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# Pheasant (*Phasianus colchicus*) hens of different origin. Dispersion and habitat use after release

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## ABSTRACT

Because of the importance of pheasants as a game bird species in many European Countries, information on the success of the restocking programs is interesting for evaluation. For this reason the survival, behaviour and habitat selection of 10 wild translocated and 20 released ring-necked pheasants (10 offspring of wild captured and 10 from the farmed strain, both farm-reared) was studied using radio-telemetry during March-August (fixes were grouped in 3 categorized periods: March 2 - April 18; April 19 - May 28; May 29 - August 16). All the captive reared pheasants were reared according to the new disciplinary rules set forth by the Toscana region for the production of pheasants destined to be released in the wild as part of a game repopulation program. The study was carried out in a hilly area of the Tuscany characterised by 18.1% woodland (core: 1654895E, 4850468N).

Results showed that live weights were higher in the farm-reared pheasants (either directly captured or offspring of the captured, P<0.05). The tarsus length statistically differed between the farmed offspring of the captured pheasants and the farm strain (P<0.05). The survival rates and breeding success of the surviving subjects were very high and did not differ between groups (survival rates: 50.0%, 70.0% and 80.0%, and breeding success: 60.0%, 28.6% and 50.0%, for the captive-reared offspring of captured wild pheasants, the captive-reared farm pheasants and the captured wild pheasants, respectively). The dispersion increased with time in the wild translocated pheasants (576 m, 889 m and 1209 m) while the offspring of the captured wild pheasants and the farm strain remained in the vicinity of the releasing site. The wild pheasants showed an increasing distance from the country houses, contrary to the offspring of captured wild pheasants and the farm strain. Artificial feeding stations were better used by the farm-reared pheasants, which remained in the vicinity of the artificial feeding points.

The results of our study showed that pheasants, reared according to the disciplinary rules stated for the production of pheasants for wildlife reproduction programs, although more expensive, can guarantee the genetic identity with the resident populations and are able to provide good survival rates and breeding success of the released pheasants, of course when restocking is carried out in areas suitable for pheasant wildlife.

*Key words:* Pheasants, Restocking, Survival-rate, Home-range, Land-use.

## RIASSUNTO

### USO DELL'HABITAT E DISPERSIONE POST-RILASCIO DI FAGIANE DI DIVERSA ORIGINE

*Nella maggior parte dell'Europa il fagiano è una delle più importanti specie soggette a prelievo venatorio ed è quindi indispensabile conoscere il reale effetto dei ripopolamenti, per una corretta gestione della specie. Per questo motivo, in una area collinare del centro Toscana (copertura boschiva 18,1%) sono stati seguiti, mediante telemetria, dopo la loro liberazione, 20 fagiani allevati (10 figli di soggetti selvatici e 10 appartenenti ad un ceppo di allevamento) e 10 fagiani selvatici traslocati dalla stessa area utilizzata per la cattura dei genitori dei soggetti selvatici allevati. Le osservazioni, effettuate nel periodo marzo - agosto, sono state raggruppate in tre periodi: 2 marzo – 18 Aprile; 19 aprile – 28 maggio; 29 maggio - 16 agosto. Tutti i fagiani provenienti dall'allevamento erano stati prodotti secondo il disciplinare di qualità, adottato dalla Regione Toscana per la produzione di fagiani da destinare ai programmi di ripopolamento.*
*I due gruppi di fagiani allevati erano caratterizzati da pesi vivi maggiori rispetto a quello dei soggetti selvatici (P<0,05). La lunghezza del tarso è risultata differire, a parità di allevamento, in funzione dell'origine genetica (ceppo selvatico>ceppo allevamento, P<0,05). La sopravvivenza dopo rilascio è risultata molto elevata in tutti i gruppi sperimentali (figli dei selvatici 50,0%, ceppo allevamento 70,0%; fagiani selvatici 80,0%) così come il successo riproduttivo (figli dei selvatici 60,0%, ceppo allevamento 28,6%; fagiani selvatici 50,0%). La dispersione dei fagiani selvatici traslocati direttamente da ambiente selvatico ad ambiente selvatico è aumentata nel tempo (576 m, 889 m and 1209 m) mentre i fagiani allevati (sia figli dei soggetti selvatici che del ceppo di allevamento) si sono dispersi meno. I fagiani selvatici hanno utilizzato meno le aree agricole vicine alle abitazioni rurali e l'alimentazione sussidiaria artificiale che invece è stata in grado di "legare" maggiormente tutti i soggetti allevati al territorio oggetto del ripopolamento. I risultati della presente ricerca confermano quindi che l'adozione delle onerose tecniche di allevamento, definite in via teorica per la produzione di fagiani da destinare al ripopolamento è in grado di fornire indici di sopravvivenza e di riproduzione, addirittura comparabili a quelli fatti rilevare dai soggetti selvatici direttamente traslocati e può consentire di introdurre nell'ambiente fagiani geneticamente non differenti da quelli residenti.*


Parole chiave: *Fagiano, Ripopolamento, Sopravvivenza,* Home-range*, Dispersione.*

## Introduction

Releasing pheasants in hunting territories is a common request from hunters. They believe that by putting more birds in hunting areas, there will be more to shoot, without considering that their survival rate and dispersion may change in correlation to the typology of the animals released. Reared and wild captured pheasants are regularly released in the Italian hunting districts (ATC) every year after the end of the hunting season in winter. Wild pheasants are usually translocated in the hunting territories from protected no-hunting areas (ZRC), characterised by particularly good habitats, but their number never covers the demand. A large amount of reared pheasants are consequently released, either in summer (before the hunting season) or in winter (before the reproductive period). The choice of the reared pheasants to be released is primarily based on the cheapest price, rather than on technical criteria which takes into account the rearing technology and the genetic characteristics of the animals (Santilli and Bagliacca, 2008).

The objective evaluations of pheasant release programs until now point to the same conclusion: pheasants that were intensively raised in a pen do not know how to utilise habitat to find food, to avoid predators and, consequently, have very low rates of survival in the wild (Hill and Robertson, 1988a, 1988b; Brittas *et al.*, 1992; Papeschi and Petrini, 1993; Leif, 1994; Woodburn, 2001; Sage *et al.*, 2003). Since survival and reproductive success after release of intensively reared pheasants is generally very low and great differences can be observed in relationship to the strain and the rearing technique (Bagliacca *et al*., 1999; Mayot, 2006; Rütting *et al*., 2007), the Tuscan Agency for Innovation in Agricultural field (ARSIA) classified the production of pen-reared pheasants in two lines: pheasants produced for quick hunting and pheasants produced for restocking the wild resident populations. Every farmer can produce pheasants for hunting, but disciplinary rules and set procedures must be followed by the farmers who want to produce pheasants certified for releasing programs (Table 1) (Dessì Fulgheri *et al*., 2004, 2005). Since genetic and behavioural differences were shown between wild and reared pheasants (Bagliacca *et al*., 2003; Santilli *et al*., 2004; Majot, 2006; Rütting *et al*., 2007), disciplinary rules state that the farmer must use as breeding parents a minimum percentage of wild pheasants captured in the same area where their offspring will be released. The production of wild captured pheasants is much lower than that of the reared strains (Wise, 1995; Fronte *et al*., 2005), so that the real outcome of this more expensive technology must be demonstrated on the performance of the released pheasants.

The aim of this study is to determine the real survival rates and the dispersion of the pheasants reared in captivity according to the rules stated for the production of pheasants produced for the restocking of the wild resident populations (either of wild or farm

Table 1. Main disciplinary rules stated by the Toscana (Italy) region for the captive-production of pheasants suitable for wildlife repopulation programs.

| Main Disciplinary Rules to raise certified pheasants for wildlife repopulation programs | | |
|---|---|---|
| Genetic characteristics of parents | | At least 10% of the reared parents must come from captures in the wild and 50% of the totally reared parents must come from wildlife origin or from their offspring. Parents can be reared for more than one year. |
| Rearing | | Till the age of 20 days, young pheasants can be reared exclusively on the ground, inside a poultry house (free density under the artificial heaters). From 20 to 40 days, young pheasants can freely move from the poultry house to a flying-pen (maximum density=0.3 sq.m/pheasant (inside+outside). From 40 days, young pheasants must be reared only outside, in a flying-pen (maximum density=3 sq. m/pheasant). |
| Feeding | | From 40 days, at least 20% of natural feed must be guaranteed in the diet (e.g. grains and/or forages). From 60 days, at least 50% of natural feed must be guaranteed in the diet (e.g. grains and/or forages). |
| Equipment: | | |
| i | Flying-pens | At least 10% of the surface must be covered by trees and shrubs (20 cm of perches per pheasant must be guaranteed by natural or artificial devices). At least 0.2% of the surface must have sand bath areas. At least 60% of the surface must be covered by grass or crops. The flying-pens must be higher than 4.5 m. |
| ii | Anti-picking devices | Never allowed in young pheasants which must be released. Spectacles and beak covers allowed only in parents, which cannot be released as pheasants for repopulation programs. |

strain) in comparison to the wild captured and relocated pheasants.

## Material and methods

*Study area*

The release study was carried out in a free hunting area close to Vinci, in the Florence hunting district ATC-FI-5 (1654895E, 4850468N). The study area was 1800 ha. The land use included the following: vineyards 18.5%; cereals 31.3%; olive groves 31.9%; wooded areas 18.1%; and untilled surfaces 0.2%. Dog training, according to the Italian law, was allowed in the study area starting from August 16, 2005 and hunting was allowed from September 18, 2005.

*Animals*

Thirty female adult pheasants were used for the trial: 10 wild pheasants, captured in February then released again in the study area (W); 10 farm reared pheasants, from a pheasant farm strain (F); 10 farm reared pheasants, offspring of wild captured pheasants (WF). Farm reared pheasants (both older than 9 months) had been reared according to the disciplinary rules stated by the Tuscan region for the production of pheasants for restocking of wild resident populations (Dessì Fulgheri *et al*., 2004, 2005). All females were equipped with a necklace tag (Biotrack TW3, with 2/3 AA battery, pulse length 20 ms, pulse rate 50 per min) and, before release, were allowed 1 week to adjust to the collars in a flying pen located in the study area and to adapt (farm reared pheasant) to the releasing habitat. Each female was weighed by electronic balance (precision 1g) and remiges length, tarsus diameter and tarsus length were measured by calliper (precision 0.05mm) according to the methodology described by Bagliacca *et al*. (1985).

*Radio tracking*

Radio tracking began on March, 20, 2005, two days after pheasant release, and ended on October the 1$^{st}$. Pheasants' locations were recorded 3-4 time a week, between 6.00 a.m. and 1.00 p.m. or between 2.00 p.m. and 8.00 p.m. Positions were determined contemporaneously by two operators with programmable receivers (151.000 – 151.999 Mhz) equipped with directional antennas (4 element Yagi) and with the help of three stationary tags put down in the area. Triangulation technique from a series of bearing points, placed throughout the study area was used to start the localization of the animals. UTM co-ordinates of the triangulation stations, of the feeding points and of the country houses in the study area were previously calculated on 3 different measurements taken by a Global Positioning Device (GPS) (Garming eTrex® Legend navigator). Triangulation stations were always visited in the same order. Alive status of the pheasants and/or broody condition was checked in approaching hens until visual observation after 3 fixed locations, to minimise pheasant disturbance. After the assessment of the broody condition pheasants were checked using only binoculars. Animal positions were recorded either on a map or on the portable GPS then transferred (GPS-Utility ltd. 1998-2006) to a geoprocessing program (ArcGis®-ESRI) where land use maps had been previously produced. The real land use map was produced in digital format by means of a preliminary process of photo interpretation, followed by field controls to check the unidentified cultivations and the actual human presence in the country buildings.

*Statistical analysis*

ANOVA was used to compare the morphological differences. The locations used in the analysis were categorised according to

3 periods (adapting phase: March 2 - April 18; laying/brooding period: April 19 - May 28; post reproduction period: May 29 - August 16), and each location within the same period was considered temporally independent. Survivals were calculated by Kaplan–Meier curve (Efron, 1988). Separate pheasant home-ranges were calculated only when more than 15 fixes were available for each period and each pheasant. Minimum Convex Polygon (MCP) and Kernel home-ranges (Worton, 1989) were performed by Spatial Analysis®-ESRI with the extension animal movement (Hooge and Eichenlaub, 1997). Home-ranges were analysed by ANOVA in relationship to the different thesis within the different periods (SAS®, 2002). Dispersion (distance from releasing sites) and distance from the artificial feeding points and country houses were calculated by ArcView®-ESRI on the digitalized maps and analysed by ANOVA in relationship to the different thesis within the different periods. Reproductive success and use of the different land-cover classes were analysed by chi square (SAS®, 2002).

**Results**

*Morphological traits*

Live weights were higher in the farm reared pheasants (either F or WF) than in the wild captured pheasants (Table 2). Tarsus lengths were shorter in F than in the wild pheasants (either W or or WF) ($P<0.05$). No significant differences were found between pheasant groups for remiges length and tarsus diameters.

*Survival and breeding success*

No statistical difference was observed between the different thesis in relationship to the survival curves (Figure 1) and the breeding success (Table 3), although the averages differed between the different groups.

*Spatial behaviour*

The dispersal distances were short in all groups, as observed by others (Wilson *et al.*, 1992). Significant differences were observed mainly between the distance from the releasing site in W and F (Table 4). The distance in W significantly differed in every pe-

Table 2. Morphological traits of the different pheasants.

| | | | | Live weight kg | Remiges length cm | Tarsus length cm | Tarsus diameter cm |
|---|---|---|---|---|---|---|---|
| Captive reared | Offspring of captured wild pheasants | WF | n. | 10 | 10 | 10 | 10 |
| | | | mean | $1.09^{a}$ | $21.98^{ns}$ | $7.97^{a}$ | $0.60^{ns}$ |
| | | | SE | 0.031 | 0.155 | 0.052 | 0.023 |
| | Farm strain | F | n. | 10 | 10 | 10 | 10 |
| | | | mean | $1.13^{a}$ | $21.94^{ns}$ | $7.25^{b}$ | $0.69^{ns}$ |
| | | | SE | 0.027 | 0.191 | 0.357 | 0.029 |
| Captured wild pheasants | | W | n. | 10 | 10 | 10 | 10 |
| | | | mean | $0.91^{b}$ | $21.97^{ns}$ | $7.99^{a}$ | $0.60^{ns}$ |
| | | | SE | 0.027 | 0.094 | 0.040 | 0.028 |

*Note: means with different letters in the same column differ per P<0.05.*

Figure 1. Survival plot and report structure of estimated pheasant survivals with summary statistics for the univariate survival analysis.

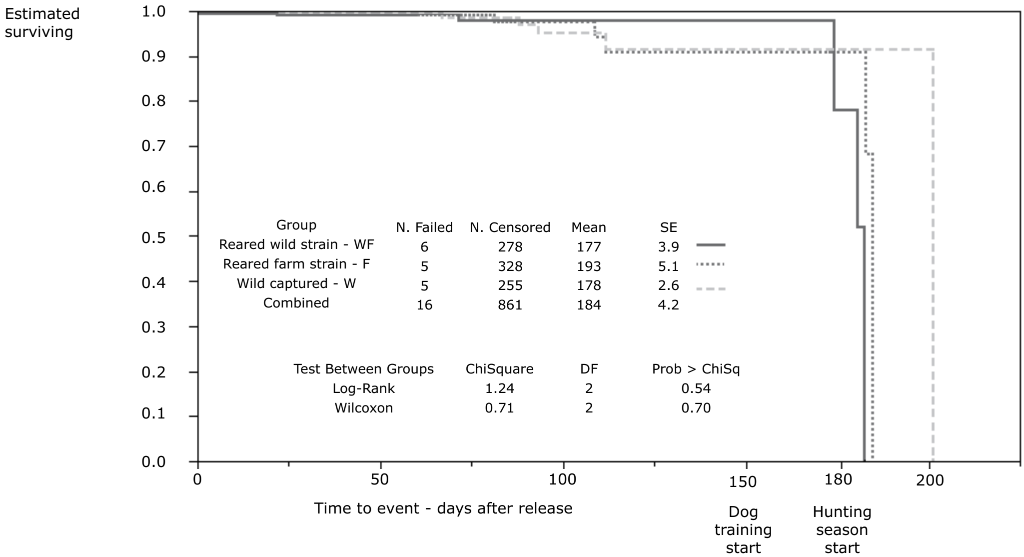



Table 3. Performance of the different pheasants after release.

| | | Captive reared | | Captured wild pheasants |
|---|---|---|---|---|
| | | Offspring of captured wild pheasants | Farm strain | |
| | | WF | F | W |
| Starting pheasants | n. | 10 | 10 | 10 |
| Survived at release | " | 10 | 10 | 9* |
| Definitely survived at laying season time | " | 5 | 7 | 8 |
| | % | 50 | 70 | 80 |
| Surviving hen success in laying season ** | n. | 3 | 2 | 4 |
| | % | 60.0 | 28.6 | 50.0 |
| Mean clutch size (chicks of about 20 days old) | n. | 4.3 | 3.5 | 4.7 |

** 1 wild pheasant died from cranial trauma in the aviary before release.*

*** Surviving hen success in laying season differed per P<0.1 between the farm strain and the wild pheasants (captured or offspring of the captured, captive-reared).*

Table 4. Least square means of some behavioural traits of the different pheasants.

| | Captive reared | | | | | | Captured wild pheasants | | |
|---|---|---|---|---|---|---|---|---|---|
| | Offspring of captured wild pheasants WF | | | Farm strain F | | | W | | |
| Periods | 1st 3/20-4/18 | 2nd 4/19-5/28 | 3rd 5/29-8/16 | 1st 3/20-4/18 | 2nd 4/19-5/28 | 3rd 5/29-8/16 | 1st 3/20-4/18 | 2nd 4/19-5/28 | 3rd 5/29-8/16 |
| Distances n. | 56 | 53 | 18 | 53 | 63 | 28 | 60 | 70 | 32 |
| From release site: | | | | | | | | | |
| m | $657^{cd}$ | $634^{cd}$ | $810^{bcd}$ | $553^{d}$ | $795^{bc}$ | $741^{bcd}$ | $576^{d}$ | $889^{b}$ | $1209^{a}$ |
| SE | 82 | 85 | 145 | 85 | 78 | 116 | 79 | 74 | 109 |
| From feeding points: | | | | | | | | | |
| m | $352^{cd}$ | $254^{d}$ | $296^{cd}$ | $377^{cd}$ | $564^{bc}$ | $496^{cd}$ | $421^{cd}$ | $763^{b}$ | $1124^{a}$ |
| SE | 80 | 83 | 142 | 83 | 76 | 114 | 78 | 72 | 106 |
| From country houses: | | | | | | | | | |
| m | $112^{bc}$ | $112^{bc}$ | $130^{bc}$ | $106^{c}$ | $129^{bc}$ | $136^{bc}$ | $116^{bc}$ | $136^{b}$ | $192^{a}$ |
| SE | 10 | 10 | 17 | 10 | 9 | 14 | 10 | 9 | 13 |
| Home-ranges: | | | | | | | | | |
| n. | 7 | 6 | 3 | 7 | 7 | 6 | 9 | 8 | 6 |
| ha (MCP) | $28^{ab}$ | $22^{ab}$ | $3^{b}$ | $45^{ab}$ | $11^{b}$ | $8^{b}$ | $37^{ab}$ | $61^{a}$ | $9^{b}$ |
| SE | 18.7 | 13.8 | 4.2 | 18.7 | 12.7 | 3.0 | 18.5 | 11.9 | 3.0 |
| ha (Kernel-95) | $22^{ab}$ | $15^{b}$ | $2^{b}$ | $25^{ab}$ | $10^{b}$ | $6^{b}$ | $35^{ab}$ | $57^{a}$ | $8^{b}$ |
| SE | 10.4 | 11.3 | 5.9 | 10.4 | 10.4 | 4.3 | 9.2 | 9.8 | 4.3 |

*Note: levels not connected by same letter were different at 0.05 of significant level.*

riod (576m, 889m and 1209m, in the 1st, 2nd and 3rd period, respectively). In F, only the distance during laying-brooding (April 19 – May 28) differed from the distance observed during the adapting period (release – April, 18). No difference was observed in relationship to the different period for WF. The distance from the feeding points followed a similar trend to that observed for the dispersion. The distance in W significantly increased with time (421m, 763m and 1124m, in the 1st, 2nd and 3rd period, respectively) while, among the farmed pheasants (F or WF), no difference was observed in relationship to the different periods. The distances from the country houses increased in every group but only in W were they statistically significant (116m, 136m and 192m, in the 1st, 2nd and 3rd period, respectively).

MCP and Kernel-95% showed an area reduction in W during the 3rd period with respect to the 2nd period (9 ha *vs* 61 ha for MCP and 8 ha *vs* 57 ha for Kernel-95%). No significant difference was observed in the other two pheasant groups in relationship to the different periods.

*Land-use*

During the 1st period, the F were more often localised than the other groups in the untilled lands. In the 3rd period, W were more often localised in the cereals and less in the olive-groves than the farmed pheasants, either WF or F (Figure 2).

## Discussion

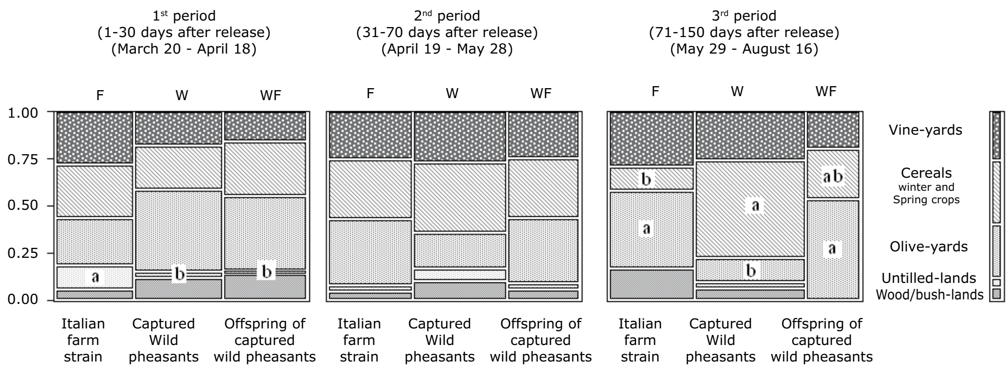
*Morphological traits*

The differences observed between the live weights in F and WF vs. W can be explained by the diet used during the period spent by the pheasant on the farm. Commercial diets, in fact, perfectly cover the requirements of the growing pheasants. The farmed animals, consequently, reach their maximum capability of growth. On the contrary, the wild pheasants, during their growth, may find insufficient food (quantitatively and/or qualitatively) so that they may not reach their maximum genetic capability of growth. Even if no difference was found between WF and F (probably also in relationship to the reduced number of measured pheasants), it is interesting to note the greater average weights generally shown in F which can be due to a genetic difference existing between the farm strains and the wild strains (Bagliacca *et al*., 2003). The tarsus length differences, which are less influenced by nutrition, confirmed the hypothesis of the genetic divergence between the morphology of the farm strain and the wild strain (either W or WF). The greater variability of the remiges length and the tarsus diameters, observed within the different groups, seem to show that these parameters are more variable and can be less useful in differentiating various pheasant strains, at least with a reduced number of measurements.

*Survival and breeding success*

The survival rates and the breeding success of the farmed pheasants reared according to the disciplinary rules (either F or WF) were very high and did not differ from W, contrary to that observed by other authors (Hill and Robertson, 1988a; Robertson, 1988; Brittas *et al*., 1992; Leif, 1994; Petrini *et al*., 1995; Sage *et al*., 2001, 2003; Venturato *et al*., 2001). Only one pheasant died within the first 50 days after release and the mortality rate was particularly low in every group, even during the nesting period (Grahn, 1993). The very positive results observed in the trial for the farmed pheasants (small difference, not statistically different from the wild ones) could be explained both by the kind of pheasants used in the experiment (produced according to the new rules for the production of pheasants for release in

Figure 2. Mosaic plots of the land use in relationship to the different periods and the different pheasants.




*Different letters on grid boxes in adjacent columns sharing the same habitat differ significantly per P<0.05 (Wald test period*pheasant).*

the wild) and by the area used for the trial, which is exceptionally suitable for phasianidae (Ferretti *et al*., 2007). Of course, when the hunting season started, the mortality rate increased dramatically; however, it is interesting to note that translocated wild pheasant were the last to be killed - about 2 weeks later than the other pheasants. The better suitability of this kind of pheasant to the environment suggests that if captive-reared pheasants are released in an area with a wild population and the hunting pressure is maintained sufficiently low, the captive-reared pheasants could be useful in safeguarding the life of the wild pheasants.

*Ethological traits*

The distance from the releasing sites showed that W seem not to be tied to the releasing site. In fact W move in search of more distant, and probably also better, habitats not only immediately after release, but also after reproduction. On the contrary, the WF and F showed a grater fidelity to the point of release.

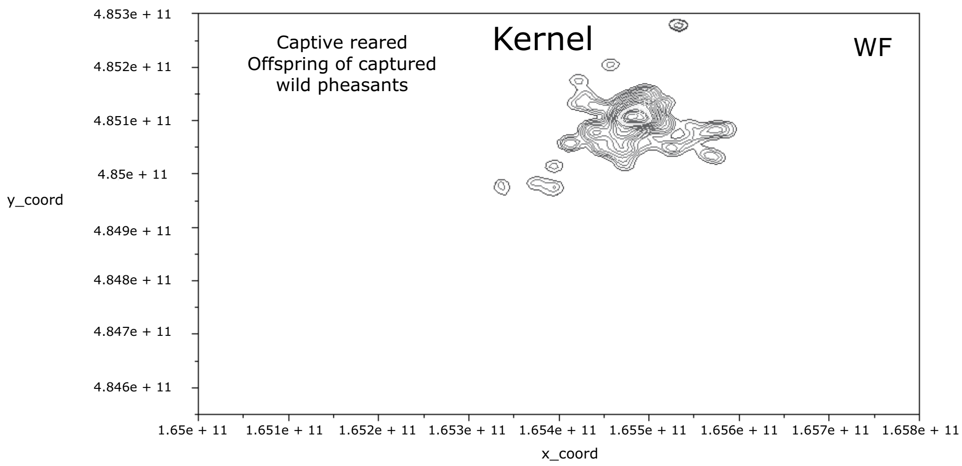
Farmed pheasants, F or WF, used the feeding points more frequently than W, which were less tied to the artificial feeding stations managed by the gamekeepers. For this reason the supplemental feeding before the brooding period, suggested by the game manager to increase the breeding success, might be less useful for W which are surely characterised by better food searching abilities than those of the farmed pheasants (Draycott *et al*., 1998; Hoodless *et al* 1999, 2001; Draycott 2002).

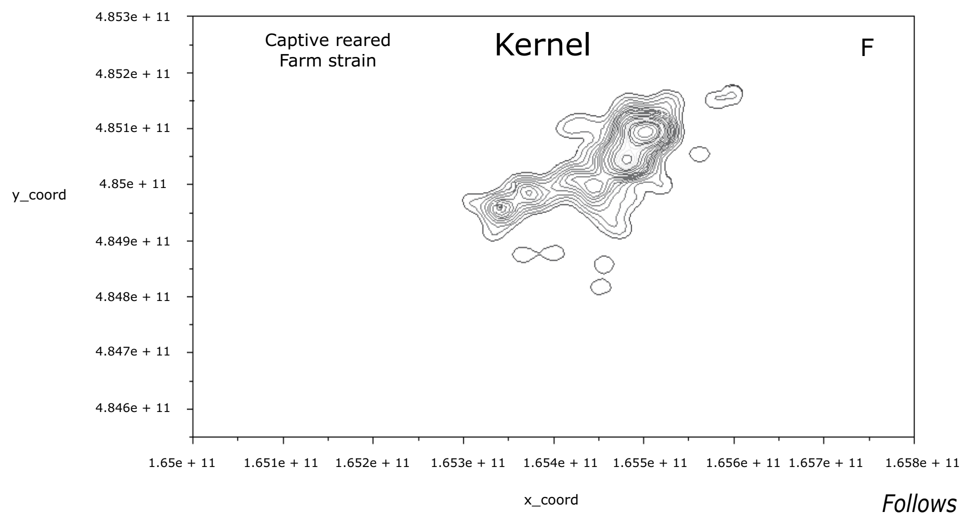
Human imprinting on pheasants, as evaluated by the observed distance from the country houses, showed that W tend to avoid areas with high densities of human buildings and search for habitats more distant from the country houses, unlike the captive reared pheasants. This behaviour affects also the distance from the releasing site and the feeding points and it is, probably, the most important difference between the farmed and the wild relocated pheasants.

After reproduction the area used by the pheasants was always reduced in every group, both in the females which successfully reared their chicks and in the females which did not succeed in their reproduction. This fact seems less related to chick-care and may be explained by both the increased availability of food due to the season and in the increased suitability of the pheasant to the new habitat. The absence of a significant reduction of the home-range during the brooding period (Whiteside and Guthery, 1983) was probably due to the fact that the females which lose their chicks or eggs, but were not killed by the predators, moved from their home-range thereby increasing the observed variability of this parameter, which was similar to that observed during the adapting phase.

The total MCP and the total kernel estimates of home-range sizes confirmed the greater dispersion of the W and the reduced dispersion of the captive reared pheasants, (either F or WF) as shown in Figure 3.

Figure 3. Total Kernel home-range sizes and total MCP sizes with the release points, the artificial feeding points and the triangulation stations.

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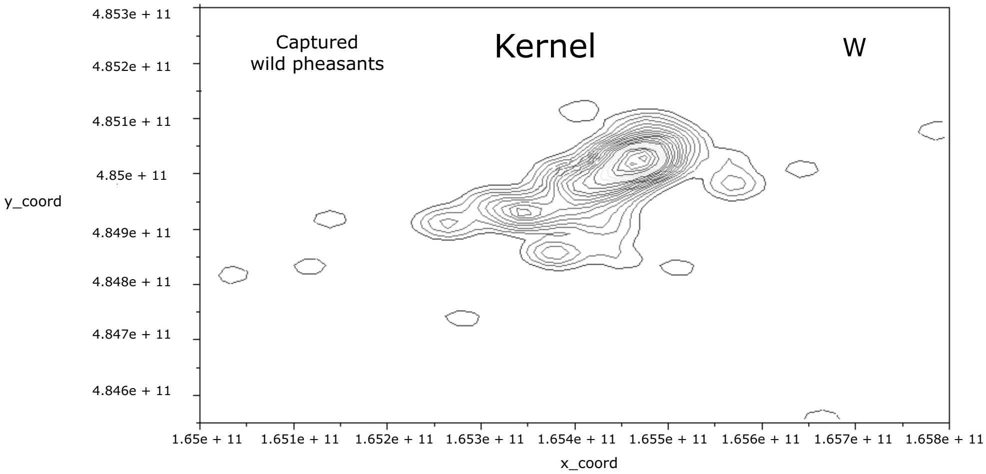


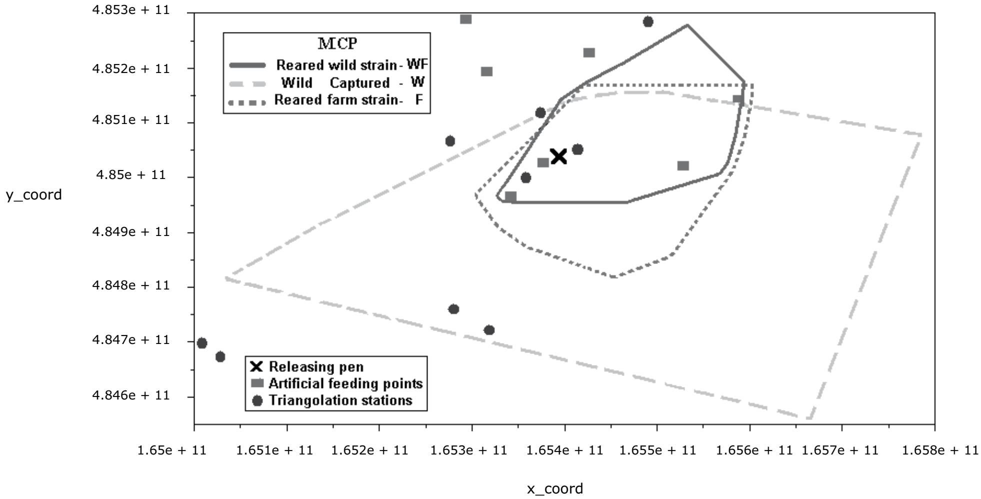


*Land-use*

The experimental area was characterised by great crop variability, a reduced dimension of the crop fields, a reduced incidence of wood and bush-land, and by the constant presence of permanent grassland below the olive groves and vineyards. Probably for these reasons the area is particularly suitable for phasianidae (Ferretti *et al*., 2007). However, the more frequent location of F in the untilled lands seems to indicate that soon after their release the captive reared pheasants are not afraid of this type of habitat, which can easily hide predators. The more frequent location of W in the cereal crops in the 3rd period seems to confirm the better food searching ability showed by this type of pheasant, which knows that they can easily find food in the cereal crops (Hill and Robertson, 1988b; Clark and Bogenschutz, 1999; Schmitz and Clark, 1999)

## Conclusions

The disciplinary rules stated by ARSIA for the certified production of pheasants for wildlife restocking programs, which increase the farming costs, were confirmed as providing acceptable survival rates of the released pheasants, at least in for those released in suitable habitats. Although in the present study no statistically significant difference in the survival rates was found between the pheasants from the farm line or to the wild line, the use of a percentage of captured pheasants on breeding farms guarantees the absence of genetic differences between wild and farmed pheasants.

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