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Panther Chameleon Challenges in Chameleonoculture: an integrative approach: wild – trade – captive propagation

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INTRODUCTION

Panther Chameleons – *Furcifer pardalis* (CUVIER, 1829) are very popular in herpetoculture for many decades. It is thanks to their relatively big size (some forms easily exceed 50cm total length and weight of 200g) and stunning variability of colors and patterns they create on their bodies, especially in adult males (NEČAS 1999). Many specimens have been imported. Yearly, thousands of CITES quotas (CITES 2020) for this species are allowed to be exported out of Madagascar. Despite of the fact, that *Furcifer pardalis* is relatively well established in the breeding programs across the US and Europe, the breeding success, if measured in relation to the huge numbers of exported animals is still miserable.

Though many attempts of illegal introduction in the habitats of Florida have been made and many animals either were released as unwanted pet or escaped from captivity there, there are only incidental reports about their finds in Florida and reports about breeding feral populations are scarce so far. Yet, especially in last year, several breeding populations have been discovered, counting thousands of specimens (M. MAUGERI, IN LITT.; see NEČAS 2020).

The breeders face lots of problems and unexpected issues arise, such as:

- No interest of males to mate
- Dystocia in females
- Low hatch rate
- Low growth rate
- High growth rate
- Weak hatchlings
- High mortality
- Problems of reproduction in further filial generations in captivity
- Infertile male-like females
- Malformations, etc.

There is a big question: “Why is that?” Some of the most important reasons are discussed in the following text, which is based on my own wild and captive observations and the information from many colleagues (PETR NEČAS, PERS. OBS. from FACEBOOK groups “LIFE WITH CHAMELEONS”, “CHAMELEON CULTURE CLUB”, CHAMELEONS GONE WILD”; CHAMELEON FORUMS; J. HOLLERAN, D. GORDINHO, L. GIBBS, M. MAUGERI, J. DUBAY, S. GOMEZ, S. PROPKOPIEV, M. UHER, I. NOSALOVA, L. NICKELSON, IN LITT.)

WILD AND CAPTIVE OBSERVATIONS

DIFFERENT ORIGIN OF MALE & FEMALE BREEDERS

Due to the fact, females of the individual populations are indistinguishable from each other, there is never a proof of the origin of the females and actually also of males. They can be mixed intentionally or by mistake or by ignorance:

- at the site of collection,



Fig 1. A male *Furcifer pardalis* from Ambilobe, Madagascar;
Photo PETR NEČAS

- during the transport,
- in the facilities of the exporter,
- in the facilities of the importer,
- and possibly elsewhere.

Anonymous exporters confirmed repeatedly, they have no way to control where the females are collected and whether they really belong to the males (O. PRONK, IN MEMORIAM, IN LITT.).

Moreover, exporters' interest is to catch wild animals and sell them to the customers. It is directly against their interest, when people establish good breeding lines in captivity. Because then, imports will be not needed any more... So, intentional mixing of males and females from different locations happens too.

In captivity, sometimes erroneous origin of the animals is given just because lack of data or by mixing real info, belief or hope; seeking high profit, sometimes the origin is faked intentionally.



Fig 2. A subcutaneous filariasis in female *Furcifer pardalis* from Ambilobe, Madagascar; Photo PETR NEČAS

PANTHER CHAMELEON IS NOT ONE SPECIES

Recent genetic studies have revealed an extreme complexity of the "Superspecies *F. pardalis*". As many as 4-11 separate evolutionary lineages with genetic distance equal to subspecies or even species status are contained in

the genome of this entity (GRBIC & AL. 2015). So, obviously, some cross-breeds might be quite vital (if from very closely related evolutionary lineages) but some, due to genetic distance and limited genetic compatibility may end up to be weak or unable to hatch, grow and/or reproduce.

THE BIOLOGY IN THE WILD IS WEAKLY KNOWN

Despite of the easy accessibility, only few people really pay a visit to the areas where Panther Chameleons live naturally. And lots of people rely on captivity reports from

the heavily modified environment rather than on observations in the home country, ignoring that namely our deep knowledge on the life history in the wild is the only real key to proper and successful husbandry in captivity.

The situation is moreover heavily complicated by the fact, the areas where *Furcifer pardalis* live now, are almost all totally degraded and their original biotopes are replaced by cultural landscape. So, understanding their real needs, based on the secondary replaced landscape with modified climate and spatial structure, is very hard.

HIGH PARASITE INFESTATION IN WILD SPECIMEN

The wild caught specimens are often heavily infested by parasites. Parasites, under natural conditions, rarely tend to kill their host - it is against their interest to save their lives and care for next generations. However, the broken homeostasis during transport, quarantine and stress, connected with it, often conditions the parasite invasions to be lethal. Same applies for "prophylactic" or wrong amateur treatment of parasites like the wrong obligatory "de-worming" with chemicals of high toxicity and unwanted side effects.

TOO SMALL GENETIC POOL

In captivity, the breeding lines are often based on individual specimens only. A success of one breeding pair usually results in tens or even hundreds offsprings. They are then distributed and breed further... Sibling breeds to sibling; closely related animals amongst themselves. This results in (sometimes unintentional or ignored) inbreeding with all its ill-effects.

INBREEDING

Trying to fix a desired trait or feature in a breeding line, breeders often do ruthless inbreeding justifying it with their commercial interests and often ignoring and hiding deliberately the negative effects of it. The result, however, is an exponentially decreasing heterozygosity, fixing genetic diseases and degrading of the genetic variability within the inbreeding lines. In another chameleon species, bred often in captivity – *Chamaeleo calyptratus* DUMÉRIL & DUMÉRIL, 1851 – the genetics in captivity is so deteriorated, that some breeding lines became already extinct, due to inability to reproduce further or due to producing a high portion of malformations (NEČAS & DVORAK, IN PREP.).

CROSSBREEDING

In seeking "designer" phenotypes, some breeders intentionally crossbreed animals of different origin to produce hybrids of absolutely not identifiable genotype and anyway unstable phenotype. Sometimes, cross-

breeding is result of lack of any information of the origin of the animal, as it is only a guess in the case of males, based on their external morphology, which can be misleading. Females can virtually not be allocated to any local population based on appearance. Sometimes, cross-breeding happens due to lack of breeding stock. Starting second generation in crossbreeding, there is no way how to know what is the composition of the genome, due to free recombination of the genes. Therefore, such hybrid breeding lines are absolutely worthless, as they represent an entity of unknown genetic composition, moreover, not equal to any genetics in the wild. Building good breeding lines from hybrids (which is often the layman intention of breeders) is illusory and the created genetic mess is often accompanied by weak or dying offspring as the result.

PHENOTYPE IDENTIFICATION AS A RULE

Due to unknown origin, breeders in captivity tend to judge the assignment to individual populations based on phenotype and outer appearance. The variability of many populations is immense, and it is not known in general (see NECAS 2020; MADCHAM 2020). For example, in the Panther Chameleon populations from Nosy Be, you can find individuals resembling typical phenotypes of Nosy Komba, Ankify, Ambanja, Nosy Mitsio, Nosy Faly (P. NECAS, PERS. OBS.). Therefore, many breeding lines get polluted by animals from different locations only due to their superficial similarity, not based on guaranteed origin. Moreover, selective breeding of special traits in captivity (sometimes combined with crossbreeding for the desired “design”) modifies the breeding line in several generations in such an extent, that they do not resemble the wild phenotype any more. This is the case e.g. of the population from Nosy Faly. These animals are very attractive in their appearance by light blue basic coloration with high content of white and the s.c. “red rain” consisting of dark red dots scattered on the head and body. As a rule, in the wild, they are colored much less conspicuously. Due to small population density, the local catchers decided to support the Nosy Faly population with new blood and released there several dozens of females from Nosy Be and Ambanja populations, thus polluting the genetics of this little island for ever (O. PRONK, IN MEMORIAM, IN LITT.). The population of Ankify is also an example of wrong identification. Most of nowadays in the US offered “true Ankify” are inn fact “orange headed specimens with blue-bars” from Ambanja. Just for the seek of selling this rare color variety expensive, the information is deliberately faked and animals are labeled as “Ankify”. Another example is the population of Tamatave, where specially almost purely red and white males were selected for breeding leaving the public to believe this is the typical appearance of the local form, which in fact is much more green and less contrast in the coloration in the case of most of the males. All this leads to bad effects of crossbreeding, inbreeding, line breeding and genetic pollution.

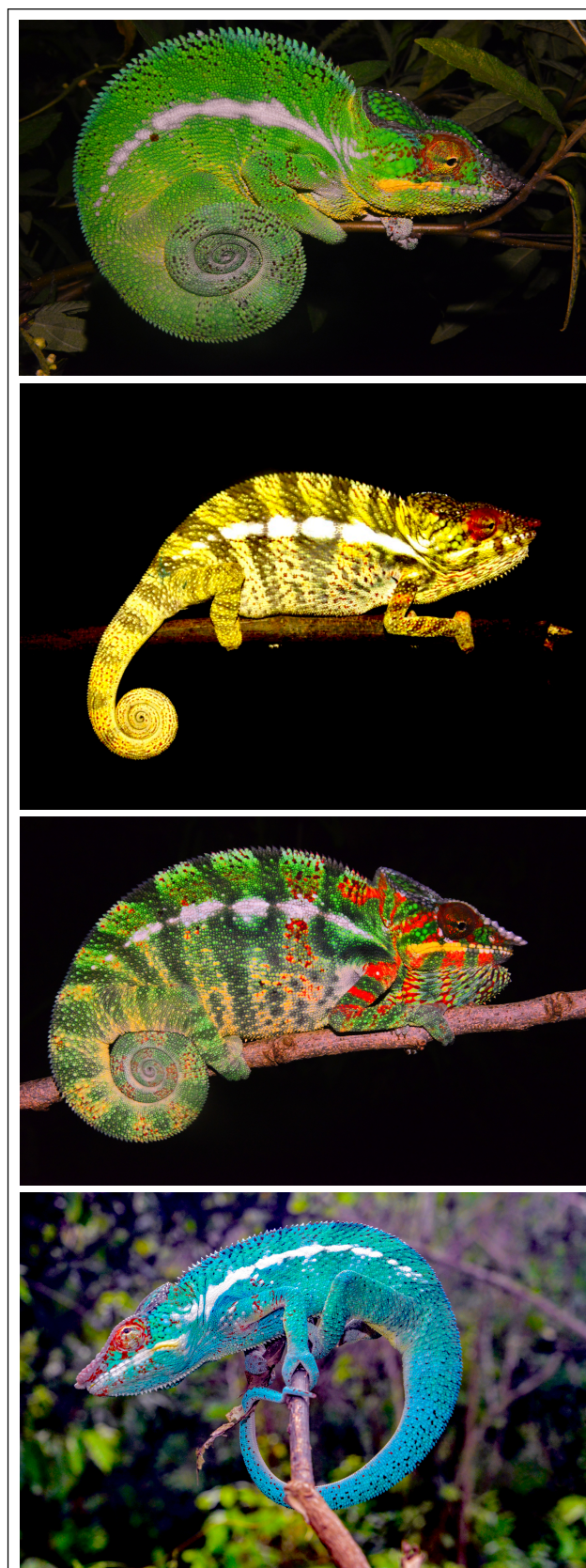


Fig 3. Variability in males of *Furcifer pardalis* from Nosy Be island, Madagascar; Photo PETR NECAS

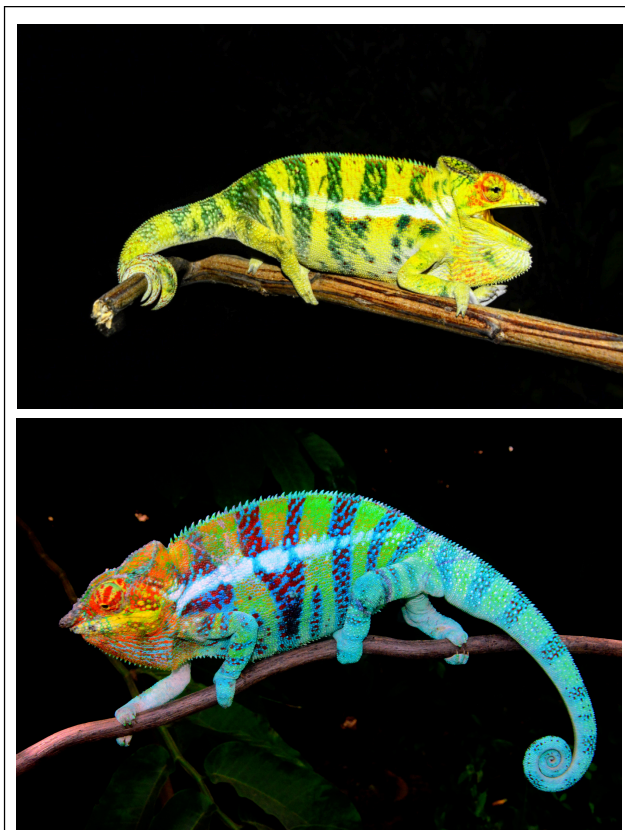


Fig 4. Males of *Furcifer pardalis* from Ankify (upper) and Ambanja (lower), Madagascar; Photo PETR NEČAS

GLOBAL AND LOCAL WARMING

Heavy to total deforestation (especially in the last 120 years) together with heavy agriculture modification of the landscape and global warming increases the temperature of the environment. This can have a destructive effect on many natural processes.

The incubation of the eggs happens at higher, not natural temperatures, it is therefore shorter and the young are forced to hatch much sooner than they would normally do: in the dry season instead of in the rainy season. This modifies their survival strategies and has influence on natural selection.

Higher temperature challenges the thermal comfort of the animals, they have to survive much higher temperatures, their metabolism speeds up, food intake necessarily rises or if not enough food available, leads to starvation and death.

Higher temperatures negatively influence spermatogenesis, and the hormonal processes tied to it, especially the onset of breeding season. Overheated males can easily become sterile or do not show interest in mating, or their sperm can be of low quality. All are indications, we have from captive breeding programs.

The warming can cause together with high UV exposure an increased frequency of mutations.

POLLUTION

Chemical pollution due to extensive agriculture and usage of fertilizers and pesticides and urban pollutants can also cause mutations and intoxications. As a paradox, one of the strongest populations of *Furcifer pardalis* on Nosy Be is around the municipal garbage place. The garbage attracts a great number of flying insects, which feed on it, and get polluted with chemicals, detergents, smoke from burning plastics etc. There is no possibility that this does not influence the health of the chameleons, feeding on insects from this area. Exactly this area, is paradoxically, the target area for local chameleon catchers, because it is the easiest place where to find the most chameleons in short period of time.

WRONG INCUBATION

Lack of the knowledge about the nutrition of the females leads often to weak eggs. Too deep and loose substrate to dig leads to exhaustion of females and dystocia. And, wrong incubation of eggs (especially unnatural humidity and temperature cycles) leads to low hatch rates, weak babies and problems with their vitality, growth, sex and development. Breeders often either experiment with the incubation temperatures and then blindly follow receipts of the more experienced colleagues, or they try to simulate the temperatures of the region, where the chameleons live. The data are however almost missing and if present, then from the urban areas, where the temperatures can be substantially different from where the eggs are laid.

HUGE RANGE

The problem of the Panther Chameleons is, that they occupy regions from sea level to over 1.000m a.s.l. and

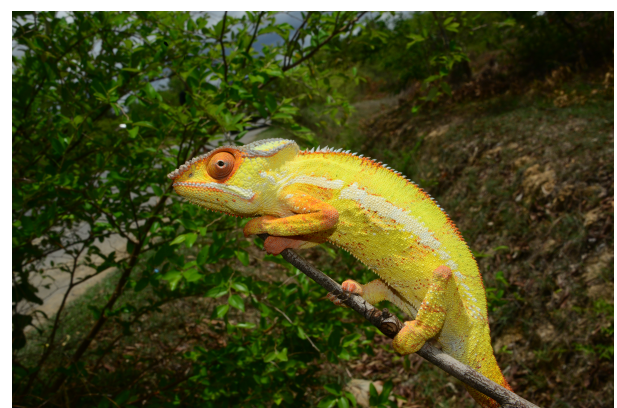


Fig 5. An overheated and dehydrated male of *Furcifer pardalis* from Ambilobe, Madagascar; Photo PETR NEČAS

live both on the extreme northern tip of Madagascar at Antsiranana (Diego Suarez), just 12 degrees under Equator, but reach 650km as far south as Toamasina (Tamatave), 18 degrees under Equator. The temperatures at night can therefore range e.g. from 27°C in the north at sea level to freezing point in the south at Andasibe (Périnet) at almost 1.000m a.s.l.



Fig 6. Female of *Furcifer pardalis* from Nosy Be, Madagascar; with a skin mutation: partial albinism. Photo PETR NEČAS

CLIMATIC CYCLES

The climate within the huge range of *Furcifer pardalis* is not stable but undergoes heavy seasonal changes and volatility. It is a big difference how the climate feels in the wintertime and in the summer; and, in the rainy monsoon season and in the dry season. All seasons differ from region to region and in dependence from the altitude substantially.

REVERSE CLIMATIC CYCLES IN CAPTIVITY

The vast majority of captive *Furcifer pardalis* live on the northern hemisphere, while their home country, Madagascar, lies in the southern hemisphere. The respective climatic cycles are therefore reversed, same as is the length of the day. The adaptation to these conditions is also an issue in captivity, especially in the case of wild caught specimens kept outdoors, e.g. in Florida and California, (Northern America, USA), or in Southern Europe such as France and Spain.

TRANSGENDER SPECIMENS

The appearance of male-like females, not able to reproduce has been reported in the captivity. And, up to 50% of the females in some wild populations are male-like, probably due to increased substrate temperature and modifications of the environment resulting in hormonal disbalance of the embryos and young specimens and conse-

quent developmental aberrations and deformities.

GENETIC MUTATIONS

Modifications of the environmental factors, extensive agriculture with mutagenous pesticides and other chemicals, exhalations etc. lead to mutations in the wild and same way also in the captivity. This all leads to pollution of the genome, not always visible in the phenotype, but having influence on their development and behavior, and increasing their mortality. The first partially albinotic *Furcifer pardalis* has been found in Nosy Be in November 2019 (P. NECAS, PERS. OBS.), the second has been reported by MIKE MAUGERI (IN LITT.) from a feral population in Florida.

MISINFORMATION

The period we live in, is typical with searching for the information in internet and on forums rather than in peer-reviewed periodicals and books. As a result, lots of wrong information is spread due to lack of quality control, writings of incompetent authors, hiding info or spreading intentional lies for securing the commercial interests.



Fig 7. A male-like infertile female of *Furcifer pardalis* from Ambanja, Madagascar; Photo PETR NEČAS

CONCLUSIONS

All this and even more, we are facing now. We desperately need to find answers to the question: "What can be the solution?"

The solution is to address as many of the negative phenomena as much as possible.

It means in concrete:

- To use correct life history data derived from the wild
- Secure a guaranteed origin of the breeding stock at the time of origin as well as during the whole breeding process

- Avoid inbreeding
- Avoid crossbreeding
- Secure a wide genetic base for building a genetically diverse breeding pool of individual populations
- Providing correct and up-to date information based on science and real wild observations and measurements
- Produce parasite- and illness-free filial generations and endorse their isolation from the sources of infection
- Provide information and education of keepers and breeders on all aspects of the proper husbandry to secure correct captive management
- Provide proper caging and captive management based on naturalistic approach simulating all vital factors and eliminating lethal ones.

All this and even more, is the aim of a special project of BION, that I have the honor to take part in and supervise.

A field expedition to the range of four local forms of *Furcifer pardalis* was conducted: Nosy Be, Ambanja, Ambilobe, and Ankaramy. Measurements and detailed field studies comprising tenths to hundreds of individuals were conducted that will be base of scientific papers and publications at one side and captive management setup of in the BION's facilities at the second.

From the four local forms, several tenths of individuals were selected individually and unmistakably marked and exported to the facilities of BION where they receive proper naturalistic care. I have been able to personally inspect each single individual and exclude all malformations, sterile females and diseases.

Each single individual is registered in a pedigree system and it will be kept for all individuals in the breeding program of BION as well as for all in the future obtaining breeding material from these breeding lines to ensure genomic purity and prevent inbreeding and crossbreeding.

Full info about the results of field studies will be shared with the community and made available on specialized sites, forums and shared with exclusively all buyers. This way, we will ensure the genome quality on such level, that it will potentially be available for reintroduction programs if necessary.

Doing this, the chameleonoculture community will obtain a new function in genomic preservation, in which breeders will be able to contribute to, as a part of a global network.

This all will bring solutions to the above mentioned problems and will secure a future oriented breeding program worldwide, in the frames of BION's project "Responsible Herpetoculture".

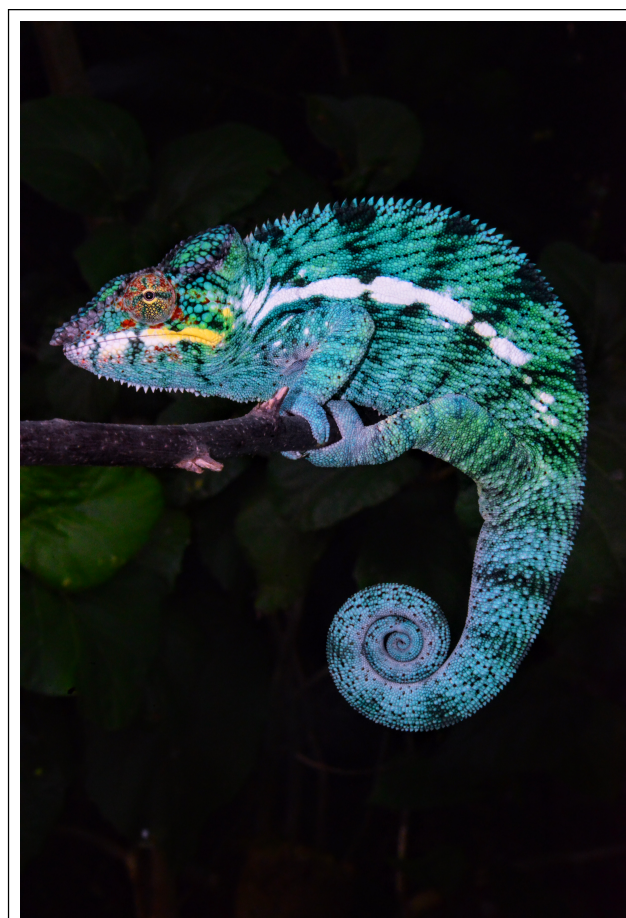


Fig 8. A male of *Furcifer pardalis* from Nosy Be island, Madagascar;
Photo PETR NEČAS

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