PARENTAL CARE OF Amphibia

Parental care is a behavioural and evolutionary strategy adopted by some animals, involving a parental investment being made to the evolutionary fitness of offspring. Patterns of parental care are widespread and highly diverse across the animal kingdom.There is great variation in different animal groups in terms of how parents care for offspring, and the amount of resources invested by parents. For example, there may be considerable variation in the amount of care invested by each sex, where females may invest more in some species, males invest more in others, or investment may be shared equally. Numerous hypotheses have been proposed to describe this variation and patterns in parental care that exist between the sexes, as well as among species.

Parental care may refer to any behaviour that contributes to offspring survival. Forms of care may include the preparing of a physical rearing environment, the provisioning of offspring or the defending of offspring from predators. Species such as ectothermic vertebrates may produce self-sufficient young, and thus no parental care is required. Conversely in other animal groups, offspring may be underdeveloped and lacking independence at birth, thereby relying on parents for nutrition and the teaching of basic survival skills. Parental care may be beneficial if offspring survival, quality or reproductive success is improved, as this ultimately increases the parent's inclusive fitness. Since parental care is costly and often affects the parent's own future survival and reproductive success, parents will make sure that any investment made into their offspring is well-spent. Since parental care involves the expenditure of resources, parental care will thus only evolve in a species that requires care.

Parental Care in Amphibians The amphibians were the pioneers amongst the vertebrates to invade land. On coming to this new environment they had to face many hostile forces and they had to develop various ways and means to overcome the obstacles. Naturally greatest importance was given to the perpetuation of race, so that they can ultimately win the struggle As a result, the reproductive, mechanism had undergone extensive modifications. Perpetuation of race can be maintained either by the process of overproduction of eggs or by caring of a small number of eggs. Rearing or caring of the offsprings is an achievement in the trend of evolution. It will be unwise to think that the care of youngs is a mammalian monopoly. Although it has taken a perfect shape in mammals, the phenomenon of parental care is quite well-developed in amphibians where extreme modifications in structure and behaviour are observed. Parental care is mostly a modification in the parents to take care of the offsprings so that with a meagre number of eggs continuation of race can be maintained. Despite the fascinating parental care behaviors exhibited by

amphibians, relatively few quantitative studies have been published on this class in comparison to birds and mammals. Six modes of parental care are recognized: egg attendance, egg transport, tadpole attendance, tadpole transport, tadpole feeding, and internal gestation in the oviduct. Whereas egg attendance and internal gestation in the oviduct are the only modes of parental care known for caecilians and salamanders, anurans display all six modes. Although parental care is widely distributed phylogenetically within the Amphibia, the percentage of species providing care is low. Postoviposition parental care has been documented in only about 5% of caecilians, 18% of salamanders, and 6% of anurans. Internal gestation in the oviduct probably occurs in about 75% of all caecilians, in 4 species of salamanders, and in 5 species of anurans. Parental care in amphibians is most commonly found in geographical areas of correspondingly high species richness. Increased survivorship of the offspring is the main benefit of parental care, as documented quantitatively by numerous studies. Reduced fitness to the parent, measured by reduced future survival or reproductive success, is the major cost of parental care.

Female Icthyophis rolled around its eggs Alytes: female carrying eggs on her back Gastrotheca It is called New World brooding (or) Marsupial frog. It has a special pouch in its skin. It opens out through an opening near the cloaca. Fertilized eggs are transferred into this pouch. The eggs are stored in this pouch where they ‘undergo development and tadpoles are liberated out. There are various ways by which the parental care is manifested in amphibians.

Selection of site: Care of the eggs is restricted to the selection of site in certain frogs and toads. In Rhacophorus schlegli of Japan, the eggs are laid in a hole on muddy bank of river or pond. The eggs are covered by foamy mucus to prevent desiccation . The eggs are washed out into the water of the river or ponds by the rain and development starts there.

In Gyrinophilus, the eggs are laid under the stones in stream. The eggs are then taken up on any part of the body and a secretion prevents growing of fungi over them. Eggs are laid on the under surface of leaves hanging above water in Hylodes. In Triton and Leptodactylus the eggs are laid under the surface of leaves near the vicinity of water.

In Triton, the eggs may be fixed with the aquatic weeds by glues. In hynobiid salamanders, the males remain with the eggs for fertilization and take active interest of the eggs.

Frothing of water: Some anurans just after the laying of the eggs, the surrounding water is made frothy by the wriggling movement of hind limbs, so that the eggs are prevented from desiccation and also can escape the sight of enemies. Both males and females participate in this process.

Foam nest: According to Mallick, Mallick and Das (1980), Polypedates (= Rhacophorus) maculatus, secrets a jelly-like secretion with eggs from time to time which is beaten by the cross-wise movement of the hind- limbs of the female partner only, resulting in a formation of a small frothy mass. The frothy mass looks like an irregular ball. At the moment of separation of partners, the frothy mass looks white but gradually turns yellowish. The mass of froth with eggs is called foam-nest. Within few hours the outer surface hardens gradually and remains in this condition for days together. Foam-nest forms on the leafy branches

of the bushes, between the leaves overhanging water, on the grass beds in between the leaves overhanging water, on the grass beds in the vicinity of water-line and on the leaves of the floating water hyacinth (Fig. 7.46). In India, foam-nest has been recorded in R. maculatus by Ferguson (1904), Annandale (1912), Mallick et al., (1980); in Rhacophorus leucomystax by Annandale (1912) and in R. malabaricus by Ferguson (1904). Bhaduri (1932, 1953) and Okada (1928) also reported the foam nest of Rhacophorus.

Formation of nests: After lying of eggs the parents take care of them by building nests. Three types of nests are encountered. They are:

Mud nest: In Hyla Faber, parents dig a small hole in the mud for the developing eggs and the surplus mud acts as the wall . Habitat – Brazil.

Leaf nest: In Phyllomedusa (Fig. 7.48A), a South American tree-frog, the leaf nest is built by folding the margin of the leaves. Leaf margins are glued together by cloacal secretion. It has an aperture at the base and the nest overhangs watery area.

Shoot nest: Triton constructs shoot nest by fixing the shoots of the trees in which the eggs are deposited and the youngs are developed. The whole nest remains covered by a gelatinous secretion.

Carrying eggs over the body: In Hyla goeldii , the females carry the eggs on their back in incipient brood pouches. The youngs come out as full-fledged frogs but With tail. The males of midwife toad, Alytes obstetricians show peculiar type of parental care. This type of toad is abundant in France and Italy. Several males are reported to collect round a female on land. Of the males, one becomes successful to grasp round the waist of the female. The male in this position massages and lubricates the cloacal region of the female, whereupon the females discharge the eggs. The eggs are fertilized during the expulsion of eggs by the sperms of the grasping male. After fertilization, the eggs are wrapped round the back of the thigh and he withdraws himself into a hole near the pond. When the eggs are ready to hatch, the male carries them to nearest water where the larvae come out. Development and metamorphosis take place in water. Phyllobates , an inhabitant of western Colombia, transport the tadpoles, carrying on the back of the females to the nearest water body. In Desmognathus, the females carry the eggs and live in underground hole. In Pipa pipa, the eggs are carried by females on the back. Similar phenomenon is observed in Cryptobatrachus evansi . The soft spongy skin on the dorsal side sinks into small pockets into which eggs are lodged . The same phenomenon is also observed in Pipa dorsigera where the eggs are deposited in pits on the back of females. During breeding season, the dorsal skin of the females becomes soft, spongy and gelatinous. The male place the eggs on the back of the female where each egg sinks into a small pit. An operculum covers the pit. It is developed out of the remnant of the egg envelop and integumentary secretion. Development is completed inside the cutaneous pit. The partitions between the pits become highly vascularized. The developing larva attains a vascular tail. Physiological exchange of materials between the embryonic and maternal tissues is claimed to occur in this animal. The larva fails to develop gills and the tadpole larva comes out 80 days after the deposition of the egg. In Nototrema (= Gastrotheca) pygmaeum, only a few eggs develop in the brood pouch bears a small slit-like opening in the posterior side.

In Nototrema marsupiata, the youngs hatch out as the tadpoles while in N. oviferum the metamorphosis is fully completed inside the brood pouch.

Carrying larva from one place to other: In Arthroleptis, the larvae are attached to the males and are carried from one pond to the other. At the time of danger they are kept inside the buccal cavity.

Placement of eggs in safest part: In oviparous caecilians as exemplified by Ichthyophis the body remains coiled round the egg mass to guard them until hatching. But in ovoviviparous caecilian, Ceotrypetes the eggs are yolky and migrate to the last part of the oviducts. When the yolk is exhausted and the external gills are atrophied, the embryos, about 25 mm long, hatch and remain inside the oviducts till the embryos become 75 mm in length. The developing youngs get nutrition from the uterine 'milk'. Metabolic exchanges also occur between the vascular maternal and foetal tissues. In Rhinoderma darwini ,the eggs are swallowed by the males and are placed inside the inflated vocal sac. The eggs may remain there up-till hatching or even up to the completion of metamorphosis. Viviparity: Extreme modification is observed in Salamandra atra and S. maculosa. The eggs are placed inside the uterine cavity where entire tadpole hood is completed. Two eggs are laid at a time. The larvae remain attached with the uterine wall by membrane which functions physiologically in the manner of a primitive placenta. The broad and vascular tail.