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Assessing wild boar presence and activity in a monitoring specific area of Campania region using camera traps

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ABSTRACT
We have measured the passage times of a wild boar family group along a known track and in two years we evaluated the frequency of the time slots in which pubescent and adult females meets the adult males to mate. Results show that family group of wild boars stably structured, has frequented the specific point in constant time slots and this fact helps researchers to estimate a dynamic behaviour of local population. This measurements and results have a concrete impact on management of the wild population.

Section: RESEARCH PAPER

Keywords: Camera traps; wild boar; monitoring; wildlife management; behavioural measurement

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1. INTRODUCTION

The negative impact associated with the presence of wild boars (*Sus scrofa*) throughout the Italian territory, as well as throughout Europe, is mainly linked to the damage caused to agriculture and the road accidents that this species is capable of causing during the year [1]. The extent of the damage is linked to the biological cycle of the animals (reproductive seasonality) and to the hunting activity permitted in the Campania Region in the period October-December. In order to establish the number of subjects that make up a specific population and the wellbeing of animals [2] it is necessary use different census methods [3].

The classical methods used for the study of wild populations [4] mainly refer to: 1) direct counting by observation; 2) indirect counting; 3) experimental analysis; 4) index counting.

1) Direct observation is a method based on the observation of animals by an operator who, by counting each individual in the study area, can define the total estimate of the potential population.

2) Indirect detection is a method based on the observation of signs and tracks left by animals during their movements. The various indirect systems are capable, through the use of mathematical formulas, of returning a number that can be associated with the population occupying a given territory.

3) Experimental analysis is a method whose purpose is to subject a hypothesis advanced theoretically or as a result of previous descriptive studies to practical verification [4].

4) The relative counts or by indices are aimed at defining indices of density or relative abundance when it is not possible to establish the exact size of a population, or of a part of it, in relation to the scarce permanence and the low coefficient of contactability of many species [5].

None of these methods is able to provide information to be used for the interpretation of behavioural habits. The proper use of camera traps, however, is able to provide these elements of knowledge.

Constant repetition over time (monitoring) provides a series of biological and ecological data that allow for the development

Figure 1. Location of the farm into the studied area.

Figure 2. Locations of camera traps around the selective observation point.

of correct species management activities. Among the various methods for studying abundance indices as well as some food activities and habits, it is possible to resort to surveys with photographic traps. This non-invasive monitoring method has been used by several researchers since the early 1990s.

Over the years he has provided valuable information on the life characteristics of large mammals [6], [7]. Through technological innovation, these tools have made it possible to define specific moments in the life of animals and the ecological interrelationships that individual species have within their habitats. The use of camera traps has made it possible to estimate the distribution area and the density [8] or size of large carnivore populations [9]-[11]. The results of the photo trapping, although analysed, can be useful for the precise evaluation of density estimates. The results, in fact, vary according to the number of camera traps distributed over a representative area of the home range of wild boar family groups. Wild boar management is one of the most complicate to obtain an acceptable number of wild animals and a good coexistence wild-human at the same time on a single agro-ecosystem [12]. Inadequate actions as well as "only the hunt" or an incorrect assessment of the family groups constitution and their number but also a wrong agro-forestry-pastoral management which leads to an unhealthy environmental condition, may affect the entire management design and make it an ecologically failure.

Our work aimed to measure the passage times of a wild boar family group along a known track and to evaluate the frequency of the time slots in the different months of two years of observations. The results show that, at the onset of the reproductive season, pubescent females meet the adult males at a defined point, allowing them to mate.

2. MATERIALS AND METHODS

2.1. Experimental design

The experimental period (2021-2022) has lasted 24 months of observations.

This work is part of a specific European Rural Development policy project (PSR 2014-2020 "S.U.S. Campania" CUP B58H19004460009) whose main objective was to address the issues related to the wild-boar presence in a specific area of Avellino province (Campania, Italy). Before to propose an innovative process based on subadult wild boars (6-12 months) management a large number of surveys were conducted in the sample area.

We have point out an observational study with utilizing camera traps to discovery the time of frequency of the fixed observation point. The camera traps were positioned as described below in order to capture images of the wild boars when they went to the observation point at the entrance and exit.

2.2. Study area

The study area is sited on Campania Region and is identified by the coordinates 40°50'33.2999"N; 14°37'40.0001"E.

The trial started with the analysis relating to a "large area", and subsequently through in the field collection data, into a "point area".

The territory of interest occupies an area of 4,700 hectares and is included in the SCA/SCI IT8040013 "Monti di Lauro", shared between 8 municipalities [Lauro, Quindici, Forino (province of Avellino); Carbonara di Nola, Palma Campania (Metropolitan city of Naples); Bracigliano, Sarno, Siano (province of Salerno)], defined as such by the EU because it includes particular forms of plant and animal biodiversity.

This biodiversity is threatened in the event of anthropic mismanagement but also by the presence of alien or invasive animals and plants that compete with the native species. One species among all is the wild boar (*Sus scrofa*) which is included in the black list of the 100 most harmful invasive species in the world. Its presence has been repeatedly reported in the study area. The "point area" was identified on the private farm (Figure 1), falling within the Municipality of Quindici (Avellino). Farm surface occupies 10.5 hectares (permanent tree crops of hazelnut and chestnut plus forest) shares surfaces with the forest (*Fagus spp and Castanea sativa*) and its importance at an environmental level is closely associated with the Special Area of Conservation "Monti di Lauro" (SCA/SCI IT8040013).

In an area where the passage of some family groups of wild boar had been demonstrated, five camera traps were installed in five fixed observation points, with the aim of verifying the subjects' entry and exit from the observation field (Figure 2).

2.3. Camera traps

Camera traps were placed on natural supports, provided with protective metal boxes against atmospheric agents (Figure 3) and placed in points from which it was possible to obtain the greatest amount of information on the animals (number, sex, age, behaviour during different hours of the day). Previous investigations had confirmed that the observation point was a passageway for some family groups of wild boars. Each camera trap was reloaded with a new video card every week from January 1, 2021 to December 31, 2022.

Five camera traps were used to measure the number and time of entry and exit of the animals from the observation point. The camera trap model used is “Spromise”® Full HD + SMS (Digital Trail Camera S358). The weight of each camera trap is 0.38 kg

Figure 3. Camera trap and in field installation.

while the dimensions are 15.3x12.4x9.0 cm. High resolution images (12 MP), infrared night lighting, motion sensors (PIR) set to high mode have been installed. Sound recording has been turned on to record animal sounds made during videos. Finally, the detection range and flash range of camera traps are 25 m and 18 m, respectively.

2.4. Animals

The images returned by the camera traps make it possible to identify the hierarchical structure of the different family groups observed. Generally, the family groups consisted of 3 maximum 4 adult females (> 1 year of age) followed by a minimum of three and a maximum of eight young animals (< 1 year of age). *Viceversa*, subadult males (1 year of age) appeared in groups of three. Finally, adult males (> 2 years of age) were observed individually. The wild boars examined by camera trap videos were classified according to sex (Male or Female) and different age groups: adult male (MA); sub-adult male (MSA); female (F). Identification of sexes and ages was done visually by species experts. The interpretation of the primary and secondary sexual characteristics, associated with the typical behavioural manifestations of families, made it possible to differentiate males from females, just as the solitary life led by adult males allowed their easy identification.

2.5. Data analysis

During the total experimental period it was possible to make 405 single evaluations on the animals captured by camera traps video, 302 examined snaps and 3.619 minutes of recorded images are studied. Time of entrance and time of exit from the observational point is measured. On the basis of a timescale of six hours each, the snaps were grouped into two different clusters: CL1 (6-11 pm); CL2 (11pm-4am). Table 1 shows the number of snaps relating to the period examined for wild boars belonging to the three age classes under study. The frequencies obtained on the total number of observations per month were compared with the non-parametric Chi-square test assuming that the three age groups attended the observation point at the same times.

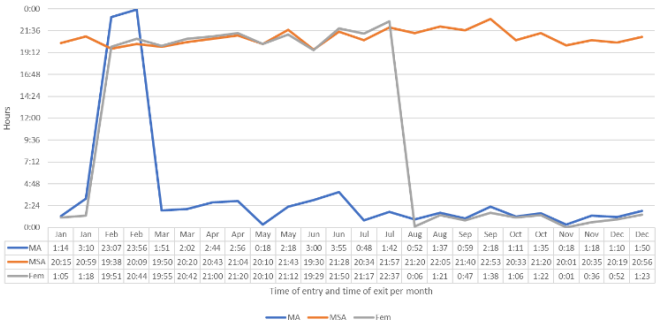

Figure 4. Hours of entry and exit from the wild boar observation area (2021).

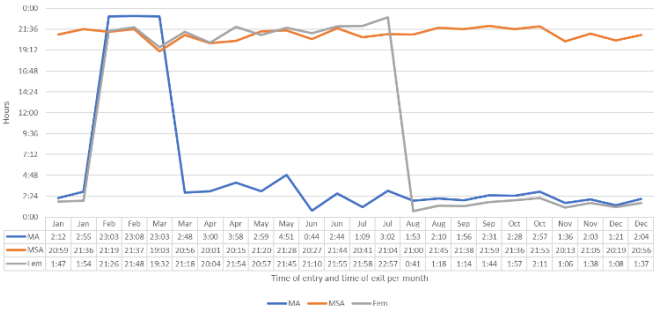

Figure 5. Hours of entry and exit from the wild boar observation area (2022).

Figure 6. Male and female subadult wild boars into observation point.

3. RESULTS

The analysis of the images downloaded from the camera traps cards allow to establish the times of entry and exit of the animals from the observation point. Figure 4 (year 2021) and Figure 5 (year 2022) show the trend of biorhythms expressed by the different age groups.

In the comparison between the two years of study, the trend of attendance times at the observation point seems almost superimposable. In fact, it appears evident that sub-adult animals, both male and female, remain united to the adult females (F) in the family group during the spring-summer period (February to July).

Table 1. Snaps (n) with wild boars in the different age groups and in the two clusters examined.

Month	Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec	
Cluster	CL1	CL2	CL1	CL2	CL1	CL2	CL1	CL2	CL1	CL2	CL1	CL2	CL1	CL2	CL1	CL2	CL1	CL2	CL1	CL2	CL1	CL2	CL1	CL2
MA	0	5	0	5	0	5	0	5	0	57	0	19	0	3	0	5	0	5	0	5	0	5	0	5
F	0	7	7	0	7	0	6	0	9	0	29	0	3	0	0	7	0	7	0	7	0	7	0	7
MSA	4	0	4	0	4	0	5	0	4	0	30	0	4	0	4	0	4	0	4	0	4	0	4	0

Figure 7. Adult females moving towards males from the family group.

Figure 9. Adult male, female rendez-vous at CL2 hours.

Figure 8. Adult males around the observation point at CL2.

Figure 10. Females in the same slot hours of the adult males.

In the time slot 6pm-11pm (CL1) subadult animals (males and females) and adult females (F) were constantly reported at the observation point (Figure 6). Between February and July (spring-summer period with increasing daylight hours) the simultaneous presence of the two age groups is closely correlated.

The behavioral situation changes radically with the advent of the beginning of the decrease in daylight hours (August). Indeed, in the period August-January and in the time slot 11:00pm and 04:00am (CL2) the females (F) leave the family group (Figure 7) to join the adult males (MA).

The adult male (MA) wild boars (Figure 8) do not appear in the images of the camera traps captured in the CL1 time slot.

Viceversa, they constantly appear in the same CL2 time slot (11:00pm - 04:00am) in which the adult females (F) are detached from the family group (Figure 9, Figure 10). This peculiarity is repeated in the two years studied.

4. DISCUSSION AND CONCLUSIONS

The results obtained in two years of observations, possible only thanks to camera traps, have allowed us to affirm that, having placed a reliable observation point (i.e. one in which the passage route of the animals is ascertained), the wild boars whose family group is stably structured, frequent the specific point in constant time slots.

The typical reproductive activity of the species (short day photoperiod) is able to condition the population dynamics. In fact, if the sub-adult males (MSA=<9 months of age) never change the time slot in which they attend the observation point, the adult females (F) detach themselves from the sub-adult males (MSA) and females remaining in the observation site in CL1 (6:00-11:00 pm).

The female's presence attracts adult males who, in CL2 time slots, join the females from the month of August (beginning of the reduction in daylight hours) until the month of January. It is probable that the pregnant females reconstitute the family group but that, in the meantime, the sub-adult males (MSA) have begun their dispersal process which will lead them to the adult age group the following year.

The increase in the number of sub-adult wild boars in the months of May and June would confirm that the females impregnated in the months of October and December, having escaped being killed due to hunting, gave birth while maintaining the level of family group at a demographic positive number. On the other hand, it is not possible to quantify the newborns of early mating (August and September) since the hunting season and the shot animals do not allow to verify the success of the couple at the beginning of the reproductive season.

Our study carried out in a sample area has therefore allowed us to clearly see the population dynamics typical of the *Sus scrofa* species and provides important indications where the Campania Region will wish to proceed with the implementation of the numerical reduction of wild boars with the selective method proposed by the PSR results of S.U.S. Campania.

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