

Phenotype Evaluation of Free-Ranging European Mouflon (*Ovis orientalis musimon*) on Kahuku Ranch, South Point Hawaii.

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ABSTRACT

Are the free-ranging European Mouflon (*Ovis orientalis musimon*) on the Kahuku Ranch "true" mouflon? Field Surveys conducted during October 1997 examined this question based on phenotype conformation. Five hundred thirty four live mouflon were examined in the field and 17 hunter-harvested rams were measured and photographed. The mouflon on Kahuku Ranch were determined to be phenotypically true, exhibiting typical or classical characteristics attributed to the species *Ovis orientalis musimon*.

INTRODUCTION

The phenotypic status of mouflon sheep (*Ovis orientalis musimon*) on the Kahuku Ranch, near the southern tip of Hawaii's Big Island, is described. South Point Safaris Ltd., the hunting company on Kahuku Ranch, requested assistance in determining the phenotypic status of sheep on their hunting concession. The purpose was to determine the appropriateness of these mouflon for designation as "true" for trophy hunting purposes.

According to Giffen (1979), Hawaii supports both purebred mouflon and feral sheep-mouflon hybrids, a situation similar to many locations on the U.S. mainland and throughout Europe. The situation is common because European mouflon will readily cross with domestic sheep (*Ovis aries*) and will produce fertile offspring (Tomiczek 1985). The question of how "true" various hunted mouflon populations are is one often raised by hunters.

European Mouflon

European mouflon are native to the Mediterranean islands of Corsica and Sardinia. Mouflon are widely distributed due to introductions to the Crimea, Germany, Switzerland, Holland, Luxemburg, Italy, Poland, Czechoslovakia, Hungary, Yugoslavia, Romania, Spain, Finland, Denmark, Bulgaria and the United States (Clark 1964; Uloth 1976; Valdez 1982). Most mouflon populations in Europe were established during the past 250 years (Tomiczek 1985, Uloth and Prien 1985). According to Valdez (1982), "The European and Cyprian mouflon probably originated from feral (domestic gone wild) primitive domestic sheep brought to the Mediterranean islands of Corsica, Sardinia, and Cyprus by man." Some reports indicate the mouflon on Corsica have interbred with domestic sheep brought to the island and domestic strains were added to European introductions to provide hunters with larger trophies (Mungall and Sheffield 1994). Mouflon are considered very similar genetically to domestic sheep and may be very similar to those wild sheep originally domesticated by man. Blood analyses reported by Stralit and Bobbak (1988) provide further evidence for close similarity between domestic sheep and mouflon. In a report on a study of hemoglobin phenotypes in wild European mouflon on the

island of Sardinia, Naitana, et al (1990) concluded there were structural and physiological homologies between domestic Sardinian sheep and mouflon for specific β -globin alleles. Hadjisterkotis (1996), in reporting on the taxonomy of mouflon on the Greek island of Cyprus indicates wild sheep on Cyprus stem from a domesticated wild strain of sheep introduced by man around 6000 BC. From analysis for cytochrome b gene in mitochondrial DNA, Arai, et al. (1997) concluded domestic sheep have been established from mouflon. This close association of European mouflon with domestic sheep on both native and introduced ranges has long made their classification problematic.

Because of their origins and close relationship to mainland moufloniforms, Valdez (1982) considered insular Mediterranean mouflon to be conspecific with mainland forms. He recognized mouflon dwelling on Corsica and Sardinia as *Ovis orientalis musimon* and those on Cyprus as *Ovis orientalis ophion*. Cugnasse (1994) classified the mouflon on the Mediterranean islands as three varieties -- *Ovis gmelini musimon*, var. *corsicana*; *Ovis gmelini musimon*, var. *musimon*; and *Ovis gmelini musimon*, var. *ophion* for the wild sheep on the islands of Corsica, Sardinia, and Cyprus, respectively. Other authors have proposed different classification schemes. *Ovis orientalis musimon* is the classification of choice for this paper. For these reasons visually observable morphological characteristics reported in the literature as typical of "true" mouflon were used to make the phenotypic determination reported here.

Study Area

The South Point mouflon population ranges over several thousand acres of the privately owned Kahuku Ranch and adjacent Kau State Forest. The landform consists of lava flows from Mauna Loa volcano vegetated to shrub steppe plant communities or forest. Some of the more recent flows are not vegetated. Topography created by the lava flow substrate provides the basis for a very diverse landscape. Mouflon are free ranging with only natural topographic features and the Pacific Ocean limiting distribution along a portion of their range. South Point mouflon are separated from other mouflon or feral sheep populations by a distance of about 20 to 30 airline miles (Giffen 1976; Giffen 1975-1979; van Riper and van Riper III 1982).

Mouflon were introduced to the Kahuku Ranch in 1968 and are managed for trophy hunting with periodic culling of females to control the population density. Mouflon are abundant, but population density or trend estimates are not available. O'Gara (1994) studied habitat conditions, food habits, and population dynamics of this mouflon population.

Cattle (*Bos taurus*), both feral and domestic, are the only other large ungulate occupying the South Point mouflon range. Forage competition may be occurring between mouflon and cattle, but range use for both species only overlaps on a portion of the wild sheep range.

METHODS

Mouflon were observed in the field for European mouflon phenotype characteristics reported by Lydekker (1901), Clark (1964), Uloth (1976), Valdez (1982), Mungall and Sheffield (1994), and others.

For rams, the characteristics include:

Hair that is close, thick, and somewhat stiff. Coarse hair rather than wool forms the outer coat. Distinct neck ruff during the rut.

General color of the coat on mature rams is rufous brown or foxy red shading into chocolate brown on the head and face.

Black on sides of the neck, throat, chest with a band of black on the flanks. Black also as a streak down the withers, on the outer front surfaces of the forelegs above the knees, and on the front and outer sides of the hind limbs above the hocks.

Ears are grayish with the margins and part of their interior white.

Muzzle and chin grayish white shading into grayish rufous in the middle of the black area on the throat.

A broad band grizzled with white defines the rear border of the saddle patch.

The buttocks and all under parts, except for a narrow streak down the forelegs, are white.

Limbs exhibit a streak of white on their back surface above the knees and hocks. Below the knees, legs are white except for a varying amount of black on the front of the anterior pair.

In winter coat the general color of the upper parts deepens and becomes more of a chestnut brown. The saddle patch on each side of body lightens until in many older rams is nearly white.

Horns of mouflon are variable, but most typically are inward at about the 3/4 curl point.

A strong sexual dimorphism exists, especially in older animals. The pelage coloration exhibited by "true" female mouflon varies from light tan to dark brown. The dorsal patch is absent or indistinct. Lambs are similar in appearance to ewes. Adult females may or may not have horns. When horns are present on females they are only a few inches in length.

Binoculars (10X) and spotting scope (15X40) were used to make field observations. Only sheep within a few hundred yards and observed under good lighting conditions were included in the sample. Particular attention was paid to spotting atypical features.

Physical measurements included horn length, horn base circumference, total length, girth, length from top of front shoulder to tip of front hoof, length from crown of rump to tip of hind hoof, ear length, eye to tip of nose length, and live weight. Data were recorded and averages calculated and compared with lengths reported for mouflon in the literature. All measurements were recorded to the nearest 1/8 inch. Each ram was assigned an approximate age. Hawaii's year-round growing season resulted in some growth rings being indistinct.

Visual observations and physical measurements, compared with similar information reported by Clark (1964), Uloth (1976), Valdez (1982), Mungall and Sheffield (1994), and others, formed the basis for an opinion as to the phenotype status of South Point mouflon.

RESULTS AND DISCUSSION

From October 9th to October 13th, 1997, 534 free-ranging wild mouflon were observed. Composition of the sample was 51, 9, and 40 percent ewes, lambs, and rams, respectively. Additionally, horn and body measurements were taken from 17 mouflon harvested by hunters. Horn measurements were taken from two additional mouflon found in the field. Live weights were taken for two harvested rams and one adult ewe.

Population

The proportion of the population sampled is not known, as no estimate of total mouflon numbers is available for this several thousand-acre wild sheep range. Most of the landform exhibits very rugged topography created by recent and historic lava flows. Vegetation consists of forest shrubland and small meadows. The mouflon are free ranging. None of the area is fenced with wildlife-tight fence. A portion of the area bounds the Pacific Ocean. The difficulty of making accurate population estimates in habitats like this is well known. Therefore, since sheep are obviously abundant, sampling effort concentrated on observing the maximum number of sheep possible rather than a predetermined sample size.

Visual Characteristics

All of the 534 mouflon observed exhibited coat coloration patterns and other physical characteristics described for true mouflon by Lydekker (1901), Clark (1964), Uloth (1976), Valdez (1982), and Mungall and Sheffield (1994). All adult rams exhibited pelage typical of the rutting season.

Physical Characteristics

Horn measurements were collected from 19 rams ranging in age from 7 to 11 years. Body measurements were taken from 17 hunter-harvested mouflon rams.

Horns

The mean age for rams sampled was 10 years. Mean horn length was 28.49 and 28.48 inches for the right and left sides, respectively. Mean horn basal circumference was 8.98 and 9.23 for the right and left sides, respectively. A tip-to-tip measurement was taken for 15 rams and a mean of 16.28 inches was calculated. The aforementioned measurements are similar to those reported by Clark (1964), Uloth (1976), Valdez (1982) and Mungall and Sheffield (1994). Typically, horns of mature (trophy type) rams were observed to arc in rather than out at the horn tips.

Body Measurements

Mean measurements for total body length, ear length, girth, and tail length were 49.22, 3.47, 32.17, and 3.59 inches, respectively. For five mouflon the, distance from top of the shoulder to the tip of front hoof, and distance from crown of the rump to tip of the hind hoof, was 28.85 and 29.13 inches, respectively. The mean hind foot length for 16 mouflon was 11.80 inches. The mean eye-to-nose distance for 10 mouflon was 5.43 inches. Mungall and Sheffield (1994) reported that purebred mouflon, unlike domestic sheep or many mouflon crosses, have a short tail of 3 to 4 inches. For two adult rams, the mean live weight was 87 pounds. Live weight for one young adult ewe was 51 pounds. Measurements such as these can show considerable variability between different populations and habitats. However, they are within the range of measurements reported by Clark (1964), Valdez (1982), Mungall and Sheffield (1994) and others.

CONCLUSIONS

Wild free-ranging mouflon inhabiting the Kahuku Ranch at South Point Hawaii are true European mouflon, exhibiting all of the typical or classic characteristics attributed to the species *Ovis orientalis musimon*.

LITERATURE CITED

- Arai, K., I. Munechika, Ito, A. Kikkawa, K. Nakamura, T. Kanazawa, and M. Losu Giyama. 1997. Phylogenetic Relationship of Caprini Estimated by Cytochrome b Gene Sequence Analysis. *Anim. Sci. Technol. (Japan)* 68(2): pages 148-155.
- Clark, J.L. 1964. *The Great Arc of The Wild Sheep*. University of Oklahoma Press. 247 pages.
- Cugnasse, J.M., 1994. Revision taxinomique des mouflons des iles mediterraneenes. *Mammalia*, t. 58, N3: pages 507-512.
- Giffen, J.G. 1975-1979. *Ecology of Moulon Sheep on Mauna Kea*. Pittman Robertson Project No. W-17-R, Study No. R-11, State of Hawaii Department of Land and Natural Resources Division of Forestry and Wildlife. 65 pages.
- Giffen, J.G. 1976. *Ecology of Feral Sheep on Mauna Kea*. Pittman-Robertson Project No. W-15-5, Study No. XI 1972-1975. State of Hawaii Department of Land and Natural Resources Division of Fish and Game. 90 pages.
- Hadjisterkotis, V.E. 1996. Herkunft, Taxonomie und neuere Entwicklung des Zyprishchen Mouflons (*Ovis gmelini ophion*). *Z. Jagdwiss.* 42: pages 104-110.
- Lydekker, R. 1901. *The Great and Small Game of Europe, Western and Northern Asia and America*. Rowland Ward, London. 445 pages.

- Naitana, S., S. Ledd, E. Cocco, L. Manca, and B. Masala. 1990. Haemoglobin Phenotypes of the Wild European Mouflon Sheep Living on the Island of Sardinia. *Animal Genetics* 21: Pages 67-75.
- O'Gara, B. 1994. Report to Trustees of the Damon Estate Concerning Mouflon on the Kahuku Ranch. Unpublished Report. 18 pages.
- Stratil, A. and P. Bobak, 1988. Comparison of Biochemical Polymorphisms in Mouflon and Sheep: Isoelectric Differences in Haemoglobins and Quantitative Variation of Mouflon Haemopexin. *Comp. Biochem. Physiol.* Vol. 90B, No. 1: pages 159-162.
- Tomiczek, H. 1985. The Mufflon (*Ovis ammon musimon*) Schreber, 1782. In the Southern and Western Countries of Europe, Northern Wild Sheep and Goat Council Special Report, Wild Sheep Distribution, Abundance, Management and Conservation of the Sheep of the World and Closely Related Mountain Ungulates. Edited by Manfred Hoes. Pages 127-133.
- Uloth, W. 1976. Das Muffelwild. A. Ziemsen Wittenberg Lutherstadt. 104 pages.
- Uloth, W. and S. Prien, 1985. The History of Mouflon Sheep (*Ovis ammon musimon*) (Schreber 1782) Central and Eastern Europe and the Development and Management of These Wild Sheep Populations. In: Northern Wild Sheep and Goat Council Special Report, Wild Sheep Distribution, Abundance, Management and Conservation of the Sheep of the World and Closely Related Mountain Ungulates. Ed. Manfred Hoefs: pages 133-137.
- Valdez, R. 1982. The Wild Sheep of the World. Wild Sheep and Goat International. 186 pages.
- van Riper, S.G. and C. van Riper III. 1982. A Field Guide to the Mammals in Hawaii. The Oriental Publishing Company, Honolulu, Hawaii. 68 pages.