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CLUTCH SIZE AND EGG SIZE
IN FOUR ANATIDAE SPECIES IN NE ITALY

Abstract. — Data on egg and clutch size of four *Anatidae* species (Mallard, Gadwall, Shoveler and Pochard) are given. Data were collected during the years 1987-89 in Comacchio lagoon (NE Italy). Clutch size was, on average, slightly bigger in our study area than in North and Central Europe for Mallard, Shoveler and Pochard. Eggs were smaller than in other European areas for Mallard, Gadwall and Pochard, the difference being about 6% of the volume, and bigger in the Shoveler. In all the species a significant variation in egg volume among clutches emerged. A positive correlation of clutch size and mean egg volume was detected for Mallard and Shoveler. The authors suggest that the observed difference in egg volume for Mallard, Gadwall and Pochard are the outcome of suboptimal environmental conditions in our latitudes than in Central and North Europe. The slightly bigger clutch size in Mallard and Pochard possibly partly compensates for the reduction in fitness probably determined by the low egg volume.

Riassunto. — *Dimensione della covata e delle uova in quattro specie di Anatidae nell'Italia nord-orientale.*

Sono esposti dati relativi alla dimensione della covata e delle uova per quattro specie di Anatidi (Germano reale, Canapiglia, Mestolone e Moriglione). I dati sono stati raccolti negli anni 1987-89 nelle Valli di Comacchio (Ferrara e Ravenna). La dimensione della covata è risultata mediamente maggiore rispetto al centro e nord Europa per Germano reale, Mestolone e Moriglione. Il volume delle uova è risultato inferiore per Germano reale, Canapiglia e Moriglione e superiore per il Mestolone, rispetto a regioni centro e nord europee. Per tutte le specie considerate è emersa una variazione significativa nel volume delle uova fra covate diverse. Per Germano reale e Mestolone è stata osservata una correlazione positiva fra dimensione della covata e volume medio delle uova. Si ipotizza che condizioni ambientali non ottimali per Germano reale, Canapiglia e Moriglione producano le differenze di volume delle uova osservate rispetto a regioni europee centrali e settentrionali e che la maggiore dimensione delle covate in Germano reale e Moriglione in parte compensi la riduzione della *fitness* probabilmente determinata dal basso volume delle uova.

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Introduction.

Many papers have described breeding parameters such as egg size and clutch size in *Anatidae* species (see CRAMP & SIMMONS 1977). However most of them concern north european populations whereas just a few report on data from the mediterranean region. This is probably because most *Anatidae* species have relatively small breeding populations and very scattered ranges, except for the Mallard, in southern Europe. No published data are available on clutch and egg size for italian breeding ducks in the wild, whereas the status of italian populations of breeding ducks has been reviewed by BRICHETTI *et al.* (1984).

In this paper we expose data on clutch and egg size of four species: Mallard (*Anas platyrhynchos*), Gadwall (*Anas strepera*), Shoveler (*Anas clypeata*), Pochard (*Aythya ferina*); we compare our data to those available from literature for Central and North European regions. We also analyze inter clutch egg volume variation and we correlate clutch size and egg volume.

Study area and methods.

Data on egg size and clutch size of the four species considered were collected during years 1987-89 in Comacchio lagoon (NE Italy). This is a 110 km² lagoon spotted by small islets where ducks breed. The islets are vegetated by alophilous species, mainly *Salicornia fruticosa*, *Salsola soda*, *Obione portulacoides*. Nests were often found within gull and tern colonies. Other *Anatidae* species breeding in Comacchio lagoon are the Shelduck (*Tadorna tadorna*), the Garganey (*Anas querquedula*) and the Ferruginous duck (*Aythya nyroca*) (BRICHETTI *et al.* 1984; SAINO, 1989).

Egg breadth and length were measured by a Vernier caliper to the nearest 0.1 mm. An index of the volume was calculated by the following formula (HOYT, 1979): $\text{volume} = \text{length} * (\text{breadth})^2 * 0.51$.

The eggs were weighed to the nearest 0.1 g by a dynamometer when each nest was found and the stage of incubation so far was unknown. Thus data on egg weight from this study are hardly comparable to those from other studies.

Results and discussion.

Data on clutch sizes of the species are reported in Table I and those on egg size in Table II. A clutch of 5 eggs of Mallard and a clutch of 7 eggs of Shoveler were excluded from the calculation of mean clutch size since they are well out of range of the others and were probably

TABLE I. — Mean clutch size \pm standard deviation and range of clutch sizes for the species considered, from this study and from literature (in CRAMP & SIMMONS, 1977).

	This study	Literature
Mallard	9,5 \pm 1,18	8.2 HILDEN, 1964 Finland
	(5)* 8 - 11	12.6 OGILVIE, 1964 England
	n = 10	9.6 FOG, 1965 Denmark
		8.7 BIRKHAED, 1985 England
Gadwall	9,73 \pm 1.56	9.96 BALAT & FOLK, 1968 Czechoslovakia
	7 - 11	9.41 BENGSTON, 1971 Iceland
	n = 11	
Shoveler	10,3 \pm 0.67	9.2 HILDEN, 1964 Finland
	(7)* 9 - 11 (17)** n = 10	
Pochard	10,18 \pm 0.87	9.5 CRAMP & SIMMONS, 1977 Germany
	8 - 11	8.09 HARLIN, 1966 Czechoslovakia
	n = 11	

* values in parentheses are probably due to uncomplete clutches.

** value in parentheses probably due to laying by two females.

still not complete clutches. A clutch of 17 eggs was excluded since it was probably the result of laying by two females.

The mean clutch size of the Mallard (9.5 eggs/nest; N = 10) is higher or equal to that observed in north european populations except the english one where the mean first clutch size was 12.6 eggs/nest (OGILVIE, 1964 in CRAMP & SIMMONS, 1977). This high value is possibly attributable to introgression of genes from domestic strains in the wild population (CRAMP & SIMMONS, 1977). The eggs of Mallard were smaller than those from northern Europe (SCHONWETTER, 1967 in CRAMP & SIMMONS, 1977). The difference was sensible since the observed differences in mean length and breadth produced a difference in mean volume of 2.9 cm³ (about 6% of the volume observed in this study).

The observed mean clutch size of the Gadwall (9.73 eggs/nest n = 11) was similar to that observed in other european areas (BALAT & FOLK, 1968 in CRAMP & SIMMONS, 1977; BENGSTON, 1971). The eggs in Comacchio were again smaller than those from central Europe, the difference on average being of 2.4 cm³ (6% of the volume).

TABLE II. — Mean \pm standard deviation and ranges of variation of egg length, breadth, volume and weight for the species considered, from this study and from literature (SCHOENWETTER, 1967, in CRAMP & SIMMONS, 1977).

	<i>This study</i>				<i>Literature</i>			
	Length (mm)	Breadth (mm)	* Volume (cm ³)	Weight (g)	Length (mm)	Breadth (mm)	* Volume (cm ³)	Weight (g)
Mallard	56.4 \pm 1.67 51.5-59.7 n = 91	39.9 \pm 1.16 37.7-42.2 n = 91	46.0 \pm 3.19 38.7-52.3 n = 91	46.0 \pm 2.28 41.0-49.5 n = 66	57 50-65 n = 500	41 37-46 n = 500	48.9	51 42-59 n = 200
Gadwall	52.9 \pm 1.77 49.6-57 n = 45	38.6 \pm 1.22 36.4-40.4 n = 45	40.3 \pm 3.29 33.7-44.4 n = 45	42.2 \pm 4.87 31.9-51.5 n = 56	55 51-59 n = 200	39 35-44 n = 200	42.7	44 35-55 n = 100
Shoveler	53.1 \pm 1.77 48.3-57.2 n = 59	37.1 \pm 1.19 33.9-39.5 n = 50	37.3 \pm 2.87 28.4-43.1 n = 59	38.2 \pm 2.61 33.0-42.2 n = 39	52 48-57 n = 257	37 35-40 n = 257	36.3	40 35-43 n = 27
Pochard	61.2 \pm 1.19 58.5-63 n = 32	42.9 \pm 0.64 41.7-43.9 n = 32	57.6 \pm 1.98 53.4-61.4 n = 32	60.8 \pm 1.86 58.0-65.0 n = 31	62 56-68 n = 300	44 39-47 n = 300	61.2	68 61-73 n = 12

* values calculated by HOYT, 1979 formula.

The Shoveler showed a higher mean clutch size (10.3 n=10) than observed in northern Europe (HILDEN, 1964) and the eggs were on average slightly bigger in our study (2.7% of the volume).

The Pochard's observed mean clutch size was 10.18 eggs/nest (N=11) whereas in central Europe it was of 9.5 eggs/nest (KEAR in CRAMP & SIMMONS, 1977) and of 8.09 (HARLIN, 1966 in CRAMP & SIMMONS, 1977). The eggs were sensibly smaller in our study area with an average difference in volume of 3.6 cm³ (6.3% of the volume).

For all the species considered a significant variation of the egg volume among the clutches was observed (Table III) thus indicating that each female tends to lay eggs of relatively constant volume. Except the case of the Pochard the between clutches variability accounted for more than 50% of the total variability in egg volume data. The clutch size was strongly correlated with intra clutch mean egg volume in the Mallard ($r = 0.92$ $P < 0.001$ $n = 9$). Also for the Shoveler a positive correlation

TABLE III. — Significance of the variation of egg volume among clutches for each species considered.

Mallard	$F_{9,81} = 13.2$	$P < 0.001$
Gadwall	$F_{4,40} = 68.8$	$P < 0.001$
Shoveler	$F_{4,54} = 17.6$	$P < 0.001$
Pochard	$F_{2,29} = 3.4$	$P < 0.05$

emerged between clutch size and mean egg volume (Kendall correlation coefficient = 1.0 $P < 0.05$ $n = 4$) but no correlation emerged for the Gadwall. No correlation analysis was performed for the Pochard due to the extremely low sample size.

Despite the paucity of the sample, mainly due to the scant breeding populations, some speculations on our results can be made.

For three species (Mallard, Shoveler and Pochard) the mean clutch size was higher or equal in our study area than in north or central european areas whereas the mean egg size for Mallard, Gadwall and Pochard was smaller. The remarkably constant difference in egg volume (about 6% less in our study area than in central and north Europe for Mallard, Gadwall and Pochard) supports the idea that geographical variation in egg size is a common phenomenon in *Anatidae* species and may be the outcome of sub optimal environmental conditions for certain species in our latitudes. BATT & PRINCE (1979) evidenced that a geographical variation in egg size occurs for the Mallard in North America and related this evidence to different climatic conditions.

Many authors (see for example PARSONS, 1970; SCHIFFERLI, 1973; and others) have shown that chicks hatched from big eggs have a greater chance of survival up to fledging age. In particular, KEAR (1965), MARCSTORM (1966) and KRAPU (1979) have shown that large Mallard eggs produce large young which survive better to long periods of starvation than young hatched from small eggs. Thus smaller eggs in our study area probably determine a lower probability of survival of the chicks.

On the other hand, in precocial birds whose chicks are able to feed by themselves, a larger number of eggs is likely to result in a greater number of chicks fledged. So we may hypothesize that the presumed reduction in fitness determined by small eggs is to some extent offset by a slightly bigger clutch size for the Mallard and the Pochard.

The fact that bigger eggs are contained in larger clutches in the Mallard and in the Shoveler is consistent with BATT & PRINCE (1979) who found a similar relation in the Mallard. BENGSTON (1971) showed that clutch size is reduced when food is scarce in many Anatidae species. Inter clutch egg volume variation is partly determined by heritability of egg size (BATT & PRINCE, 1979) but an important source of phenotypic variation in egg size is food availability and quality during pre-laying period (KRAPU, 1979). Since food availability is able to affect both clutch and egg size we may suppose that females which lay large eggs and clutches are those in better nutritional conditions.

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