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Growth of nestlings in great tit *Parus major*

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Weight is one of the most important parameters used to estimate the energy flow through animal populations (Wiens and Innis 1974).
Weight measurements are often obtained with scales in fact, the weight of nestlings changes rapidly during the days before leaving the nest; then it must be measured daily. A good daily estimation of weight may be obtained by means of an equation, describing the weight by the age; so, we can avoid measuring the nestling daily.
The growth of nestlings is not a linear process, but a sigmoid one (Ricklefs 1968). In this paper I describe the growth curve of nestlings in Great Tit *Parus major* by means of the equation $y = e^{a-b/x}$ (Del Vecchio 1982), which has shown a good correspondence to actual data in previous researches (De Filippo, *com. pers.).*
Vivara (40° 45' N, 13° 58' E) is a Mediterranean island (32 ha) dense with bush, with an uncultivated (over 20 years) olive-grove colonized by shrubs, and patches of *Quercus pubescens* wood representing the potential vegetation (Caputo 1964/65). On the island different aspects of ecology of the *Great Tit* population have been studied (Fusco *et. al.* 1989a, Fusco *et al.* 1989b). During the research 43 nest-boxes were placed at random on trunks and branches of the most common species of trees. During the reproductive seasons from 1984 to 1987 (April to June depending on climate in different years or on the different laying time among pairs), all nest-boxes occupied by birds were regularly controlled until hatching. Then, the growth of the nestling was controlled until fledging day, measuring the weight by means of a field balance "Pesola" (max 30 g, accuracy 0.1 g). I recognized individually the nestlings by means of rings that were placed at the legs when the birds reached an adequate size. Before ringing, every nestling was identified by means of the different size, being the eggs laid and hatched at daily intervals. In the analysis I considered the nestlings only when I was able to recognize their age without errors.
I elaborated data of 37 nestlings hatched from 14 different nests. Average brood size in these nests was 4,8 nestlings (s.d. = 1.4).
On Vivara Island Great Tits breed a single time (except one event of second breeding that occurred in a pair during the 1985) (Fusco *et al.* 1989a).
The regression between weight (W: grams) and age (days) were obtained using the software SPSS-PC (Norusis 1984), by transforming the equation $W = e^{a-b/age}$ into the linear one $\ln W = a - b/age$.

Table I - Regression between weight and age of pulli according to the linearized growth curve.

Correlation coefficient		r =	0.954
Determination coefficient		r^2 =	0.909
Standard error		s.e. =	0.212
VARIANCE ANALYSIS			
	D.F.	SUM X^2	MEAN X^2
Regression	1	16.40	16.40
Residual	35	1.59	0.04
F = 361.73	P<0.0001		
COEFFICIENTS OF THE EQUATION			
	ES	t	P<
a = 2.85	0.05	49.4	0.0001
b = 3.83	0.20	19.0	0.0001

The regression between weight and age is well fitted to the equation used here, as the correlation and variance analyses show (Table 1). Therefore on Vivara Island the weight of the nestlings of Great Tits may be estimated every day by $W = {}^{2.85-3.83/age}$.
Using equations to predict weight in applicative studies, several factors affecting growth-rate and final value were critically considered. For example, the mean body size in Great Tit, as in other endotherms, increases according to latitude (Lack 1947). However, at the same latitude the growth rate, the clutch size and the pairs density may be effected by environmental factors which change among habitats or sites in a single area (Kluijver 1951, Lack 1966, Krebs 1970, Perrins e Jones 1974, Perrins 1979).

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Riassunto — È stata studiata la popolazione di *Parus major* su Vivara, una isola mediterranea estesa 32 ha, la cui vegetazione è rappresentata da macchia e da resti di oliveto non coltivato e isole di bosco di *Quercus pubescens* relitto della vegetazione potenziale.

- Sono stati misurati i pesi di *pulli* nati in cassette nido la cui età in giorni era ben nota.
- È stata derivata l'equazione $W = e^{2.85-3.83/days}$ che ben descrive la curva di accrescimento dei *pulli*.

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