Is the European Leaf-toed gecko Euleptes europaea also an African? Its occurrence on the Western Mediterranean landbrige islets and its extinction rate

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Is the European Leaf-toed gecko *Euleptes europaea* also an African? Its occurrence on the Western Mediterranean landbrige islets and its extinction rate

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Abstract. *Euleptes europaea* is a relictual gecko with a West Mediterranean disjunct distribution fragmented in hundreds of isolated populations living on islands, tiny islets and three small continental areas. It is considered near threatened by the IUCN. Its Northern distribution in France and Italy is well known but its actual presence on some Tunisian islets has not been confirmed since its discovery during the second part of the 19th century.
Several field trips were undertaken to check its presence on the Northern Tunisian islands. It was confirmed on one islet and discovered on two, but the species has gone extinct on two other islets. Its occurrence on the landbridge islets displays a clear discrepancy between: on one hand, the Northern (Provence-Liguria) and Southern (Tunisia) edges of its distribution where its occurrence is low with documented extirpations or steep demographic declines and on the other hand, the geographic centre of its range (Sardinia, Corsica, Tuscan Archipelago) where its occurrence is high without any documented extirpation.

Keywords. Distribution, extirpation, population decrease, Tunisia, herpetofauna, islands, Mediterranean

Introduction

The European Leaf-toed gecko *Euleptes europaea* (Gené, 1839) belongs to a monophyletic genus endemic to the Western Mediterranean (Bauer, Good and Branch, 1997). According to Gamble et al. (2007) it is part of the family Sphaerodactylidae of Gondwaian origin. Archeozoological datas (Estes, 1969; Müller, 2001; Müller and Mödden, 2001) suggest that this genus present distribution is the result of the contraction of an ancestral Miocene larger area ranging further North in Western Europe (France, Germany and Slovakia). According to Bauer et al. (2008) it may be a survivor of a once more widespread European lineage of geckos. Nowadays, this gecko is mainly insular and its range is restricted: North, to Liguria (Italy), on the mainland and two islets; West, Marseilles' islands (France); East, on the coast of Tuscany (Italy); South, on some islets of the Northern Tunisian coast. The geographic centre of the distribution includes Sardinia, Corsica and the Tuscan Archipelago (Capocaccia, 1956; Vanni and Lanza, 1978, Delaugerre, 1997; see fig 1).

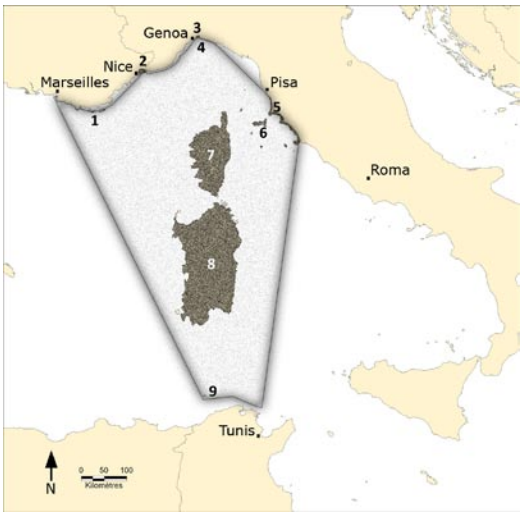

Figure 1. Distribution of *Euleptes europaea* in the Western Mediterranean: 1- Provence' islands; 2- Alpes-Maritimes' mainland; 3- Ligurian mainland; 4- Ligurian islets; 5- Coast of Tuscany ; 6- Tuscan Archipelago ; 7- Corsica and satellite islets ; 8- Sardinia and satellite islets ; 9- Northern Tunisian islets.

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Table 1. Island and islets off the Northern Tunisian coast, with vascular plants. The fossil island of Tabarka (Tbarka) was not included, neither the non-marine Chikli islet surrounded by the Tunis lake. The islands whose name is underlined host a permanent human settlement; when followed by (R) = ship rat *Rattus rattus* (rats removed from Zembretta island on 2009). From Oueslati (1995), S. Ghelouz/APAL, pers. com.; U = unknown; ~surface = approximate values; presence of *E. europaea*: 19c = 19th century discovery, * discovered (this paper), C= confirmed (this paper), NC= not confirmed (this paper), ?= still searching.

Archipelago	Island (I) or islet (i)	Coordinates	elevation in m asl	surface m^2	nocturnal searches	diurnal searches	Presence of *Euleptes europaea*
Galita	I Galita (R)	37°31'36"	391	7 520 000	05/06	05/06	?
Jalta		08°56'02"			05/07	05/07	
					07/10	05/08	
						07/10	
	i Galiton	37°30'00"	158	299 000	05/06	05/06	19c/NC
		08°52'40"			05/07	05/07	
					07/10	07/10	
	i La Fauchelle	37°29'47"	137	136 000	05/06	05/06	19c/C
	(R) *Aguglia*	08°53'06"			07/10	05/07	
						07/10	
	i Gallina (R)	37°33'06"	60	31 000	05/06	05/06	*
		08°56'58"					
	i Pollastro	37°33'15"	~35	6 000		05/07	/
		08°57'14"				07/10	
	i Gallo (R)	37°33'25"	119	89 000	05/08	05/96	*
		08° 57'24"			07/10	05/07	
						05/08	
						07/10	
Fratelli	i Fratelli Nord	37°18'26"	~55	U	05/07	05/07	/
Rchadet		09°24'51"					
Lakhouet	i Fratelli Sud	37°18'00"	~40	U		05/07	/
		09°23'58"					
	i Pilau (R)	37°12'09"	116	~80 000		05/07	/
		10°14'32"					
	i Plane (R)	37°10'53"	14	~90 000		05/07	/
	El Ouatia	10°19'42"					
Cani	i Grand Cani	37°21'19"	18	~60 000	08/09	08/09	19c/NC
Dzirette El		10°07'30"					
Klèbe	i Cani Est	37°21'27"	~15	~6 000	08/09	08/09	/
		10°07' 41"					
	i Cani Ouest	37°21'11"	~17	~10 000	08/09	08/09	/
		10°07'12"					
Zembra	I Zembra (R)	37°07'32"	435	3 890 000	05/07	06/07	/
Jammour	*Jammour el Kbir*	10°48'22"			06/07		
	i L'Antorcho	37°08'38"	U	~1500			not visited
		10°47'43"					
	i La Cathédrale	37°07'05"	U	~8 000			not visited
		10°47'21"					
	i Zembretta (R)	37°06'17"	53	20 000	06/07	06/07	/
	Jammour es Sghir	10°52'26"					
	i Zembrettino	37°06'23"	U	U		06/09	/
		10°52'19"					

This relictual gecko, non anthropophilous and specialist of narrow rocky crevices, is very small: svl 30-40 mm and weight 1-2 g. It is able to persist on tiny islets, on the very edge of the terrestrial life, where it remains the last terrestrial vertebrate. On several thousand square meters islets, it may maintain populations of several hundred adults (Delaugerre, 1981a, 1985, 1992; Salvidio, Lanza and Delaugerre, 2011). It is thought to have low overseas dispersal capacities.

Its disjunct Mediterranean distribution is fragmented in hundreds of isolated populations inhabiting islands, tiny islets and few small continental areas. It is considered near threatened by the IUCN (Corti et al., 2008) and Salvidio and Delaugerre (2003) recommended that its conservation status should be assessed all over its distributional range to evaluate strategies for population conservation.

But first of all, the precise limits of its range had to be established. As a matter of fact, since the end of the 19th century its continental and insular distribution in France

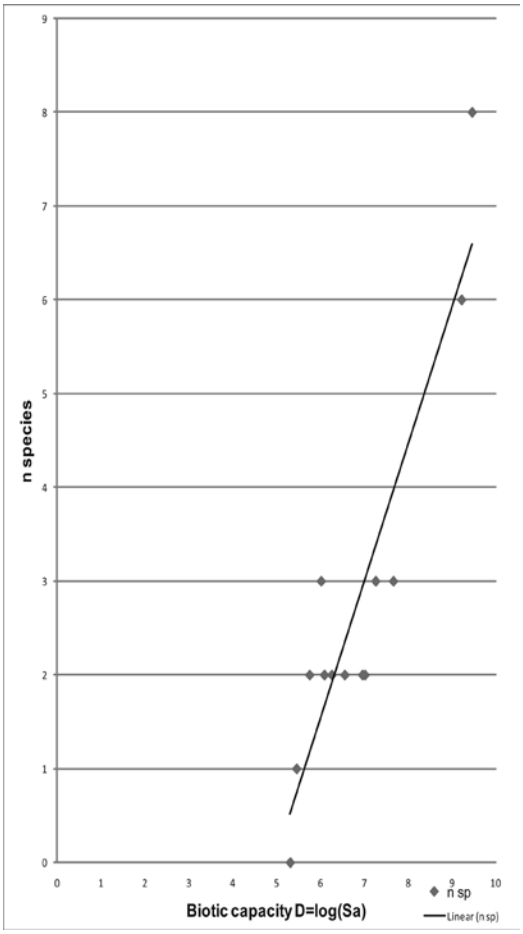

Figure 2. Specific diversity of the herpetofauna of the Northern Tunisian islands and Index of Biotic capacity (from table 2).

and Italy has been widely documented (references in Salvidio, Lanza and Delaugerre, 2011); however its presence on some islets off the Northern Tunisian coast has never been confirmed since its early discovery in 1876 and 1877 (D'Albertis, 1878, Issel, 1880). This is the reason why Aristarchi (2004) wonders about its actual presence in North Africa, underlining the lack of museum specimens and the absence of records since the second part of the 19th century.

Is *E. europaea* a truly Tyrrhenian and Southern European Gecko? Or is it also African? And has there been any geographic variation of its occurrence on Mediterranean islands?

Methods

To answer those questions and to improve the knowledge of the insular herpetofauna of Northern Africa, several field investigations were performed by two of us (SN and RO) from the late 1990's and during five field trips (from 2006 to 2010), 16 of the 18 islands and islets off the Northern Tunisian coast (from the Algerian border till the Cap Bon) were investigated by MD and RO (table 1). If some islands were only shortly visited, eleven were more thoroughly searched with nocturnal investigations. For each island, we also mention the herpetofauna observed (table 2). For geographical and geomorphological description, see Oueslati (1995).

In the daytime, visual surveys were undertaken in every suitable habitat to spot foraging animals; it was also looked under stones, logs... for sheltered herpetofauna. A special attention was paid to gecko's faecal pellets into narrow crevices and on steep rock faces. Geckos were mostly searched by night with head and hand lamps on rock faces, between vegetation and rocks and on pebble beach's. During the multidisciplinary PIM (Petites Iles de Méditerranée) field trips, much other information's were also recorded: flora census, mammal census especially for ship rats *Rattus rattus* (Linnaeus, 1758) (with trapping), nesting marine birds and raptors.

Statistical tests were performed with Open Stat 2009 software. The "biotic capacity" of islands was estimated using the Index D (Delaugerre and Dubois, 1985; Perez Mellado et al., 2008) with the formula D= log(**Sa**), where **S** is the surface of the island, and **a** its maximal altitude. In the analysis of the occurrence of *Euleptes* on islets, the Provence and the Ligurian islets were grouped because they are geographically linked and because the low number of Ligurian islets wouldn't have allowed the use of statistical test.

Results

Galita Archipelago

Galita Island

Euleptes europaea has never been recorded from Galita island even if it is mentioned by some authors (see for instance Mourgue, 1910; Blanc, 1936) by confusion with the neighbouring islets. Several diurnal and nocturnal searches were performed on various rocky outcrops but the only geckos observed were *Tarentola mauritanica* (Linnaeus, 1758) (widespread) and *Hemidactylus turcicus* (Linnaeus, 1758) (village and surroundings). Those two geckos were not present in 1875-1876-1877 (Pavesi, 1876; D'Albertis, 1878; Issel, 1880); they have colonized Galita island during the second part of the 20th century (Lanza and Bruzzone, 1959; Schneider, 1969; Lanza, 1973). *E. europaea* being recorded from four satellite islets of Galita (this paper), it is likely that it was also originally present on Galita itself and has gone extinct or might still live undiscovered on some remote area of this relatively large island.

Herpetofauna: *Discoglossus pictus* Otth, 1837 (belonging to the Sicilian cluster and not to the Tunisian

one, according to Zangari, Cimmaruta and Nascetti, 2006), *Pelophylax saharicus* (Boulenger, 1913) (a colonisation around 2000 then extinction 3-4 years later), *Testudo graeca* Linnaeus, 1758 (widespread), *Tarentola mauritanica*, *Hemidactylus turcicus*, *Chalcides ocellatus* (Forsskål, 1775), *Timon pater* (Lataste, 1880), *Macroprotodon c. mauritanicus* Guichenot, 1850, *Natrix maura* (Linnaeus, 1758).

Galiton islet

E. europaea was observed by E. d'Albertis on the 27th September 1876 (D'Albertis, 1878: 314). Despite several accurate nocturnal searches performed in every suitable habitats (May 2006, May 2007, July 2010), its presence was not confirmed and the only gecko seen was *Hemidactylus turcicus* (widespread). At the beginning of the 20th century (1914-1916) a lighthouse and three landing stages were built and since, the islet hosts a permanent human settlement. *Hemidactylus* was not present at the time of d'Albertis journey and it may have colonized the islet since the 50's or earlier (Schneider, 1969). We do believe that the European Leaf toed Gecko has gone extinct from the Galiton islet.

Herpetofauna: *Hemidactylus turcicus*, *Chalcides ocellatus*, *Psammodromus algirus doriae* Bedriaga, 1886 (subspecies endemic to Galiton and La Fauchelle islets).

La Fauchelle

Euleptes europaea was observed by E. D'Albertis, G. Doria, A. Issel and R. Gestro in August 1877 (Issel, 1880: 208). According to A. Nistri (pers. com. 2010), specimens from this islet were collected for the Firenze "La Specola" natural history museum by B. Lanza and. Carfi in 1966. Its presence was confirmed by one of us (MD) on the 18th May 2006 on the so-called "Presqu'îlot à l'ail" on the Western part of La Fauchelle and thereafter confirmed on both parts of the island on July 2010.

Herpetofauna: *Euleptes europaea*, *Chalcides ocellatus*, *Psammodromus algirus doriae*.

Gallina

Euleptes europaea was discovered here on the 16th May 2006 by MD and RO; out of ten geckos sighted, five were captured. During their two journeys on the archipelago, the -excellent- naturalists of the "Violante" failed to find it on Gallina and Gallo (D'Albertis, 1878; Issel, 1880).

Herpetofauna: *Euleptes europaea*, *Chalcides ocellatus* (on Gallina and Gallo *C. ocellatus* often displays a uniform dark-brown pigmentation lacking dorsal stripes; R. Ouni also observed a very peculiar trend to carnivory, the skinks feeding a part of the year from dead birds stolen from the nests of Eleanora's Falcon *Falco eleonorae* Gené, 1839).

Pollastro

Though this tiny islet was not visited at night time, no reptile was seen, neither any evidence (faecal pellets of sauria).

Gallo

E. europaea was discovered here (one adult) on June 1996 by SN and RO. It was the first confirmation of its presence on the archipelago since the 19th century. In May 2008 and July 2010 MD and RO spent respectively three and two nights and a total of 91 *E. europaea* were captured (the morphometry of the Tunisian leaf-toed geckos and their phylogenetic relationships are under study).

Herpetofauna : *Euleptes europaea*, *Chalcides ocellatus*

Fratelli islets

Fratelli North

No evidence of *E. europaea*, the only gecko here is *Tarentola mauritanica* (with a very peculiar "jumping instead of walking" behaviour).

Herpetofauna: *Tarentola mauritanica*, *Chalcides ocellatus*

Fratelli South

No evidence of *E. europaea* or other gecko.

Herpetofauna: *Chalcides ocellatus*

Pilau islet

No evidence of *E. europaea* but another unidentified gecko (*Tarentola* or *Hemidactylus*) might be present according to the shape and the "ceiling-position" of the faecal pellets observed.

Herpetofauna: *Chalcides ocellatus, Psammodromus algirus* (Linnaeus, 1758).

Plane islet

No evidence of *E. europaea*, the only gecko here is

Table 2. Herpetofauna of the Northern Tunisian islands. From D'Albertis (1878), Issel (1880), Lanza and Bruzzone (1959), Schneider (1969), Blanc (1988). *= original data (this paper); E= extinct; Dp= *Discoglossus pictus*; Ps= *Pelophylax saharicus*; Tg= *Testudo graeca*; Ee= *Euleptes europaea*; Ht= *Hemidactylus turcicus*; Tm= *Tarentola mauritanica;* Co= *Chalcides ocellatus*; Tp= *Timon pater*; Pa= *Psammodromus algirus*; Mma= *Macroprotodon mauritanicus*; Mmo= *Malpollon monspessulanus*; Hh= *Hierophis hippocrepis*; Nm= *Natrix maura*.

	Dp	P s	T g	Ee	Ht	Tm	Co	Tp	Pa	Mma	Mmo	Hh	Nm
Galita	x	E	x		x	x	x	x		x			x
Galiton				E	x		x		x				
La Fauchelle				x			x		x				
Gallina				*			x						
Pollastro													
Gallo				*			x						
Fratelli Nord						*	*						
Fratelli Sud							*						
Pilau							*		*				
Plane					x		*						
Grand Cani				E	*		*						
Cani Est					*								
Cani Ouest					*		*						
Zembra					x		x		x	x	x	x	
Zembretta					x		x		x				
Zembrettino							*						
n islands	1	0	1	3 +2 E	8	2	14	1	5	2	1	1	1

Hemidactylus turcicus (already known, see D'Albertis, 1878: 287).

Herpetofauna: *Hemidactylus turcicus, Chalcides ocellatus*.

Cani islets

Those islets are 3 (not 2): Grand Cani with the lighthouse (built around 1860) separated from East Cani by a few meters wide sea channel and several hundred meters westward: West Cani.

Grand Cani

E. europaea has been recorded here on the September 22th 1876 (D'Albertis, 1878: 289) "with another lizard". After one night of investigation in August 3rd 2009 (MD, RO) we were unable to confirm its presence. *Hemidactylus turcicus,* who colonized the island since 1876, was very abundant on the 3 islets (143 animals seen in 180 minutes). Grand Cani, being a small and flat islet very easy to investigate we are confident that *E. europaea* has gone extinct.

Herpetofauna : *Hemidactylus turcicus, Chalcides ocellatus*.

East Cani

No evidence of *E. europaea*, the only gecko here is *Hemidactylus turcicus*

Herpetofauna: *Hemidactylus turcicus.*

West Cani

No evidence of *E. europaea*, the only gecko here is *Hemidactylus turcicus*

Herpetofauna: *Hemidactylus turcicus, Chalcides ocellatus*.

Zembra islands

Zembra

Despite accurate investigations, we didn't find evidence of *E. europaea,* the only gecko here is *Hemidactylus turcicus* (widespread).

Herpetofauna (already described by Blanc, 1988): *Hemidactylus turcicus, Chalcides ocellatus*, *Psammodromus algirus, Malpolon monspessulanus* (Hermann, 1804)*, Macroprotodon c. mauritanicus, Hemorrhois hippocrepis* (Linnaeus, 1758)*.*

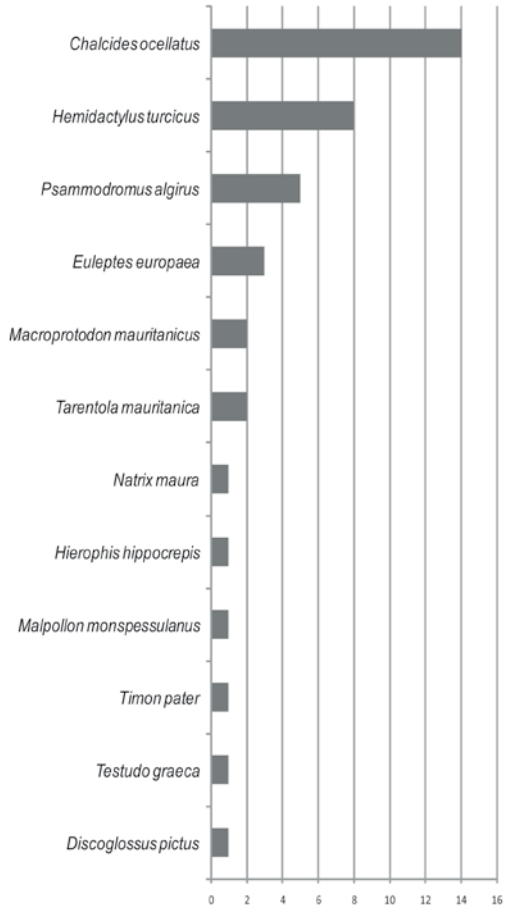

Figure 3. Occurrence of the herpetofauna on the Northern Tunisian islands (from table 2).

Zembretta

No evidence of *E. europaea*, the only gecko here is *Hemidactylus turcicus*

Herpetofauna (Blanc, 1988): *Hemidactylus turcicus, Chalcides ocellatus*, *Psammodromus algirus.*

Zembrettino

No evidence of *E. europaea* or other gecko.

Herpetofauna: *Chalcides ocellatus*

Discussion

The island herpetofauna

Two species of amphibians and eleven species of reptiles have been found on the 16 investigated islands (table 2). Galita is the only island inhabited by amphibians; Zembra the other island with freshwater doesn't have any. The reptile fauna includes: 1 land turtle, 3 gekkotan lizards, 1 scincid lizard, 2 lacertid lizards and 4 colubrid snakes. The specific richness (ranging from 0 to 8) is strongly correlated with the size and biotic capacity of the islands, $r = 0.916$, $p<0.01$ (fig 2). The large sized skink *Chalcides ocellatus* is the most frequent species, even on tiny islets (fig 3, Table 2), followed by *Hemidactylus turcicus* and *Psammodromus algirus*. The snakes inhabit the two larger islands, Galita and Zembra. Four islands are devoid of geckos and *Tarentola mauritanica,* widespread in most of the Western Mediterranean and on the nearby Tunisian coast, is –surprisingly- the less common species of the family.

The European Leaf-toed gecko's distribution

The European leaf-toed gecko is indeed also an African or at least a Maghrebian species. It is confirmed on the Tunisian islets. In the Galita Archipelago, it has been discovered on two islets, confirmed on one and it has

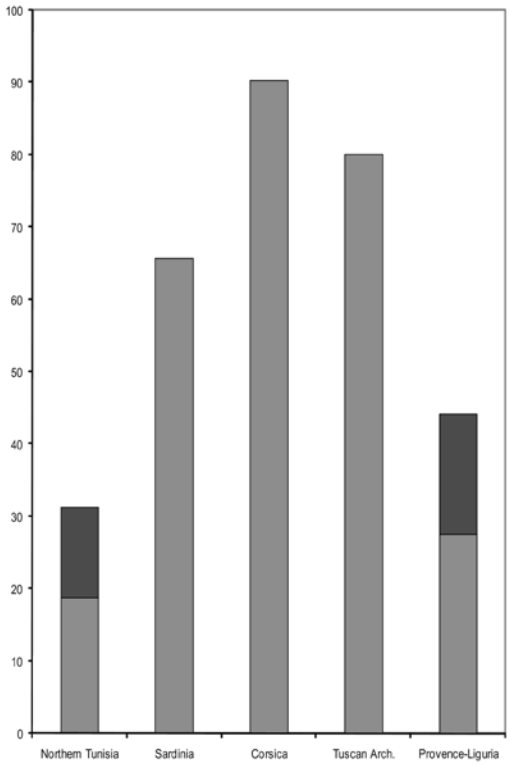

Figure 4. Occurrence of *Euleptes europaea* and rate of extirpation on the islands of the Western Mediterranean. (from table 3). Bars in light grey: occurrence of *E europaea*; bars in dark grey: extirpation rate or steep demographic decline.

Table 3. Occurrence of the European Leaf-toed gecko on the islets of the Western Mediterranean. Tunisia (this paper); Sardinia, Tuscan Archipelago and Liguria (Sindaco et al.., 2006); Corsica (Delaugerre and Cheylan, 1992;M Delaugerre pers. com.); Provence (Cheylan G, 1983; Cheylan M, 1983; M Cheylan pers. com; J.-Y. Dardun pers com.; M Delaugerre pers. com; PIM database).

	n islets	n islets with confirmation of *E. europaea*	n islets with documented extirpation or demographic decline
Northern Tunisia	16	3	2
Sardinia	105	69	0
Corsica	82	73	0
Tuscan Archipelago	25	20	0
Liguria	5	2	0
Provence	78	20	6

gone extinct on another. In Cani islets too, it has is gone extinct. It seems absent from the other investigated islets. The two islets where *E. europaea* has been extirpated host a lighthouse and a permanent human settlement. Both were also colonized by *H. turcicus* during the 20th century.

The Galita Archipelago and Cani islands were severed from the Tunisian coast about 18 000 to 20 000 years ago (maximum of the Würm regression) or even earlier, with rising sea levels (Oueslati, 1995; Rohling et al., 1998; Emig and Geistdoerfer, 2004; A. Gauthier pers. com.). Thus, the absence of the European Leaf-toed gecko from the Tunisian mainland suggests a historic extirpation. Such a phenomenon also probably occurred in coastal France (Provence) and Italy (Liguria and Tuscany). In Marseilles for instance, this gecko inhabits some landbrige islets very close to the shore that were severed from the mainland some centuries ago and it has never been found on the mainland, till now (Delaugerre, 1981b; Salvidio and Delaugerre, 2003). In the French Alpes-Maritimes, in Liguria and in Tuscany there are only few continental and disjunct populations (Capocaccia, 1956; Kulesza et al., 1995; Renet et al., 2008; Oneto, Ottonello and Salvidio, 2008) suggesting an ancestral range contraction.

Frequency on islands and extirpation rate

The occurrence of *E. europaea* on the Northern Tunisian islets is fairly low: 3/16 of the investigated islet, plus two documented extirpations. Is there a variation of this occurrence between the various regions of its range? In some geographic areas, like the Sardinia, the Corsica and the Tuscan Archipelago, the species is widespread and there is no extirpation recorded (table 3) and this is not an artefact due to lack of 19th century data (see references in Capocaccia, 1956; Salvidio, Lanza and Delaugerre, 2011). Along the Southern European coast, from Provence to Liguria, this occurrence is much lower with several extirpations, just like in Northern Tunisia (fig. 4). The insular populations of *E. europaea* are much more frequent in the centre of the range, without any historical extirpation than in the Southern and Northern edges where they are sparse and subject to local extinctions. A low occurrence on the islets of a given area does not imply low population densities.

These differences of rates tested by pairs (table 4) are statistically significant $p<0.05$ for 6 comparisons between in one hand the Tunisia and the Provence-Liguria against the Sardinia, the Corsica and the Tuscan Archipelago. The comparison between Tunisia and Provence-Liguria are not significant ($p>0.5$), neither are the comparisons between Sardinia-Corsica and Tuscan Archipelago (except between Corsica and Sardinia). Plotted together, the centre block compared with the peripheral block is highly significant $p<0.001$.

Out of eight documented evidences of extirpation or drastic demographic decline (Table 5), six occurred on "large" islands with human settlements; seven have (or had) introduced ship rat populations and four of them

Table 4. Occurrence of *E. europaea* on islets of different part of its range (from table 3) compared two by two with Chi square. Above the diagonal are indicated the values of Chi2 and below the values of p.

	Northern Tunisia	**Sardinia**	**Corsica**	**Tuscany**	**Provence-Liguria**
Northern Tunisia		6.942	27.511	9.744	0.083
Sardinia	0.0084		13.691	1.909	26.792
Corsica	0.0000	0.0002		1.372	63.734
Tuscany	0.0018	0.1671	0.2415		21.922
Provence-Liguria	0.7735	0.0000	0.0000	0.0000	

have (or had) been colonized by another species of gecko. On the Marseilles' Grand and Petit Congloués, after almost a century of disappearance and despite several negative searches, *E. europaea* was "resurrected" five years after rat eradication (J. Y. Dardun pers. com., 2003), suggesting that when at very low densities the species becomes cryptic and difficult to be observed even by professional herpetologists.

What could be the meaning of this geographic variation of occurrence on landbrige islands and of this difference of extinction rates?

Most of the 311 islands and islets considered in this analysis (table 3) are small sized and didn't undergo through anthropogenic habitat destruction. They were and are still nowadays out of reach of direct human disturbance. Only the largest islands have been permanently inhabited (less than 50 out of 311) and ~34 are today. The main habitat disturbance has been the result of biological invasions by mammals like ship rat *Rattus rattus,* which began some 2400 years ago in Western Mediterranean (Vigne and Valladas, 1996; Ruffino and Vidal, 2010), by feral cats or rabbits; by Gekkonid lizards and also by invasive plants. In addition, during the second part of the 20th century the rising number of the marine bird *Larus michahellis* Naumann 1840, in relation to the human-induced food resources, has probably strongly affected many insular ecosystems (see for instance Vidal, Médail and Tatoni, 1998).

If, according to the overall shape of the distribution of the genus and of the species, *E. europaea* is to be considered a Western Mediterranean relict and its presence on islands relictual (Capocaccia, 1956; Kulesza, Delaugerre and Cheylan, 1995; Bauer, Good and Branch, 1997; Delaugerre, 1997; Bauer et al., 2008), several, non-exclusive, hypotheses can be formulated.

1) The geographic variation of its occurrence on islands is mostly related to the presence on the adjacent mainland before the islands were severed (Richman, Case and Schwaner, 1988, Case, Bolger and Richman, 1998; Foufopoulos and Yves, 1999). If it is so, the European Leaf toed gecko had undergone its range retraction on the Tunisian mainland and in Provence (at least on French Var and Alpes Maritimes) and Liguria, when those landbridge islands were formed as a consequence of rising sea levels at the end of the Pleistocene. This hypothesis is congruent with the variation of occurrence but doesn't explain the differential extinction rate.

2) The variation of occurrence is the result of: a) a range retraction, as stated above; b) followed by an historic extinction process still in progress.

But why extinction proneness should vary, geographically? As stated by Foufopoulos and Yves (1999), the differential persistence abilities are presumably due to differences in ecological requirements and/or life history traits. As far as we know (without a thorough understanding of the processes of extinction), the life history traits associated with its surviving capacities in insular context are pretty much the same throughout its range (Delaugerre, 1992; Salvidio and Oneto, 2008; Salvidio, Lanza and Delaugerre, 2011): genetic adaptation to minimum population size, adaptability to the ecosystem limited and variable resources, adaptation to climate change, resistance to colonizing species and to interspecific interactions including diseases and parasitism.

3) If we take into account: the occurrence on islands, the extinctions rates and the mainland distribution (presumably absent from Tunisia and only isolated populations in Southern France, Liguria and coast of Tuscany); all the most vulnerable populations appears to be under a "continental effect", whereas central populations, occupying ancient Mediterranean islands, seem protected. Could insularity act as a shield against the progression of threats such as pathogen agents?

If, conversely, its presence on islands is the result of dispersal (hoping that phylogenetic study in progress will help answering this question, Carranza et al., pers com) an alternative hypothesis may be formulated.

1) This gecko is undergoing (or has undergone) a process of natural expansion from the very centre of its area toward Northern and Southern banks of the Western Mediterranean as stated by Müller (2001). Its variation of occurrence on islands means that colonization is in progress. There are no extirpations or geckos' demises but only failed colonization attempts. To be confirmed, this hypothesis will have to establish how those geckos could have achieved such a wide marine dispersion over hundreds or thousands kilometres. Especially dealing with a non-swimming reptile, specialist of rocky outcrops and living mostly on uninhabited islets devoid of trees or any floating items.

Table 5. Island where extirpation or long lasting demographic decline of *Euleptes europaea* has been recorded. Provence from Mourgue (1909, 1910, 1924), Jahandiez, Lantz and Parent (1933), Philippe (1955), J. Y. Dardun pers. com.(2003), Delaugerre (1981b), M. Delaugerre pers. com., M. Cheylan pers. com , Aillaud and Bayle (1996), Nougaret and Péténian (2003), Salvidio and Delaugerre (2003). Tunisia, this paper.

	island	extirpation (year of last sighting)	demographic decline followed by population recovery	human settlement	ship rat	colonization by another gecko
Provence[5]	Pomègue	/	(1910-1997)	X	X[1]	X[2]
	Ratonneau	/	(1910-1997)	X	X	X
	If	/	(1924-1955)	X	X	/[3]
	Grand Congloué	/	(1910-2003)	/	X	/
	Petit Congloué	/	(1910-2003)	/	X	/
	Ile de Bendor	(1933)	/	X	X	/
Tunisia	Galiton	(1876)	/	X	/	X
	Grand Cani	(1876)	/	X	/[4]	X

1: Feral cats were also numerous on the « Frioul islands » (i e Pomègue linked by a dike with Ratonneau) as stated by Mourgue (1930:77) who wrote about *Lacerta ocellata= Timon lepidus*: "La présence de nombreux chats les a fait disparaître, comme du reste les autres lézards (*Lacerta serpa campestris*), *Phyllodactyles*. »; 2: On the « Frioul islands » *Tarentola mauritanica* has been recorded at the beginning of the 20th century, according to Mourgue (1910): "…La preuve, c'est qu'au Frioul, où touchent certains navires, on a trouvé le *Platydactyle*". This gecko is absent nowadays; 3: Colonized by the lizard *Podarcis sicula campestris* Philippe (1955); 4: In 1876, ships rats were numerous on the Cani islands, at least on West Cani, as stated by D'Albertis (1878: 288): "Discesi al second scoglio si fece caccia di lucertole e topi, che vi sono abondantissimi". Nowadays, the Cani islands are devoid of ship rats; 5: *E. europaea* was also considered extirpated from the Marseilles' îlot des Pendus where it was discovered by Blanc (1876) but it might be the result of a misunderstanding, the 19th century "îlot des Pendus" being now called "îlot Nord d'Endoume" where Euleptes is present (Delaugerre 1981a).

Conclusion

Those faunistic results and the biogeographic analysis is a contribution to the knowledge and to the better understanding of a peculiar distribution of an endemic Mediterranean gecko. *E. europaea* is not only an European but is also a Maghrebian species. Its occurrence on the Western Mediterranean islands displays a clear trend, with on one hand a central area (Corsica, Sardinia, Tuscan Archipelago) with high frequency of occurrence and no extirpation; and on the other hand, the Northern (Provence-Liguria) and Southern (Tunisia) edges of its range, with lower occurrence and several cases of historical extirpation or long lasting demographic declines, always related to human settlements, ship rat or other geckos 'invasions.

The meaning of this trend depends on the relictual versus dispersal origin of this species on the islands. In the first case it would calibrate the history of a range retraction and evidence an historic extinction in progress related to a "continental effect"; in the other it would show a range expansion. Phylogenetic studies in progress will help to choose the right hypothesis. It will be a pre-requisite to elaborate a realistic and efficient conservation strategy.

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