# Differential predation upon small and large pen-reared grey partridges (*Perdix perdix*) after release


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## The project

- The hunting management district "ATC Pisa 15", in Central Italy has attempted since 1996 the reintroduction of the grey partridge, disappeared in the area during the '70s.
- Radio-tracking has been used to measure dispersal and survival, and to analyse causes of mortality of released animals. A total of 3150 young pen-reared birds, 73 of which radio-marked, in 138 groups have been released in two years.
- A sizeable self-sustaining population would require a large protected area, which is not available in Pisa province. We therefore aimed at creating a metapopulation in the network of smaller protected areas within dispersal distance and linked by suitable habitat.

## The grey partridge in Italy

- The partridge was very common in several region of Italy (including Tuscany) until the '60s. It has disappeared in the '70s, probably because of several interacting factors (changes in agricultural techniques, predators, unregulated hunting).
- The numerous reintroduction attempts have been largely unsuccessful, in spite of large numbers of birds released.
- The most successful project was probably conducted in Pavia province, where a self-sustaining population was established. In this case, large release pens were utilised.

## Study area

Partridges were released in 12 selected areas among the protected ones, for a total of over 10,000 hectars.


**Selected areas**

| | Total area (ha) | Woodland (%) | Cereal fields (%) | Suitable habitat (ha) |
|---|---|---|---|---|
| Collebrunacchi | 954 | 10 | 51 | 859 |
| Casa all'Olmo | 1740 | 6 | 75 | 1306 |
| Montecastelli-La Paganina | 552 | 30 | 36 | 399 |
| Larderello-Montecerboli | 900 | 44 | 17 | 200 |
| il Poggione | 504 | 16 | 62 | 358 |
| Rio Arbiaia | 879 | 7 | 63 | 879 |
| S. Martino-Pialla | 764 | 5 | 70 | 764 |
| S. Dalmazio | 450 | 40 | 32 | 227 |
| Sasso Pisano | 850 | 29 | 26 | 612 |
| Serrazzano | 486 | 32 | 38 | 244 |
| Ser Ripoli | 1100 | 26 | 40 | 850 |
| Vicarello Villa Magna | 1500 | 15 | 66 | 1306 |
| TOTALE | 10679 | | | 8004 |

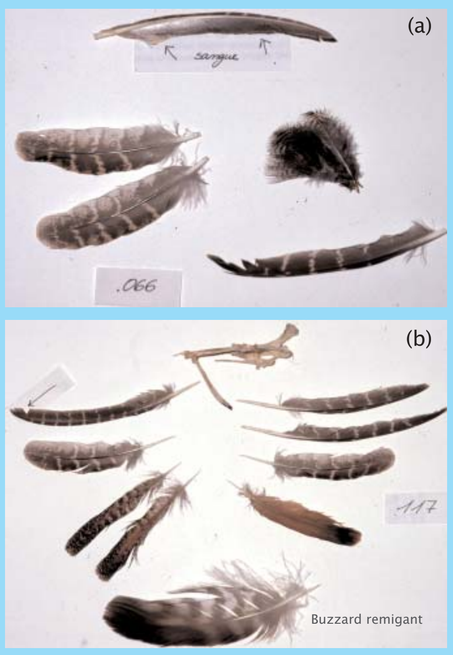
## Methods

- All released birds (80 to 90 days old) were pen-reared under standard condition. Birds were released in groups close to shelters containing a live adult bird, permanently kept as a decoy, and feeding and drinking points.
- We placed a radio harness (total mass= 7 g, c.a 2.2% of body mass of birds at release) with mortality sensor to the back of 73 birds (one per group released), and a uniquely numbered flag on the back of another 340 birds (4 per group released).
- Before release we recorded the sex, body mass, tarsus length, wing length and fat deposit of each radioed bird; we sampled parasites by means of cloacal swab.
- Radioed birds were located twice a week, and groups were approached whenever possible to observe and count individuals.
- In case of death the remains were collected for subsequent analyses. Predator signs were searched for in the surroundings and noted.
- Mortality was estimated by means of Kaplan-Meier product-moment method.

**Released birds**

| Year | Total | No. of groups | Birds per group |
|---|---|---|---|
| 1997 | 1615 | 85 | 18-20 |
| 1998 | 1535 | 53 | 29-30 |

Courtesy of Margherita Marzoni




Buzzard remigant

## Post-mortem analyses

Post-mortem analyses allowed the estimation of:
- general physical condition
- nutritional status
- gizzard, stomach and intestine contents (to evaluate whether birds fed correctly before death)
- presence of lesions (skin, subcutaneous, muscle and bone) to discover type of traumas (bites, impacts)
- presence of internal lesions and haemorrhages, referable to either traumas or diseases
- external and internal parasites.

We also checked for the presence of parasites in the stomachs and intestines.

When remains did not allow a thorough analysis (as in the frequent occurrence of recovery of feathers and bones) we relied on more indirect evidence:
- presence of blood (indicating active predation rather than scavenging)
- signs of tooth (a) or beak (b) marks on the feathers, bones or radio
- signs of presence (faeces, tracks etc.) of potential predators in the immediate surroundings.

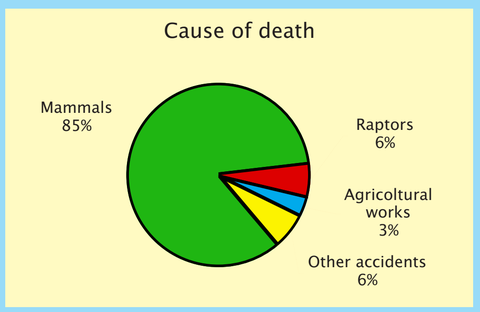
**Difference between morphology of birds**

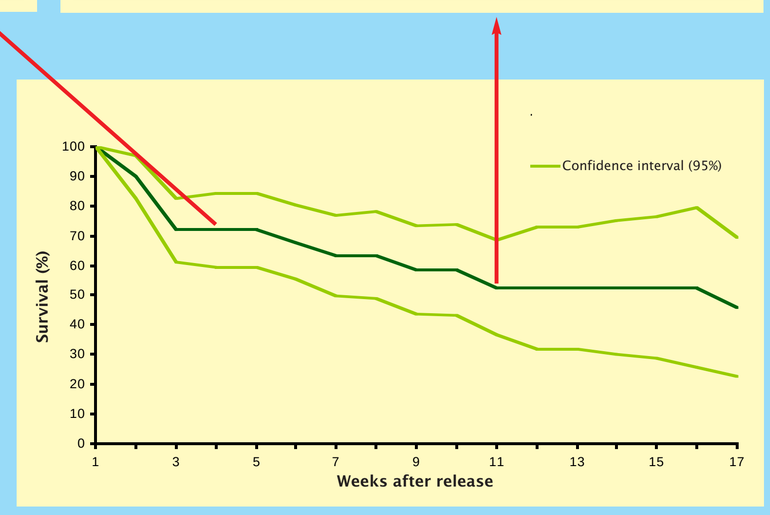
**at 4 weeks after release**

| Variable | Alive (N=32) mean ± SD | Preyed upon (N=13) mean ± SD | t | *P* |
|---|---|---|---|---|
| Tarsus length | 54.6 ± 1.80 | 53.492 ± 2.13 | 1.652 | NS |
| Body mass | 321.63 ± 24.57 | 304.15 ± 23.44 | 2.234 | < 0.05 |
| Max tarsus diameter | 6.0 ± 0.39 | 5.8 ± 0.36 | 1.748 | NS |
| Wing length | 15.2 ± 0.42 | 14.9 ± 0.47 | 2.219 | < 0.05 |

**at 11 weeks after release**

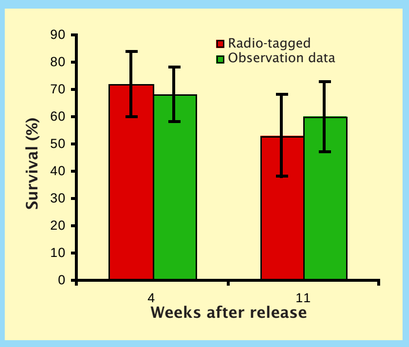
| Variable | Alive (N=16) media ± SD | Preyed upon (N=20) media ± SD | t | *P* |
|---|---|---|---|---|
| Tarsus length | 54.6 ± 1.96 | 53.8 ± 2.00 | 1.205 | NS |
| Body mass | 323.06 ± 25.76 | 311.95 ± 26.01 | 1.281 | NS |
| Max tarsus diameter | 5.9 ± 0.38 | 5.9 ± 0.44 | -0.109 | NS |
| Wing length | 15.2 ± 0.47 | 15.0 ± 0.49 | 1.669 | NS |




## Results

- The most frequent cause of death has been predation by mammals (85%) followed by raptors (6%); further mortality was caused by casualties (6%) and agricultural activities (3%).
- In the first 4 weeks after release, mortality was highest (28%); predated birds were lighter (t = 2.23; N = 45; $P < 0.05$) and with shorter wings (t = 2.22; N = 45; $P < 0.05$) than surviving ones. Mortality decreased afterwards, reaching 46% after 17 weeks. At this stage, surviving birds were not morphologically different from dead ones. Predation therefore changed from a selective process in the first period, concerning mostly small, presumably less vigourous birds, to a random one.
- Males and females were equally vulnerable to predation (chi-square, $\chi^2 = 0.002$, df = 1; NS).
- At four weeks from release average group size was 13 ± 1.94 (N = 9, excluding merged and split groups), i.e. an estimated survival of 68%. At the same time, survival of radioed birds was 72%. At eleven weeks from release average group size is 11.4 ± 2.55; N = 10, for an estimated survival of 60%; survival of radioed birds was then 53%. We concluded that the radio does not seem to increase mortality.




## Conclusions

- Radio-tracking is fundamental to analyse release success. Very light transmitters do not seem to cause an increase in mortality rates, and allows for an accurate assessment of dispersal and mortality.
- In the first period after release mortality factors act selectively towards smaller animals. Afterwards, predation becomes a random process respect to morphology at release. Mortality rates in the second period are similar to those of wild birds.
- The heavy mortality of the first period could be reduced selecting better animals (e.g. improving rearing conditions).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