Unique Embryo Developmental Characteristics of Native Frogs of Fiji

Following page: Logging a forest of rare and endangered tree species on Choiseul Island. Top: Landowner in logged forest. Once the company leaves landowners and communities are left with degrade forests, polluted streams and are worse of than before the company came. Above: Logging pond and road in Goragosele Passage which enters Xanthostemon forests.

Text and photographys by Edward Narayan

Reproduction is the foundation on which a species survives, thrives or, failing this becomes extinct. Therefore, the study of reproduction is fundamental to conserving species, populations and, indirectly, the vitality of entire ecosystem. Anurans have remarkably diverse reproductive modes as part of their life history strategies and no other vertebrates matches them in the sheer variety of ways in which they procreate. There are 29 types of reproductive modes reported in anurans. Amphibians are probably best known for a mode of reproduction in which eggs are laid in water, hatch into tadpoles and subsequently undergo tadpole metamorphosis into a morphologically distinct adult form. Notably, this aquatic-terrestrial lifecycle pattern, while long familiar to naturalists in the northern hemisphere, is much less typical of tropical species.

Fiji Islands, which enjoys a typical tropical climate, with a trade wind blowing across the islands to cool things down during most of the year, is home for two wonderful terrestrial frog species, the Fiji ground frog (Platymantis vitianus) and the Fiji tree frog (Platymantis vitiensis). FGF is currently listed as endangered and FTF is near threatened according to the World Conservation Union (IUCN). This article explores the embryonic development of these frogs, revealing the unique way in which these frogs procreate.

Like most tropical and subtropical species, both FGF and FTF are capable of reproduction throughout the year but rainfall seems to be the primary extrinsic factor controlling the timing of reproductive activity. Tropical anurans breed throughout that part of the year when rainfall is sufficient to provide oviposition sites. Terrestrial oviposition (nesting) may have evolved in response to pond-drying, competition, or predation in large bodies of water. The deposition of eggs out of water is a major step in the trend toward terrestriality in anurans.

Laboratory incubation of fertile egg masses of FTF and FGF was conducted at the University of the South Pacific, Fiji Islands. A plastic container with a meshed lid was used for incubation and the container. Natural substrates such as a small pandanus stem (20 cm length) and bamboo (20 cm length) were used keep the eggs within the incubation container. The egg mass was covered with cotton, moistened using deionised water, in order to maintain moisture during incubation. The entire set-up was placed near a partly shaded laboratory window to ensure appropriate relative humidities and external temperature conditions were provided. The incubation container had a meshed lid and the average incubation temperature ranged from 26-28oC and average relative humidities ranged from 94-100%. The embryonic development of FGF and FTF species, until hatching of froglets was observed and the unique features are presented below.

Morphological features and biometrics of eggs:

FTF and FGF had a round shape with a transparent jelly layer covering the inner egg yolk and space between the egg yolk-jelly was filled with abdominal fluid. One day incubated FGF eggs (Fig 1) were larger in size ranging from 8-10 mm while FTF eggs (Fig 2) from similar incubation time ranged in size from 6-8 mm.

Incubation Period for Eggs:

The embryonic development of both FGF and FTF eggs took between 29-31 days till the hatching of froglets. The developmental characteristics of embryos of both species were similar throughout the incubation period. The embryo developed from a small depression on the surface of the egg yolk, and within three days the head-tail end of the embryo was distinct (Fig 3). At the end of the first week of embryonic development, the tail was prominent and the lateral movement of the tail helped to re-orient the embryo onto the surface of the egg yolk (Fig 4). By the third week of embryonic development, the embryo developed pigmented eyes and snout, and its anterior limbs (Fig 5) were prominent. Minute blood vessels diverged from a small beating heart across the periphery of the egg yolk. The egg yolk shrunk as the embryonic development proceeded to late third week and the embryo lay below the surface of the egg yolk. A pair of abdominal sacs maintained the embryo at resting position. The posterior limbs developed by early forth week and skin pigmentation was distinguishable. By late forth week, the tail reduces in size (Fig 6) and the froglet form was evident. The froglet was surrounded by a fluid-filled membrane sacs, and then the tail is completely reabsorbed (Fig 7). Thus both FGF and FTF embryos undergo a direct mode of development forgoing a free-living tadpole stage. During hatching the froglet used its snout and anterior-posterior limbs to break out of the abdominal fluid membrane.

Typically, the hatched froglets of both FGF and FTF (Fig 8) have their second digit of both the anterior and posterior limbs longer than the rest of the digits. Each anterior limb has four digits while each posterior limb has five digits. The average incubation period for both frog species until hatching is 29-31 days.