# *DAILY MOVEMENT PATTERN VARIATIONS IN WILD BOAR (Sus scrofa* L.*)*

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**Abstract:** We propose a new classification of the daily movement patterns obtained by radiotracking on 29 free-ranging wild boars (*Sus scrofa* L.) and we analyze the selection of patterns with regard to sex and age. To characterize the daily movement patterns we take into account two parameters: the maximum distance from the initial point (that is the initial diurnal resting place) and the distance between the initial resting place and the final resting place. We also discuss the relevance of these parameters to our objective and we determine a set of metric limits underlying the proposed classification. We identified five patterns: "Ranging widely": the animal moves further than 1,000 m from the initial point and stops at a final resting place which is located further than 1,000 m from the initial one; "Ranging and return": the animal moves further than 1,000 m from a initial point and stops at a final resting place which is located between 500 and 1,000 m from the initial one; "Loop": the animal moves further than 1,000 m and stops at a final resting place which is less than 500 m from the initial one; "Stay and rest nearby": the animal does not move further than 1,000 m and stops at a final resting place which is between 500 and 1,000 m from the initial one; "Stay": the animal does not move further than 1,000 m and stops at a final resting place which is less than 500 m from the initial one. Finally, we try to explain the importance of the selection of these different daily movement patterns in determining the socio-spatial organisation of Wild boar populations.

**Keywords:** Wild boar, *Sus scrofa* L., Suidae, Daily movements, Movement patterns, Socio-spatial organisation, Radio-tracking.

**IBEX J.M.E. 3:98-101**

## 1. Introduction

Little litterature is available to date on daily movements of wild ungulates recorded by radio-tracking (Deer: Tester & Sinniff,1965; Caribou: Craighead *et al.*, 1973; White-tailed deer: Marchinton & Jeter,1966). For this reason, telemetry studies on Wild boar have progressively evolved, to take into account different parameters in order to define daily movement patterns.

The daily movements of Wild boar were first studied by Mauget (1979; 1980), to take into account basic concepts such as: *(i)* feeding areas; *(ii)* movement speed. As Douaud (1983) we also used (Janeau & Spitz,1984) these basic concepts of Mauget, but we also included an additional parameter: *(iii)* the utilisation of the initial resting place. Some years ago we proposed (Spitz & Janeau,1990) to analyse daily movements with regard to: *(i)* activity zone; *(ii)* maximum distance from the initial resting place; *(iii)* the utilisation of the initial resting place; *(iv)* movement sinuosity.

Our objective now is to propose a new classification which is more descriptive of the daily movement patterns obtained by radiotracking and to analyze the pattern selection with regard to sex and age. We also try to explain the importance of the selection of the different daily movement patterns in determining the organisation of Wild boar populations.

## 2. Material and methods

### 2.1. Study areas

The study areas were located in the south of France: *(i)* Grésigne (ca 44° N and 1°45' E); *(ii)* Massif du Caroux Espinouse and Montagne Noire (ca 43° 22' N and 2° 21' E); *(iii)* Camargue (ca 43°30' N and 4°30' E); *(iv)* Lauragais (ca 43°30' N and 1°20' E).

### 2.2. Animals

A total of 29 wild boars representing all sex and age categories were radio-collared and were the subject of a total of 95 x 24-hour monitoring sessions (the difference between the number of wild boars here and in Table 1 (row Total) derives from the fact that some of the collared wild boars changed age category during the study period).

We divided our sample into four animal categories: *(i)* the adult females with nutritionally dependant piglets (F. nut), the age of piglets is less than 3 months; *(ii)* the juveniles (Juv.), which are between 3 months and 8 months old; *(iii)* the sub adults (S. Ad.), which are between 8 months and 2 years old; *(iv)* the adults, including the females (Adt. F) with

young more than 3 months old or without young, and the males (Adt. M).

**Table 1: Number of wild boars (per sex/age category) monitored during 24-hour radiotracking sessions.**

| Sex/Age categories | Number of Animals | Number of Sessions |
|---|---|---|
| F. nut. | 9 | 20 |
| Juv. | 3 | 10 |
| S. Ad. | 10 | 35 |
| Adt. F. | 8 | 18 |
| Adt. M. | 3 | 12 |
| Total | 33 | 95 |

### 2.3. Field data

The field data consisted of locations of animals obtained during 24-hour radio-tracking sessions (the average interval between locations was 15 minutes). All bearings were obtained from vehicle tracking units (2 working simultaneously in the case of 24-hour monitoring sessions), each one consisting of dual 4-element Yagi antennae, a null-peak box (AVM), a receiver (AVM LA 12) joined to a digital data processor (T.D.P.1. Telonics) to record the level of the input signal, and head-phones. The animals' positions were calculated from reference to fixed radio beacons at known coordinates (Spitz & Janeau, *op. cit.*).

### 2.4. Data processing

For 24-hour monitoring sessions a simple computer programme was used to calculate the location and the following parameters (Spitz & Janeau, *op. cit.*): - the total distance travelled (TDT), *i.e.* the sum of the straight line distances from fix to fix; - the maximum distance from the departure point (MDP); - the average radius (AVR), *i.e.* the mean of the distances of the fixes from their barycentre; - the distance between resting places (DRP), *i.e.* the distance between two consecutive diurnal resting places. These parameters and examination of the data lead us to define 5 different patterns of daily movement (Fig 1):

P. 1: "Ranging widely", the animal moves further than 1,000 m from the initial point and stops at a final resting place which is located further than 1,000 m from the initial one.

P. 2: "Ranging and return": the animal moves further than 1,000 m from the initial point and stops at a final resting place which is located between 500 and 1,000 m from the initial one.

P. 3: "Loop": the animal moves further than 1,000 m and stops at a final resting place which is less than 500 m from the initial one.

P. 4: "Stay and rest nearby": the animal does not move further than 1,000 m and stops at a final resting place which is between 500 and 1,000 m from the initial one.

P. 5: "Stay": the animal does not move further than 1,000 m and stops at a final resting place which is less than 500 m from the initial one.

Five hundred meters is the maximum width of an area of zonal activity, as defined by Mauget in 1979. That is for a wild foraging animal in a limited area for a few hours. A thousand meters is the maximum width of the daily home range of a Wild boar exhibiting two bouts of zonal activity from its resting place, but in opposite directions.

We found (Tab. 2) that we needed only two parameters to define the daily movement patterns: MDP (maximum distance from the departure point) and DRP (distance between resting places). Furthermore, TDT (total distance travelled) and AVR (average radius) are well correlated with MDP. Means of TDP, MDP, and AVR in the patterns P.1, P.2 and P.3 were significantly higher than those in P.4 and P.5. We also observed that the mean of DRP for pattern P.1 was significantly higher than in the other patterns and that the mean of DRP in patterns P.2 and P.4 was significantly higher than in patterns P.3 and P.5.

**Table 2: Means of the total distance travelled (TDT), the maximum distance from the departure point (MDP), the average radius (AVR) and the distance between resting places (DRP) for each pattern of daily movement.**

| Pattern | TDT | MDP | AVR | DRP | n |
|---|---|---|---|---|---|
| P. 1 | 8005 m | 2471 m | 704 m | 2130 m | 34 |
| P. 2 | 6945 m | 2354 m | 655 m | 789 m | 7 |
| P. 3 | 6981 m | 1901 m | 685 m | 239 m | 14 |
| P. 4 | 3144 m | 783 m | 221 m | 665 m | 9 |
| P. 5 | 3744 m | 529 m | 138 m | 178 m | 31 |

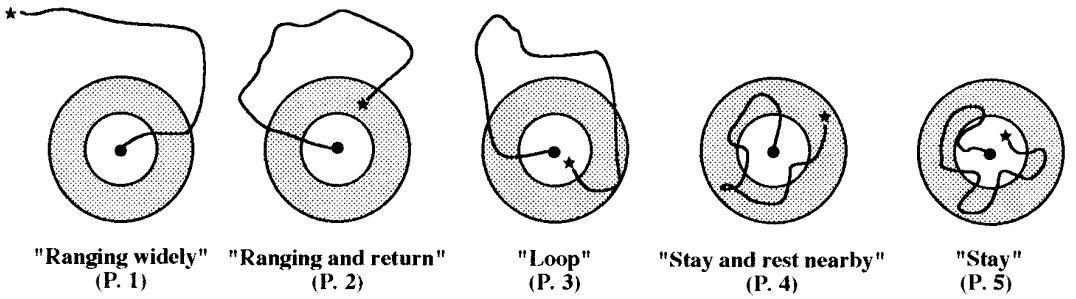


Figure 1 - Movement patterns of Wild boar (the radius of the small circle = 500 m; the radius of the large circle = 1,000 m).

**3. Results**

The females with dependant piglets used the pattern "Stay" (P. 5) in 55% of observations (Fig. 2), while the pattern "Ranging widely" (P. 1) and the pattern "Loop" (P. 3) were each used in 15% of observations. The two other patterns "Stay and rest nearby" (P. 4) and "Ranging and return" (P. 2) were used less than 10% each.

Among juveniles, the first pattern selected was "Ranging widely" constituting 30% of observations, the second choices were the patterns "Ranging and return", "Loop" and "Stay and rest nearby" (20% each) and the pattern "Stay" was observed on 10% of occasions.

The subadults preferentially used the pattern "Ranging widely" (51%) and then the pattern "Stay" (29%). The three other patterns were also used, but at much lower frequency.

The adult females without young or with non-dependent juveniles used only three patterns, two of which incorporated returning to the initial site, the pattern "Stay" (50%) and the pattern "Loop" (22%). The third pattern selected was "Ranging widely" (28%). The adult males used the pattern "Ranging widely" preferentially (42%), the patterns "Ranging and return" and "Loop" in the same proportions (25%), but the pattern "Stay and rest nearby" much less. The pattern "Stay" was never used by this class of animals.

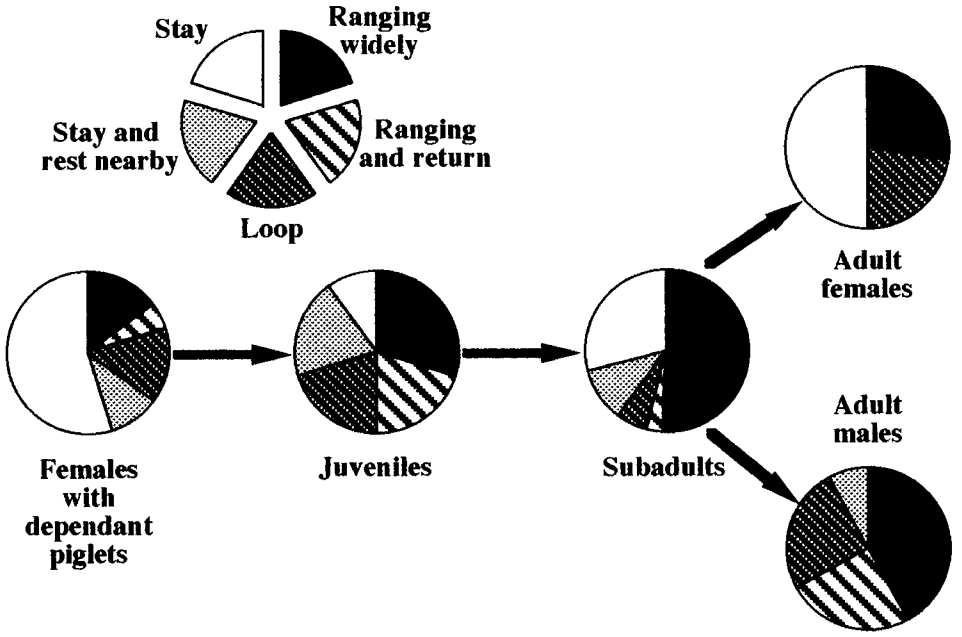


Figure 2 - Daily movement patterns used by animals with regard to sex and age categories (given as percentage).

## 4. Conclusion

Patterns which include returning to the initial resting place were used by all adult females in 70 to 72% of the observations, in contrast to the 25 to 35% for all other categories of individuals. The behaviour of adult females is thus characterized by fidelity to a limited number of preferred areas, and has consequences for the choice of farrowing sites. Patterns where the final resting place was distant from the initial point were used by only 15% of adult females with dependent piglets but by 30% of other adult females, and also by juveniles. This can be related to the movements which occur inside a limited home range, but with segregation of non-dependent juveniles from adult females during the resting phase (Cousse, 1994). The post-weaned piglets (juveniles) soon, exhibit different choices to these of their mother. We can explain this phenomenon by the differences that we observed in the juveniles polyphasic index, which was higer than the females polyphasic index after the weaning period (Cousse & Janeau, 1992) and the ultradian rhythm maintained by juveniles post-weaning but lost by females after the weaning period (Cousse *et al.*, this volume). At the subadult stage, the daily movement choices were different to those at the juvenile stage. Subadults adopted the most exploratory pattern ("Ranging widely") as this is in fact the dispersal phase. The adult males circulate around some reproductive females and, in contrast to the behaviour of females, use only a few of the patterns including ranging less than 1,000 m from the initial resting place.

Finally we conclude that the spatial stability of a Wild boar population can be explained by the daily movement preferences of adult females.

## References


COUSSE S., (1994) - *La construction de l'espace-temps individuel et de l'organisation socio-spatiale chez le Sanglier* (*Sus scrofa* L.). *Une analyse systémique*. Thèse de doctorat, Université Paul Sabatier, Toulouse.

COUSSE S. & JANEAU G., (1992) - Time budget and polyphasic activity in Wild boar, *Sus scrofa* L. In: *"Ongulés/Ungulates 91"*, F. Spitz, G. Janeau, G. Gonzalez & S. Aulagnier (eds), S.F.E.P.M. - I.R.G.M., Paris-Toulouse: 391-394.

COUSSE S., JANEAU G., SPITZ F. & CARGNELUTTI B., this volume - Temporal ontogeny in the Wild boar (*Sus scrofa* L.): A systemic point of view.

CRAIGHEAD J.J., CRAIGHEAD F.C., RUFF R.F. JR. & O'GARA B.W., (1973) - Home ranges and activity patterns of nonmigratory Elk of the Madison Drainage Herd as determined by biotelemetry. *Wildl. Monographs*, 33(4): 6-50.

DOUAUD J.F., (1983) - *Utilisation de l'espace et du temps et ses facteurs de modulation chez le Sanglier, Sus scrofa* L., *en milieu forestier ouvert (Massif des Dhuits, Haute-Marne)*. Thèse de 3ème cycle, Université de Strasbourg.

JANEAU G. & SPITZ F., (1984) - L'espace chez le Sanglier: occupation et mode d'utilisation journalier. *Gibier et Faune Sauvage*, 1: 73-89.

MAUGET R., (1979) - Mise en évidence, par captures-recaptures et radiotracking, du domaine vital chez le Sanglier (*Sus scrofa* L.) en forêt de Chizé. *Biology of Behaviour*, 1: 25-41.

MAUGET R., (1980) - *Régulations écologiques, comportementales et physiologiques (fonction de reproduction) de l'adaptation du Sanglier, Sus scrofa* L., *au milieu*. Thèse d'état, Univ. F. Rabelais, Tours.

MARCHINTON R.L. & JETER L.K., (1966) - Telemetric study of deer movement - ecology in the southeast. *Proc. 20th Ann. Conf. S.E. Assoc. of Game and Fish Comm.*, Asheville, N.C.: 189-205.

SPITZ F. & JANEAU G., (1990) - Spatial strategies: an attempt to classify daily movements of Wild boar. *Acta Theriol.*, 35(1-2): 129-149.

TESTER J.R. & SINNIFF D.B., (1965) - Aspects of animal movement and home range data obtained by telemetry. *Trans N. Amer. Wildl. Conf.*, 30: 379-392.

# *EFFECTS OF SHOOTING WITH HOUNDS ON SIZE OF RESTING RANGE OF WILD BOAR (Sus scrofa* L.*) GROUPS IN MEDITERRANEAN HABITAT*

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**Abstract:** Resting sites of 8 Wild boar (*Sus scrofa* L.) groups were determined by radiotracking in the Montpellier garrigue. The locations of about 1,600 resting sites recorded during a 3 years period show that the animals have three seasonal ranges: May through August; September through December; January through April. There is a marked increase in area covered by the resting sites beginning in October, apparently induced by the onset of the hunting season, in mid-September. When the hunting season opens, mean distances between successive resting sites also increase, but decrease again after its closure. Analysis of these distances during the hunting season (September through December) revealed that movements were shorter (about 1,220 m) on days without shooting and longer (about 1,600 m) on days with driven game shooting. It confirms that shooting with hounds, a general practice in the South of France, is the main factor of Wild boar disturbance. Winter ranges (3,139 ha) were relatively large because of the wide-ranging movements of Wild boar groups returning from the areas where they had fled to, which were situated far from their initial summer ranges.

**Keywords:** Wild boar, *Sus scrofa,* Suidae, Home range, Hunting, Hounds, Resting sites.

**IBEX J.M.E. 3:102-107**

## 1. Introduction

Wild boar radio-tracking data and capture-recapture operations indicate that the Wild boar is a rather sedentary animal, even if some individuals undertake long movements (Andrzejewski & Jezierski, 1978; Boisaubert & Klein, 1984).

A comparison of various data obtained in France, however, indicates that in the North of the country Wild boar populations are extremely sedentary (Boisaubert & Klein, *op. cit.*; Vassant *et al.*, 1992) whereas they have more extensive home ranges in the South (Spitz *et al.*, 1984; Dardaillon, 1986; Dardaillon & Beugnon, 1987; Cargnelutti *et al.*, 1991).

Gerard *et al.* (1991) presented several hypotheses which might explain this phenomenon: hunting pressure, artificial diet feeding, population pressure, etc. According to Singer *et al.* (1981) and Belden and Pelton (1976), Wild boar sometimes makes true seasonal "migrations" in altitude to search for food.

Among all the factors we have analysed during our study, it seems that the main factor explaining the above-mentioned difference in behaviour are the conditions under which Wild boar shooting takes place (hunting methods and hunting pressure).

## 2. Study area

The study site is situated in the Montpellier garrigue area in the north-western part of the Hérault department (Fig. 1). It extends eastwards covering the garrigue in the Gard department, northwards over the Cévennes mountain massif and southwards over the wine-growing plain.

The vegetation in the study site is characteristic of the upper mesomediterranean stratum. The main woodland community in the garrigue is holly oak (*Quercus ilex*) representing 40% of the vegetation cover, followed by the treeless garrigue (16%), the pubescent oak *Quercus pubescens* (5%), and conifer *Pinus* sp. garrigues (6%), holly oak coppices (4%) and open or conifer-mixed hardwoods (8%). The other 21% of vegetation cover includes afforestations, pine groves and fallow lands (IFN, 1984).

Wild boar hunting is mostly a group sport involving pursuit with packs of big hounds. Each locality possesses 2 or 3 packs of hounds. Hunting is allowed on only three days a week (Wednesday, Saturday and Sunday), and on holidays, from mid-September to January first. About 20 hunters participate in each drive. The beaters cover some 200 to 400 ha of

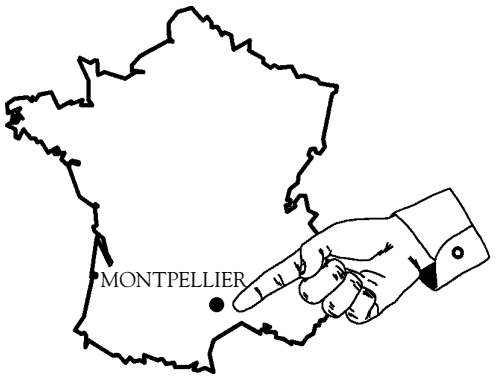


Figure 1 - Location of the study area.

ground per outing, the hunters being posted at strategic points, such as ridges, crossroads etc.

## 3. Material and methods

### 3.1. Capture

The animals were captured in mobile box traps (2 m x 1 m x 1 m) (Jullien *et al.*, 1988) after several days of observation. This allowed us to define the hierarchical position of each individual within the group. When possible, the sow and all her young were captured together (Fournier *et al.*, 1993). Sows were equipped with a transmitter collar of the Pulsar 2001 (146-148 MHz) type.

The data presented here concern 8 family groups averaging 9 individuals. Each group was monitored for a 5 to 18 months during 3 consecutive years (1990 to 1992).

### 3.2. Radio-tracking

The data analysed represent daily locations that were made when animals were on their diurnal resting site. A minimum of 3 bearings were taken from a vehicle equipped with a Yaesu (FT 290 RII) receiver linked to a directional 7 stranded Tonna antenna. The Lambert bearings were then calculated with the help of the LOCATE II computer programme.

In the present study two types of data are analysed:

- "area of resting range", which is the surface englobed by the resting sites, as measured by the convex-polygon method and calculated using RANGE II;
- "distance between two successive resting sites", which is the shortest distance between the resting sites of two consecutive days. This distance is not the total distance over which the active Wild boar moved.

## 4. Results

Changes in resting polygon size between the non-shooting period (January through August) and the shooting season (September through December) are indicated for each Wild boar group in table 1.

The mean resting polygon size increased from 1,390 ha to 5,139 ha, which, according to the sign test ($P = 0.0039$ - Dagnelie, 1970) is highly significant. In fact, the increase was significant as soon as the hunting season started ($P = 0.035$) and extremely marked in October ($P = 0.004$) (Tab. 2).

Immediately after closure of the hunting season, area of resting ranges decreased. However, the number of collar-marked sows that were still alive ($n = 3$) was too small to qualify this decrease as significant.

Table 3 also indicates that the mean distances between successive resting sites were significantly larger during the hunting period. These movements decreased immediately after the hunting season (Tab. 2).

A comparison of the mean distances between resting sites on days without driven Wild boar shooting (1,217 m) and with driven shooting (1,598 m) over three hunting seasons shows a highly significant increase ($P = 0.002$) (Tab. 4). These results confirm the significant change in Wild boar behaviour during the hunting period.

## 5. Discussion

The present study indicates that Wild boar shooting with hounds is the main disturbance factor inducing changes in behaviour of Wild boar groups.

In fact, all animals react very rapidly to this type of shooting by increased mobility. The study of the size of resting ranges shows, however, that they have two types of reactions, according to the hunting pressure the group is subjected to.

- When the animals are frequently forced off their resting site, and this was the case for 6 out of 8 Wild boar groups, they will finally leave their summer range in search of more tranquil ranges. According to Jullien *et al.* (1991), in the Arc-en-Barrois forest, in 15 cases, 47% of the sows left their home range after a single drive hunt, moving on average 1,800 m. In our more closed and uninterrupted environment, Wild boar groups left their territories only after being disturbed several times within a rather

**Table 1: Comparison of Wild boar resting range sizes between hunting and non-hunting season (P = 0.0039; sign test).**

| WILD BOAR GROUP N° | JANUARY - AUGUST (outside hunting season) (ha) | SEPTEMBER - DECEMBER (hunting season) (ha) |
|---|---|---|
| 1 | 422 (n=87) | 2036 (n=52) |
| 2 | 5965 (n=212) | 15440 (n=155) |
| 3 | 3192 (n=135) | 6213 (n=39) |
| 4 | 281 (n=43) | 6068 (n=102) |
| 5 | 360 (n=92) | 497 (n=92) |
| 6 | 194 (n=16) | 4785 (n=90) |
| 7 | 139 (n=24) | 4616 (n=86) |
| 8 | 569 (n=256) | 859 (n=110) |
| MEAN | 1390 (n=865) | 5139 (n=726) |

short period (more than 3 disturbances per fortnight). If during their wanderings they find a quiet spot, they may stay there a few days or a few months until the next incident.

The case of Wild boar group n°2 shows that in mid-December, after one and a half month of roaming (Fig. 2), it settled, found a quiet sector, 15 km from its initial range, where it stayed throughout the month of January (Fig. 3). After a few tentative return movements, it reoccupied its former range definitively in April. Mauget *et al.* (1984) indicate that this phenomenon has been observed before by Spitz (pers. comm.) in two individuals (one male and one female) in the Grésigne forest, where drives with hounds took place two days per week.

Depending on the amount of disturbance, the increase in size of resting range during the hunting period may thus be important. All sows that escaped shooting came back in March or April. For the Wild boar groups that we studied, three seasonal resting ranges can be defined, with the following average areas (6 Wild boar groups per season):

| May-August | September-December | January-April |
|---|---|---|
| 255 ha | 6,626 ha | 4,511 ha |
| *n* = 241 | *n* = 589 | *n* = 196 |

- If hunting pressure on the groups is less important, they will stay on their range, but nevertheless increase their movements. In this case, there is no displacement, but rather an increase in range size (Fig. 4) (average surface area of range for 2 groups).

| May-August | September-December | January-April |
|---|---|---|
| 203 ha | 678 ha | 394 ha |
| *n* = 213 | *n* = 219 | *n* = 110 |

**Table 2: Monthly changes in mean resting range sizes (ha) and mean distances (m) between successive diurnal resting sites for 8 Wild boar groups (p; sign test).**

| MONTH | J | F | M | A | M | J | J | A | S | O | N | D |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MEAN AREA (ha) OF RESTING RANGE | 539 | 517 | 1670 | 291 | 80 | 139 | 260 | 134 | 365* | 1274** | 1813 | 2378 |
| MEAN DISTANCE (m) BETWEEN RESTING SITES | 523 | 734 | 691 | 649 | 446 | 665 | 891 | 729 | 997 | 1279 | 1391 | 1589 |
| NUMBER OF WILD BOAR GROUPS | 3 | 3 | 3 | 3 | 3 | 5 | 4 | 8 | 8 | 8 | 7 | 7 |
| NUMBER OF RESTING SITES | 18 | 60 | 81 | 87 | 81 | 119 | 97 | 170 | 219 | 191 | 138 | 121 |

* P < 0.035 (Aug. —> Sept.)
** P < 0.004 (Sept. —> Oct.)

**Table 3: Comparison of mean distances (m) between successive Wild boar diurnal resting sites in hunting and non-hunting seasons (P = 0.0039; sign test).**

| WILD BOAR GROUP | OUTSIDE HUNTING | HUNTING |
|---|---|---|
| N° | SEASON (m) | SEASON (m) |
| 1 | 1079 (n=80) | 1443 (n=43) |
| 2 | 622 (n=180) | 1430 (n=137) |
| 3 | 638 (n=117) | 2364 (n=32) |
| 4 | 1184 (n=41) | 1214 (n=90) |
| 5 | 892 (n=81) | 895 (n=86) |
| 6 | 704 (n=21) | 1566 (n=76) |
| 7 | 735 (n=11) | 1599 (n=80) |
| 8 | 558 (n=233) | 819 (n=106) |
| MEAN | 801 (n=764) | 1416 (n=650) |

**Table 4: Effect of driven Wild boar shooting on mean distances between successive diurnal resting sites moved over by Wild boar groups from September to December (P = 0.002; sign test).**

| WILD BOAR GROUP N° | DAYS WITHOUT HUNTING (m) | DAYS WITH HUNTING (m) |
|---|---|---|
| 1 | 1403 (n=26) | 1503 (n=17) |
| 2 (1991) | 1389 (n=57) | 1445 (n=48) |
| 2 (1992) | 677 (n=22) | 1867 (n=9) |
| 3 | 2010 (n=18) | 2632 (n=15) |
| 4 | 1090 (n=51) | 1375 (n=39) |
| 5 | 795 (n=51) | 1040 (n=34) |
| 6 | 1508 (n=45) | 1648 (n=31) |
| 7 | 1493 (n=47) | 1750 (n=33) |
| 8 | 591 (n=58) | 1126 (n=48) |
| MEAN | 1217 (n=375) | 1598 (n=274) |

It is interesting to note that the size of summer resting ranges of these 2 groups are almost the same and, above all, very small.
With regard to summer, our results agree with those of Kurz and Marchinton (1972), Mauget (1980), Douaud (1983), Spitz (1992), Boitani *et al.* (1992) etc., who found home ranges between 200 and 500 ha.
For autumn and winter ranges, only Janeau and Spitz's work (1984) in the Grésigne area can be compared to our study, because of the similar form of boar hunting conducted on the study sites. In fact, these authors indicated 4,000 to 6,000 ha annual home ranges for sows.

## 6. Conclusion

By daily monitoring of the 8 Wild boar groups, we were able to show that the hunting pressure in a Mediterranean environment with driven game shooting with hounds is a significant factor of seasonal modification in Wild boar behaviour.
The increase in areas of resting ranges and in the distances between two successive resting sites is significant from the opening of the hunting season and most marked in October after 3 to 4 weeks of shooting. Two behaviour patterns were observed:
- the animals subjected to a high hunting pressure left their original territory but returned later.
- with little disturbance, the animals stayed on their original range, although its size increased.
The groups which temporarily altered their activity patterns and moved towards quieter ranges, all returned to their territory of origin for farrowing. Hunting pressure and the tendency to return to the same seasonal ranges observed in subadult or adult females is essential information for wise management of Wild boar populations.

## 7. Acknowledgements

We wish to thank the hunters and all the stu-

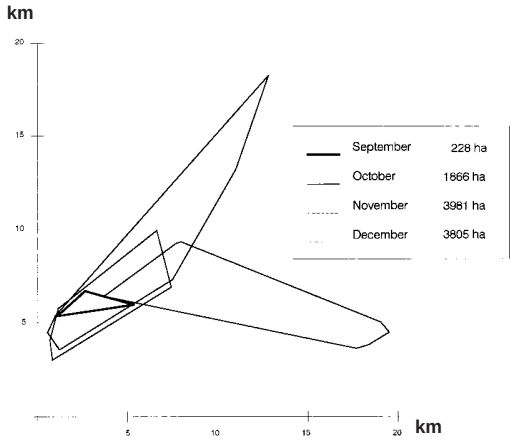


Figure 2 - Changes in monthly resting range size (ha) and configuration for Wild boar group n° 2, during the hunting season.

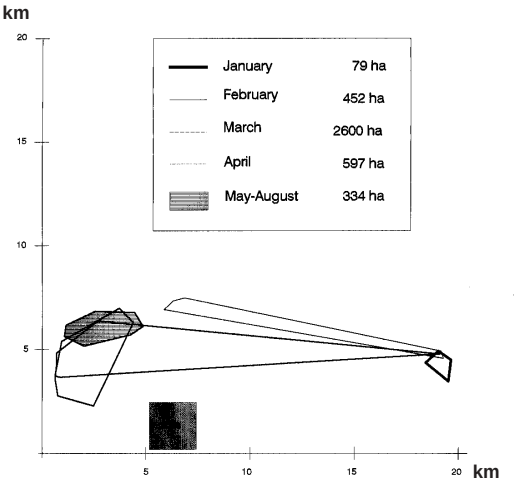


Figure 3 - Changes in monthly resting range size (ha) and configuration for Wild boar group n° 2, outside the hunting season.

dents who participated in this programme for their assistance.

## REFERENCES

ANDRZEJEWSKI R. & JEZIERSKI W., (1978) - Management of a Wild boar population and its effect on commercial land. *Acta Ther.*, 23: 309-339.

BELDEN R.C. & PELTON M.R., (1976) - Wallows of the European Wild hog in the Mountain of east Tennessee. *J. of the Tennessee Acad. of Sciences*, 51(3): 91-93.

BOISAUBERT B. & KLEIN F., (1984) - Contribution à l'étude de l'occupation de l'espace chez le Sanglier *(Sus scrofa)* par capture et recapture. Symposium International sur le Sanglier. F. Spitz & D. Pépin (eds), Toulouse, *Les Colloques de l'INRA*, n° 22: 135-150.

BOITANI L., MATTEI L., MORINI P. & ZAGARESE B., (1991) - Experimental release of captivity reared wild boars *(Sus scrofa)*. In: *"Ongulés/Ungulates 91"*, F. Spitz, G. Janeau, G. Gonzalez & S. Aulagnier (eds), S.F.E.P.M.- I.R.G.M., Paris - Toulouse: 413-417.

CARGNELUTTI B., GERARD J.F., SPITZ F., VALET G. & SARDIN T., (1991) - Résultats préliminaires sur l'éco-éthologie du Sanglier *(Sus scrofa)* en région agricole à faible taux de boisement. *Bull. Mens. Off. Natl. Chasse*, 163: 15-20.

DAGNELIE P., (1970) - *Théorie et méthodes statistiques*. Les Presses Agronomiques de Gembloux, Vol. 2.

DARDAILLON M., (1986) - Some aspects of the orientation in space of *Sus scrofa* as revealed by data on home range, habitat use and movements. In: *Orientation in Space*, G. Beugnon (ed.), Toulouse, Privat/I.E.C.: 63-70.

DARDAILLON M. & BEUGNON G., (1987) - The influence of some environmental characteristics on the movements of Wild boar *(Sus scrofa)*. *Biol. Behav.*, 12: 82-92.

DOUAUD J.F., (1983) - *Utilisation de l'espace et du temps et ses facteurs de modulation chez le Sanglier (Sus scrofa* L.) *en milieu forestier ouvert (Massif des Dhuits, Haute-Marne)*. Thèse de 3ème cycle. Université Louis Pasteur, Strasbourg I.

FOURNIER P., MAILLARD D. & FOURNIER-CHAMBRILLON CH., this volume - Use of spotlight for capturing Wild boar.

GERARD J.F., TEILLAUD P., SPITZ F., MAUGET R. & CAMPAN R., (1991) - Les ongulés sauvages de France. *Rev. Ecol. (Terre et Vie)*, suppl. 6: 11-66.

I.F.N. (Inventaire Forestier National), (1984) - *Résultats du deuxième inventaire forestier*. Département de l'Hérault.

JANEAU G. & SPITZ F., (1984) - L'espace chez le Sanglier (*Sus scrofa* L.): occupation et mode d'utilisation journalier. *Gibier Faune Sauvage*, 1: 73-89.

JULLIEN J.M., BRANDT S., VASSANT J. & CHANTECAILLE S., (1991) - Des sangliers chassés en battue en forêt domaniale de Chateauvillain/Arc-en-Barrois: leurs "stratégies" pour échapper aux chasseurs et aux chiens. *Bull. Mens. Off. Natl. Chasse*, 162: 29-36.

JULLIEN J.M., VASSANT J., DELORME D. & BRANDT S., (1988) - Technique de capture de sangliers. *Bull. Mens. Off. Natl. Chasse*, 122: 28-35.

KURZ J.C. & MARCHINTON R.L., (1972) - Radiotelemetry studies of feral hogs in South Carolina. *J. Wildl. Manage.*, 36: 1240-1248.

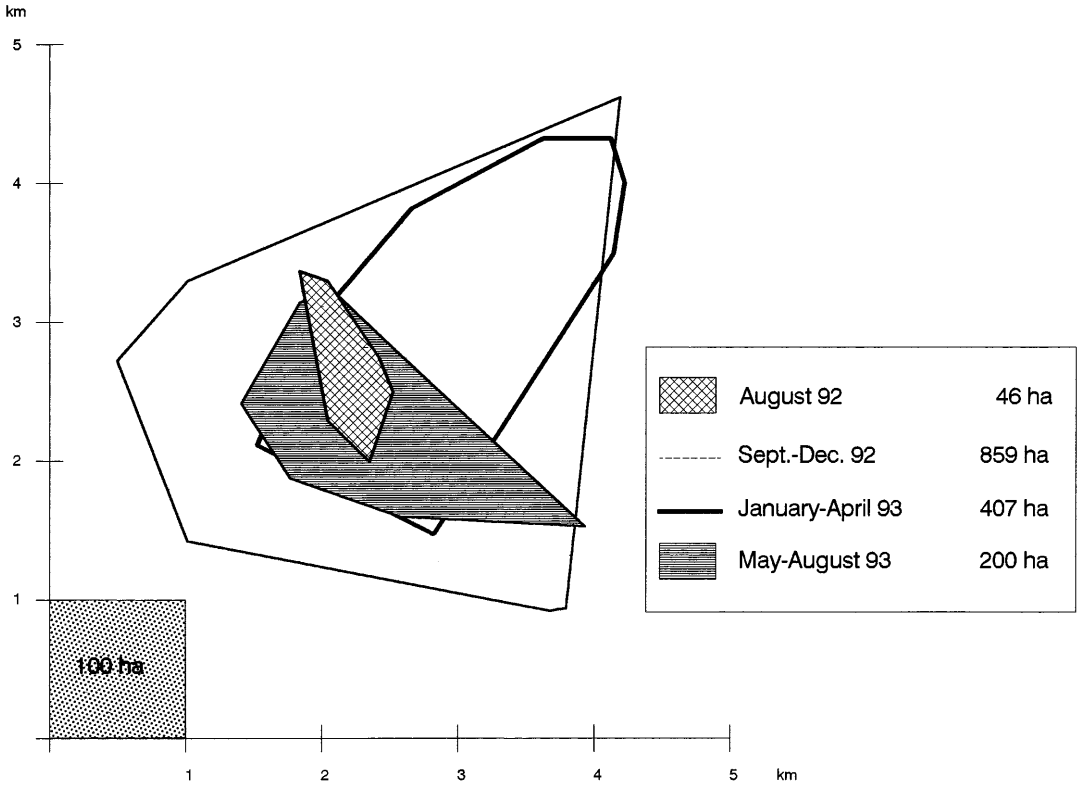


Figure 4 - Changes in seasonal resting range size (ha) and configuration for Wild boar group n° 8.

MAUGET R., CAMPAN R., SPITZ F., DARDAILLON M., JANEAU G. & PÉPIN D., (1984) - Synthèse des connaissances actuelles sur la biologie du Sanglier, perspectives de recherche. Symposium International sur le Sanglier. F. Spitz & D. Pépin (eds), Toulouse, *Les Colloques de l' INRA*, n° 22: 15-50.

MAUGET R., (1980) - *Régulations écologiques, comportementales et physiologiques (fonction de reproduction), de l'adaptation du Sanglier (Sus scrofa* L.) *au milieu*. Thèse d'état, Université François Rabelais, Tours.

SINGER F.J., OTTO D.K., TIPTON A.R. & HABLE C.P., (1981) - Home ranges, movements and habitat use of european Wild boar in Tennessee. *J. Wildl. Manage.*, 45: 343-353.

SPITZ F., (1992) - General model of the spatial and social organization of the wild boars *(Sus scrofa* L.). In: *"Ongulés/Ungulates 91"*, F. Spitz, G. Janeau, G. Gonzalez & S. Aulagnier (eds), S.F.E.P.M.- I.R.G.M., Paris - Toulouse: 385-389.

SPITZ F., JANEAU G. & VALET G., (1984) - Eléments de démographie du Sanglier *(Sus scrofa)* dans la région de Grésigne. *Acta Oecol., Oecol. Applic.*, 5: 43-59.

VASSANT J., BRANDT S. & JULLIEN J.M., (1992) - Des sangliers encore plus sédentaires qu'il était imaginable de le croire. *Bull. Mens. Off. Natl. Chasse*, 165: 31-39.

# *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)<br>0.18 - 0.55 (Singer *et al.*, 1981) |
| MSTM (km/h) | 0.04 | 0.56 (Janeau & Spitz, 1984)<br>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 % |

## REFERENCES

FERRARIO G., MERIGGI A. & TOSI G., (1986) - Situazione attuale e problemi di gestione del cinghiale *(Sus scrofa)* in Lombardia. *Proc. Il cinghiale ieri, oggi, domani*. Siena, 28/2 - 1/3 1986.

JANEAU G. & SPITZ F., (1984) - L'espace chez le Sanglier (*Sus scrofa* L.): occupation et mode d'utilisation journalier. *Gibier Faune Sauvage*, 1: 73-89.

KURZ J.C., MARCHINTON R.C., (1972) - Radiotelemetry studies of feral hogs in South Carolina. *J. Wildl. Manage.*, 36 (4): 1240-1248.

MCCALL T.C., BROWN R.D. & DEYOUNG C.A., (1988) - Mortality of pen-raised and wild White-tailed deer bucks. *Wildl. Soc. Bull.*, 16 (4): 380-384.

MATTEI L., (1987) - *Analisi degli areali (home range) in una popolazione selvatica di cinghiali* (*Sus scrofa* L.). Tesi di laurea, Università di Roma.

MAUGET R., (1980) - Home range and activity patterns of the european Wild boar (*Sus scrofa* L.) as determined by radio tracking. In: *A handbook on biotelemetry and radio tracking*. Amlaner C. & Macdonald D. (eds), Pergamon Press.

NONIS D., (1988) - *Studio dei ritmi d'attività di una popolazione selvatica di cinghiali* (*Sus scrofa* L.). Tesi di laurea, Università di Roma.

SINGER F.J., OTTO D., TIPTON A. & HABLE C., (1981) - Home range, movements and habitat use of european Wild boar in Tennesse. *J. Wildl. Manage.*, 45(2): 343-353.

STICKEL L. & WARBACH O., (1960) - Small mammals population of a Maryland Woodlot. *Ecology*, 41(2): 269-286.

SWIHART R. &, SLADE N., (1983) - Home range indices for the Ispid cotton rat *(Sigmodon hispidus)* in northeastern Kansas. *J. Mamm.*, 64 (4): 580-590.

WHITE G. & GARROTT R., (1990) - *Analysis of wildlife radio-tracking data*. Academic Press Inc.

# *SPACE USE BY PEN-RAISED WILD BOARS (Sus scrofa) RELEASED IN TUSCANY (CENTRAL ITALY) - II: HOME RANGE*

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**Abstract:** The purpose of this study is investigating space occupation patterns shown by pen-raised wild boars released into the wild for restocking. Fourteeen pen-raised wild boars, released for restocking near Siena (Tuscany), were radiocollared and monitored from March 1990 to January 1991. Spatial exploration, determined by weekly convex polygons, chronological linked fixes, weekly geometric center trends and home range formation processes were studied for each individual. Total explorated and weekly used area (Minimum Convex Polygon method) were compared between sexes. Males and females displayed different space use. Total home ranges of males (mean area = 11.48 $km^2$) were significantly ($P<0.01$) larger than those of females (mean area = 3.77 $km^2$). No significant differences ($P>0.05$) were found between used area and distance moved by males and females during first week. From second week on females concentrated their movement and stabilized their use of space while males were more explorative during the whole observation period.

**Keywords:** Wild boar, *Sus scrofa,* Suidae, Restocking, Movements, Space utilization.

**IBEX J.M.E. 3:112-116**

## 1. Introduction

During last decades in Italy Wild boar populations have rapidly increased, mainly because of environmental changes and human handling. The natural expansion of populations from bordering countries and the wide use of restocking for hunting purposes caused the observed extension of geographical distribution (Spagnesi & Toso, 1991).

The present italian Wild boar populations show genetic effects of the past introduction of individuals belonging to different subspecies or crossed with domestic pigs, released by hunters with the aim of increasing body and litter size of animals (Apollonio *et al.*, 1988).

In spite of the wide use of restocking practice, we found no published reports concerning fate of pen-raised wild boars after release.

McCall *et al.* (1988) observed higher mortality rate in pen-raised White-tailed deer released into the wild, than in their wild counterparts. From this study results high mortality of pen-raised deer for hunting and poaching occurred during the first four months after release.

Ecological and spatial aspects involved have been not studied, so home range formation process and space use in pen-raised released into the wild are unknown.

The purpose of this study is to investigate about space occupation shown by pen-raised wild boars released into the wild, that is to analyze their spatial exploration, home range formation process, sex-related differences and eventual interactions with free wild boars, and to compare these processes and patterns of pen-reared wild boars to those of free wild ones.

## 2. Study Area

The study was conducted in the Siena farmland (Tuscany) in a low-hill area (190 $km^2$). Elevation range from 200 to 600 m u.s.l. Annual precipitation averages 1,160 mm with most occurring in late spring and fall. Annual average temperatures range from 4.6°C in January to 24°C in July. The area is covered by 68% woods and 32% open habitat type. Predominant plant communities are formed by woodland and include coppice and old-growth oak-chestnut woods and pine forest. In the study area traditional Wild boar hunting is open from November to January.

## 3. Material and Methods

From March 1990 to January 1991 fourteen pen-raised wild boars (8 males of which 5 three years old and 3 twenty months old; 6 females of which 1 three years old and 5 twenty months old) were fitted with radio-collars and released into the wild. Movements of each individual were sampled by daily radio-location conducted throughout a 24-hour period and by continuous 24-hour monitoring. Information on eventual association with free Wild boar population were obtained from sight record, when possible, or from observations of animals' tracks. Results obtained for each individual

were employed to investigate differences between sexes.
Spatial analyses were carried out using a G.I.S. (Geographical Information System), radiolocations were reported on an habitat map built for the area, habitat analysis is still in elaboration.
Home range evolution for each individual was investigated by total and weekly home range analysis (Minimum Convex Polygon method; Schoener, 1981). "Total home range" represents cumulative explored area from release moment and "weekly home range" the area used during every successive week after release. Area/ time curves were plotted for each individual in order to compare total and weekly areas trends and to identify, if asymptotic trends were found, the end of exploration movements and the achievement of stable use of areas. Total and weekly convex polygons were built for each individual because useful for a quick graphical estimate (Jennrich & Turner, 1969); from that, information about shifts or stability in use of areas during successive weeks after release were obtained (Boitani *et al.*, 1992).
In order to investigate the spatial exploration pattern expressed by each individual, chronologically linked fixes (CLF) were plotted, where consecutive locations are connected with distinguishing lines; actually CLFs proved to be very useful in separating periods of stable range from periods of range expansion (Voigt & Tinline, 1980).
To help the comparison, the locations of range weekly geometric centers were calculated. The geometric centre is a 2-dimensional average of the locations occupied by an animal during a period without other biological implications (Stickel & Warbach, 1960). In the present study geometric centre has been employed to describe movements inside total explorated area and to investigate eventual removal tendencies from release point, also furthest distances traveled by animals from release site (FDR) to death site or location at end of the study were calculated.

## 4. Results

A total of 868 locations was collected. Tracking period was interrupted about 4-8 weeks after release for 78.6% of animals. For animals n°4 and n°14 were employed only fixes collected during six weeks after release, to make the data comparable with those of the other animals; animal n°7, died after only six days after release, was ignored (Tab. 1). The end of tracking period for 75% of cases was due to animals' death.
From analysis of total cumulative area/time curves results that curves level off for 46.2% of individuals (n = 6, of these 2 are males and 4 are females) (Fig.1), while the curves do not for 53.8% of individuals (n = 7, of these 5 are males and 2 are females) (Fig.2).
From the analysis of weekly used area/time curves, animal's weekly convex polygons, animal's

**Table 1: Individual results of total observation days and fixes number collected, total home range area and furthest distance from release site (FDR).** (Adult: three years old, Juveniles: twenty months old).

| Animal n° sex and age | Observation days (n) | Fixes tot (n) | Total h. r. area ($km^2$) | FDR (km) |
|---|---|---|---|---|
| 1 m A | 50 | 36 | 14.468 | 3.024 |
| 2 m A | 37 | 28 | 13.027 | 4.257 |
| 3 m A | 35 | 33 | 9.187 | 4.630 |
| 4 m A | 42 | 34 | 8.765 | 4.965 |
| 5 m A | 42 | 36 | 11.984 | 3.598 |
| 6 f J | 25 | 19 | 4.750 | 2.245 |
| 8 f J | 44 | 33 | 4.546 | 4.099 |
| 9 f J | 54 | 48 | 5.562 | 2.853 |
| 10 f J | 25 | 17 | 1.664 | 1.748 |
| 11 f J | 26 | 18 | 2.343 | 2.302 |
| 12 m J | 62 | 42 | 8.125 | 4.828 |
| 13 m J | 57 | 38 | 3.937 | 2.461 |
| 14 f A | 42 | 29 | 1.187 | 1.748 |

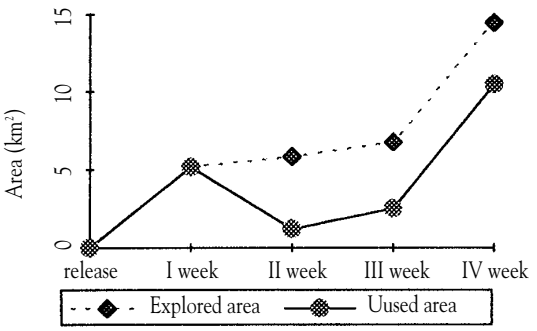


Figure 1 - Comparison of total cumulative explored and weekly used area occupied by male n° 1.

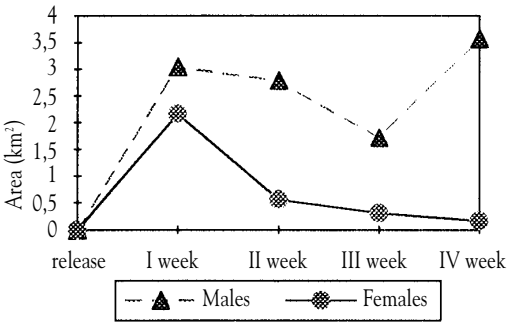


Figure 3 - Comparison between sexes of mean weekly used areas.

trails (CLF) and weekly geometric centres trends, two different space uses result: 61.5% of individuals (n = 8, of these 2 are males and 6 are females) explore most of the space during a short period after release and movements are concentrated inside the initially visited area, while 38.5% of individuals (n = 5), all males, keep on visiting new areas and these ones, used in subsequent weeks, are only partially overlapped. Mean total area explored by adult males (n = 5, x = 11.48 km²) is significantly greater (t-test, P< 0.01) than area explored by young females (n = 5, x = 3.77 km²).

Comparing total cumulative explored and weekly used areas' values between sex and age classes (Fig.3) no significant differences result during first week after release, while during the following weeks mean area of males is significantly greater (t-test, P< 0.05) than that of females. There is also a significant decrease (t-test, P< 0.05) of mean area used by females from first to second week after release. Furthest distance travelled by males from the release site (x = 4.094 km) is significantly greater (t-test, P< 0.05) than that travelled by females (x = 2.649 km); also, all females cover the greatest distance from the release site during first week, while males do it during the whole observation period (Tab.2).

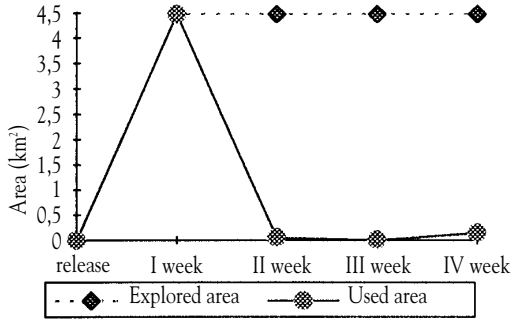


Figure 2 - Comparison of total cumulative explored and weekly used area occupied by female n° 8.

## 5. Discussion

In the present study the high mortality rate prevented longer sampling, so the number of

**Table 2: Comparison between sexes of mean total and weekly home range area (km²) and further distance from release site, FDR (km).**

| Mean Values | Males | Females | Statistical values (t-test) |
|---|---|---|---|
| Total h. r. area | 11.486 | 3.773 | P<0.01 |
| I° week h. r. area | 3.043 | 2.165 | n.s. |
| II° week h. r. area | 2.780 | 0.555 | P<0.05 |
| III° week h. r. area | 1.717 | 0.312 | P<0.05 |
| IV° week h. r. area | 3.574 | 0.175 | P<0.05 |
| FDR | 4.094 | 2.649 | P<0.05 |

observations allowed only a partial vision. Nevertheless results offer some information.
In the study about wild animals the achievement of an asymptote in cumulative area/time curve, as sampling goes on, permitted to determine the space habitually used by an animal; in the present study it points out the end of explorative phase: as sampling goes on there is no increase in total visited area. Cumulative area estimates final home range that is total space visited by an individual, where the curve levels off the home range is a stable one. Expansion dynamics around release site allows to better understand space use shown by pen-raised wild boars.
Considering wild boars' spatial and social organization, the two sex and age classes examined in this study (adult males and young females) can be considered representative of the two sexes in spatial occupation, in fact adult males show the spatial pattern of the solitary males, while the young females that of social groups of females and young.
Two prevalent trends were found in space use, these appeared in close relation with sex. Also considering results of sex classes analysis different space use shown by sexes after release can be focalized.
During first week differences between sexes were not found. From second week on females concentrated their movements inside the explored area without going further afield, on the contrary males kept on exploring new areas and moved long distances. So at end of tracking period females ended explorative phase and became stable in the space use, while males did not: they used larger area than females and died (mainly due to poaching and hunting), so their stabilization pattern is still unknown.
In the present study space use shown by animals is due to two factors: the impact with a new unknown environment and biological differences between sexes. The captivity and the release are common to all animals and cause homogeneity during the first week; from second week both sexes space use appeared similar to that of free wild boars described in literature, also females appeared most rapidly adapted to new condition.
Inside a wild boars free population each individual uses its own space in close relation with the spatial structure of population and piglets learn resource distribution and location of seasonal range from older animals; exploration connected with dispersal tendencies is more common in males (Singer *et al.*, 1981; Spitz, 1992).
Several authors found in the Wild boar free populations the size of the home range larger for males than for females (Mauget, 1980; Singer *et al.*, 1981; Mattei, 1987; Spitz, *op. cit.*). Mean total home range size visited by all animals in present study ($x = 9.9$ km$^2$) appeared similar to home range area occupied by free ranging wild boars ($x = 7.5$ km$^2$) previously studied in the same study area (Mattei, *op. cit.*) in relation to the different tracking period (respectively about one and three years).
In the case of free wild boars, Mattei (*op. cit.*) found that groups of females, yearlings and young used total home range size similar to that of solitary males; therefore nocturnal home range, corresponding to actively occupied range, resulted greater for males. Such differences in space use shown by sexes were in close relation with different use of resources and with social structure. Groups of females used zones with high concentration of resources while males used resources widely scattered so they moved uniformly inside their home range occupying an area greater than that occupied by females. Different space and resource use displayed by sexes has been observed in many ungulates and serves to reduce competition among males and other groups; also, a solitary male requires considerably less food than a group of females, yearlings and young (Singer *et al.*, *op. cit.*).
The hypothesis of an association between pen-raised females and social groups of the free Wild boar population can not be rejected, it may be the cause of the rapid stabilization observed for females.

## REFERENCES

APOLLONIO M., RANDI E. & TOSO S., (1988) - The systematics of some italian populations of Wild boar *(Sus scrofa). Boll. Zool.*, 3: 213-221.

BOITANI L., MATTEI L., MORINI P. & ZAGARESE B., (1992) - Experimental release of captivity reared wild boars *(Sus scrofa)*. In: *"Ongulés/Ungulates 91"*. F. Spitz, G. Janeau, G. Gonzalez & S. Aulagnier (eds), S.F.E.P.M. - I.R.G.M., Paris-Toulouse: 413-417.

JENNRICH R. & TURNER B., (1969) - Measurement of non-circular home range. *J. Theoret. Biol.*, 22: 227-237.

MATTEI L., (1987) - *Analisi degli areali (home range) in una popolazione selvatica di cinghiali* (*Sus scrofa* L.).Tesi di laurea, Università di Roma.

MAUGET R., (1980) - Home range and activity patterns of the european Wild boar (*Sus scrofa* L.) as determined by radio tracking. In: *"A handbook on biote-*

*lemetry and radio tracking"*, Amlaner C. & Macdonald D (eds), Pergamon Press.

MCCALL T.C., BROWN R. D. & DE YOUNG C. A., (1988) - Mortality of pen-raised and wild white-tailed deer bucks. *Wildl. Soc. Bull.* 16 (4): 380-384.

SCHOENER W., (1981) - An empirically based estimate of home range. *Theor. pop. Biol.*, 20: 281-325.

SINGER F.J., OTTO D., TIPTON A. & HABLE C., (1981) - Home range, movements and habitat use of european Wild boar in Tennesse. *J. Wildl. Manage.*, 45(2): 343-353.

SPAGNESI M. & TOSO S., (1991) - Evoluzione recente della situazione faunistico gestionale in Italia. *Proc. II° Convegno nazionale dei biologi della selvaggina*, Bologna 7-8 marzo 1991.

SPITZ F., (1992) - General model of the spatial and social organization of the wild boars (*Sus scrofa* L.). In: *"Ongulés/Ungulates 91"*. F. Spitz, G. Janeau, G. Gonzalez & S. Aulagnier (eds), S.F.E.P.M. - I.R.G.M., Paris-Toulouse: 385-389.

STICKEL L. & WARBACH O., (1960) - Small mammals population of a Maryland Woodlot. *Ecology*, 41(2): 269-286.

VOIGT R. & TINLINE R., (1980) - Strategies for analyzing radio tracking data. In: *"A handbook on biotelemetry and radio tracking"*, Amlaner C. & Macdonald D. (eds), Pergamon Press.

# *PRELIMINARY DATA OF THE WILD BOAR (Sus scrofa) SPACE USE IN MOUNTAIN ENVIRONMENT*

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**Abstract:** The work presents the preliminary data of wild boars spatial occupation in mountain environment, based on 9 radio-tagged animals followed during 16 months. The authors suggest that resting places choice and daily movements patterns are related to important seasonal change of the environment and particularly to thermal comfort and safety.

**Keywords:** Wild boar, *Sus scrofa,* Suidae, Radiolocation, Activity, Resting places, Mountain environment, Europe.

**IBEX J.M.E. 3:117-121**

## 1. Introduction

Wild boar reproductive success in mountain environments took place during the last twenty years; the damages to alpine prairies and to typical crops of mountain economy (Macchi *et al,* 1992) and the conspicuous number of shootings during hunting season (Durio *et al,* 1992) confirm this trend. Actually no works are published on space use by wild boars in high altitude habitat. Only the studies in the "Great Smoky Mountains National Park" (Singer *et al.,* 1981), and in Caroux Espinouse and Montagne Noire (Cousse, 1994), refer to low mountain environments.

The aim of our work is to present some data we collected using radiolocation techniques, about Wild boar spatial occupation in alpine environment, during a 16 months period. We tried to verify the following points:

- Where the resting places are located in regard to the altitude, the vegetation type and the seasons.
- How wild boars choose their resting places: i) regarding "thermal comfort" as proposed by authors like Mauget (1980), Singer *et al.* (1981), Douaud (1983), Janeau and Spitz (1984), Dardaillon (1986), Cousse (1993); ii) regarding quiet and safety as proposed by Mauget (*op. cit.*), Douaud (*op. cit.*), Janeau and Spitz (*op. cit.*), Dardaillon (*op. cit.*).
- Where the feeding areas are located, in regard to the altitude, the vegetation type, the resting places, and the seasons.
- How wild boars daily movements are organized.

## 2. Study area

The area is located in the middle of Susa Valley, (northern Cozie Alps), on the right hydrographic side, with northern exposure (Fig.1); 40% of the study area is a protected zone (Orsiera-Rocciavrè Natural Park). The meteorological conditions of the area are characterized by low yearly precipitations (minimum about 1,000 mm) (De Biagi *et al.,* 1990). Vegetation is divided into altitude classes identified by:

- chestnut wood (*Castanea sativa*) until 1,000 m;
- beech wood (*Fagus sylvatica*) until 1,400 m;
- conifer wood (*Abies alba, Larix decidua*) until 2,100 m;
- bushes (*Alnus viridis, Rhododendron* sp.) from 1,400 m to 2,200 m;
- alpine prairie from 2,100 m till the rocks limit, about 2,400 m

Many other species live in this area and particularly, among ungulates, Red deer (*Cervus elaphus*), Roe deer (*Capreolus capreolus*) and Chamois (*Rupicapra rupicapra*).

Cows, sheep and goats are pastured since June until October inside the Orsiera-Rocciavrè Natural Park limits, that starts from the level of 1,300 m.

## 3. Material and methods

Nineteen (19) wild boars were caught using 6 sash-door traps baited with corn grains (*Zea mais*) and located in areas between 500 m and 1,550 m where food was usually distributed. Once trapped boars were immobilized with

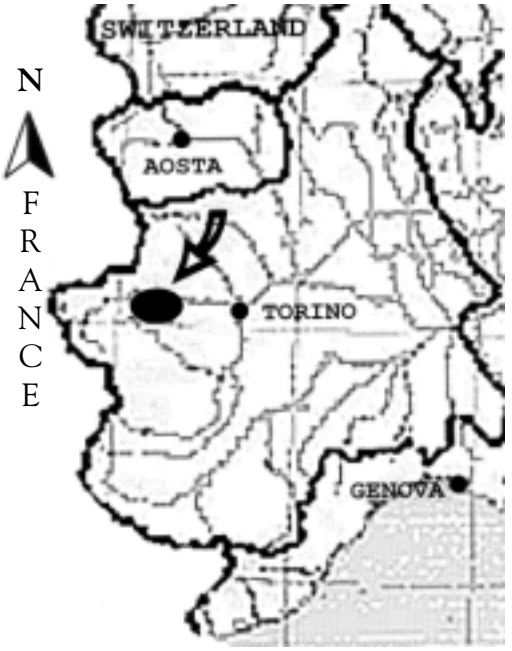



Figure 1 - Study area.

detaining traps or with anaesthetic injection and marked with ear tag (Alflex model). Biometric measurements (weight, metatarsus length, neck circumference) and teeth examination (Iff, 1978) allowed us to age the animals.

Nine (9) wild boars were fitted with double stage T.W.-2 Biotrack transmitters (148-149 MHz) supplied with a lithium 3.6 V.C.C. cell and a 1/4 wave length whip antenna. Transmitters were potted in epoxy resin and fixed on a leather collar. Total weight of the radio-collar was about 350 g (< 5% of wild boars' weight). On field we used 4 elements hand held Yagi antennas, receivers (CE 12 Custom Electronics of Urbana Inc.), headphones, high precision compass and topographic maps (1:25,000). Each animal location was estimated by 2 directional bearings from 2 receiving stations in known places. We identified by a preliminary study the adequate receiving places for the whole study area: 22 receiving positions (and 22 associated and partially overlapping sectors) were so determined, allowing us to take fixes of radio-collared animals wherever they were in the study area. Reflected signals were sometimes received leading us to repeat the fix from a better receiving position. When it was possible, we used fixed radio-beacons as reference points, but these beacons were often unavailable because of the hard territory geomorphology. We tried the Null-peak triangulation system where geomorphological condition allowed its use (uneasy to transport, unusable in sites with excessive reflections). Bearings accuracy was immediately controlled by a triangulation program on personal computer and fixes were repeated when accuracy was too low.

Radio-locations were made each 15 minutes (Spitz, 1988) since animals' departure from initial resting place to the next resting place. Animals' locations were reported using UTM I.G.M.I. cartography (1:25,000, 1:10,000). This work was conducted 2 days a-week since August 1992 till November 1993. The data obtained are not fully analyzed. The results we present in this paper are based on 114 resting places and 24 daily movements. Ninety nine (99) resting places and the 24 daily movements refer to 2 females, initially caught as subadults, that gave birth to 1 and 3 piglets respectively in the next farrowing season (1993). The remaining 15 resting places concern 5 males (1 adult, 4 subadults) that moved away from the study area after few months, and 2 subadults (1 male, 1 female) whose collars stopped working approximately after 20 days since the tagging.

We shall use the terms "winter" or "bad season" to refer to a period that goes from half September to April, characterized by particularly hard weather conditions, and the terms "summer" or "good season" to refer to the better weather part of the year.

The animals we studied were spread all over the study area, so we tried to divide it into altitude classes.

- The first class goes from the bottom of the valley (about 500 m) to 1,350 m.
- The next class goes from 1,350 to 1,800 m.
- The last class goes from 1,800 m to the edge of the mountain chain (about 2,500 m).

## 4. Results

### 4.1. Resting places

The radio-tagged animals resting places are shown in figure 2. We can see in figure 3 that location altitude changes according to season. We studied the ground conformation of these places and we found out a preference for:

- high altitude and south-eastern exposure, near rocky faces or big stones, where vegetation varies from low bushes to thin larches, during bad season. The medium altitude of

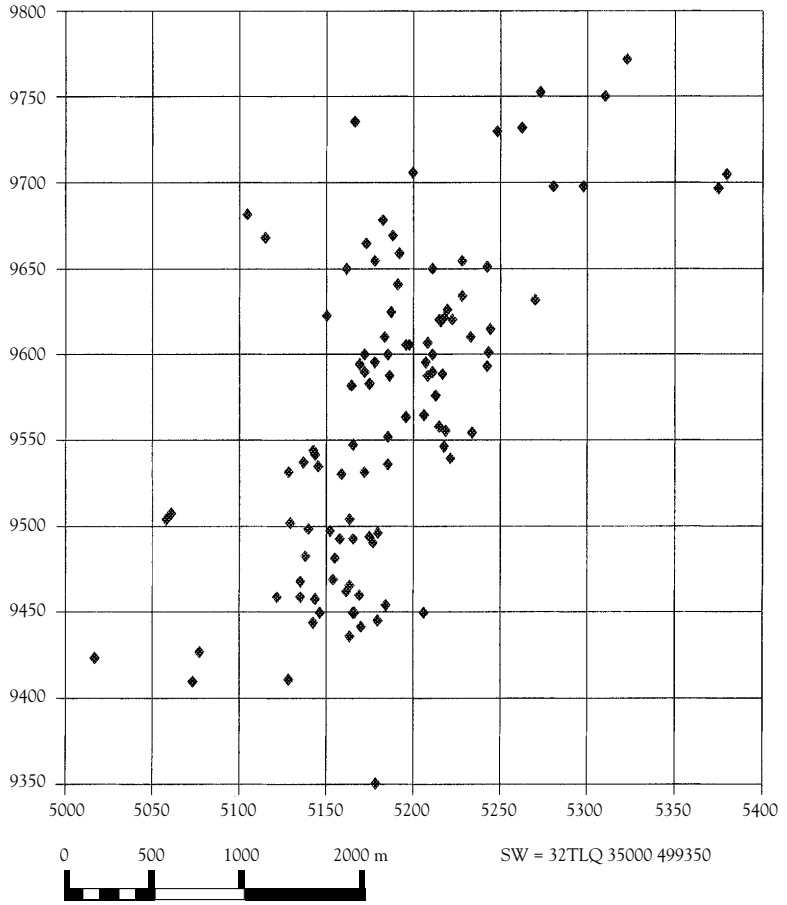



Figure 2 - Resting places UTM grid.

winter resting places is 1,595 m (min. 1,380 m, max. 1,810 m). Higher resting places were given up for lower ones only when snow cover was high (> 80 cm).

• medium-low altitude, fresh climate, water and vegetation abundance, north eastern exposure, during good season. The medium altitude of summer resting places is 1,235 m (min 990 m, max. 1,480 m).

The slope of resting places varies from 0 to 5 degrees in summer while it reaches even 20° in winter. This is probably linked to better insolation, better water drain of the ground, shorter snow persistence time.

The absence of diurnal resting places in the vicinity of some particular areas with farms, houses and touristic places is patent. Moreover, displacements were noticed in relation to human disturbance, particularly poachers' shooting, and some of these displacements suggest an use of the protected areas (Natural Park) as "safe" zones.

### 4.2. Female movements

Radio-tagged females showed 2 movement types according to season (Fig. 4):

- In winter they quickly descend from their high altitude resting areas to reach feeding places at lower altitude (800 - 1,300 m). They often visit beech and chestnut woods (Durio *et al.*, 1995). Whereas their speed is high while they are going down, when they reach lower altitudes, bearings confidence ellipses overlap, identifying slow moving areas (speed < 1 km/h). Three-four hours later wild boars return to resting areas and usually they rest in a nest

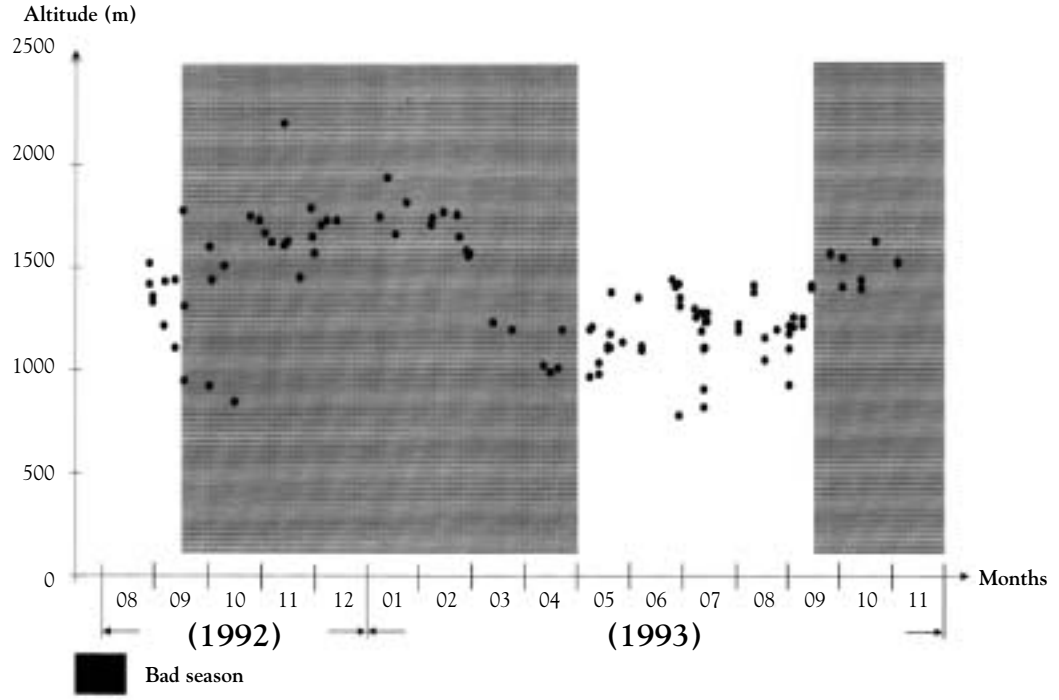



Figure 3 - Variation of resting places altitude through months.

that is different from the starting one as in "loop pattern" by Spitz and Janeau (1990).
- In summertime altitude range is shorter and resting areas overlap feeding places (800 - 1,200 m). Activity movements are more diversified than in winter in regard to patterns suggested by Spitz and Janeau (*op.cit.*). All these patterns were observed: "small zone", "loop", "zig-zag" and "ranging".
The mean movement parameters differences between winter and summer are described in the figure 5.

## 5. Conclusion

We have observed variations of the resting place location (altitude, vegetation type) in regard to the season. These variations confirm the hypotheses about thermal comfort, safety and quietness preferences.
Females daily movements differences occur also in regard to the season and can be related to the change in overlapping of feeding and resting areas. Consequently, we observe variations of the mean movement parameters.
This work, in progress, must be analyzed with the male data and new field records, to precise and understand the spatial behaviour of Wild boar in the high elevation environment.

## References

COUSSE S., (1994) - *La construction de l'espace-temps individuel et de l'organisation socio-spatiale chez le Sanglier (Sus scrofa). Une analyse systémique*. Thèse doctorat de l'Université P. Sabatier, Toulouse, 71 pp.

DARDAILLON M., (1986) - Some aspects of the orientation in space of *Sus scrofa* as revealed by data on home range, habitat use and movements. In: *Orientation in space*. G. Beugnon (ed), Toulouse, Privat/I.E.C: 63-70.

DE BIAGGI, E. STOPPA T. & SCOTTA M., (1990) - Proposta per una suddivisione del Piemonte in settori eco-geografici. *Riv. Piem. St. Nat.*, Vol.XI.

DOUAUD J.F., (1983) - *Utilisation de l'espace et du temps et ses facteurs de modulation chez le Sanglier (Sus scrofa) en milieu forestier ouvert (Massif des Dhuits, Haute Marne)*. Thèse Univ. Strasbourg.

DURIO P., GALLO ORSI U., MACCHI E. & PERRONE A., (1992) - Monthly birth distribution and structure of an Alpine population of Wild boar *(Sus scrofa)* in North-West Italy. In: *"Ongulés/Ungulates 91"*, F. Spitz, G. Janeau, G. Gonzalez & S. Aulagnier (eds), S.F.E.P.M. - I.R.G.M., Paris - Toulouse: 395-397.

DURIO P., BONI I., PERRONE A. & PIRONE S., (1995) - The Chestnut woods undergoing marginalization in Piemonte mountainous areas - interactions with ungulates with particular respect to the Wild boar. In: *Sustainability of mediterranean ecosystems*. Roman F. (ed). Ecosystems Research Reports, CEE, Bruxelles, n° 19: 123-134.

IFF U., (1978) - Détermination de l'âge chez le Sanglier. *Diana* (Suisse), 10: 377-381.
JANEAU G. & SPITZ F., (1984) - L'espace chez le Sanglier: occupation et mode d'utilisation journalier. *Gibier Faune Sauvage*, 1: 73 - 89.
MACCHI E., GALLO ORSI U., PERRONE A. & DURIO P., (1992) - Wild boar *(Sus scrofa)* damages in Cuneo Province (Piedmont, Italy, NW). In: *"Ongulés/Ungulates 91"*, F. Spitz, G. Janeau, G. Gonzalez & S. Aulagnier (eds), S.F.E.P.M. - I.R.G.M., Paris - Toulouse: 431-433.
MAUGET R., (1980) - Régulations écologiques, comportementales et physiologiques (fonction de reproduction) de l'adaptation du Sanglier *(Sus scrofa)* au mileu. *Thèse d'état*, Univ. Tours, 355 pp.
SINGER F.J., OTTO D.K., TIPTON A.R. & HABLE C.P., (1981) - Home ranges, movements and habitat use of european Wild boar in Tennessee. *J.Wildl. Manage.*, 45 (2): 343-353.
SPITZ F., (1988) - Exploitation des données de radiotracking de 24 heures. Actes du Colloque International: *"Suivi des Vertébrés Terrestres par Radiotélémétrie"*. Principauté de Monaco: 147-152.
SPITZ F. & JANEAU G., (1990) - Spatial strategy: an attempt to classify daily movements of Wild boar. *Acta Theriol.*, 35 (1-2): 129-149.

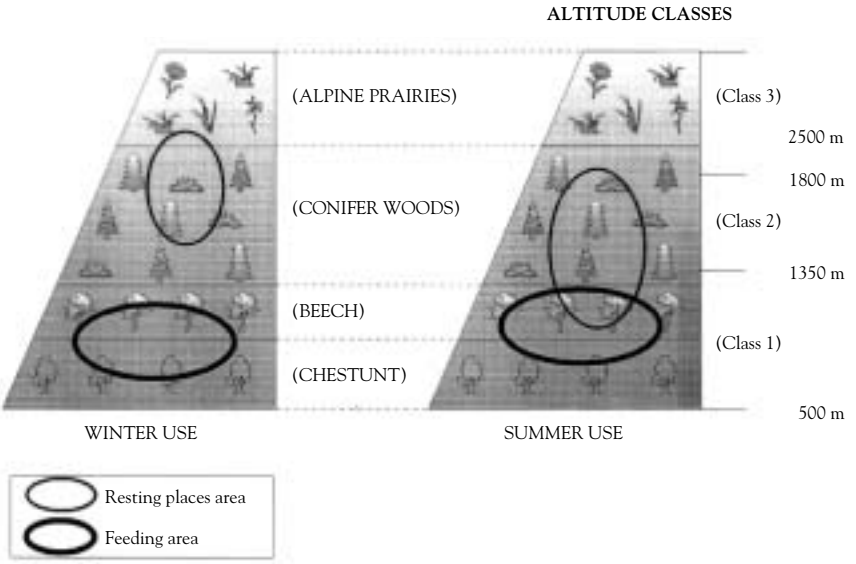
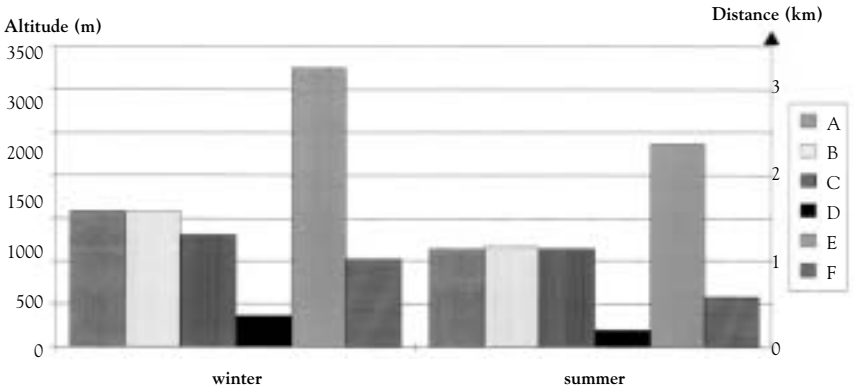



Figure 4 - Environment use.




A) Starting resting place altitude (m); — B) Ending resting place altitude (m); — C) Altitude of the farthest location reached during night activity (m); — D) Altitude difference (m); — E) Horizontal covered distance (total deplacement) (km); — F) Distance of the farthest location from starting resting place (km).

Figure 5 - Mean movement parameters: differences between winter and summer.

# *TEMPORAL ONTOGENY IN THE WILD BOAR (Sus scrofa* L.*): A SYSTEMIC POINT OF VIEW*

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**Abstract:** Fifteen free-ranging wild boars (*Sus scrofa* L.) were studied by biotelemetry in Southern France. Five indicators of activity (circadian and ultradian rhythms, polyphasism, total duration of resting and of movements) were used and their comparison between different categories of animals permitted to describe some ontogenetical differences. Infants and juveniles were characterized by an ultradian and a circadian rhythmicity, adults (except breeding females) only by a circadian one. An important number of activity and resting phases (polyphasism) was observed in young animals and breeding females. Juveniles slept less, moved more and were more diurnal than other animals. The construction of the sleep-wake rhythm was explained by the combination between external (environmental) and internal perturbations in a self-organizing system.

**Keywords:** Wild boar, *Sus scrofa,* Suidae, Biotelemetry, Activity, Rest, Rhythm, Ontogeny, System, Polyphasism.

**IBEX J.M.E. 3:122-125**

## 1. Introduction

Ontogeny means the construction of a young animal (or human) under the action of both internal and external factors, such as maturation and experience (Schneirla, 1966; Gottlieb, 1976; Campan, 1980). Moreover, as said in the title, we consider the individual as a system, more precisely a self-organizing system (Varela, 1989).

Such a system is closed off from its environment; so this environment doesn't provide information but only causes perturbations whose interpretation is elucidated in the system (Varela, *op. cit.*). The new emerging forms, for example a new organization or a new behaviour, result from the interactions between external events considered as perturbations and the internal mechanisms of self-organization.

In free-ranging wild boars, we first compared some biotelemetry indicators between infants, juveniles and adults. This permitted us to deduce some rules about the construction of sleep-wake rhythms in this species. The theoretical approach of self-organization was then used to discuss the results

## 2. Study area

All the data were obtained in three study areas of Southern France, in the Camargue from 1985 to 1987 and in the Caroux-Espinouse and Montagne Noire massifs from 1989 to 1991. The Camargue is a flat area, with a mediterranean climate; it consists of similar proportions of croplands and marshes, with very small scattered woods and shrublands (Dardaillon, 1984). The two massifs range from 200 to 1200 m u.s.l. with a mediterranean climate influenced by altitude and exposure; their vegetation is diverse (holm oak, chestnut, conifer, various types of heathlands and grasslands; Auvray, 1983; Anonymous, 1979).

## 3. Material and methods

Fifteen wild boars (Tab. 1) were trapped and fitted with collars containing a double-stage transmitter joined to a mercury switch sensitive to the animal's head position (Janeau & Hachet, 1991). The activity was recorded in real time with a multi-channel biotelemetry system (Janeau *et al.*, 1987). It permitted (Janeau *et al.*, 1991) to distinguish between resting (*sleep*), activity on site and activity with movement (these two last items could be gathered in *wake*).

To study ontogeny, the animals were classified (Spitz, 1992) into (i) *infants* before weaning (ii) *juveniles* from 3 to 8 months (iii) *sub-adults* from 8 to 24 months and (iv) *adults*. Females were divided according to the lapse of time since birth of the piglets; they were considered as an independant sample when breeding infants (*Females with infants*) or with the adult males when breeding juveniles or non breeding (*Other adults*). Results on infants were derived from those of mothers (Cousse, 1994) or were

**Table 1: Number of wild boars and biotelemetry sessions for each category of animals. A female could successively belong to the second and third categories of this table.**

| | Number of different wild boars | Number of 24-h biotelemetry sessions |
|---|---|---|
| JUVENILES | 5 | 16 |
| FEMALES WITH INFANTS | 6 | 13 |
| OTHER ADULTS | 8 | 12 |

**Table 2. Characterization of the activity according to categories of animals.**

| | INFANTS | JUVENILES | FEMALES WITH INFANTS | OTHER ADULTS |
|---|---|---|---|---|
| Circadian rhythms | ? | + | + | + |
| Ultradian rhythms | + | + | + | - |
| Polyphasism | + | ++ | + | - |
| Total duration of resting | >50% | 43% | 49% | 50% |
| Total duration of activity with movements | ? | 33% diurnal | 25% nocturnal | 36% nocturnal |

found in the litterature. Unfortunatly, no data could be obtained on sub-adults.
Five indicators (Tab. 2) were used to describe the activity of the wild boars. They were the subjects of papers which can be consulted for more precision: circadian and ultradian rhythms in Cousse *et al.* (in press), polyphasism (which was calculated by the number of transitions between resting and activity) in Cousse and Janeau (1992), total duration of resting and of movements in Cousse and Janeau (*op. cit.*) and Janeau *et al.* (in press).

## 4. Results

The presence of a circadian rhythm (Tab. 2) was typical of all studied wild boars (but we found no bibliographical information for infants).
On the contrary, the presence of an ultradian rhythm was characteristic of infants, juveniles and females with infants (Tab. 2). Empirically, all the mean ultradian periods obtained appeared close to a 3-hour interval for the youngest animals and to its harmonics (6 hours, 9 hours and so on) for the oldest animals and for the females (Cousse *et al., op. cit.*). In the juveniles, the ultradian rhythm disappeared around the seventh month. In the females, it disappeared almost immediately after the weaning of the piglets (Cousse *et al., op. cit.*).
The polyphasism was maximal in young animals (10 to 30 transitions, Cousse & Janeau, *op. cit.*) and in females with infants (5 to 30 transitions); it was correlated to several short phases of activity on site inserted in long phases of resting. A progressive decrease of this parameter was observed in females during the breeding period. It was minimal (a single period of resting and a single one of activity) for adult females out of the breeding period and for adult males (Cousse & Janeau, *op. cit.*).
The total duration of resting was the longest in infants (Dallaire *et al.* 1974; Kuipers & Whatson, 1979). After weaning, this duration tended to decrease like in many other young ungulates (Richard-Hansen, 1992). Juveniles slept about fourty percent of the time and the adults about fifty percent (Janeau *et al.*, in press).
Duration of movements was low for infants and for females with infants (Janeau *et al.*, in press). It was greatest for juveniles and for adults (about thirty and fourty percent of the time). Juveniles tended to move during the day-light while all adults were nocturnal. Synchronization with sunset existed for juveniles, but is was less obvious than in adults; on average, they began to move one hundred

minutes before sunset, while the adults began to move only ten minutes after it (Janeau *et al.*, in press).

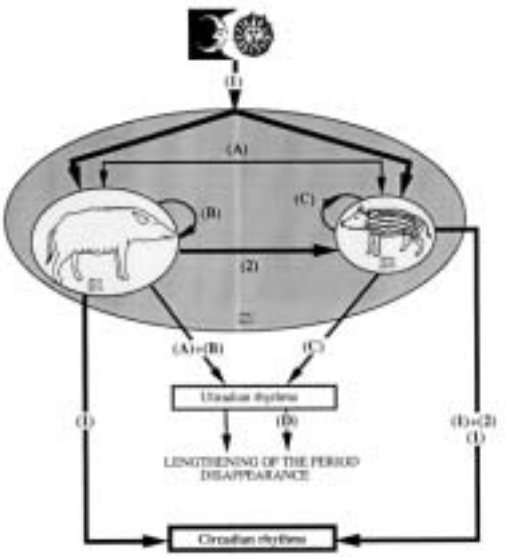
## 5. Discussion

For the German biologist Ashoff (1963), biological rhythms (circadian and ultradian) are mainly endogeneous. They can adjust to external factors, the Zeitgebers, and then modify their period or their amplitude; the principal Zeitgebers are photoperiod (Ashoff, *op. cit.*), temperature (Hoffman, 1969), food (Reinberg, 1974) and some social features (Gwinner, 1966). The rhythms are also checked by pacemakers, or biological clocks (Boulos & Terman, 1980), which can be considered as autonomous oscillators (Rusak & Zucker, 1975). For example, a rhythmic function, like locomotor activity, can result from the actions of several oscillators, which are coupled or independant.

The biological clock of the circadian rhythm comprises off at least two oscillators (Boulos & Terman, *op. cit.*); the first one is linked to feeding and anticipates the Zeitgeber. The second one is linked only to the photoperiod. For many authors (Hoppenbrouwers & Sterman, 1975; Stone, 1987), the ultradian rhythms come from the desynchronization of several physiological parameters of the organism, among others those linked to the nervous system. They would arise from the immaturity of the organism and wouldn't be subjected to a Zeitgeber.

After birth, piglets stay around one week in the nest (Gundlach, 1968) and their total nutritional dependance creates several correlations between maternal activities and those of the young. This maternal periodic feeding component must be considered as a precocial Zeitgeber for the unweaned animal (Fig. 1). Therefore, the rhythm in piglets would be initiated by the maternal feeding Zeitgeber when they stay in the birth place. It would be supplanted by the photoperiodism when the animals begin to leave the nest (Fig. 1). Both factors would affect the juvenile, a phenomenom which explains the differences observed between age classes in their synchronization with sunset.

According to a systemic point of view, the rhythms are the emergence of the relations between the different levels of the organism. The ultradian rhythms with a fundamental period of 3 hours observed in the youngest wild boars (*system S2* in Fig. 1) would be the first expressions of these co-actions just after the birth. During its development, the animal would be subjected to a series of disorganisations and reorganizations. These would explain the lengthening of the period then the disappearence of the ultradian rhythm. For females with piglets (*S1* in Fig. 1), the addition of internal hormonal perturbations and of external ones, like the presence of piglets and suckling, would cause the emergence of ultradian rhythms (Fig. 1). The disappearance of these perturbations would result in the single circadian attractor.




1: photoperiodic Zeitgeber
2: maternal Zeitgeber
A: suckling and social releasers
B: hormonal modifications
C: non-synchronization
D: maturation

Figure 1. Construction of the individual sleep-wake rhythms.

## 6. Conclusion

Systemic explanations permit to understand the development of an individual (*S2*) in relation to its environment which includes of course the mother (*S1*). But the ultradian rhythms permit the coordination between the activities of the mother and those of the young. Another systemic point of view is to consider the mother and the piglet as constitutive elements of a new system (*S3*). The ultradian rhythm is

then an emergence of their reciprocal interactions. However, for the Wild boar, it seems more judicious to consider that this new system includes the mother and all the members of the litter.

## REFERENCES


ANONYMOUS, (1979) - Itinéraires écologiques et phytogéographiques en Montagne Noire. *Ressources pédagogiques Nationales*, C.R.D.P. Toulouse, 7, 19 pp.

ASCHOFF J., (1963) - Comparative physiology: diurnal rhythms. *Annu. Rev. physiol.*, 25: 581-600.

AUVRAY F., (1983) - *Recherches sur l'écoéthologie du Mouflon (Ovis ammon musimon S. 1872) dans le Massif du Caroux-Espinouse (Hérault) en vue de définir de nouveaux sites d'accueil*. Thèse de Doctorat, Univ. Sciences et Techniques du Languedoc, Montpellier, 176 pp.

BOULOS Z. & TERMAN M., (1980) - Food availability and daily biological rhythms. *Neurosci. biobehavioral Rev.*, 4(2): 119-131.

CAMPAN R., (1980) - *L'animal et son univers, Etude dynamique du comportement*. Privat Bios, Toulouse.

COUSSE S., (1994) - *La construction de l'espace-temps individuel et de l'organisation socio-spatiale chez le Sanglier (Sus scrofa* L.). *Une analyse systémique*. Thèse 3° cycle, Univ. P. Sabatier, Toulouse, 71pp.

COUSSE S. & JANEAU G., (1992) - Time budget and polyphasic activity in Wild boar, *Sus scrofa* L. In : *"Ongulés/Ungulates 91"*, F. Spitz, G. Janeau, G. Gonzalez & S. Aulagnier (eds), S.F.E.P.M.-I.R.G.M., Paris-Toulouse: 391-394.

COUSSE S., QUENETTE P.Y., JANEAU G., LAUGA J. & CARGNELUTTI B., (1995) - Ontogeny of the rest-activity rhythm in the Wild boar. *Z. Saügetierk.*, 60: 143-149.

DALLAIRE A., TOUTAIN P.L. & RUCKENBUSH Y., (1974) - Sur la périodicité du sommeil paradoxal, faits et hypothèses. *Physiol. behav.*, 13: 395-400.

DARDAILLON M., (1984) - *Le Sanglier et le milieu camarguais: dynamique co-adaptative*. Thèse 3° Cycle, Univ. P. Sabatier, Toulouse, 345 pp.

GOTTLIEB G., (1976) - Conceptions of pre-natal development: behavioral embryology. *Psychol. Rev.*, 83: 215-234.

GUNDLACH H., (1968) - Brutfürsorge, Brutpflege, Verhaltens-Ontogenese und Tagesperiodik beim Europaïschen Wildschwein (*Sus scrofa* L.). *Z. Tierpsychol.*, 25: 955-995.

GWINNER E., (1966) - Entrainment of a circadian rhythm in birds by species-specific song cycles (Aves, Fringillidae: *Carduelis spinus, Serinus serinus*). *Experientia*, 22: 765.

HOFFMAN K., (1969) - Temperaturcyclen als Zeitgeber der circadienen Periodik. *Verh. dt. Zool. Ges.*: 265-274.

HOPPENBROUWERS T. & STERMAN M.B., (1975) - Development of sleep state patterns in the kitten. *Exp. neurol.*, 49: 822-838.

JANEAU G. & HACHET T.H., (1991) - Utilisation de la biotélémétrie pour l'étude de l'activité des animaux sauvages. In: *Suivi par biotélémétrie des vertébrés terrestres*, Principauté de Monaco: 133-145.

JANEAU G., SPITZ F., LECRIVAIN E., DARDAILLON M. & KOWALSKI C., (1987) - Système automatique d'acquisition en temps réel et à distance de paramètres biologiques sur animaux en liberté. *Acta Oecol., Oecologia applicata*, 8(4): 333-341.

JANEAU G., COUSSE S. & SPITZ F., (1991) - Activity pattern of Wild boar, *Sus scrofa* L. In: *Proceedings of the 11th International Symposium on Biotelemetry*, A. Uchiyama & C.J.Jr Amlaner (eds), Waseda University Press, Tokyo: 123-127.

JANEAU G., COUSSE S., MANN C.S. & SPITZ F., in prep. - Time-budget of Wild boar, *Sus scrofa* L.: duration of activities, diurnal-nocturnal distribution and synchronization with sunset.

KUIPERS M. & WHATSON T.S., (1979). Sleep in piglets: an observational study. *Appl. anim. ethol.*, 5 : 145-151.

REINBERG A., (1974) - Chronobiology and nutrition. *Chronobiologia*, 1: 22-27.

RICHARD-HANSEN C., (1992) - *Socialisation et modalités d'organisation sociale chez l'Isard (Rupicapra pyrenaica) dans le cadre des théories systémiques et d'auto-organisation, Implications évolutives*. Thèse 3° cycle, Univ. P. Sabatier, Toulouse, 82 pp.

RUSAK B. & ZUCKER I., (1975) - Biological rhythms and animal behavior. *Ann. Rev. Psychol.*, 26:137-172.

SCHNEIRLA T.C., (1966) - Behavioral development and comparative psychology. *Q. Rev. Biol.*, 41: 283-302.

SPITZ F., (1992) - General model of the spatial and social organization of the wild boars (*Sus scrofa* L.). In: *"Ongulés/Ungulates 91"*, F. Spitz, G. Janeau, G. Gonzalez & S. Aulagnier (eds), S.F.E.P.M.-I.R.G.M., Toulouse-Paris: 413-417.

STONE R.D., (1987) - The activity patterns of the Pyrenean desman (*Galemys pyrenaicus*) (Insectivora: Talpidae), as determined under natural conditions. *J. Zool.*, 213: 95-106.

VARELA F., (1989) - *Autonomie et connaissance, Essai sur le vivant*. Seuil, Paris, 255 pp.

# *PRELIMINARY DATA OF ACTIVITY PATTERNS OF WILD BOAR (Sus scrofa) IN THE MAREMMA NATURAL PARK (ITALY)*

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**Abstract:** Seventeen adult wild boars were radiotracked for 24 - hours sessions (n=90) between March and September 1993. Contrary to other studies, time devolved to activities such as moving, feeding, etc. (65%) was significantly higher than time spent resting (35%) in both sexes. The activity was more synchronized to sunrise than to sunset. Part of these results could be explained through food shortage occurring during the study period.

**Keywords:** Wild boar, *Sus scrofa,* Suidae, Activity rhythm.

**IBEX J.M.E. 3:126-127**

## 1. Introduction

Studies carried out on the activity rhythm of the European Wild boar (*Sus scrofa*) showed that wild boars are typically nocturnal animals, their activity period always occurring between sunset and sunrise (Douaud, 1983; Cugnasse *et al.*, 1987; Cousse & Janeau, 1991). A close synchronization between the beginning of the activity phase and sunset was also demonstrated by others (e.g. Mauget, 1984) while the relation between the end of activity and sunrise was less obvious.

The aims of the present study were: 1. to determine sex-related differences of activity patterns in adult wild boars in late-spring and summer months in a Mediterranean area; 2. to test the synchronization of activity with sunset and sunrise.

## 2. Study area and methods

The study was carried out in the Maremma Natural Park, Central Italy (42° 39' N, 11° 05' E). Seventeen adult wild boars (*i.e.*>3 years old) were captured and equipped with transmitters and radiotracked for one to three 24-hours periods each month during one to seven months (from March to September 1993).

## 3. Results and discussion

Ninety 24-hours tracking periods and 4320 recordings were obtained. Direct observation of the tracked females revealed that none of them farrowed during the study period.

A chi-square test indicated that no significant differences ($P > 0.1$) occurred between daily activity of males and females in different months. All the tracked wild boars were more active at night though most of them were also active during daylight. Results from the F-test comparing variances of the beginning of activity at sunset and the end of activity at sunrise, showed that the activity phase of the wild boars was significantly more synchronized with sunrise.

Several authors showed that sex-related differences in activity rhythm occur during the farrowing period (late-spring) when females display a polyphasic activity (Janeau & Spitz, 1984; Cousse & Janeau, *op.cit.*); after this period the typical biphasic rhythm is restored. Our study was carried out during a period of food shortage when many wild boars died of starvation (unpubl. data) and most of the females had no piglets. As food availability represents one of the most important factors influencing activity rhythm our results could be explained through food shortage.

Contrary to other studies, time spent in activities such as moving, feeding, etc. (about 65%) was significantly higher than time spent resting (about 35%) in both sexes. The lack of food may also explain why all the animals were active during daylight too; on the other hand, as Briedermann (1971) and Douaud (*op.cit.*) pointed out, diurnal activity occurs when wild boars are living in an area where hunting is not carried out.

As far as the synchronization of activity with

sunset and sunrise was concerned, our results showed the opposite pattern if compared to earlier studies; probably because most of the wild boars in our study started activity in early afternoon and decreased activity in the morning, a close synchronization appeared between the end of activity and sunrise.

## REFERENCES

BRIEDERMANN L., (1971) - Ermittlungen zur Aktivitätsperiodik des Mitteleuropaïschen Wildschweines (*Sus scrofa* L.). *Zool. Garten.*, Leipzig, 40 (6): 302-327.

COUSSE S. & JANEAU G., (1991) - Time budget and polyphasic activity in Wild boar, *Sus scrofa* L. In: *"Ongulés/Ungulates 91"* F. Spitz, G. Janeau, G. Gonzalez & S. Aulagnier (eds), S.F.E.P.M. - I.R.G.M., Paris-Toulouse: 391-394.

CUGNASSE J.M., TEILLAUD P. & BON R., (1987) - Résultats préliminaires sur l'activité diurne et la structure des groupes de sangliers (*Sus scrofa* L.) dand les Monts de l'Espinouse. *Gibier Faune Sauvage,* 4: 267-277.

DOUAUD J.F., (1983) - *Utilisation de l'espace et du temps et ses facteurs de modulation chez le Sanglier Sus scrofa L., en milieu forestier ouvert (Massif des Dhuits, Haute Marne).* Thèse 3ème cycle, Univ. Strasbourg.

JANEAU G. & SPITZ F., (1984) - L'espace chez le Sanglier: occupation et mode d'utilisation journalier. *Gibier Faune Sauvage,* 1: 73-89.

MAUGET R., (1984) - Rythme d'activité et budget-temps chez le Sanglier européen (*Sus scrofa* L.). Symposium International sur le Sanglier. F.Spitz & D.Pépin (eds.), Toulouse, *Les Colloques de l'I.N.R.A.*, n° 22: 79-92.

# *GROUPING PATTERN OF JAPANESE WILD BOAR (Sus scrofa leucomystax)*

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**Abstract:** Seven types of social group were recognized for adult Japanese wild boars (≥2 years old). However, males were always solitary and females most frequently formed basic family groups (1 female with her youngs). Since a basic family group contains only one adult (mother) it is concluded that both male and female Japanese wild boars were basically solitary. Continuous observations on social groups revealed that group formations in adults changed throughout the year in relation to the timing of farrowing.

**Keywords:** Wild boar, *Sus scrofa leucomystax,* Suidae, Social behaviour, Family groups, Asia.

**IBEX J.M.E. 3:128-129**

## 1. Introduction

The Wild boar (*Sus scrofa*) is widely distributed and abundant, but the knowledge of its social system is still extremely limited. It is mainly due to the difficulty of direct observation in the wild.

Recently, Dardaillon (1988) reported quantitative data on social groupings of the Wild boar in France. However, since she did not identify individuals, the stability of group memberships and kin relationships remained uncertain. The present study aims to clarify social groupings of Japanese Wild boar (*Sus scrofa leucomystax*) by direct observations on a population of identified individuals.

## 2. Study area and methods

The study was conducted in the Rokko mountain area in central Japan from 1982 to 1988. Since 1979, wild boars in the area have been fed voluntarily by inhabitants. Direct observations of wild boars were carried out at provisioning sites, and we observed wild boars for more than 2000 hours. Wild boars appearing there were individually identified by pattern of notches on ears.

Social groups of adult wild boars (≥2 years old) were classified into 7 types as follows: 1. solitary male; 2. solitary female; 3. adult female group, (AFG); 4. basic family group (BFG) = 1 female with her infants (<1 year old) or juveniles (1 year old); 5. extended family group (EFG) = 1 female with her both infants and previous youngs; 6. surplus family group (SFG) = 1 female with her infants and females without young; 7. multifamily group (MFG) = several females with their infants, juveniles or both infants and previous youngs.

## 3. Results

Table 1 shows seasonal distributions of social groups. All males were solitary in every season (except for temporal consort groups with estrous females) whereas females were categorized into 6 types of group. The frequency of the 6 types of group was relatively stable among seasons ($\chi^2$ =2.68, p>0.95). BFGs were most frequent, accounting for 59% of the total of the 6 types of group. MFGs and Solitaries accounted for further 15% and 11% of the groups, respectively.

During the study period, a total of 63 social groups have been observed over one month (Tab. 2). Solitary males were never observed to form a group with any other individuals, while in females, solitaries sooner or later formed BFGs by farrowing.

All BFGs, except 5 which disappeared from the observation sites, maintained until the next farrowings. When mothers formed BFGs with their new youngs, their previous youngs generally became independent of their mothers (16 out of the 23 cases). Some mothers allowed their previous female youngs to remain in the new BFGs, so that EFG or SFG were formed. If a mother had a stillbirth or lost the whole litter

**Table 1: Seasonal distribution of social groups of the Wild boar in Rokko mountain area.**

| Social groups | Spring n | Summer n | Autumn n | Winter n | Total n |
|---|---|---|---|---|---|
| Male Solitary | 13 | 18 | 9 | 20 | 60 |
| Female Solitary | 6 | 10 | 5 | 3 | 24 |
| BFG | 31 | 40 | 25 | 29 | 125 |
| AFG | 0 | 2 | 0 | 0 | 2 |
| EFG | 3 | 6 | 4 | 4 | 17 |
| SFG | 4 | 4 | 2 | 3 | 13 |
| MFG | 6 | 11 | 8 | 6 | 31 |

early in the nursing stage (4 cases), she usually reformed a BFG with her previous female youngs (3 cases). Two of such 3 BFGs developed to MFGs by simultaneous farrowings of mothers and daughters.
AFGs broke down when a partner farrowed or developed to a MFG by the partners' simultaneous farrowing. Both EFGs and SFGs were maintained until the next farrowing. After farrowing, mothers formed new groups (BFG, EFG or MFG) with farrowing youngs, but those which could not produce youngs joined her daughter's BFG or became solitary.
MFGs were formed by the simultaneous farrowings of females in a group. Adult female associations in MFG sometimes lasted for several years through simultaneous farrowings. However, when a female did not produce youngs she became solitary, formed a BFG with her previous female youngs or did a SFG with her partner's BFG.

## 4. Discussion

The basic social unit of the Japanese Wild boar in the Rokko mountain range was formed by a solitary male or a female in a BFG; EFGs, MFGs, SFGs and AFGs were occasionally formed.
Some authors reported the Wild boar as gregarious (Gundlach, 1968; Frädrich, 1974), probably because of forming a SFG or a MFG.
However, since BFG contains only one adult (mother), it is concluded that both male and female Japanese wild boars in our population are basically solitary.
In the formation of adult female associations, familiarity between individuals in the same social group in addition to kin relationships played an important role. Individuals which had dispersed into other social groups were not observed to regroup.

**Table 2: Number of social groups which have been observed over one month.**

| Social groups | n |
|---|---|
| Male Solitary | 6 |
| Female Solitary | 6 |
| BFG | 32 |
| AFG | 2 |
| EFG | 5 |
| SFG | 5 |
| MFG | 7 |
| Total | 63 |

Social groups of wild boars were generally stable throughout the year between post and pre-farrowing seasons, and the changes of group formations were mainly caused by farrowing.
Matriarchal groups were generally disrupted at farrowing time, and such disruption seems to be the rule in most other areas (Gundlach, *op. cit.*; Frädrich, *op. cit.*; Dardaillon, *op. cit.*). In the present study, however, previous female youngs occasionally remained in the group of their mother and newly born youngs, while all male youngs separated from their mothers at farrowing time.

## References

DARDAILLON M., (1988) - Wild boar social groupings and their seasonal changes in the Camargue, southern France. *Z Säugetierk,* 53: 22-30.

FRÄDRICH H., (1974) - A comparison of behaviour in the Suidae. In: *The behaviour of Ungulates and its relation to management,* V. Geist & F. Walther (eds), IUCN, Switzerland: 133-143.

GUNDLACH H., (1968) - Brutfürsorge, Brutpflege, Verhaltensontogenese und Tagesperiodik beim europäischen Wildschwein (*Sus scrofa* L.). *Z. Tierpsychol.,* 25: 955-995.

# *STUDY OF THE WILD BOAR (Sus scrofa* L.*) MEMORY IN ITS ORIENTATIVE BEHAVIOUR*

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**Keywords:** Wild boar, *Sus scrofa,* Suidae, Olfaction, Orientation, Memorization.

**IBEX J.M.E. 3:130**

The study of the capacity of the wild boar's memory in the process of the orientative behaviour development has been carried out on two females (4 and 2 years old) of tame Wild boar in natural conditions and on groups of wild boars from the forest reservation, "Codru".
The individuals' reactivity and their behaviour as a function of time and space have been determined. The first series of experiments has been carried out by placing their favourite food on identical territories at different distances from the zone "home range". In the second series of experiments the peculiarities of behaviour and memorization of the informative field in connection with negative stimuli (factors of stress, etc.) have been determined.

It has been stated that in the process of development of the orientative behaviour in the zones which they attended 2 and more times, the wild boars are influenced by the memorization of the peculiarities of the relief, flora, soil, olfactoric field and other components of the informative field of the territory. The capacity of memorization of wild boars varies with age and is more developed at middle aged adults. In a group of wild boars in natural conditions the differences in memorization by males and females have been observed: memorization is more pronounced by the first ones for the negative stimuli, and by the last ones for the positive stimuli.

# *USE OF SPOTLIGHTS FOR CAPTURING WILD BOAR (Sus scrofa* L.*)*

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**Abstract:** The implementation of a radio-tracking programme for Wild boar (*Sus scrofa* L.) required the trapping of entire groups. Prior to their actual capture, the wild boars were observed with a specially-devised "visual capture" technique allowing to obtain data on group structure and to identify previously marked individuals. wild boars were captured in portable box traps (2 m x 1 m x 1 m) with drop gates. The number of box traps required for capturing a group was conditional to the number of animals and their aggressivity. An infrared range detection system warned the observer that the animals were approaching the traps. For night-lighting the boars we used a 50 or 100W spotlight placed in front of the traps, that could be switched on from a closed vehicle, parked some 60 m away. The animals reacted the same to both yellow and white light. 84.5% of the individuals did not react at all when the light turned on, 10% left but came back in less than 5', and only 5.5% left the place for good. As soon as all the members of the group were identified and entered the traps, they were captured by closing the gates simultaneously. Although this method is labor-intensive, it gives much information on the ethology of the species.

**Keywords:** Wild boar, *Sus scrofa,* Suidae, Capture, Trapping, Technics, Groups.

**IBEX J.M.E. 3:131-133**

## 1. Introduction

In a survey of the various methods to capture Wild boar by Jullien *et al.* (1993), it was shown that the portable box trap is the easiest trapping method, but the least effective one for the automatic capture of adult Wild boar. The drop net (Jullien *et al.,* 1987) is better adapted to boars, although it requires immediate manipulation at capture, which may be very difficult at night.

Authors who have studied Wild boar, all used a trapping system that automatically locks when tripped (Andrzejewski & Jezierski, 1978; Baettig & Braunschweig, 1980; Mauget, 1980; Singer *et al.,* 1981; Douaud, 1983; Boisaubert & Klein, 1984; Janeau & Spitz, 1984; Klein, 1984; Spitz *et al.*,1984; Spitz, 1989).

As part of a project to study the wild boar's spatial occupation in a Mediterranean environment, we wanted to know the size and structure of the Wild boar groups we were monitoring by radio telemetry. Therefore we devised a "visual capture" technique which, first, allowed us to identify the Wild boar groups that regularly came to the feeding troughs, and then to simultaneously capture all the individuals belonging to the same group.

## 2. Study area

The study area is situated near Montpellier (Hérault, France). It is characterized by a dense Mediterranean vegetation, dominated by holly oak (*Quercus ilex*). Mean hunting losses throughout this sector amount to 0.76 animals/km$^2$ (Spitz & Valet, 1991). There are no cervids on this territory.

## 3. Material and methods

### 3.1. Observations

There are several types of optical equipments on market for observing animals at night (amplifier tubes, infra-red binoculars). Beside the fact that such equipment is expensive, it mostly provides a limited view and does not allow to evaluate the exact location of the animal with respect to the trap. The use of a source of light is thus absolutely necessary for observing animals at night.

Animals were observed from an entirely closed vehicle, stationed at some 60 m from the box traps and facing the prevailing wind. The immediate surroundings of the box traps should be cleared sufficiently to give a large range of vision, allowing to see the animals standing at the sides of the traps (Vassant *et al.,* 1990).

A 50 or 100 watt spotlight, operated from the vehicle, was placed in front of the box traps. A moving infrared range detection system next to the site warned the observer that the animals were approaching. The yellow filter that had been placed in front of each spotlight the first two years of observation (1990-1991) was later taken away (1992).

We distinguished three different reactions of

wild boars to night-lighting:
- no reaction at all, or just a slight reaction without moving away;
- the animals moved away, but for less than 5 minutes;
- the animals moved away for more than 5 minutes, or left for good.

### 3.2. Captures

We used the box traps described in Jullien *et al.* (1988). Measuring 2 m x 1 m x 1 m, they are made with a metal frame and covered with double-twisted wire netting.
To limit the effects of competition among the animals, the traps were arranged in pairs. Wild boars belonging to the same group may enter the traps in such a way that the social rank order (dominant/dominated) within the group is not disturbed. According to the size of such groups, more than 2 traps may be used.
5 to 8 kg of grain maize per day were used as bait. The drop gates of the traps were closed simultaneously by means of an electric signal sent from the vehicle.
Before capture, the Wild boar groups were observed many times so that they were well known when captured.

## 4. Results and discussion

Spotlighting Wild boar at feeding sites was found to be a valuable method for observing the animals at close range without disturbing them. Less than 5.5% fled when the spotlight was turned on (Tab. 1). The colour of the light did not seem important ($X^2 = 4.85$).
A small series of observations may inform about the structure of a group, the relationships between members of a group and the social rank order of the individuals.
Also, with the help of this selective capture technique, an entire Wild boar group can be trapped. The proportion of adult females in the captures was higher than that obtained in automatic traps (21.5% vs. 6.5%) (Tab. 2).
The capture rate of sows was lower in the automatic traps because the first female entering the trap triggered the falling gate. This prevented other sows from entering the trap. This does not apply to males, which are mostly solitary individuals or living in small groups.

## 5. Conclusion

Night-lighting the capture site does not create much disturbance. The method provides a means for observing and capturing animals

**Table 1: Reaction of the animals when the light came on.**

| | LIGHT ON (samples) | ABSENCE OF REACTION | FLIGHT < 5 min. | FLIGHT > 5 min |
|---|---|---|---|---|
| YELLOW LIGHT (1990 - 1991) | 50 | 76% | 16% | 8% |
| WHITE LIGHT (1992) | 58 | 91.5% | 5% | 3.5% |
| TOTAL | 108 | 84.5% | 10% | 5.5% |

**Table 2: Comparison of trapping results obtained in Hérault (France) with mobile box traps.**

| Animal's category | % animals caught | |
|---|---|---|
| | Visual capture Study area (n = 84) | Automatic trap Other sites (INRA-IRGM) (n = 319) |
| Female > 35 kg | 21.5% | 6.5% |
| Female < 35 kg | 38% | 43% |
| Male > 35 kg | 7% | 7.5% |
| Male < 35 kg | 33.5% | 43% |

under excellent conditions. It allows to identify the composition of the Wild boar groups that will be monitored by telemetry and to study, through successive observations after visual marking, the changes in group structure over a long period.

**6. Acknowledgements**
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**REFERENCES**

ANDRZEJEWSKI R. & JEZIERSKI W., (1978) - Management of Wild boar population and its effect on commercial land. *Acta Theriol.*, 23: 309-339.

BAETTIG M. & BRAUNSCHWEIG R., (1980) - Première étude sur les déplacements des sangliers en Suisse Romande. *Diana* 7: 228-231.

BOISAUBERT B. & KLEIN F., (1984) - Contribution à l'étude de l'occupation de l'espace chez le Sanglier *(Sus scrofa)* par capture et recapture. Symposium International sur le Sanglier. F. Spitz & D. Pépin (eds), Toulouse, *Les Colloques de l' INRA*, n° 22: 135-150.

DOUAUD J.F., (1983) - *Utilisation de l'espace et du temps et ses facteurs de modulation chez le Sanglier (Sus scrofa* L.*) en milieu forestier ouvert (Massif des Dhuits, Haute-Marne)*. Thèse de 3ème cycle. Université Louis Pasteur, Strasbourg I.

JANEAU G. & SPITZ F., (1984) - L'espace chez le Sanglier (*Sus scrofa* L.). Occupation et mode d'utilisation journalier. *Gibier Faune Sauvage*, 1: 73-89.

JULLIEN J.M., VASSANT J., DELORME D. & BRANDT S., (1987) - Une technique de capture de groupes de sangliers particulièrement efficace: le filet tombant. *Gibier Faune Sauvage*, 4: 203-208.

JULLIEN J.M., VASSANT J., DELORME D. & BRANDT S., (1988) - Techniques de capture de sangliers. *Bull. Mens. Off. Natl. Chasse*, 122: 28-35.

JULLIEN J.M., BRANDT S. & VASSANT J., (1993) - Sélectivité de cinq modes de piégeage pour le Sanglier. *Techniques de capture et de marquage des ongulés sauvages*. D. Dubray & F.D.C. Hérault (eds), Montpellier: 95-101.

KLEIN F., (1984) - Contribution à l'étude de la croissance du Sanglier (*Sus scrofa* L.), par capture recapture. Symposium International sur le Sanglier. F. Spitz & D. Pépin (eds), Toulouse, *Les Colloques de l' I.N.R.A.*, n° 22: 57-67.

MAUGET R., (1980) - *Régulations écologiques, comportementales et physiologiques (fonction de reproduction), de l'adaptation du Sanglier (Sus scrofa* L.*), au milieu*. Thèse d'état. Université François Rabelais, Tours.

SINGER F.J., OTTO D.K., TIPTON A.R. & HABLE C.P., (1981) - Home ranges, movements and habitat use of European Wild boar in Tennessee. *J. Wildl. Manage.*, 45: 343-353.

SPITZ F., JANEAU G. & VALET G., (1984) - Eléments de démographie du Sanglier (*Sus scrofa*) dans la région de Grésigne. *Acta Oecol., Oecol. Applic.*, 5: 43-59.

SPITZ F., (1989) - Mortalité et dispersion chez le sanglier *(Sus scrofa)* de Camargue. *Gibier Faune Sauvage*, 6: 27-42.

SPITZ F. & VALET G., (1991) - Etude démographique des sangliers du Languedoc. *Bull. Mens. Off. Natl. Chasse*, 159: 28-39.

VASSANT J., BRANDT S. & JULLIEN J.M., (1990) - Essai de dénombrement d'une population de sangliers par observations sur places d'affouragement. *Bull. Mens. Off. Natl. Chasse*, 147: 21-26.

# *ZOLETIL® IMMOBILIZATION OF WILD BOAR (Sus scrofa* L.*)*

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**Abstract:** Many Wild boar (*Sus scrofa* L.) experiments carried out over the last 15 years required capturing and handling of the animals. Since Zoletil® N.D. has been used successfully to immobilize many wildlife species, we tested it on 46 free-ranging wild boars, captured in box traps and on 17 hand-reared wild boars. They were anesthetized in the box trap with the help of a hypodermic pistol. The freeze dried form of Zoletil® N.D. allowed us to administer strong dosages despite the very small volumes required by our method of teleanesthesia.
Mean induction time (loss of equilibrium, collapse and effective lying down) was 3' 41" and did not depend on the administered dosage (r = 0.14). With a dosage rate between 6.8 and 9.2 mg/kg of body weight, all animals slept between 15 minutes and one hour. Sleep was deeper and longer when more than 9.2 mg/kg were administered. The maximum dosage tested without lethal effect was 15 mg/kg. Therefore we recommend a mean dosage of 8 mg/kg, which allows for a 15% estimation error of body weight. The very agitated recovery phase is a critical period during which the animal must be kept under constant surveillance to prevent any heart or respiratory failure due to added stress. The use of an immobilizing agent for Wild boar allows people to manipulate it safely, without much risk for the animal.

**Keywords:** Wild boar, *Sus scrofa,* Suidae, Anesthesia, Immobilization, Handling, Zoletil® N.D..

**IBEX J.M.E. 3:134-136**

## 1. Introduction

Handling live Wild boar (*Sus scrofa* L.) is a very delicate and sometimes dangerous procedure for the researcher as well as for the animal. Many authors have therefore adopted the use of an immobilizing drug. The results of recent experiments, however, have been disappointing (Wood *et al.*, 1977; Duchamps, 1985; Janeau *et al.*, 1993).
The successful use of Zoletil® N.D. on several wildlife species, as well as the preliminary results obtained by Klein *et al.* (1993) on the Wild boar persuaded us to continue dose-effect experiments on this species.

## 2. Material and methods

Zoletil® N.D. is a combination of two substances: tiletamine, a potent dissociative anesthetic, and zolazepam, a benzodiazepine derivative. The latter attenuates the undesirable effects of dissociative anesthesia, owing to its important anticonvulsive and muscle-relaxant properties. The form of the freeze dried product allows reconstitution with sterile water at concentrations of 100 to 400 mg/ml, which are compatible with the very small volumes required by our method of teleanesthesia.
Experiments were carried out in France with 46 free-ranging wild boars captured in box traps (Jullien *et al.*, 1988) and on 17 pen-reared boars forced into restraining cages.
After an estimation of body weight, the animals were injected intramuscularly while in the box trap or in the restraining cage with a syringe dart containing the pressurized solution, shot from an air pistol. The various stages of anesthesia were recorded to the nearest second, starting at time To, the time of successful injection:

*Induction time* To → Ti: animal has completely collapsed and does not respond to external stimuli.
*Anesthesia time* Ti → Tr: first signs of recovery.
*Immobilization time* Ti → T1: first time animal is standing up.
*Recovery time* Tr → Td: animal will stand up for a long time and flee.
*Flight of animal* To → Td.

All wild boars were weighed (Fig.1).

## 3. Results

48 out of 63 wild boars were completely anesthetized with doses ranging from 2.96 to 15 mg/kg of body weight. The 15 remaining animals were only partially immobilized with doses varying from 1.4 to 6.79 mg/kg (Fig. 2).

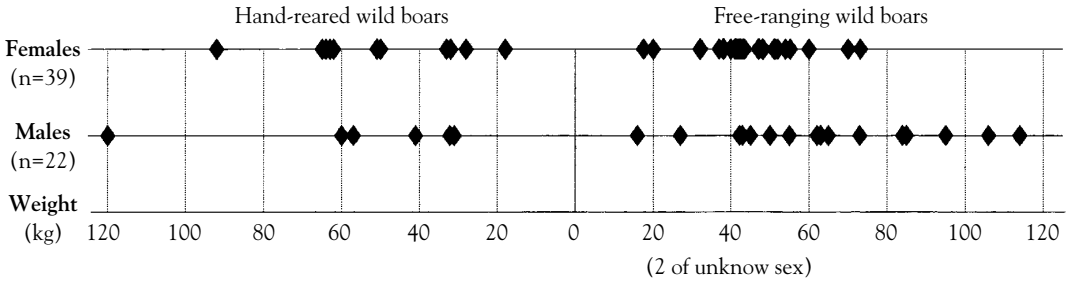


Figure 1 - Weight distribution.

They had to be kept in restraining cages.
Table 1 shows the mean time period of sleep throughout the different phases of anesthesia for all animals that had slept.

**Table 1 - Mean time period of the different phases of anesthesia.**

| | MEAN TIME | SD | RANGE |
|---|---|---|---|
| Induction | 3'41" | 1'24" | 1'30"-8' |
| Anesthesia | 37'37" | 16'41" | 13'-87' |
| Immobilization | 57'45" | 21'49" | 21'-107' |
| Flight | 86'44" | 27'40" | 32'-155' |

## 4. Discussion and conclusion

The state of stress of the Wild boar at the moment of injection will affect the response to anesthesia. However, our data did not allow us to show any differences in susceptibility to the drug between boars living in the wild and those in captivity.
Induction time is short (3'41") and does not depend on the administered dose ($r$ = 0.14). The mean period of anesthesia of 37'37" is sufficient to carry out time-consuming data collection. With dosages of 6.8 to 9.2 mg/kg, all animals (n = 25) slept between 15 and 65

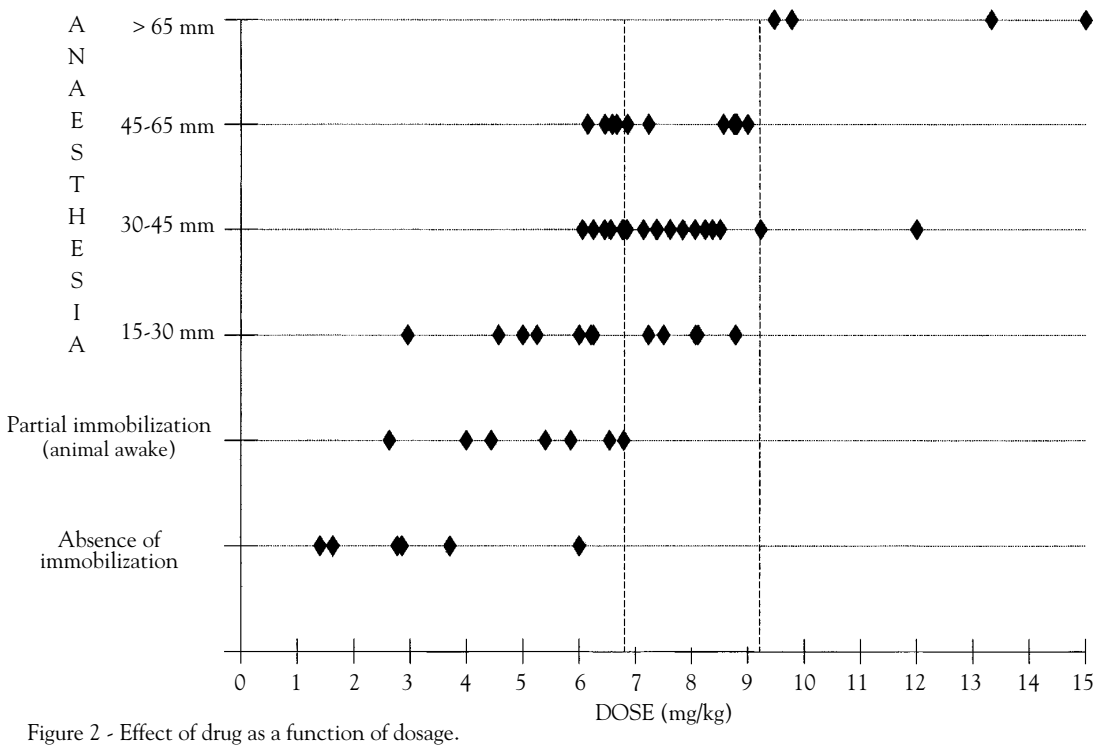


Figure 2 - Effect of drug as a function of dosage.

minutes (x = 37'17"). At a dose rate of more than 9.2 mg/kg sleep will be more profound and longer (Fig. 2).
Mean immobilization time is 57'45", whereas the time period obtained by Baber and Coblentz (1982) with a combination of ketamine and xylazine (1:1) was only 43'48". Other drugs like succinylcholine chloride (Zurowski & Sakowicz, 1965; Matschke & Henry, 1969; Wood *et al.*, *op. cit.*), sernylan (Henry & Matschke, 1972) and azapérone (Janeau *et al.*, *op. cit.*) gave immobilization periods that were too short and highly variable.
The recovery period is very agitated (intensive leg movements, animals frequently fall down). Its variation in time (45'26" on average; sd = 26'38") does not depend on dose rate ($r$ = 0.14). Environmental conditions should be optimal during recovery of the animals, including a quiet place, with shade if the weather is hot. In fact, the only case of mortality was a sow near parturition. When the animal woke up, it squeezed under a vehicle and died of stress.
All our data show the qualities of Zoletil® N.D. and the advantage of using it on Wild boar. We recommend a mean dosage rate of 8 mg/kg. This will permit a 15% error estimation of body weight while staying within the range of 6.8-9.2 mg/kg for which we obtained 100% anesthesia lasting for 15 to 65 minutes.

**5. Acknowledgements**
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**REFERENCES**

BABER D.W. & COBLENTZ B.E., (1982) - Immobilization of feral pigs with a combination of ketamine and xylazine. *J. Wildl. Manage.*, 46(2): 557-559.

DUCHAMPS A., (1985) - Immobilisation d'animaux sauvages en pratique. Bilan et perspectives. *Proceedings of the 17th International Union Game Biologists*, September 1985, 17: 795-802.

HENRY V.G. & MATSCHKE G.H., (1972) - Immobilizing European wild hogs with sernylan. *J. Tenn. Acad. Sci.*, 47: 81-84.

JANEAU G., GLEIZE J.C. & DUNCAN P., (1993) - Immobilisation du Sanglier *(Sus scrofa)* par voie chimique. In: *Techniques de capture et de marquage des ongulés sauvages*. D. Dubray & F.D.C. Hérault (eds), Montpellier: 33-36.

JULLIEN J.M., VASSANT J., DELORME D. & BRANDT S., (1988) - Techniques de capture de sangliers. *Bull. Mens. Off. Natl. Chasse*, 122: 28-35.

KLEIN F., MAGAR A., JULLIEN J.M., COURTHIAL J.J., DELORME D. & HAMANN J.L., (1993) - L'utilisation de l'anesthésie pour manipuler le Cerf, le Sanglier et le Chevreuil préalablement capturés par moyens mécaniques. *Techniques de capture et de marquage des ongulés sauvages*. D. Dubray & F.D.C. Hérault (eds), Montpellier: 27-32.

MATSCHKE G.H. & HENRY V.G., (1969). Immobilizing European wild hogs with succinylcholine chloride. *J. Wildl. Manage.*, 33: 1039-1041.

WOOD G.W., JOHNSON E.E. & BRENNEMAN R.E., (1977) - Observations on the use of succinycholine chloride to immobilize feral hogs. *J. Wildl. Manage.*, 41: 798-800.

ZUROWSKI W. & SAKOWICZ M., (1965) - Effects of succinycholine chloride on wild boars. *J. Wildl. Manage.*, 29: 626-629.