

Early and double breeding in a pack of hybrid wolves in Calabria (Southern Italy)

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ABSTRACT

Some anomalies in the breeding cycle of a pack of wolf-dog hybrids in a semi-anthropized area in the central-western part of Calabria are described. The data were collected between October 2019 and March 2021 by direct observations and video-camera trapping. In addition to recording anomalous morphological and phenotypic traits present in varying degrees in some individuals of the pack, we documented for two consecutive years the breeding of a subordinate female that was about three months early compared with the normal wolf breeding cycle. Moreover, in spring 2020, it was possible to observe double breeding within the same pack, due to the regular reproduction of the dominant female.

KEY WORDS

Canis lupus; Wolf×dog hybridization; introgression; reproductive physiology; early breeding.

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INTRODUCTION

Wolf × dog hybridization has been documented in several parts of the world at different times (Salvatori et al., 2020; Kusak et al., 2018; Pilot et al., 2018; Hindrikson et al., 2012; Godinho et al., 2011; Randi, 2011; Vilà et al., 2003). In the past, episodes of crossbreeding with dogs were presumably less frequent and thus genetically more easily diluted in wolf populations. However, there has been an increase of cases in recent years, especially in countries where the large number of stray dogs and other anthropogenic factors have favored opportunities for contact (in Ciucci, 2012).

In Italy, recent estimates of the timing of hybridization events indicate that the peak of recorded cases occurred at the end of the 1990s (Galaverni et al., 2017), suggesting that most of the hybrids date to the phase of the wolf's numerical and range expansion that started in those years and is still ongoing (Fabbri et al., 2007; Galaverni et

al., 2015; Marzano et al., 2017; Marucco et al., 2018).

Hybridization with dogs and the deleterious consequences of gene introgression currently represent one of the main threats for conservation of the wolf (Donfrancesco et al., 2019; Hindrikson et al., 2017). The phenomenon places at risk not only its genomic integrity but also its adaptive capacity, with the irreversible loss of allele frequencies likely responsible for ecological and behavioral adaptations (Lynch & O'Hely, 2001).

Despite the increasing number of genetic studies to evaluate the amount of introgression in natural populations, little is known about the behavior and ecology of hybrids in the wild (Lescureux & Linnell, 2014). Recent studies, also carried out via satellite telemetry, have analyzed the spatial and alimentary ecology in some packs of wolf-dog hybrids (Molinari, 2020). However, aspects related to physiology and reproductive behavior remain poorly documented and mostly refer to studies con-

ducted in the last century. In particular, some differences in reproductive physiology were recorded in an 8-year experimental work conducted on 101 individuals of wolf hybrids in captivity (Iljin, 1941). That study revealed sexual receptivity of the hybrids only once a year as in wolves, but also found in most of the individuals an advance of 2–3 months compared to the wolf's normal breeding period.

Although the extent of hybridization is poorly known also in Calabria, cases have recently been recorded both in areas of stable presence of the species, e.g. in the protected areas of Pollino and Aspromonte (AA.VV., 2019), and in semi-anthropized rural areas of more recent colonization, as the authors report below.

MATERIAL AND METHODS

In the present note, investigations carried out over a period of about a year and a half on a pack of wolf-dog hybrids in the wild are described, and some data on the ecology and reproductive physiology are provided. In particular, cases of reproduc-

tion by two different females are documented, one of which was about 2–3 months early compared to the normal wolf breeding period.

The investigations began in autumn 2019 when, during some surveys aimed at expanding the study of the species in Calabria, the presence of a group composed of three individuals was detected, two of which with anomalous traits compared to the wolf's wild phenotypic standard. The pack's *core area*, with a high degree of anthropization and environmental degradation, was identified in the central-western part of Calabria in a foothill band overlooking the coast of the Tyrrhenian Sea, characterized by various types of productive activities (agricultural, industrial and artisanal) as well as the presence of various strategic infrastructures.

The data were acquired by means of direct observations and video-photographic surveys (two surveys per month for a total of 36 days), programmed opportunistically and making use of a digital reflex camera with telephoto lens and a camera trap with low glow infrared LEDs set for video recording (two camera-traps for 75 days in two different recording sessions).



Figure 1. Dominant couple (WD1 and WD2) and subordinate female (WD3).

RESULTS

It was possible to distinguish a phenotypically wild-type female (WD2) and two other individuals, a female (WD3) and a male (WD1), with signs of hybridization (Figs. 1, 2). The anomalous characters of each individual (Table 1) refer to the phenotypic markers of hybridization reported in the literature (Ciucci et al., 2003; Anderson, 2009; Ciucci, 2012; Caniglia et al., 2013; Galaverni et al., 2017). From behavioral observations, it was possible to define the hierarchy of the pack by identifying the dominant couple as WD1 and WD2. At the end of February 2020, WD3 was observed in the lactation phase, and during subsequent monitoring the yelps of an unknown number of pups coming from the den site were heard. These observations document the anomalous breeding of a subordinate female of the pack that was ca. 2–3 months early compared to the wolf standard. Further checks revealed the presence of only one pup (WD4) with clear signs of hybridization (Fig. 2) whose phenotypic traits suggest that WD3 bred with an individual external to the pack, probably one of the local

shepherd's dogs phenotypically very similar to WD4. The appearance of traits related to the different breeds of dogs involved in crosses is a naturally expected consequence and is also described in some studies conducted in captivity (Silver & Silver 1969).

In the following months, direct observations documented the continuous use of the area and the constant association of the three adults and the pup. In June 2020, WD2 was observed with clearly visible mammae; thus, it was possible to confirm the reproduction of the dominant couple consistent with the normal breeding seasonality of wolves.

Following the installation of two camera traps near the breeding site, some of the dynamics governing the pack's social organization were observed. In this phase, the role of helper assumed by WD4 became clear; in the absence of the adults, it often remained to support and watch over the newborn pups. At the end of June, it was possible to document the presence of four other pups which in the subsequent growth stages presented anomalous phenotypic traits (Table 1; Fig. 2). The pack composed in this way remained together until the sub-



Figure 2 - Pack's individuals observed until March 2021.

Individual	Abnormal phenotypic traits
WD1 ♂	abnormal extension of the face mask accentuated contrast of the coat color depigmented claws
WD2 ♀	wild-type
WD3 ♀	particularly dark coat color excessive fur length abnormal morphological proportions
WD4 ♂	mottled coat color excessive fur length abnormal morphological proportions dewclaws on the hind limbs long curved tail depigmented claws
WD5 ♂	coat with isabelline shades depigmented claws dewclaws on the hind limbs
WD6 ♂	melanistic coloring of the coat with large white spots dewclaws on the hind limbs
WD7 ♀	melanistic coloring of the coat with white spots dewclaws on the hind limbs
WD8 ♂	face mask with anomalous contrast and extension accentuated contrast of the coat color dewclaws on the hind limbs particularly evident supraocular marks

Table 1. Abnormal phenotypic traits recorded for each individual of the pack.

sequent 2021 reproductive phase, and at the end of February of the same year the early breeding of WD3 was observed again. Although there is a lack of genetic data able to define the generation in which the hybridization occurred and phenotypic traits are less reliable from a methodological perspective, in this specific case all the character states currently recognized as an effective indication of hybridization were recorded (melanism, dewclaws

on the hind legs, depigmented claws). Moreover, the observed reproductive dynamics and the simultaneous presence of multiple diagnostic traits objectively indicate genetic introgression in the pup (WD4) and, more generally, the hybrid origin of the pack. The atypical social structure compared to traditional wolf packs probably caused the low reproductive success of WD3. In fact, lack of parental care and lower pack cohesion can lead to a higher rate of mortality of pups of hybrids with respect to wolves (Mengel 1971; Vilà & Wayne 1999; Godinho et al., 2011).

Although it was not possible to determine the actual size of the pack's territory, the constant frequentation of the home site throughout the year suggests that it is extremely small and stable. The absence of potential natural prey suggests the presence of food sources of anthropogenic origin available all year round. This is supported by the known tendency in the area for illegal disposal of both butchery wastes and carcasses of dead farm animals. In some areas with strong anthropization and scarcity of wild prey, wolves have exploited resources of anthropogenic origin in an opportunistic manner (Boitani 1982; Meriggi et al. 1991; Ciucci & Boitani 1998). It is likely that the absence of conflicts with the interests of the local inhabitants (and of eventual poaching incidents) is, at least in part, due to this type of food availability. Certain factors such as the availability of water and the strategic position with possible escape routes may have determined the choice of the home site, despite the absence of vegetation cover of the main daily resting site. In fact, the ecological observations described herein were possible thanks to an ideal situation of observability, in a logistical context that guaranteed to the monitored individuals the perception of safety and control of the surrounding area.

CONCLUSIONS

The present work is one of the few field studies on the reproductive ecology of wolf × dog hybrids in a semi-anthropized context. The reported observations are further testimony to the possible behavioral and physiological changes caused by anthropogenic hybridization in the wolf. In the absence of a clear and shared way to manage the problem (Salvatori et al., 2020), we believe that any

contribution is useful to highlight one of the most insidious problems (with irreversible consequences) for conservation of the wolf.

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