SPACE USE BY PEN-RAISED WILD BOARS (Sus scrofa) RELEASED IN TUSCANY (CENTRAL ITALY) - I: DAILY MOVEMENT PATTERNS

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Abstract: In order to study the ecology of pen-raised Wild boar released for restocking, 22 ear-tagged wild boars were released into the wild near Siena (Tuscany). Fourteen of them, fitted with radiocollars, were followed from March '90 to January '91. Two kinds of observation techniques were used: individual locations and continuous observation. The mean distance between successive locations, the mean movement rate and the maximum distance between any two locations were calculated for each individual. Spatial analysis of movements was carried out using a G.I.S. Continuous observations were used to identify different models of activity: local activity, movement and traveling.

Keywords: Wild boar, *Sus scrofa,* Suidae, Ungulates, Space use, Space utilization.

IBEX J.M.E. 3:108-111

1. Introduction

Since 1950 in Italy hunting associations have released wild boars imported from central Europe for restoking purposes. At the moment these actions are controlled by public administrations but illegal introductions are still going on (Ferrario *et al.*, 1986).

Our purpose is to identify the movement patterns of pen-raised wild boars released into the wild to determine the biological and environmental parameters involved.

2. Study area

The study area is a hilly region of 190 Km^2 located in the Siena farmland (Tuscany); the whole area is covered by 68% wood and 32% open habitat type. The Merse river running from west to east cuts the area in two parts characterized by different habitat structures. In both the areas broadleaf woods are the main habitat type (49% in the north and 56% in the south), but in the north a big percentage of land is occupied by cultures (32%), mostly

Table 1: Values of indices calculated for each individual.
For animals 4 and 14 are employed only fixes collected during six weeks after release, to make the data comparable with the other animals; animal n°7, died after only six days after release, is ignored. (GDL = greatest distance between locations, MDL = mean distance between locations, MSTM = mean speed of total movements).

Animal n° and sex	Total fixes (n)	Total days (n)	G D L (km)	MDL (km)	MSTM (m/h)
1 m	36	50	5.529	1.461	72.92
2 m	28	37	5.281	1.374	54.70
3 m	33	35	6.087	1.298	65.17
4 m	34	42	5.042	1.473	60.98
5 m	36	42	6.055	1.223	50.52
6 f	19	25	2.990	1.032	26.56
8 f	33	44	4.104	0.687	41.75
9 f	48	54	3.348	0.759	27.89
10 f	17	25	2.262	0.784	29.56
11 f	18	26	2.606	0.784	66.91
12 m	42	62	5.336	1.111	49.03
13 m	38	57	2.699	0.538	20.67
14 f	29	42	1.513	0.469	31.64

cereals, while in the south a smaller percentage (8%) of land is cultivated and fields are small and scattered through the woods.

3. Material and methods

A total of 22 pen-raised wild boars marked with ear tags were released into the wild. Fourteen of them (8 males and 6 females, of which 6 three-years old and 8 twelve-twenty-four months old) fitted with a radiocollar were followed from March 1990 to January 1991. For each animal daily radiolocations distributed in 6 four-hours intervals and continuous observations (12-24 h) were collected. Only data collected during the first 4-8 weeks from the release are analysed in this work. Three of the radiocollared wild boars (1 female, 2 males) were released in the north of the study area and 11 (5 female, 6 males) in the south. A habitat map was realised: the records of environmental data, and their analysis were performed by a GIS (Geographic Information System). A grid (unit grid = 250 x 250 m) on the area's map was used to identify the locations.
Data analysis on daily radiolocations allowed the study of Wild boar movements and percentage of activity after release. For this purpose the following indices were calculated for each individual: mean distance between successive locations (Stickel *et al.*, 1960); greatest distance between two successive daily locations (Stickel *et al.*, *op. cit.*), mean speed of total movement (White & Garrot, 1990) from the release site.
Continuous observations analysis allowed to define different activity types:
- local activity for deplacements shorter than grid unit (250 x 250 m) length in 30 min. ($v < 0.5$ km/h);
- medium-speed movement for longer distances (0.5 km/h $< v < 2$ km/h);
- traveling ($v > 2$ km/h) recognizable also by the straightline runs.

The way in which the activity is divided in these different types of movement is exposed (percentage of active time occupied by each activity type). The activity patterns in the woods and in the open areas, in the northern release site and in the southern release site were compared, also in buffer zones (200 m) between woods and open areas.

4. Results

It has been possible to know the destiny of 16 animals: 75% of them died, 7 killed by hunters, 4 by poachers and 1 for other causes (probably traffic victim).
Table 1 shows the results of individual indices values. Comparison between results and mean values obtained for free wild boars, briefly showed in table 2, pointed out that pen-raised wild boars displayed a movement pattern different from free ones: greatest and mean distance covered were greater while mean speed of total movement adopted was smaller for pen-raised wild boars than for free ones.

Table 2: Comparison between present data and literature data of indices calculated for pen-raised and free wild boars. (GDL = greatest distance between locations, MDL = mean distance between locations, MSTM = mean speed of total movements).

Indices's values	Pen-raised wild boars	Free wild boars
GDL (km)	4.33	3.3 (Kurz &Marchinton, 1972)
MDL (km)	1.08	0.66 (Janeau & Spitz, 1984) 0.18 - 0.55 (Singer *et al.*, 1981)
MSTM (km/h)	0.04	0.56 (Janeau & Spitz, 1984) 0.40 (Singer *et al.*, 1981)

The activity phase in this period is the 50% of total time and is divided between local activity (53%), medium-speed movement (44%) and traveling (3%) as shown in table 3.
The results concerning woods and open areas are shown in table 4, the comparison of patterns (local activity and movement) found in the two habitats is significant ($P<0.005$). The activity patterns observed in the two release zones (Tab.5) differ significantly ($P<0.001$); in the southern one with less food availability, active deplacements (movement and traveling) prevail. Also in the activity patterns analysis relating to the buffer zones significant differences are observed between northern and southern areas ($P<0.001$) (Tab.6).

Table 3: Percentages of active time occupied by different activity types for the total of continuous observations data and for the whole study area (3,340 minutes).

Local activity	53 %
Medium - speed movement	44 %
Traveling	3 %

5. Discussion

Studies on animal introduction show high mortality rate that we also observed, in periods immediately following the release (McCall *et al.*, 1988).
Our animals are more active if compared with wild ones, the activity is about 50% and 40% respectively (Mauget, 1980; Nonis, 1988). Covered distance and mean speed of total movement observed differ from that of free wild boars. Comparison points out smaller speed and longer distance for pen-raised wild boars than for free wild boars. Results underline that life conditions before release as well as exploration of the new environment both played a role in pen-raised animals movement once they were released into the wild.

Table 4: Percentages of the three activity types in woods and in open areas.

	Woods	Open areas
Local activity	47 %	65 %
Medium-speed movement	48 %	35 %
Traveling	5 %	---

Particularly limited movements in the enclosure and artificial feeding caused animals to become overweight and influenced their movement mean speed after the release; on the other hand, space exploration around the release sites to meet boars' requirements established long-distance movement since distribution of resources was unknown to animals.
The higher percentage of "local activity" found in the open areas suggests that this type of activity is associated mostly with a feeding behaviour and the exploitement of concentrated resources such as crops. Therefore the active movement phases, prevailing mainly in wooded environments, suggest an explorative behaviour and the exploitement of scattered resources (Janeau & Spitz, 1984).
While studying wild animals Mauget (*op. cit.*) found that feeding phase (25.21% of the day) was longer than movement phase (16.50%); in the present study this difference is not significant, because of the increase of movement activity related to explorative behaviour and the necessity of colonizing the new habitat.
Environmental characteristics also affect movement patterns: in the southern area poorer environments with scattered resources oblige the wild boars to be more erratic.

Table 5: Percentages of the three activity types in the northern and in the southern release sites.

	North	South
Local activity	60 %	38 %
Medium-speed movement	39 %	56 %
Traveling	1 %	8 %

Animals may be advantaged from spending most of their energies looking for resources, in fact they explore large areas, move long distance and also favour active movement rather than resting activity. On the other hand they are forced to adopt more economical mean speed of total movement, so the observed pattern may be required to meet energy needs of animals; but it makes animals most visible and vulnerable by hunters and poachers.
In conclusion two factors mostly influence restoked animals' fate and their survival: 1) greater sensitivity to predaction by man; 2) greater erratism and vulnerability to starvation, in proportion to poverty and bad distribution of resources. Released animals become a marginal and less well adapted part of the population, so they exploit less safe environment.

Table 6: Percentages of the three activity types in the buffer zones (200 m) between woods and open area in the northern and in the southern release sites.

	Buffer zone	
	North	South
Local activity	60 %	41 %
Medium-speed movement	40 %	51 %
Traveling	< 0.5 %	8 %

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