Studies on the *Furcifer angeli* chameleon for the purpose of reopening international trade in the species

EU-CITES Capacity-building project
No. S-422

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CITES Secretariat

About the EU-CITES Capacity-building project

The project *Strengthening CITES implementation capacity of developing countries to ensure sustainable wildlife management and non-detrimental trade* was approved for funding by the European Union in 2009.

A major challenge for many countries is the difficulty in meeting the requirements for trade in CITES-listed species, ranging from legal sourcing and sustainability requirements, to the effective control of legal trade and deterrence of illegal trade. Mechanisms exist in CITES and in both exporting and importing countries that promote and facilitate compliance – although Parties are often hampered by a lack of capacity or a lack of current biological or trade information with respect to certain species. This can result in levels of trade which are unsustainable, which in turn can impact on economic growth and local livelihoods, and reduce options and incentives for conserving and managing wild resources effectively.

The overall aim of EU's support is to strengthen capacities to implement the Convention and satisfy the CITES-related requirements of trading partners (such as the European Union), to prevent overexploitation and to ensure legal international trade in wild fauna and flora does not exceed sustainable levels.

This publication is one of the reports and tools developed under this project, which provide information and guidance to Parties in a particular area of concern based on needs identified by developing countries.

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FINAL REPORT

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Résumé

Furcifer angeli is found in dry forests in north-western Madagascar. Its export has been suspended by CITES since 1995. Field studies aimed at collecting information on its population size and conservation status have been conducted with a view to reopening international trade in the species. This information will be used to establish export quotas and issue non-detriment findings. The studies were carried out in Marosely in the Sofia Region and in Andranomiditra in the Boeny Region. The population density of *F. angeli* was estimated using the Distance Sampling method along forest transects and transect paths. According to a risk assessment, the vulnerability of the *F. angeli* species in relation to collection was medium. The field studies were conducted in April and May 2013. *F. angeli* was recorded only in Marosely with an average density of 4.6 individuals/ha, varying between 2.5 and 8.5 individuals/ha, and with a 95% confidence interval. The size of the population on this site was estimated at 1,500 individuals on the basis of the minimum density value of the confidence interval. Since the export quota proposed for this site is 150 individuals per year, collection in the Sofia Region is restricted. This quota is non-detrimental as it represents only 10% of the population on the collection site and only 0.06% of the population in the Sofia Region. A collection procedure is proposed in order to facilitate the monitoring of the impact of collection.

Contents

I. Context and objectives

Meeting trade demands in CITES species is a major challenge for many countries. Under its project aimed at strengthening the CITES implementation capacity of developing countries, the CITES Secretariat has allocated funding to the Madagascar CITES Management Authority in order to ensure sustainable wildlife management and non-detrimental export. Countries suspected of not fulfilling the CITES requirements may be subjected to a series of international sanctions, including trade suspension. *Furcifer angeli* is one of the species affected by this project.

The *Furcifer angeli* chameleon is found on a broad area of distribution in the west of Madagascar and is listed in the « Least Concern » category of the IUCN Red List of Threatened Species (IUCN, 2012). This species is abundant in primary forests, as well as in degraded habitats within and outside protected areas. It is relatively easy to identify on the basis of external morphological characteristics.

Trade in Angel's Chameleon was suspended in 1994. However, the suspension was lifted on the condition that Madagascar implement the six recommendations issued at the 58th meeting of the Standing Committee. Subsequently, Madagascar informed the Animals Committee at its 26th meeting of its intention to reopen international trade in *F. angeli.* However, in order for non-detriment findings to be issued, additional fieldwork demonstrating that such trade would not be detrimental to the survival of the species in the wild, is required.

The overall objective of this project is to establish a sustainable quota for *F. angeli* and to issue a non-detriment finding on the basis of field research aimed at collecting data to support a resumption of trade in this species.

Specific objectives are:

- To study the *F. angeli* population;
- To identify potential collection sites;
- To issue a non-detriment finding for this species;
- To establish a sustainable quota for *F. angeli*;
- To develop a fair system for the collection of *F. angeli* in the wild;
- To strengthen the capacity of the Management Authority of Madagascar to monitor export in *F. angeli.*

II. STUDY SITE

Owing to the virtual impossibility of counting *Furcifer angeli* on its entire area of distribution, research sites have had to be selected in order to be able to assess its national population size. As this research is conducted for commercial purposes, certain criteria have to be respected when choosing the sites. Firstly, the collection sites have to be located within the species' extent of occurrence, defined during the workshop on the IUCN status of reptiles of Madagascar in 2011. Secondly, they have to be located outside protected areas as collection in these areas is prohibited. In addition, the sites must be easily accessible to facilitate collection as such. Lastly, the sites must be properly managed to ensure that collection is monitored with a view to assessing its impact on the animal. Thus, Marosely, which is located in the Bongolava forest corridor, and Andranomiditra (Tsaramandroso), located close to but completely outside the Ankarafantsika National Park, have been selected for the assessment of the *Furcifer angeli* population in this study. The site at Marosely is managed by VOI (Vondron'Olona Ifotony) or the local community, while the Andranomiditra site is managed by the fonkotany with « voamieran'ny ala » who cooperate with park officers since the site is very close to the park.

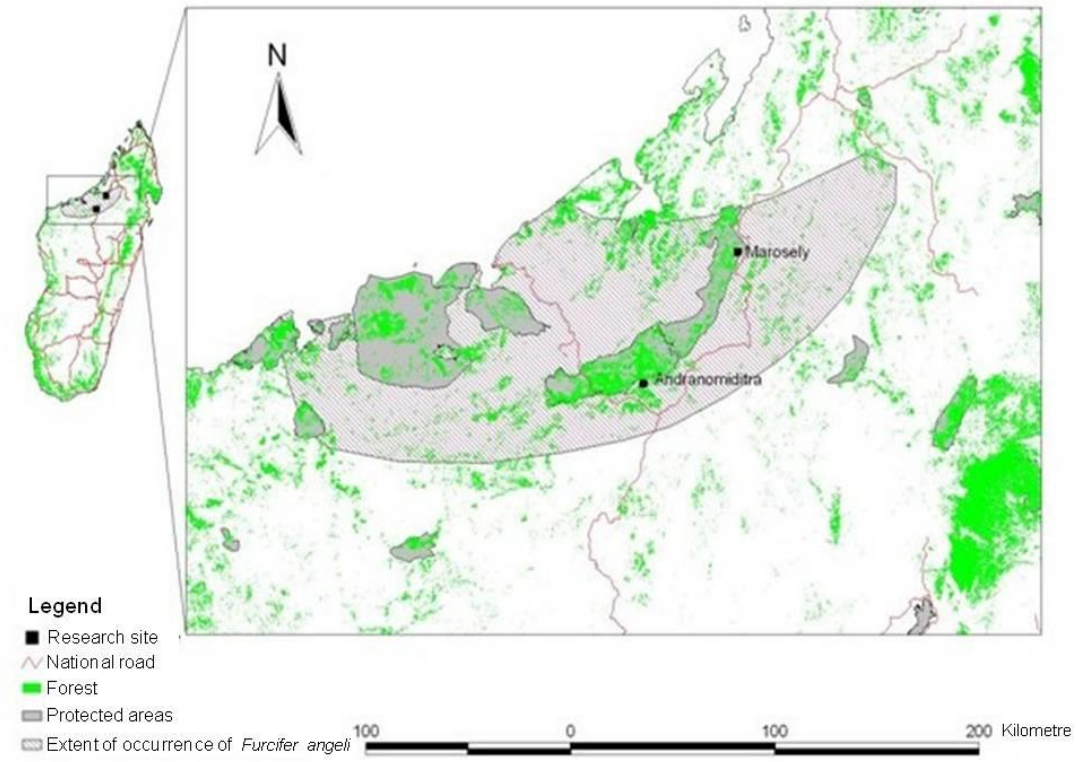
The field study was conducted from 20 April to 18 May 2013, a period during which chameleons are still active before going into hibernation.

Table 1. Geographic coordinates of the study sites.

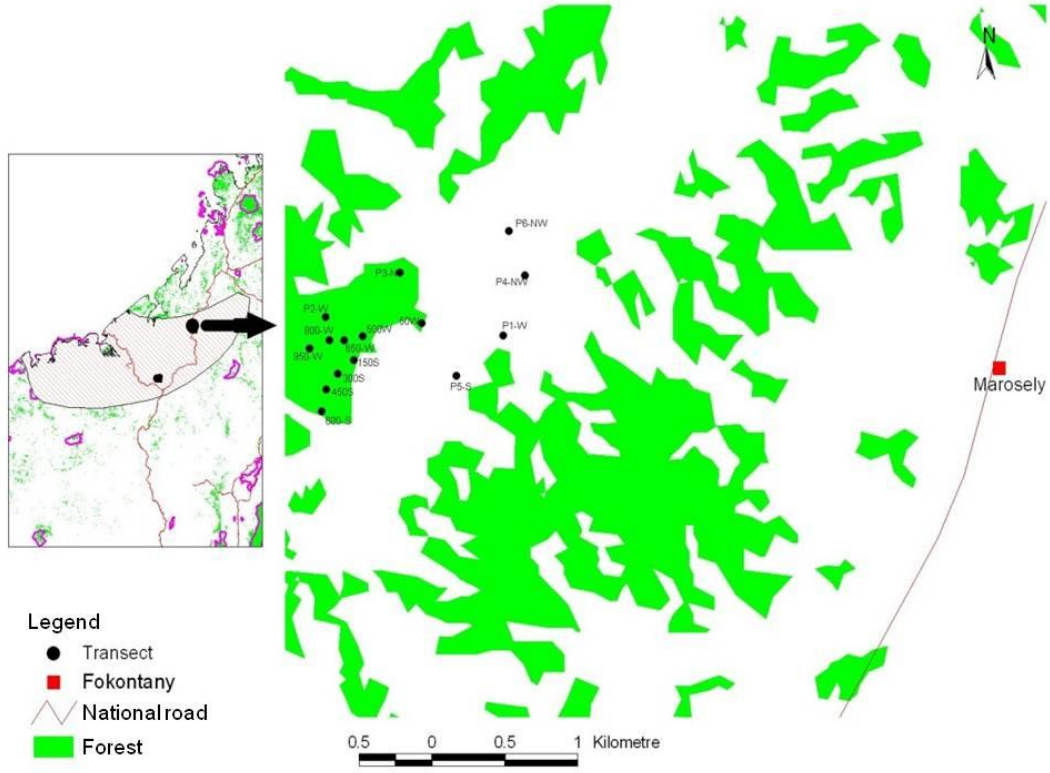
Sites	Geographic coordinates	Altitudes (m)	Habitat characteristics	Threats
Marosely	S15°39'06.1'' E47°34'56.1''	200 - 305	Dry dense deciduous highly and least disturbed forest	Illegal timber exploitation; creation of cart trails
Andranomiditra	S16°29'06.9'' E47°08'26.1''	137 - 206	Dry dense deciduous highly and least disturbed forest	Logging Slash-and-burn agriculture

Map 1 shows Marosely, which is located in the Sofia Region, and Andranomiditra, located in the Boeny Region, in relation to the area of distribution of *F. angeli*, protected areas, forests and the national road passing through this area.

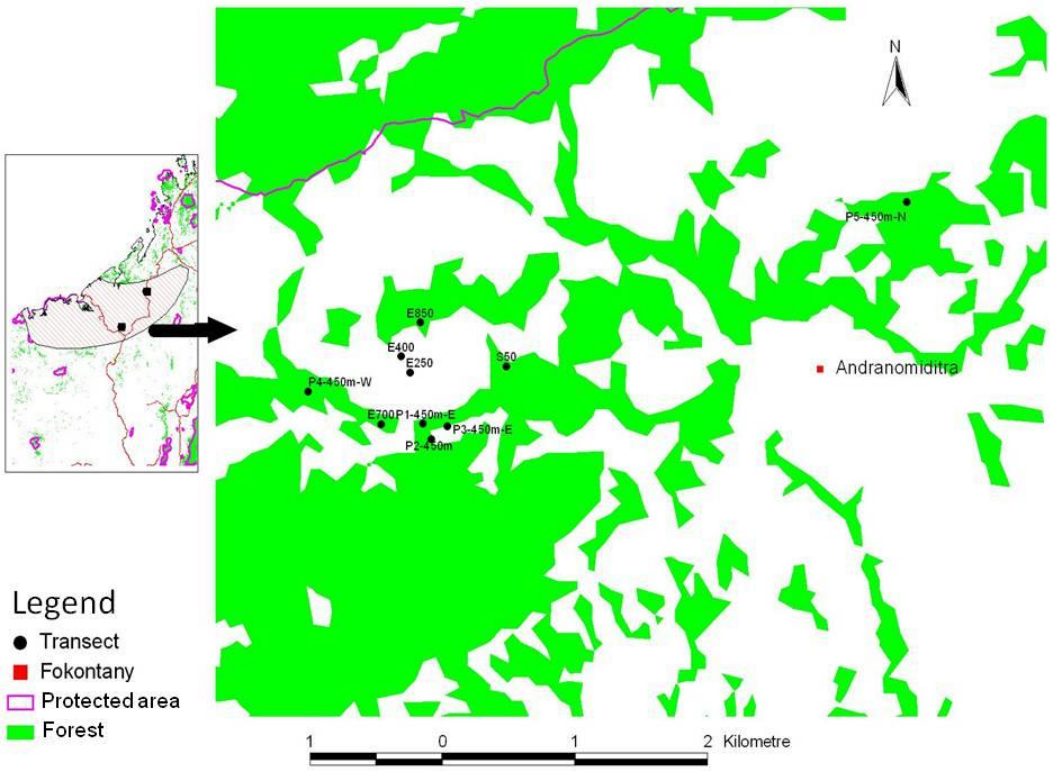
Map 2 shows paths No. 1, 4, 5 and 6 which are located in a fragmented forest. Owing to a lack of available data, this part of the Marosely forest is not shown on forest maps. Marosely is located at the edge of the new protected area (NAP) forest corridor, therefore the research sites are not at the core of the new protected area.



Map 1. Location of the two research sites.



Map 2. Location of transects and research paths on the Marosely site.



Map 3. Distribution of transects and research paths in Andranomiditra.

Map 3 (above) shows the location of transects and transect paths on the Andranomiditra site. It is located to the east of the Ankarafantsika National Park. All the research was carried out in the least disturbed forest fragments.

III. METHOD

a) Distance Sampling

The *Distance Sampling* method was used to study the *Furcifer angeli* population on each of the two chosen sites. This method is already being used by several researchers to study chameleons in Madagascar and other countries. The method consists in tracing the main path which crosses all possible habitat types on the site. From this main path, forest transects made up of three parallel lines, each 50 m long, 20 m apart and running in a randomly chosen direction, were placed haphazardly during the day. In addition to these forest transects, transect paths of different length were laid in these various habitats. However, since transect paths covered a larger area and several habitat types at once, they were longer than forest transects.

In order to limit disturbance caused to the chameleons, these forest transects and transect paths were arranged at least 24 hours before being surveyed. Observations were made at night, which is when chameleons are easy to observe (Jenkins et *al.*, 1999). These observations were made once on a forest transect or transect path during the visit to the site. They were made by two people positioned on each side of the observation line and each equipped with a Peztl myo xp head-lamp. During the survey, all chameleons were observed and as soon as a chameleon was sighted the various parameters required for the study were recorded before it could be collected. The perpendicular distance between the observation line and the point on which the encountered individual is found is one of the most important parameters for density calculations. These data were registered together with other ecological data such as the perch height as well as the height, type and condition of the roost. All individuals encountered were collected into bags and measured. Each sighting location was marked by a flag in order to return each individual the next day to the place where it had been collected. The individuals were measured the morning after being detected. During the measurements, the species, sex and age of each individual were determined, morphometric data taken and each individual was weighed.

On each transect, a study of the microhabitat of each spot on which individuals had been sighted and of some points on which no individuals had been found was carried out. This study was conducted in a 5 m x 5 m quadrat. Several parameters were determined in this quadrat, including: percentage of canopy opening, percentage of litter cover and grass cover; the number of large trees, bushes and trees which have been cut down or have fallen as result of natural causes; liana abundance as an index of 1 to 3, as well as vegetation density at different levels.

Several of the individuals observed were photographed.

DISTANCE software (version 5.0) has been used to estimate population density (Thomas et al., 2004). This density is a function of the size of the surveyed population and the total effort of the observations made. However, the greater these two parameters, the more reliable the density; an analysis of the latter shows a weak coefficient of variation. The perpendicular distance from each observation point to the observation line has been used for this density calculation.

In addition to calculating density, the *Distance Sampling* method makes it possible to calculate the abundance index (the number of individuals per unit of distance) of the species.

The national population size of *Furcifer angeli* is calculated by multiplying the density calculated by the Distance software by the surface area of the species' extent of occurrence.

b) Non-detriment finding

Non-detriment findings (NDF) are an obligatory procedure in trade in species listed in CITES Appendix II (CITES, 1979), such as *Furcifer angeli.* This procedure makes it possible to demonstrate that export in the species concerned, respecting the established quota, is not detrimental to the survival of this species. For Madagascar, this procedure has two phases: an assessment of risks to the species, and the issuance of non-detriment findings as such, followed by a proposal of a quota.

- **Provisional risk assessment (Pre-NDF)**

Whereas the questions contained in this information assessment table are divided into categories, the replies are given parameter by parameter. The reply chosen for each parameter is marked. The parameters of each category are then regrouped in another table and assigned a score (CITES, 2011). The scores range from 1 to 5, with 1 denoting the parameter associated with the least risk for the species and 5 - the one with the greatest risk. The different categories considered are: the intrinsic vulnerability of the species, the general threats to the population and the potential impact of the proposed collection. Each category has an average score: a, b and c, respectively. A coefficient is assigned to each category: 2 for the category of intrinsic vulnerability of the species, 1 for the general threats to the population and 2 for the potential impact of the proposed collection. These scores make it possible to calculate the weighted pre-NDF risk score for the species concerned (CITES, 2011). This score is calculated using the following formula:

$$\frac{(a \times 2) + (b \times 1) + (c \times 2)}{5}$$

Once the pre-NDF score has been calculated, the species is classified into one of the three categories adopted at the Cancun workshop (2008):

- « Low risk », with a score of 0 to 2.0;
- « Medium risk», 2.1 to 3.5;
- « High risk», 3.6 to 5.

This score makes it possible to classify the species on the basis of the risk to which it is exposed as a result of its potential collection and if this collection is maintained. If the pre-NDF risk score is between 0 and 2.0, the species is said to be at low risk. In addition, its non-detriment finding is favourable. If the score is between 2.1 and 3.5, collection carries medium risk for the species. In this case, its non-detriment finding will only be favourable if very strict procedures are followed. These procedures depend on the monitoring in place at the collection site.

If the risk score is between 3.6 and 5.0, potential collection is associated with a high risk for the species. Hence, the non-detriment finding is unfavourable. In this case, the next stage in the study is to adjust the quota and resubmit a proposal.

- **Non-detriment findings and quota calculations**

  Five main issues have to be addressed in order for non-detriment findings to be issued:

  1- The range of the species concerned;
  2- The size of its population;
  3- Management system and collection rate;
  4- Collection monitoring and verification;
  5- Conservation and the precautionary principle;

A quota for a species is established after one or several potential collection sites for trade purposes has or have been identified and a study of the species on these sites has been conducted. In addition, on each potential collection site, the population density calculated following this study will be used to establish a national quota for the species for commercial purposes.

The formula used to calculate the quota is one adopted by the Malagasy scientific authority. This calculation follows a specific procedure: firstly, the density of the species at the potential collection site and its area of occupancy in hectares must be known. For this study, the area of occupancy has been used because it is more precise than the extent of occurrence. As the species studied is a forest species found at altitudes ranging from 40 to 300 m in the western part of Madagascar, it is more reliable to use the surface of this area of occupancy. Density, expressed in the number of specimens/ha is calculated using Distance 5.0 software.

The national population size can then be calculated by multiplying the population density in a certain location by the extent of occurrence or, in this case, the area of occupancy of the species.

Since collection for commercial purposes must be carried out outside protected areas, calculating the area of distribution outside these areas is indispensable. To this end, the species' range outside protected areas is calculated by subtracting the total surface area of protected areas with a forest habitat and with altitudes between 40 and 300 m, which are located in the area of occupancy of the species.

Thus, the size of the population found outside protected areas is calculated by multiplying the local population density by the extent of occurrence outside protected areas.

The size of viable population is equivalent to 20% of the size of the population found outside protected areas. This reflects a consideration of various parameters which could affect the species, such as: the habitat specificity, population fragmentation, habitat alteration and anthropogenic pressure on the species.

In addition, the size of harvestable population of this species is 10% of viable population. This 10% reduction can be explained by the need to ensure the survival of the species.

Lastly, the annual quota calculated for the species, which can be changed depending on the assessment of the persons in charge of establishing this quota, is 10% of harvestable population.

For the case of *F. angeli*, it has been decided to use only the population of the Sofia Region, for which data are available. The quotas calculated and proposed in this report are therefore valid only for the collection sites identified for this region.

The studies of the species on the potential collection sites will analyse the population structure because it is important to determine not only the number of marketable individuals but also the marketable segment of the population. The latter refers the number of individuals by sex and age which can be marketed without adversely affecting the wild population.

In addition, the season or seasons, and the opening and closing of the collection period should be indicated.

IV. RESULTS

Four chameleon species have been surveyed in the course of this study, namely *Furcifer angeli, F. rhinoceratus, F. oustaleti* and *Brookesia stumpffi*, with the total effort on the two sites amounting to 8,800 m.

1) Population size

Furcifer angeli have been detected only in Marosely, with 22 individuals. On the other hand, *F. rhinoceratus*have have only been recorded in Andranomiditra. Table 2 below lists the densities of the species detected on the two study sites.

Table 2. Densities of chameleon species detected on each site.

Site	Species	Total effort (m)	Density (Number)	CV(%)	df	Confidence interval (95%)
Marosely	*Furcifer angeli*	5,400	**4.7** (22)	30.21	27.10	2.5 – 8.5
	Furcifer rhinoceratus	5,400	- (0)	-	-	-
	Furcifer oustaleti	5,400	4.2 (18)	30.79	38.78	2.3 – 7.6
Andranomiditra	*Furcifer angeli*	3,400	- (0)	-	-	-
	Furcifer rhinoceratus	3,400	4.2 (13)	30.31	23.90	2.2 – 7.7
	Furcifer oustaleti	3,400	5.4 (17)	27.02	19.92	3.1- 9.5

CV: Coefficient of variation
df. : Degrees of freedom

The population density of *Furcifer angeli* is 4.7 individuals per hectare in a confidence interval of 2.5 to 8.5 individuals per hectare, which represent the minimum and the maximum density values. This density result is reliable, with a coefficient of variation of 30.21%.

The total effort in Marosely was 5,400 m and the abundance index is 0.40 individuals per 100m.

Given the average density of 4.7 individuals/ha on a range of 3,150,600 ha, the size of the national population of the *F. angeli* species is approximately equivalent to 14,681,796 individuals and that of the Sofia Region to 233,048.

2) Pre-NDF Risk Assessment

This practice consists in assessing the risk to which the species is exposed as a result of various parameters.

Diagram 1. Graphical representation of a risk assessment for *Furcifer angeli*.

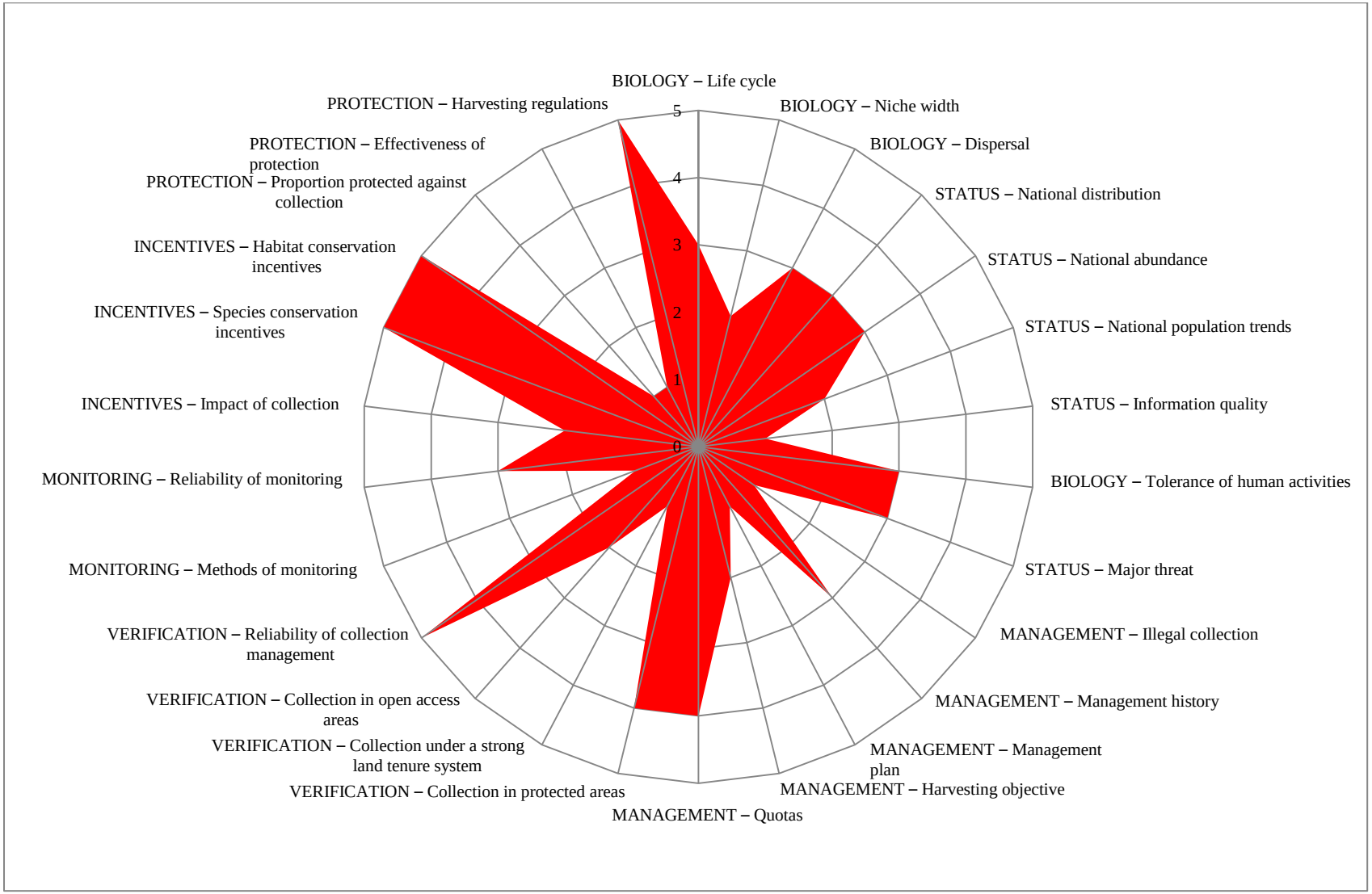


Table 3. Information assessment system for the *Furcifer angeli* species.

This system allows for the weighted pre-NDF risk score to be calculated after parameters have been regrouped and each group of variables weighed.

Group	Question Number	Question Category	Question	Replies 1 à 5
Intrinsic vulnerability of the species (Coefficient=2)	2.1	BIOLOGY	**BIOLOGY – Life cycle**	3
	2.2		**BIOLOGY – Niche width**	2
	2.3		**BIOLOGY – Dispersal**	3
	2.5	STATUS	**STATUS – National distribution**	3
	2.6		**STATUS – National abundance**	3
	2.7		**STATUS - National population trends**	2
	2.8		**STATUS –Information quality**	1
			a	2,43
General threats acting upon population (Coefficient=1)	2.4		**BIOLOGY – Tolerance of human activities**	3
	2.9		**STATUS –Major threat**	3
	2.1	MANAGEMENT	**MANAGEMENT – Illegal collection**	1
			b	2,33
Potential impact of the proposed harvest (Coefficient=2)	2.11		**MANAGEMENT – Management history**	3
	2.12		**MANAGEMENT – Management plan**	1
	2.13		**MANAGEMENT – Harvesting objective**	2
	2.14		**MANAGEMENT – Quotas**	4
	2.15	VERIFICATION	**VERIFICATION – Collection in protected areas**	4
	2.16		**VERIFICATION – Collection under a strong land tenure system**	1
	2.17		**VERIFICATION - Collection in open access area**	2
	2.18		**VERIFICATION – Reliability of collection management**	5
	2.19	MONITORING	**MONITORING – Methods of monitoring**	1
	2.2		**MONITORING – Reliability of monitoring**	3
	2.21	INCENTIVES	**INCENTIVES – Impact of collection**	2
	2.22		**INCENTIVES – Species conservation incentives**	5
	2.23		**INCENTIVES – Habitat conservation incentives**	5

	2.24	PROTECTION	**PROTECTION- Proportion protected against collection**	1
	2.25		**PROTECTION – Effectiveness of protection**	1
	2.26		**PROTECTION – Harvesting regulations**	5
			c	2.81

$$\textbf{Weighted "Pre} - \textbf{NDF Risk Score"} = \frac{(2.43 * 2) + (2.33 * 1) + (2.81 * 2)}{5} = \mathbf{2.5}$$

The weighted Pre-NDP Risk Score is 2.5. This score makes it possible to classify *Furcifer angeli* among species at medium risk on the basis of the risk scale adopted by Working Group 7 on Reptiles and Amphibians at the Cancun workshop in 2008.

3) Quota calculation

Table 4 below shows calculations of the annual quota for *Furcifer angeli* on the basis of the formula adopted by Madagascar for chameleons. The minimum density value of the confidence interval on the Marosely site, i.e. 2.5 individuals/ha, has been used to calculate the quota. This value has been used in order to avoid overestimating the population size.

Table 4. Calculation of an annual quota for *Furcifer angeli*.

Species	***Furcifer angeli***
Minimum density (Sofia)	2.50
Viable habitat (Sofia)	93,219.17
Population size (Sofia)	233,047.93
Viable habitat outside protected area (Sofia)	45,863.16
Population size outside protected area (Sofia)	114,657.90
Size of viable population (Sofia)	22,931.58
Size of harvestable population (Sofia)	2,293.16
Calculated annual quota	229.32

A quota of 229 individuals/year has been calculated for the *Furcifer angeli* of the Sofia Region. The proposed quota is 150 individuals per year. In accordance with the NDF procedure, this quota is considered cautious.

4) Non-detriment findings

For the issuance of non-detriment findings:

a) Geographic distribution

Furcifer angeli occurs in the western part of Madagascar (Boeny and Sofia Regions) at altitudes ranging between 0 and 300 m above sea-level. Therefore, its extent of occurrence covers over 3,086,804,257.8 ha. This species occupies the least degraded and degraded forests of western Madagascar. Its area of occupancy reflects a balance between its extent of

occurrence and ecological parameters favourable for the species, such as habitat type and altitude. This viable area for the species is equivalent to 391,877.90 ha. Numerous protected areas, which occupy 45% of the viable area, are in place within its extent of occurrence.

Since the present study aims at reopening trade in this species, it has simply focused on the Sofia Region as data on its population are available at present. In this region, the viable area for Furcifer *angeli* extends over 93,219.17 ha, 51% of which are protected (47,356.01 ha). The data used to calculate the quota have been taken exclusively from the Sofia Region.

b) Population size

The population size is obtained by multiplying the density of the species by the surface area of its viable area. To have a more reliable estimate of the population size, the most reliable scenario has been used, namely the minimum density calculated for *F. angeli* by the Distance software, i.e. 2.5 individuals per hectare. Thus, the national population size has been estimated at 979,695 individuals. Of this national population, 233,048 individuals, or 23%, are in the Sofia Region where collection will be carried out. If trade in this species is reopened, the site proposed for its collection in Marosely can hold 1,500 individuals.

c) Management system and collection rate

To ensure that collection does not affect the survival of the species, several conditions for managing collection have been fixed:

- Collection period: from February to April;
- Restricted collection area in the Sofia Region;
- Identified collection site: Marosely (about 600 ha);
- Collection of juvenile individuals or pregnant females is prohibited;
- Collection impact should be monitored.

The site proposed for the collection of this species is managed by a local community which works closely with the competent regional authorities. These conditions make it possible to keep track of the levels of collection in order to be able to assess its impact on the population.

d) Collection monitoring and verification

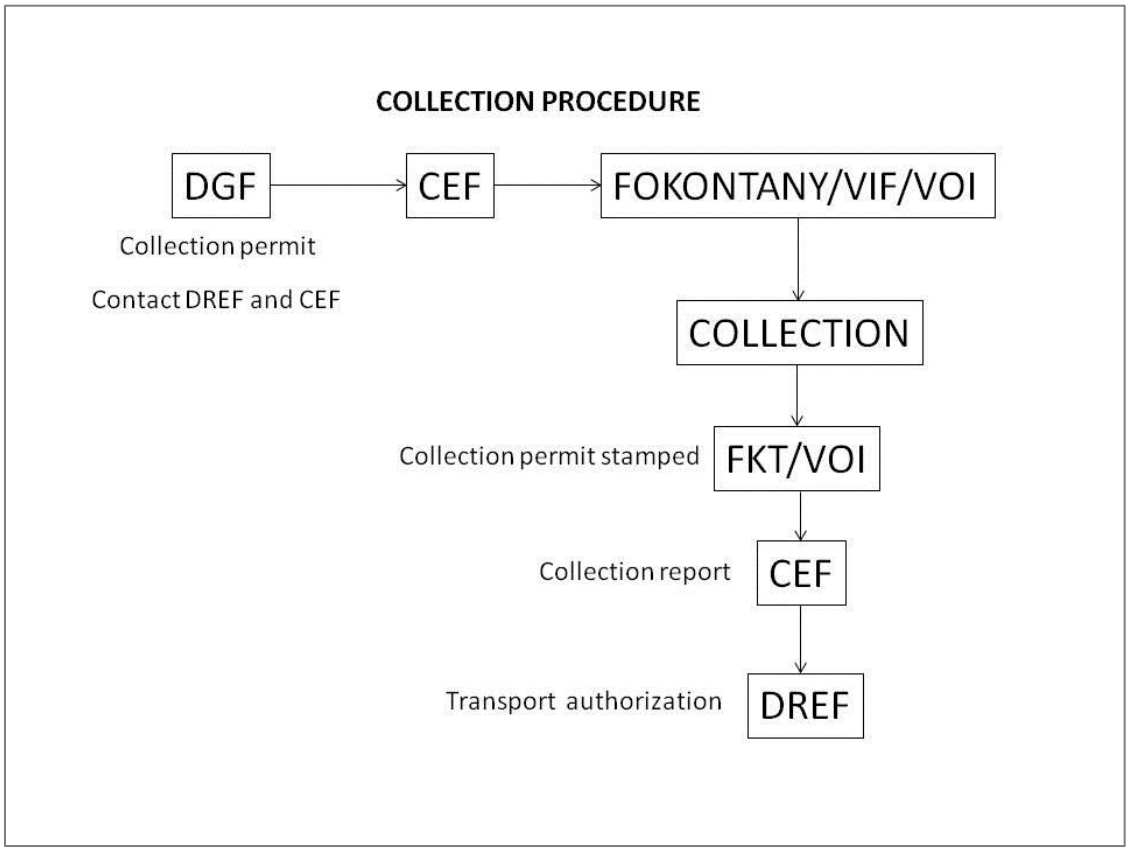
The proposed collection area is monitored by the local community closest to the location, which means that anyone entering or exiting this area must register with the community. A procedure for collecting *Furcifer angeli* has been adopted to ensure that collection is properly managed. Diagram 2 shows the collection procedure involving all levels of verification from collection through to export. This procedure is also a way to help monitor the impact of collection on the population of the collection area.

e) Conservation and the Precautionary Principle

The proposed quota of 150 individuals per year is lower than the calculated quota (229 individuals). This quota is proposed in order to compensate for the extra 10% on legal quotas of operators during collection in the field, and collection is carried out only on a site in Marosely. Hunters must come from an area where collection is approved because they have better knowledge of places where collection can be carried out and where it cannot. The

Marosely forest shelters at least 1,500 individuals of *F. angeli*, which accounts for only 0.64% of the population of the region where collection will be carried out. The quota of 150 individuals accounts for only 10% of the stock available at the collection place and 0.06% of the population of the Sofia Region.

Diagram 2: Collection procedure for *Furcifer angeli*



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