PAPER

Captive rearing technologies and survival of pheasants (*Phasianus colchicus* L.) after release

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Abstract

Studies have repeatedly emphasized the limited survival of pheasants reared using traditional methods compared to the wild one. For this reason we performed a field trial to compare survival rates, home ranges and habitat uses of pheasants artificial hatched and reared (traditional method) with pheasants artificial hatched and reared by fostering mothers (hens). A total of 117 artificially hatched pheasants, 57 artificially brooded after hatch and 60 brooded by fostering hens, were equipped with a radio necklace tag or a poncho tag. Both groups were localized two-three times a week after their release in the wild. The survival rates of the brooded-by-hen pheasants showed an improvement of survival rates, either poncho or radio tagged (P<0.05), 90.0% *vs* 57.1% and 35.0% *vs* 21.1%, respectively. The average maximum dispersion was 390 and 426 m and the home range were 12.0 and 11.6 ha in artificially brooded and brooded-by-hen pheasants, respectively. The land use showed that the woods were less represented than the available in the home range of every pheasant. For this reason the woods can be reduced in the agricultural areas interspersed with natural Mediterranean vegetation.

Introduction

The Italian population of pheasants (*Phasianus colchicus* L.) is constituted by more or less isolated sub-populations, preserved in *protected areas* (PA) and in few Italian Hunting Districts (IHD) (Cocchi *et al.*, 1998). The groups of animals, which are in free hunting territories, cannot be considered real populations because these groups are not self-sustaining, but they are artificially re-constituted year after year by regular restocking with new pheasants (Santilli and Bagliacca, 2008). The restocking, using captive reared pheasants, is widespread in many IHD and in most of them is the only technique used for wildlife management. The use of captive reared animals have a wide range of negative effects on management (Meriggi, 1998) and several studies have shown that these animals have a poor attitude to settle in the wild (Cocchi *et al.*, 1998; Papeschi and Petrini, 1993; Santilli and Mazzoni Della Stella, 1998; Santilli *et al.*, 2004; Ciuffreda *et al.*, 2007; Bagliacca *et al.*, 2008). These studies have emphasized that the limited survival of pheasants reared using traditional methods are mainly due to the inefficient behavior versus the predators and the reduced ability to utilize natural foods. Since these behaviors are provided by the mother, we performed a field trial to compare survival rates, home ranges and habitat uses of pheasants artificial hatched and reared (traditional method) with those of pheasants artificial hatched and reared by fostering mother hens.

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Key words: Pheasant, Rearing, Survival rate, Home range, Habitat use.

Received for publication: 10 August 2011.
Revision received: 11 December 2011.
Accepted for publication: 12 December 2011.

Italian Journal of Animal Science 2012; 11:e29
doi:10.4081/ijas.2012.e29

Materials and methods

Pheasants

For the trial we used 57 days old pheasants (29 males and 28 females) artificially brooded for the first 30 days (Control) and 60 days old pheasants (30 males and 30 females) artificially raised with a brooding hen (Hen). At the age of 60 days old the pheasants of each group were randomly chosen and transferred in two aviaries where they were weighed (technical balance, ±1g) and the following measurements were taken: tarsus length, tarsus diameters (minimum and maximum), spur length and remiges length measured according to the methodology described by Bagliacca *et al.* (2008).

A total of 40 pheasants (half Control and half Hen) were equipped with radio necklace tag (Biotrack TW3+½AA) and 77 pheasants (37 Control and 40 Hen) were equipped with numbered and differently colored poncho tag. The weight of the radio (with cell, antenna and collar) was equal to the maximum acceptable weight suggested by Venturato *et al.* (2009) for still growing pheasants and below the value of 3% of the bird body weight considered acceptable for the survival of the bird (Perez *et al.*, 2004). Only 114 pheasants were released the following day of their handling, since two pheasants equipped with the poncho tags and 1 pheasant equipped with the radio tag were lost in consequence of the damage occurred during handling for collar supplying and/or measuring.

Study area

The experiment was carried out in two no-hunting areas (PA) named *Leccio Poneta* and *Le Bartaline* (centroid Guass-Boaga Rome 1940=1684322-4836210 and 1687671-4823035, surface=176 ha and 184 ha, for *Leccio Poneta* and *Le Bartaline*, respectively). Both PA were located in the Province of Florence (Central Italy) and had similar environmental characteristics: agricultural areas with natural vegetation, as well as trees and shrubs, mainly of the Mediterranean variety, see Table 1.

Both PA were equipped with small aviaries, m 30×3 each, and fenced acclimatization areas: 3 ha in *Leccio Poneta*, and 9 ha in *Le Bartaline*. The hunting guards and landowners performed the constant monitoring and control of the predator population and regularly inspected and refilled 6 artificial feeding points in *Leccio Poneta* and 3 artificial feeding points in *Le Bartaline*.

Localization techniques

Locations of pheasants began on late September and ended on early April. The locations of tagged pheasants were recorded 2 or 3 times a week from the early morning until early afternoon: the radio locations were obtained according to the methodology described by Bagliacca *et al.* (2008); the locations of poncho tagged pheasants were obtained by direct sighting through the aid of binoculars and then by telescope.

When a radio tagged pheasant had not been directly seen or triangulated more than twice in the same place, direct sighting was always used the next time, to verify the condition of the subject (suspected death). Cards were also used to register the habitat where each the pheasant had been observed/localized by triangulation.

Data processing

Data on biometrics measurement (live weight, tarsus length, diameters, spur length, and remiges length), recorded before release, were submitted to variance analysis in relation to the groups and sex (SAS, 2002). Survival rates were analyzed by the Kaplan-Meier method, in relation to tag, group, sex and within the different PA of release (Efron,1988; Lee, 1980; Petrini, 1995; Pollock *et al.*, 1989a,b; SAS, 2002). In particular, when a pheasant had been checked alive or changed its position in two consecutive sightings, it was coded as alive, whereas if the poncho or the radio tag had been found, with or without the body of the pheasant, the pheasant was coded as dead. The dispersions (maximum distances reached from the point of release) were calculated on a Geographic Information System (GIS) (ArcGIS®- ESRI) and submitted to variance analysis in relation to tag, group and sex within the different release PA (nested model; SAS, 2002). The home range, Minimum Convex Polygon (MCP), of each subject was determined using the Hawth's Tool GIS (ArcGIS®-ESRI); the MCP was determined only for pheasants with a radio collar that had been observed at least 5 different times. The MCPs were then subjected, as in the previous cases, to variance analysis (SAS, 2002).

The land use (environmental composition of each home range and the type of environment assigned to each location) was obtained using Hawth's Tool GIS (ArcGIS®-ESRI) and controlled with the habitat registered in the cards. The land use maps, in digitized format, were produced by a preliminary process of photo-interpretation, then verified by a location scout view into the field. The following environmental types were used: woods, shrubs area, fallow farmlands, vineyards, olive orchards, spring crops for game, winter crops for game, grassland and pastures, urban areas (such as cities and construction sites) and rivers and ponds. The environmental availability was calculated from random points used like centers of circles with an area equal to the average pheasant home range, calculated for each PA (Fearer and Stauffer, 2004). The environmental choices: home range choice and choice in the home range (log transformed) were then submitted, as in the previous cases, to variance analysis (Aebisher *et al.*, 1993; Manly *et al.*, 2002; Pendleton *et al.*, 1998; SAS, 2002). If there was an available habitat in the home range not being used by the animal, zero values were converted to 0.01% before the log transformation and the use of that habitat was considered biased (Aebisher *et al.*, 1993).

Results and discussion

Pheasants

The pheasants (either males or females) produced using the traditional method, Control group, were heavier than the pheasants produced using artificial hatching and foster mother rearing, Hen group, P<0.01 (Table 2). Also all the other morphological traits followed the same trend observed for the body weights, but the statistical differences were reached only for remiges length, tarsus diameters and spur length between the males and tarsus max diameter for females. These unexpected results show that the best pheasant growth rate can be obtained only with the totally controlled rearing conditions used by the standard technology. The use of the foster mother rearing, even if the pheasants fed the same feed of the Control, does not allow the pheasant chicks to reach their maximum potential growth. Evidently, the foster mother cannot furnish the optimal thermal conditions guaranteed by the controlled artificial heating of the poultry house and her pheasants looks worse than the artificially reared pheasants.

Survival rates

The results of the final survival rates (Table 3) showed difference survivals in relationship to the different rearing technique; the pheasants of the group Hen showed a significant improvement of their survival rates, either with poncho or radio tags (90.0% *vs* 57.1% and 35.0% *vs* 21.1%, respectively). Also the trend of the mortality significantly differed between Control and Hen (Figure 1).

The final survival rates of the pheasants bearing a poncho was significantly higher than the final survival rates of the radio tagged pheasants (74.4% *vs* 28.2%). Surely the survival rates of the poncho tagged pheasants were deeply overestimated (not every dead pheasant can be found). For this reason ponchos can be used

Table 1. Land uses in the two no-hunting areas *Le Bartaline* and *Leccio Poneta*.

Land use	*Le Bartaline* surface, ha	*Leccio Poneta* surface, ha
Woods	18.0	57.4
Shrubs land	8.3	62.5
Fallow farmlands	24.4	21.4
Vineyards	32.8	9.1
Olive orchards	41.1	10.1
Spring crops for game	1.7	1.3
Winter crops for game	5.1	2.7
Grasses and pastures	28.4	4.2
Urban areas	24.0	6.3
River and ponds	0.4	1.4
Total	184	176

Table 2. Morphologic characteristics of the pheasants.

Parameter	Males		Females		Overall
	Control N = 29	Hen N = 30	Control N = 28	Hen N = 30	SEM
Live weight, g	1235^A	960^B	945^D	749^C	0.0744
Tarsus length, cm	8.53	8.50	7.44	7.43	0.0113
Remiges length, cm	23.8^A	22.7^B	21.7^C	21.3^C	0.0092
Tarsus diameter min., mm	6.93^a	6.59^b	5.92^c	5.69^c	0.0065
Tarsus diameter max., mm	10.2	8.84	8.42	7.68	0.0088
Spur+tarsus diameter, mm	18.6^A	14.6^B			0.0253

$^{a-c}$Means with different letters differ per P<0.05; $^{A-C}$means with different letters differ per P<0.01.

only for the comparison between different groups with equivalent subjects and cannot be used to evaluate absolute survival rates.

However, also the survival rates estimated with the radio-tagged pheasants were very high (Warner and Etter, 1983; Venturato *et al.*, 2009) either in the Control or in the Hen group but both our groups of pheasants were reared expressly with the aim of their future release into the wild (no nasal blinders, early access to flying pens and so on).

Use of the fenced acclimatization areas

The position of the pheasants was studied in two periods (during the month of release and during the 5th month after release) (Table 4). Differences were evidenced in relation to the time elapsed from release and the rearing technologies. The month after release the fenced acclimatization areas was less used by Control pheasants than by Hen pheasants while 5 month later the fenced acclimatization areas was less used by Hen pheasants than by Control pheasants (72.78 *vs* 76.54 and 54.17 *vs* 43.14, for control and hen, respectively; P<0.01). As expected, the fenced acclimatization areas was less used during the 5th month than during the month following the pheasant release, either for Control or Hen (72.78 *vs* 54.17 and 76.54 *vs* 43.14, for Control and Hen, respectively; P<0.01).

After release, probably, the Hen pheasants are more able than the Control pheasants to recognize the game crops cultivated inside the fenced area. The Hen group received the imprinting needed to find food by their mother hens while the Control group did not received any imprinting. For this reason the presence of the Control pheasants is reduced inside the fenced area because most of them wander outside in search for the known feeders. The clear effect of dispersion which characterizes the 5th month (significant for both groups, but more evident in the Hen group than in the Control group) showed that with the approaching of the reproductive season the fenced area is abandoned by most of pheasants (Meriggi, 1998).

Pheasant home range surfaces and dispersion

No difference was observed between the home range surfaces and the dispersion (average max distances from the releasing sites) of the two groups (Table 5). The data of the home-range sizes are useful, as reference parameters, to dimension the PA in agricultural areas interspersed with natural Mediterranean vegetation. The data of the dispersion are useful to locate the place for the releasing sites of the captive reared pheasants inside the same PA (Cocchi *et al.*, 1998; Bagliacca *et al.*, 2008).

Pheasant land use

The data concerning the pheasant land uses (considering both the PA), referring to both sexes, are shown in Figure 2. The winter crops-for-game, the spring crops-for-game and the fallow farmlands were more represented within the home ranges of both group of pheasants. These results confirmed the great importance to cultivate crops for game in the PA. Winter crops for game (wheat, broad beans and oats) represented old and not-harvested crops, seeded the previous year. In this phenological state these crops are still able to provide feeding and also good protection and hiding places for the pheasants.

Most of pheasant fixes were observed in fallow farmlands, woods, crops for-game and shrubs land. No fix was observed in the urban areas and river and ponds. Also in this case the importance of the fallow farmlands and the crops for game was confirmed by the pheasant presence.

The presence of the woods was reduced in the home range but a great number of fixes was located in the woods within the home range because the tree perching is very important for pheasants (Cocchi *et al.*, 1998).

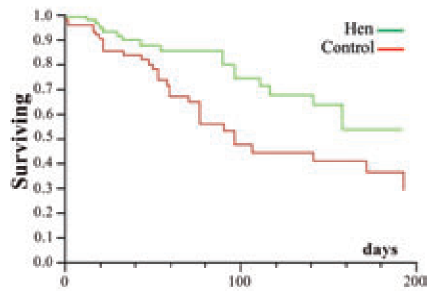

Figure 1. Survival rates of the two groups of pheasants (Kaplan-Meier).

Table 3. Survival rates of the reared pheasants: effect of different rearing technologies and tag.

	Poncho tag	χ^2-tests	Radio tag	χ^2-tests	Both tags	χ^2-tests
Control		Wilkoxson 4.07 P=0.04 Log-rank 5.50 P=0.02		Wilkoxson 1.80 P=0.18 Log-rank 1.34 P=0.24		Wilkoxson 5.48 P=0.02 Log-rank 5.50 P=0.02
Released/dead, N	35/15		19/15		54/30	
Survived, %	57.1		21.1		44.4	
Hen						
Released/dead, N	40/4		20/13		60/17	
Survived, %	90.0		35.0		71.7	
Both						
Released/dead, N	75/19		39/28		114/47	
Survived, %	74.4		28.2		58.8	
χ^2-test		Log-rank 1.14 P=0.02 Wilkoxson 0.23 P=0.63				

Table 4. Use of the fenced acclimatization areas: effect of different rearing technologies and time elapsed from release.

		Control	χ^2-tests	Hen
Month of release,	N	46/169	Wilkoxson 9.54 P<0.01	38/162
	%	72.78	Log-rank 10.27 P<0.01	76.54
χ^2-test:Wilkoxson		7.94 P<0.01		42.9 P<0.01
Log-rank		7.73 P<0.01		42.8 P<0.01
5 months after release,	N	33/72	Wilkoxson 9.16 P<0.01	54/81
	%	54.17	Log-rank 9.34 P<0.01	43.14

Table 5. Home range areas and dispersion of pheasants (average max distances from the releasing sites) in relationship to the rearing technologies.

Protected areas		Control group	Hen group	SEM
Le Bartaline and *Leccio Poneta*	Pheasant, N	20	19	
	Dispersion, m	426	390	46.7
	Home range, ha	11.6	12.0	2.0

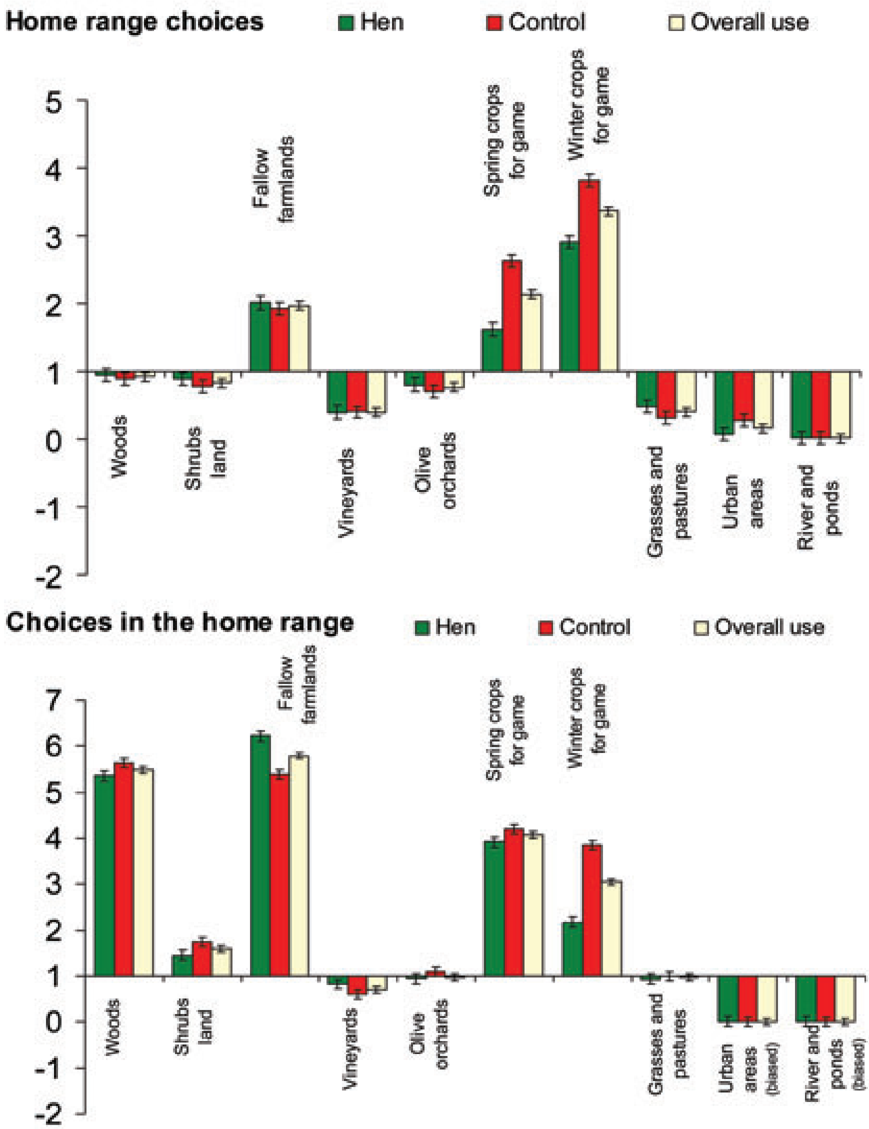

Figure 2. Land uses in the pheasant (bars with SEM). Least square means >1 show larger uses; Least square means <1 show smaller uses.

Conclusions

The survival rates of the reared pheasants can be increased with the adoption of the technique of mother fostering applied to the artificially hatched pheasants chicks.

Our experiment demonstrated that the estimation of the future survival in the wild of the farmed pheasants cannot be based on the simple measurement of the morphological traits. In fact the brooded pheasants, which showed the best survival rate showed the worst morphological traits.

The land use showed that the woods can be reduced in the agricultural areas interspersed with natural Mediterranean vegetation since they are less represented than the available in the home range of the pheasants.

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