SOME UNIQUE FEATURES OF EGG LAYING AND REPRODUCTION IN *ICHTHYOPHIS MALABARENSIS* (TAYLOR) (APODA; AMPHIBIA).

B. R. SESHACHAR, T. A. BALAKRISHNA*, KATRE SHAKUNTALA*
AND K. R. GUNDAPPA†

Centre for Theoretical Studies, Indian Institute of Science, Bangalore 560 012, India
**Department of Zoology, Bangalore University, Bangalore 560 056, India*
†Department of Zoology, J. C. B. M. College, Sringeri 577 139, India

ABSTRACT

The paper describes egg laying and reproduction in *ICHTHYOPHIS MALABARENSIS*. 100 eggs, the largest ever in Apoda, are laid in a single string and manipulated by the female into a massive clutch. The reproductive strategies in the species are discussed.

INTRODUCTION

Recent interest in the Gymnophiona (Apoda) has led to the discovery of several outstanding features in their ecology, anatomy, physiology and development. Their restricted distribution over the 4 large land masses of the world along the tropical and pan-tropical belts, including some islands in the Indian Ocean, adds to the interest. The 34 genera and 166 species so far recorded[1] display a striking constancy of form, structure and life history. With a few aquatic species, all are elongate, limbless, terrestrial and burrowing forms. India is the home of at least 3 genera, *Ichthyophis, Uraeotyphlus* and *Gegeneophis*[2] and perhaps also a fourth, *Indotyphlus*[1]. Of these, *Ichthyophis* is the most common. It has several species (28) of which at least 8 are reported from this country. The Western ghats, from the southern tip of peninsular India to north of Bombay and the rain forests of north east India, appear to offer the right habitat for several terrestrial species[3]. However, individuals are scarce and much effort is needed to obtain these burrowing animals. The authors have been able to identify several areas in South India where they live, and it has been possible not only to make collections of adults, larvae and eggs of species of more than one genus, but also to make studies on their ecology, habits, structure, life history and behaviour.

The present paper describes some unique features of egg laying in *Ichthyophis malabarensis*, never recorded before.

OBSERVATIONS

The Gymnophiona are singular in that in all cases known, fertilization is internal. In terrestrial, oviparous species, the eggs are laid in burrows, on land and the female parent guards the egg-mass. The picture of *Ichthyophis glutinosus* by the Sarasins[4] is now classic and has found itself in text-books of vertebrate zoology all over the world.

Wake[5] has recently given a list of caecilian species whose clutch sizes and egg sizes have been reported. Generally the egg number varies from 6 to 40 in a clutch. The smallest clutch is in *Idiocranium russeli* with 6 eggs as also in species of *Siphonops*. Clutches up to 30 eggs are reported in *Geotrypetes* and *Gymnopis* and 28 to 32 eggs in *Dermophis mexicanus*. In *Gegeneophis carnosus* 15 eggs per clutch have been reported[6]. Recently in *Ichthyophis glutinosus* the number of eggs per clutch has been reported to range between 25 and 40[7].

It was therefore a matter of great interest to find in July 1981, in the environs of Sringeri, a female of *Ichthyophis malabarensis*, coiled round a large clutch of eggs. *I. malabarensis* is a comparatively large caecilian and Taylor's[1] description of the species is based on two specimens reported to have been collected several years ago from "South India". The present is the first record of the species from the state of Karnataka (see Figure 1A and B).

The egg-cluster offers great interest. The clutch had as many as 100 eggs, the largest number reported in any caecilian. Clearly the eggs filled the body of the female and it must have taken considerable time and effort on its part to lay them. Presumably every one of its eggs was laid. Later dissection revealed that there was not a single egg left in it.

The data on the eggs of the clutch are given in Table I. The eggs are connected with one another by transparent, hollow, untwisted cord which is continuous with the jelly coat covering each egg (see Fig. 1 C and D). The egg is spherical, 8·5 mm in diameter and 253·15 mg in weight. There is a surprising uniformity in the diameter of the eggs as well as in the distance separating one egg from another (10·25 mm. See Fig. 1D). It was possible to disentangle the egg mass which resulted in a single string of eggs extending over a length of 186·5 cm (more than six feet!), astonishing when compared with the parent which measured only 38·5 cm.

Some attempts have been made in other amphibians to establish clutch size-clutch volume-body size

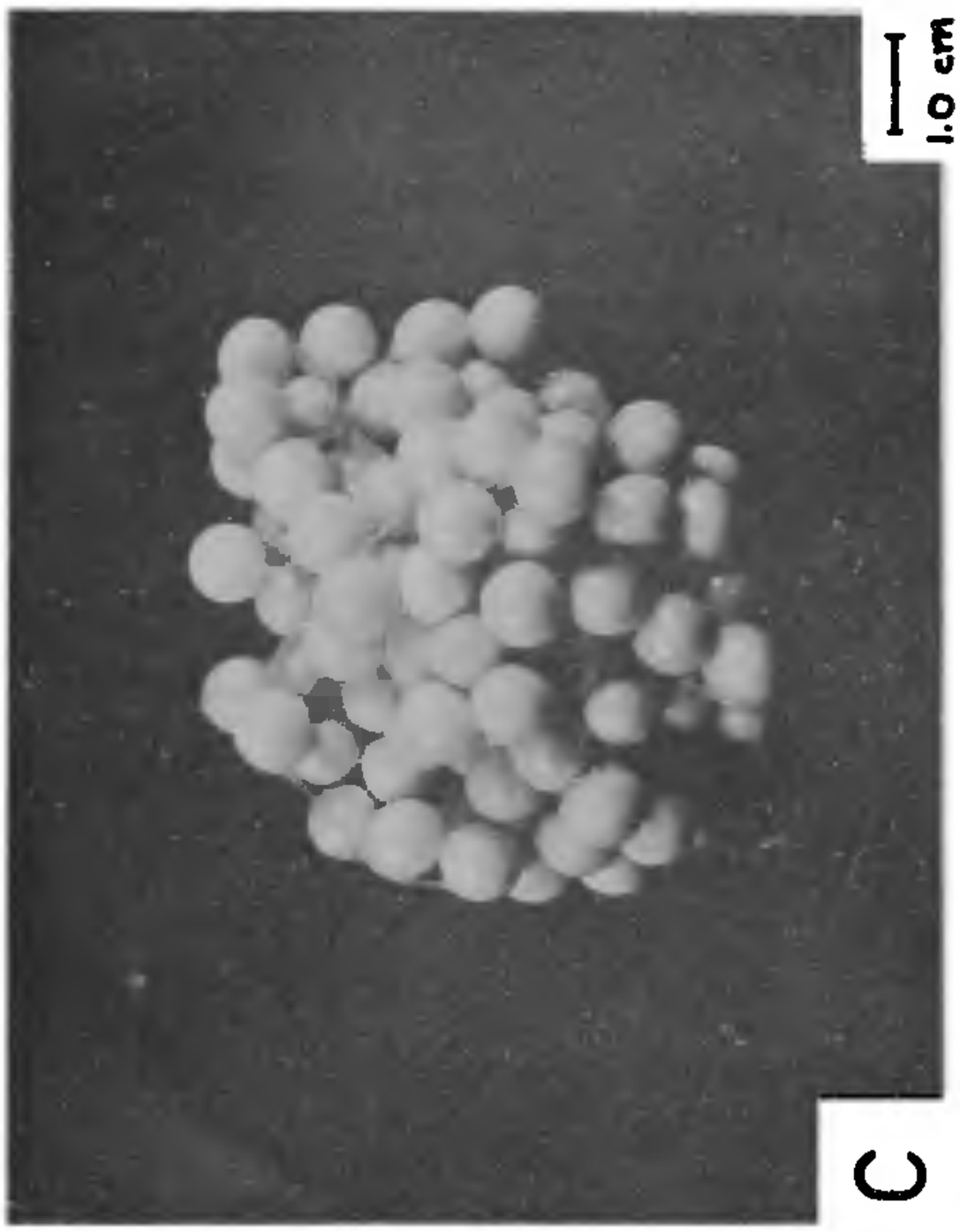

FIG. 1. A. Anterior lateral view of *I. malabarensis*. B. Posterior ventral view of the same. C. Egg cluster of *I.*

TABLE I

Data on the eggs of **I. malabarensis**

1	Total weight of the egg mass	25·31 g
2	Total volume of the egg mass	32·18 cc
3	Total length of the egg-string	186·50 cm
4	Weight of single egg (with jelly coat)	253·15 mg
5	Diameter of the egg	8·50 mm
6	Distance between successive eggs	10·25 mm
7	Total weight of yolk deposited	19·50 g

relationships[8]. However, in caecilians this has not been attempted, perhaps due to inadequate information on a sufficiently large number of species. It is a matter of considerable interest here that the female could accommodate an egg clutch volume of 32·2 cc and a total egg weight of 25·3 g.

DISCUSSION

As in other caecilians[5], it is presumed that in *Ichthyophis malabarensis* too fertilization is internal. In all cases where eggs have been reported in the Apoda, embryos in varying stages of development have been observed[4,6,7]. In the present case, however, no detectable embryo was noticed in any of the hundred eggs. Two possibilites exist. One is that the eggs have been laid soon after fertilization and before the embryo had developed to any noticeable extent within the female parent. If so, this is the first record of a caecilian egg clutch laid at such an early stage of incubation. One can visualise the extensive time/energy the parent has to spend in caring for these eggs.

The other possibility is that the eggs have not been fertilized. No male was found in the vicinity in spite of efforts to find one; this, taken along with the absence of embryo in any of the eggs over several days of observation, leads us to conclude that the eggs are unfertilized. Non-availability of a male for copulation, even after completion of egg-maturation, could have impelled the female to get relieved of the physical and physiological pressure of its massive egg clutch. Laying of unfertilized eggs in *I.malabarensis* is singular among the Apoda. Indeed this is the first record of any land vertebrate laying eggs as many as this. Further, the observed parental care of presumably an unfertilized clutch of eggs, suggests that the phenomenon is under the influence of endogenous factors and bears no relationship with either copulation or fertilization.

Caecilians are characteristic examples among the Amphibia, with the following unique features which must be taken into account in any discussion on their reproductive strategies; (a) terrestrial life, (b) modification of the cloaca in the male into an intromittent organ, (c) internal fertilization (d) fewer, large sized eggs filled with yolk, and (e) parental care. From the anuran situation, also found in cryptobranchid urodeles[9] where, generally speaking, a large number of eggs are laid and fertilization is external, through the urodela which exhibit internal fertilization (by means of spermatophores), the passage into the Apoda is both sharp and striking. The number of eggs is markedly reduced in this group consistent with copulation, transmission of sperms into the female by an intromittent organ, internal fertilization and parental care, – all of which are not only closely and undeniably related with one another but also act as a package in the reproductive strategies in this group.

In the present case of *I. malabarensis*, of the five features listed above, two, i.e. the number of eggs and internal fertilization, are out of step not only with the other three but also between themselves, with the result that the strategies of reproduction remain unfulfilled. The large number of eggs and absence of external fertilization associated with terrestrial life have perhaps rendered internal fertilization almost untenable.

The scarcity of individuals of *I. malabarensis* as compared with *I. glutinosus* has struck us as rather odd, especially in the face of the very large number of eggs it lays. Mortality during embryonic development, hazards of unprecedented severity during larval life, and loss of eggs due to other reasons[7,8] are known to regulate population size in the Amphibia. In the present instance absence of fertilization could be an important, additional factor.

1. Taylor, E. H., *The Caecilians of the world; A taxonomic review*, University of Kansas Press, Lawrence, 1968.
2. Seshachar, B. R., *Proc. Indian Acad. Sci.*, 1942, **B15**, 278.
3. Gundappa, K. R., Balakrishna, T. A. and Katre Shakuntala, *Curr. Sci.*, 1981, **50**, 480.
4. Sarasin, P. and Sarasin, F., *den Jahren 1884-86. Zur Entwicklungsgeschichte U. Anat der Ceylonische blindwuhle Ichthyophis glutinosus*, C. W. Kreidel's Verlag, Wiesbaden, 1887–1890
5. Wake, M. H., in *The Reproductive Biology of Amphibians.* eds, D. H. Taylor and S. I. Guttman, Plenum Press, New York, 1976.
6. Seshachar, B. R., *Curr. Sci.* 1942, **11**, 439.
7. Breckenridge, W. R., and S. Jayasinghe, *Ceylon J. Sci., (Biol. Sci.)*, 1979, **13**, 187.
8. Salthe, S. N., and Mecham. J., in *Physiology of the Amphibia*, ed. B. Lofts, Vol. III, Academic Press, New York, 1974.
9. Goin, C. J., *in Annual Report of Smithsonian Institution*, 1959, p. 427.