

# Taxonomic impediment to conservation: the case of the Moroccan 'ferret' *Mustela putorius* ssp.

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## Abstract

The origin of the Ferret *Mustela furo*, which is presently known only in captivity and as wild-living populations descended from captive stock, is not fully understood. Generally, the population of polecat-/ferret-like animals in the Moroccan Rif is considered the result of ancient introduction, but molecular and palaeontological evidence contests this hypothesis. Therefore, more research is needed to understand the origin and taxonomic significance, and thus conservation significance, of Moroccan *Mustela*. Taxonomic and nomenclatorial confusion with domestic Ferrets, an introduced pest in several world ecosystems, plays a role in overlooking the perhaps serious conservation needs of a potential Maghrebian endemic. Given lack of recent records for wild ferrets in Morocco, a survey in the historical range of the species is urgently needed.

**Keywords:** fossil records, Maghreb, polecat, uncertain native/introduced status

## Résumé

L'origine du Furet *Mustela furo*, à présent seulement représenté en captivité et dans des populations sauvages provenant de souches captives, n'est pas complètement connue. Généralement la population d'animaux représentant la famille des putois / furets dans le Rif marocain est considérée comme étant le résultat d'une introduction ancestrale, cependant l'analyse moléculaire et les preuves paléontologiques réfutent cette hypothèse. Par conséquent, de plus amples recherches sont nécessaires afin de comprendre l'origine et l'importance taxonomique, ainsi que l'importance de conservation du genre *Mustela* marocain. La confusion au niveau de la taxonomie et de la nomenclature avec le furet domestique, un animal nuisible introduit dans plusieurs écosystèmes mondiaux, joue un rôle crucial dans le manque d'actions entrepris face à l'important besoin de conservation de la potentielle souche endémique magrébine. Suite au manque de données récentes pour le furet sauvage au Maroc, une enquête sur la répartition historique de cette espèce est nécessaire de toute urgence.

**Mots-clés:** Maghreb, origine indigène/introduite incertaine, putois, vestiges fossiles

Recognition of taxa is a necessary prerequisite for meaningful conservation of biodiversity. The ancient transport by humans of wild and domestic mammals to new lands has caused more than one problem to taxonomy. In particular, insular endemic taxa have often been taxonomically recognised despite their recent, human-mediated origin, and so Gippoliti & Amori (2002) argued that they attract more conservation attention than they really deserve. The opposite problem also arises, where conservation attention has sometimes been delayed for populations assumed to have been introduced by human agency, as with Central American Squirrel Monkey *Saimiri oerstedii* and the Bornean race of Asian Elephant *Elephas maximus borneensis* (Cropp & Boinski 2000, Fernando *et al.* 2003). Molecular investigations have often been powerful tools in elucidating the origin and establishing the true autochthony of such populations.

The Mediterranean Region is particularly prone to these problems, owing to a long history of human-mediated transportation of animals. Especially on islands, anthropochorous taxa have often distracted from the study of native endemic ones (Gippoliti & Amori 2006). A further complication is represented by the movement and release of domestic animals at different stages of domestication (Groves 1989).

Mustelids of the genus *Mustela*, subgenus *Putorius* include four closely related Holarctic taxa: Black-footed Ferret *Mustela nigripes* from North America, Steppe Polecat *M. eversmannii* and Western Polecat *M. putorius* from Eurasia and the

domesticated Ferret *M. furo*. Hybridisation occurs among all these taxa (Davison *et al.* 1999) and their conspecificity has been inferred by some authors (Marmi *et al.* 2004), but genetic introgression is suggested by the mitochondrial (mt) DNA of European Mink *M. lutreola* (Davison *et al.* 2000).

The Ferret is generally regarded as the domestic form of Western Polecat, but also (considering the distinctiveness of its skull from that of *M. putorius*) as a possible hybrid between *M. putorius* and the taxonomically very close *M. eversmannii*, or even a derivative of the latter (e.g. Miller 1912). The diploid chromosome number is  $2n=40$  for *M. putorius* and *M. furo*, but  $2n=38$  for *M. eversmannii*. The former two species have morphologically identical chromosome sets, but the karyotype of *M. eversmannii* differs by a single Robertsonian rearrangement (Volobuev *et al.* 1974). Molecular data derived from the nucleotide sequences of the nuclear interphotoreceptor retinoid binding protein (IRBP) and mitochondrial cytochrome b genes ally *furo* to *putorius* rather than to *eversmannii* (Sato *et al.* 2003), but mitochondrial data may not be considered conclusive at present (Kurose *et al.* 2008) and further studies of nuclear DNA are needed to clarify this situation.

The Greek geographer Strabo claimed an African origin of the Ferret when recounting its importation from 'Libya' (then used for much wider area than the country of today) to the Balearic islands to control European Rabbits *Oryctolagus cuniculatus* around 20 AD (Davison *et al.* 1999). Traditionally, a wild population referred to as *Mustela putorius furo* has been

reported from the Moroccan Rif, a compact mountain range in Northern Morocco (Cabrera 1930, Halternorth & Diller 1980, Kingdon 1997) and possibly in the isolated Beni Snassen massif (Griffiths & Cuzin in press). According to these latter authors, these areas are comparatively wooded and rainy (400–1,100 mm or more annual rainfall), compared with neighbouring areas in Morocco. While Morocco is listed in the range of *M. putorius* in compilations such as Wozencraft (2005) and the current version of *The IUCN Red List of Threatened Species* (Fernandes *et al.* 2008), these do not flag the potential taxonomic distinctiveness of this population, the sole African representative of *Mustela*, subgenus *Putorius*. Moreover, the population is not mentioned (text or map) in Corbet's (1978) review of Palaearctic mammals and several authors considered this population to be of feral origin, owing to uncertainty concerning the African origin of the Ferret (e.g. Aulagnier & Thévenot 1986). This population's perceived descent from domestic animals is borne out by the current wide nomenclatural usage of *furo* for both.

The view of an autochthonous Moroccan population seems to have received scant attention, despite important positive evidence in the last decade. Late Pleistocene (300,000 years onwards) remains of *M. putorius* (*sensu lato*) were discovered in the d'El Harhoura cave 1 at Rabat-Temara, less than 200 km south of current range. Although no precise dating of *Mustela* remains is available, these records are consistent with the natural presence of the species in North Africa (Aouraghe 2000). Furthermore, a phylogenetic study of mustelids dated the split between the *putorius* and *furo* lineages as 340,000 year before present (Sato *et al.* 2003), an estimate agreeing with the high divergence within other Palaearctic lineages that occur in the Maghrebian Region (a well-defined biogeographic province of the Palaearctic, encompassing Morocco, Algeria and Tunisia), such as the garden dormouse *Eliomys melanurus* and Red Deer *Cervus elaphus barbarus* (Filippucci *et al.* 1988, Pitra *et al.* 2004). A recent investigation of ancient mt DNA of the extinct North African Brown Bear *Ursus arctos* revealed the presence of a clearly distinct lineage not found in Europe (Calvignac *et al.* 2008).

These new data lead some support to the origin of the domestic Ferret being a highly divergent African lineage of *M. putorius*. If its autochthony can be confirmed, a formal description and naming of the North African polecat, even at subspecific level, is needed. In agreement with Opinion 2027, March 2003, by the International Commission on Zoological Nomenclature, the name *furo* is not available for a wild taxon (Gentry *et al.* 2006): it was introduced by Linnaeus specifically for domestic Ferrets. Thévenot & Aulagnier (2006), believing that Ferret is descended from the population native to Morocco and distinct from *M. putorius*, listed '*M. furo*' as extinct in the wild owing to a total lack of recent records (S. Aulagnier *in litt.* 2008), while Griffiths & Cuzin (in press), on the contrary, authored a profile of the Maghrebian taxon under the name '*M. putorius*' for the handbook *Mammals of Africa*. According to these latter authors, the last reported observations of wild animals were from two localities in the area of Chefchaouen (western Rif) in 1986 and 1987. Formal nomenclatorial recognition of the Moroccan population should also have beneficial effects for its conservation. In contrast, domestic Ferret does not require conservation, having been responsible for major ecological damage since it was released in New Zealand and other oceanic islands (e.g. Medina & Martín 2009).

Molecular investigation of tissues of historical and more recent specimens should provide fundamental insight, albeit perhaps not definitive, concerning the origin of the Moroccan population and its relationship with domestic Ferrets. Meanwhile, the present conservation status of the species in Morocco needs clarification before it is too late. Hopefully, the absence of recent records is only the result of the scarcity of interest for a perceived 'feral' species not included among protected species by Moroccan law (Griffiths & Cuzin, in press), but the danger is real to lose a unique member of Maghrebian biodiversity. The Barbary race of Lion *Panthera leo leo* is extinct in the wild and the captive diaspora is heavily genetically polluted by Lions of sub-Saharan races (Burger & Hemmer 2006, Schnitzler 2011). The low conservation interest in the taxonomic ambiguity that is the Maghrebian polecat contrasts with that of the closely related Black-footed Ferret, which has received considerable attention and financial funds in the United States of America, becoming one of the most successful cases in modern conservation biology (Seal *et al.* 1989, Jachowski & Lockhart 2009).

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### References

- Aouraghe, H. 2000. Les carnivores fossiles d'El Harhoura 1, Témara, Maroc. *Anthropologie, Paris* 104: 147–171.
- Aulagnier, S. & Thévenot, M. 1986. *Catalogue des mammifères sauvages du Maroc*. Institut Scientifique, Rabat, Morocco.
- Aulagnier, S., Haffner, P., Mitchell-Jones, A. J., Moutou, F. & Zima, J. 2008. *Guides des mammifères d'Europe, d'Afrique du Nord et du Moyen Orient*. Delachaux et Niestlé, Paris, France.
- Burger, J. & Hemmer, H. 2006. Urgent call for further breeding of the relic zoo population of the Critically Endangered Barbary Lion (*Panthera leo leo* Linnaeus, 1758). *European Journal of Wildlife Research* 52: 54–58.
- Cabrera, A. 1930. La patria del *Putorius furo*. *Boletín de la Reale Sociedad Española de Historia Natural* 30: 477–480.
- Calvignac, S., Hughes, S., Tougard, C., Michaux, J., Thévenot, M., Philippe, M., Hamdine, W. & Hänni, C. 2008. Ancient DNA evidence for the loss of a highly divergent Brown Bear clade during historical times. *Molecular Ecology* 17: 1962–1970.
- Corbet, G. B. 1978. *The mammals of the Palaearctic region: a taxonomic review*. British Museum (Natural History) and Cornell University Press, London, U.K., and Ithaca, U.S.A.
- Cropp, S. & Boinski, S. 2000. The Central American Squirrel Monkey (*Saimiri oerstedii*): introduced hybrids or endemic species? *Molecular Phylogeny and Evolution* 16: 350–356.
- Davison, A., Birks, J. D. S., Griffiths, H. I., Kitchener, A. C., Biggins, D. & Butlin, R. K. 1999. Hybridization and the phylogenetic relationship between Polecats and domestic Ferrets in Britain. *Biological Conservation* 87: 155–161.
- Davison, A., Griffiths, H. I., Brookes, A., Maran, T., MacDonald, D. W., Sidorowich, V. E., Kitchener, A. C., Irizar, I., Villate, I., González-Esteban, J., Ceña, J. C., Ceña, A., Moya, I. & Palazon Miñanos, S.

2000. Mitochondrial DNA and paleontological evidence for the origins of endangered European Mink, *Mustela lutreola*. *Animal Conservation* 4: 345–355.
- Fernandes, M., Maran, T., Tikhonov, A., Conroy, J., Cavallini, P., Kranz, A., Herrero, J., Stubbe, M., Abramov, A. & Wozencraft, C. 2008. *Mustela putorius*. In: IUCN 2011. *IUCN Red List of Threatened Species*. Version 2011.1. www.iucnredlist.org. Downloaded on 17 August 2011.
- Fernando, P., Vidya, T. N. C., Payne, J., Stuewe, M., Davison, G., Alfred, R. J., Andau, P., Bosi, E., Kilbourn, A. & Melnick, D. J. 2003. DNA analysis indicates that Asian Elephants are native to Borneo and are therefore a high priority for conservation. *PLoS Biology* 1: 110–115.
- Filippucci, M. G., Rodinò, E., Nevo, E. & Capanna, E. 1988. Evolutionary genetics and systematics of the garden dormouse, *Eliomys Wagner*, 1840. 2 – Allozyme diversity and differentiation of chromosomal races. *Bollettino di Zoologia* 55: 47–54.
- Gentry, A., Clutton-Brock, J. & Groves, C. P. 2006. The naming of wild animal species and their domestic derivatives. *Journal of Archaeological Science* 31: 645–651.
- Gippoliti, S. & Amori, G. 2002. Anthropochorous mammal taxa and conservation lists. *Conservation Biology* 16: 1162–1164.
- Gippoliti, S. & Amori, G. 2006. Ancient introductions of mammals in the Mediterranean Basin and their implications for conservation. *Mammal Review* 36: 37–48.
- Griffiths, H. I. & Cuzin, F. in press. *Mustela putorius*. In Kingdon, J. & Hoffmann, M. (eds) *The mammals of Africa, vol. 5. Carnivores, equids and rhinos*. Academic Press, Amsterdam, Netherlands.
- Groves, C. P. 1989. Feral mammals of the Mediterranean islands: documents of early domestication. Pp. 46–58 in Clutton-Brock, J. (ed.) *The walking larder*. Unwin Hyman, London, U.K.
- Halternorth, T. & Diller, H. 1980. *A field guide to the mammals of Africa including Madagascar*. Collins, London, U.K.
- Jachowski, D. S. & Lockhart, J. M. 2009. Reintroducing the Black-footed Ferret *Mustela nigripes* to the Great Plains of North America. *Small Carnivore Conservation* 41: 58–64.
- Kingdon, J. 1997. *The Kingdon field guide to African mammals*. Academic Press, London, U.K.
- Kurose, N., Abramov, A. V. & Masuda, R. 2008. Molecular phylogeny and taxonomy of the genus *Mustela* (Mustelidae, Carnivora), inferred from mitochondrial DNA sequences: new perspectives on phylogenetic status of the Back-striped Weasel and American Mink. *Mammal Study* 33: 25–33.
- Marmi, J., López-Giráldez, J. F. & Domingo-Roura, X. 2004. Phylogeny, evolutionary history and taxonomy of the Mustelidae based on sequence of the cytochrome b gene and a complex repetitive flanking region. *Zoologica Scripta* 33: 481–499.
- Medina, F. M. & Martín, A. 2009. A new invasive species in the Canary Islands: a naturalized population of Ferrets *Mustela furo* in La Palma Biosphere Reserve. *Oryx* 44: 41–44.
- Miller, G. S. 1912. *Catalogue of mammals of western Europe in the British Museum*. British Museum, London, U.K.
- Pitra, C., Fickel, J., Meijaard, E. & Groves P. C. [sic] 2004. Evolution and phylogeny of Old World deer. *Molecular Phylogenetics and Evolution* 33: 880–895.
- Sato, J. J., Hosoda, T., Wonsan, M., Tsuchiya, K., Yamamoto, Y. & Suzuki, H. 2003. Phylogenetic relationships and divergence times among mustelids (Mammalia: Carnivora) based on nucleotide sequences of the nuclear interphotoreceptor retinoid binding protein and mitochondrial cytochrome b genes. *Zoological Science* 20: 243–264.
- Schnitzler, A. E. 2011. Past and present distribution of the North African–Asian Lion subgroup: a review. *Mammal Review* 41: 220–243.
- Seal, U., Thorne, E. T., Bogan, M. A. & Anderson, S. H. (eds) 1989. *Conservation biology and the Black-footed Ferret*. Yale University Press, New Haven, CT, U.S.A.
- Thévenot, M. & Aulagnier, S. 2006. Mise à jour de la liste des mammifères sauvages du Maroc. Janvier 2006. *Go-South Bulletin* 3: 6–9.
- Volobuev, V. T., Ternovsky, D. V. & Graphodatsky, A. S. 1974. [Taxonomic status of Ferret based on karyological data]. *Zoologicheskii Zhurnal* 53: 1738–1739. (In Russian.)
- Wozencraft, W. C. 2005. Order Carnivora. Pp. 532–628 in Wilson, D. E. & Reeder, D. M. (eds) *Mammal species of the world. A taxonomic and geographic reference*, 3rd edn. Johns Hopkins University Press, Baltimore, U.S.A.

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