speculation can be, that very likely, the clutch was a result of s.c. *amphigonia retardata* (TOLLEY & HERREL 2014), when stored sperm in oviducts is used to fertilize the next clutch. The level of fertilizing was very low, as only three eggs were developing after one week post deposition, so the quality of the stored sperm could potentially be the reason.

Пантеровый хамелеон, *Furcifer pardalis* (CUVIER, 1826) (Reptilia: Chamaeleonidae), с глазами на небе полости рта

МАКСИМ САВОНЧИК & ПЕТР НЕЧАС

Мутации происходят в природе регулярно. Очевидно что они являются одним из двигателей эволюции. О большинстве из них мы никогда не узнаем, так как они исчезают как нежизнеспособные или непроявляющиеся. Только некоторые проявляются заметным способом. Одни из мутаций происходят на молекулярном уровне в ДНК и проявляются в модификации ферментов, другие, называемые макромутациями, видны как макроскопические модификации органов или частей тела. Макромутации известны, напри-мер, как деформации крыльев и голов у мух рода *Drosophila* FALLÉN, 1823 (ANONYMUS 2020) или как полидактилия у домашних кошек (LANGE & AL. 2013).

Большая часть мутаций происходит естественным путем, но многие вызваны влиянием человека, особенно таким как загрязнение окружающей среды или особым (неэтичными) методом размножения в неволе - инбридингом. У хамелеонов это явление было задокументировано в статье NECAS & DVORAK (2020) на примере Йеменского Хамелеона, *Chamaleo calyptratus* DUMÉRIL & DUMÉRIL, 1851. В некоторых случаях мы точно знаем причину мутации и принципы, как работают мутагенные факторы, но в других, особенно встречающихся крайне редко мутациях, причины науке неизвестны.

Предмет этого сообщения - уникальный и сенсационный случай макромутации, которая никогда не наблюдалась ни у хамелеонов, ни у рептилий, и которая является вторым историческим отчетом о такой мутации у всех позвоночных. Наблюдение представлено и прокомментировано далее.

24 апреля 2019 года самка *Furcifer pardalis* в неволе депонировала 19 яиц в питомнике первого автора. В течение недели 16 из них оказались бесплодными. Только два яйца развивались в течении семи месяцев,

после чего они должны были вылупиться (NECAS, 1999). 17 апреля 2020 года, почти через год после того, как яйцо было отложено, последнее оставшееся яйцо значительно сдулось, что характерно для вылупливающегося яйца, но оно не было разрезано. Яйцо было вскрыто, и внутри был найден мертвый мутант с деформированной головой, с глазами, расположенными на небе полости рта, направленными вперед, смотрящими из открытой пасти. Глаза были частично слиты, как и веки, оставляя одно отверстие для обоих глаз. Зрачков было двое, по одному на каждом глазном яблоке, которые были медиально сросшимися. Итак, этот случай также представляет собой первый исторический случай (неполной) циклопии у хамелеонов.

Исторически известен только один подобный случай мутации глаз, развивающихся на небе полости рта: *Anaxyrus hemiophrys* (COPE, 1886), который был найден живым (DAWKINS 2006; CREW 2014). Причина явления не была выяснена.

В описанном нами случае Хамелеона с глазами в пасти, так же трудно предположить причины мутиции. Ни паразитарных инфекций (животное в неволе), ни инбридинга (только несколько поколений в неволе), ни какого-либо явного воздействия химического загрязнения не отмечено. Мы предполагаем что весьма вероятно кладка яиц была результатом так называемой *amphigonia retardata* (TOLLEY & HERREL 2014), при хранении сперматозоидов в яйцеводах для оплодотворения следующей кладки. Уровень оплодотврения был очень низким, так как только три яйца из 19ти развивались через неделю после их отложения, поэтому потенциальной причиной могло быть качество сохраненной спермы.

Фиг.1,2,3: Мутант пантерового хамелеона с глазами на небе полости рта, Фото МАКСИМ САВОНЧИК

Fig.3: Mutant of *Furcifer pardalis* with eyes on the roof of mouth cavity. Photo MAXIM SAVONCHIK

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The Language of Chameleons: how the animals, which cannot talk and do not hear, communicate

The Horns

PETR NEČAS,
with illustrations of **ANASTASIIA SHIRIAEVA** and photos of **PETR NEČAS**

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Note: this text is an example from the book dealing exactly with this topic, this is just a sample

HORNS

USE YOUR HORNS FOR SPECIES RECOGNITION, THEN AS WEAPONS!

The horns are bony structures on the heads of some chameleon species, specifically and mainly developed in males. Females usually don't have horns or their horns are in reduced form. Male's horns divide into the true horns, which have a bony base and are covered with one thin layer of keratin, which represents one extremely enlarged cranial scale, and the false horns, which are covered with enlarged plate-like or spiky scales. The primary function of horns serves to a process called character displacement, with which, thanks to different head ornamentation (including horns), the males can demonstrate their belonging or not-belonging to the same species as the female, that is the subject of interest. The secondary function of horns is that they serve as "weapons" in combats of two rival males, who form territories, which they protect and try to be the only male in (or at least in it's visible part). Once two males with horns meet, they tend to start a fight using the horns to attempt to push the weaker male from the branch to fall down and escape the territory. As a rule, they don't harm each other. It is more a ritual fight. Bigger horns allow more leverage power and are therefore be considered stronger and better, so bigger horned males are usually more successful in defending their territory and consequently in mating the females that are approached by them. Tertiary, they can be used as "weapons" to threaten predators too.

Trioceros jacksonii xantholophus, male, Chogoria, Kenya
Photo PETR NEČAS

Two Jackson's Three-Horned Chameleon (*Trioceros jacksonii*) are about to fight on a branch.

Bigger Horns: "Hey, you! Please consider not fighting with me. Look, how big my horns are, you have no chance to win the fight! I will kick you down from the branch and you will fall and hurt yourself."

Smaller Horns: (Exposing his side to the bigger one) "Let me try! My horns are shorter but I'm younger and maybe more powerful than you! So let's compete and see who will be the winner."

Bigger Horns: (The BH approaches the small one and hooks his horns into the horns of the smaller male.) "Ok, let's fight! I will show you how powerful I am!"

Smaller Horns: (hiding below the branch) "Hey, ok. I can see that I have no chance. Please, let me go!"

The Horns, Drawing ANASTASIIA SHIRIAEVA