

A Short Note on the Recent Taxonomic Developments and Molecular Findings on the Cyprian Mouflon (*Ovis GmeliniOphion*) and the Sardinian Mouflon (*Ovis Gmelini Musimon*)

Eleftherios Hadjisterkotis^{1*}, Daria Sanna², Monica Pirastru² and Paolo Mereu²

¹Agricultural Research Institute, Cyprus

²Department of Biomedical Sciences, University of Sassari, Italy

*Corresponding author: Eleftherios Hadjisterkotis, Agricultural Research Institute, P.O. Box 22016, Nicosia 1516, Cyprus



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ABSTRACT

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Mini Review

The classification of Mediterranean and Asiatic mouflons, urials and their hybrids are under constant debate, taxonomic confusion and spelling inconsistencies. Based on morphological criteria, karyological and biochemical evidence and geographic distribution, several classifications and taxonomical revisions of these species have been proposed during the last two centuries [1]. To solve this inconsistency, the problem was discussed during the 2000 taxonomy workshop in Ankara (Turkey) among the members of the IUCN Caprinae Specialist Group of the Species Survival Commission (SSC). These experts could not agree whether the scientific name for urial should be *O. orientalis* or *O. vignei* [2]. However, the participants suggested that there should be a differentiation between mouflons and urials, partly as consequence of the differences in the number of chromosomes, (mouflon: $2n = 54$; urial: $2n = 58$), referring to them as *O. gmelini* and *O. orientalis*, respectively. More recently, the name *Ovis orientalis Gmelin 1774*, was placed on the Official List of Specific Names in Zoology by ICZN, Opinion 2027 [3], but it probably refers to a hybrid [4], however, the name is nonetheless unusable (Art. 17.2) [5] and may enter into homonymy (Art. 23.8).

The ICZN [3] ratified the published 1996 Bulletin of Zoological Nomenclature opinion that the Asian mouflon shall be called

O. orientalis and the European/Mediterranean mouflons were grouped with the domestic sheep, *O. aries*. On the contrary to the Ankara workshop, during the 6th World Congress on Mountain Ungulates and 5th International Symposium on Mouflon which took place in Nicosia Cyprus (August 29 - Sept. 1st, 2016), all participants decided unanimously: 'To uniformly update the taxonomy of the Cyprus mouflon to *Ovis gmelini ophion* within the relevant legal and scientific framework ...' [6]. Such a decision was based mainly on the recent work of Sanna, et al. [7], who reported the first complete sequence of a Cypriot mouflon mitochondrialDNA (mtDNA) and performed phylogenetic analyses using datasets of whole *Ovis* mitogenomes, and of D-loop fragments comprising samples from the main Mediterranean islands. Based on the work of Sanna, et al. [7], as the Cyprian mouflon mitogenome sequence did not match any of the domestic sheep haplogroups (HPG) described so far, Hadjisterkotis, et al. [1] argued that *O. g. ophion*:

- Is not a feral form of the domestic sheep, but rather a real wild sheep, related but divergent from *O. aries*;
- Should be considered as one of the most probable ancestors of the domestic sheep species belonging to HPGs C and E.

In addition, the Cyprian mouflons were found closely related to the Anatolian individuals carrying the D-loop haplotype X [8]. This finding supports the Hadjisterkotis [9,10] and Hoefs, et al. [11] observations that, based on the phenotypes of the Cyprus mouflon and the Armenian mouflon, suggested the Cyprian wild sheep is a subspecies of *Ovis gmelini*. The mouflons of Cyprus are characterized by perverted supracervical horn growth [11] (Figure 3, p. 50, Hadjisterkotis, et al. [1]). Such types of horns are rare in wild sheep, being considered as diagnostic characters only for two subspecies of mouflon (Cyprian and Armenian), with occasional specimens also reported for the European mouflon and the “Red sheep” of the Elbrus Mountains of northern Iran. These “Red sheep” are assumed to be hybrids between the Armenian mouflon and the Transcaspians (*Ovis orientalis arkal*). Therefore, Hadjisterkotis, et al. [1] concluded that the Cyprus mouflon, should not be attributed to the species *O. aries*, but rather be managed as a separate and genetically distinct taxonomic conservation unit, namely *O. gmelini ophion*.

Contrary to the above conclusive decision of the scientific committee and the participants of the 6th World Congress on Mountain Ungulates and 5th International Symposium on Mouflon, no decision was taken for the European Mouflon. To date, five different domestic sheep (*Ovis aries*) mitochondrial haplogroups clustering in two main clades have been identified [7]. Considering that the analysis of mtDNA represents an ideal and extensively used molecular tool to infer the origin of the species and to estimate levels of genetic variation during the process of domestication [7], Mereu, et al. [12] characterized the first complete mtDNA sequence of a Sardinian mouflon with the aim to shed light on the influence of different genetic and environmental parameters on the current mouflon diversity patterns, and on the phylogenetic relationship between Sardinian mouflon and its wild and domestic relatives. The results pointed out that Sardinian mouflons maintained their original genetic features which became lost in the relatives living in the European mainland countries, and that there is no relationship with domestic sheep.

These findings evidenced the need to revise the systematic classification and nomenclature of the European (Sardinian) mouflon, taking into consideration its crucial role in the raise of the most worldwide spread haplogroup (HPG B), and also the selection process which originated the current domestic sheep.

In the light of the above reported recent findings, we believe that the downgrading of the European/Mediterranean mouflons with domestic sheep [3] was based on insufficient data, and mouflon taxonomy should be revised, based on the findings and suggestions of Mereu, et al. [12] and the resolutions of the 6th World Congress on Mountain Ungulates and 5th International Symposium on Mouflon, held in Nicosia Cyprus in 2016.

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Eleftherios Hadjisterkotis. Biomed J Sci & Tech Res



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