ABSTRACT

A comparative study of the salinity tolerances of four common species of South Indian anurans shows that under natural conditions, Rana crassa, Rana hexadactyla, Ramanella variegata and Bufo melanosticus may survive indefinitely in 25% n.s.w. Bufo melanosticus alone may survive in 35% n.s.w. indefinitely.

INTRODUCTION

It is generally presumed that anurans cannot tolerate salt waters. Neill (1958) compiled an exhaustive list and bibliography of amphibians and reptiles occurring in salt waters. Excepting for the work of Ruibal (1959) on Rana pipiens and Gordon et al. (1961) on Rana cancrivora no experimental work has been done to determine the salinity tolerances of anurans. In India, Annandale (1907) recorded Rana tigerina, Rana cyanophlyctis and Bufo melanosticus from the brackish ponds at Port Canning, Lower Bengal, of which Rana cyanophlyctis was recorded by Annandale (1928) from the brackish-waters of Chilka Lake. Since various species of anurans are reported to frequent salt waters and are known to tolerate them variably, more so in the tropics of S.-E. Asia, and in view of the paucity of experimental work, the present work has been undertaken to determine the salinity tolerances in four common species of South Indian anurans.

METHODS

Adult anurans belonging to the species Rana crassa, Rana hexadactyla, Bufo melanosticus and Ramanella variegata were collected from areas in and around Tambaram (Lat. 12° 55’ N., Long. 80° 07’ E.). They were kept alive in the laboratory and were starved for 12 hours prior to the commencement of experiments. Natural Sea-Water (n.s.w.) was diluted to various concentrations. Uniform sized individuals of each species were used in these
experiments, five individuals for each concentration. They were measured from the tip of the rostrum to the anterior end of the cloacal opening and were put in five separate glass containers, all having the same dilutions of n.s.w. The ratio of the body volume of each individual immersed, to that of the volume of water in each container was roughly 1:5. Survival time was noted for each of the five frogs and the average was taken into consideration. Death point was denoted by the frog falling on its back at the base of the container and showing no response to pinpricks. After death, each frog was taken out and dissected to determine sex and other observable internal changes. Average survival time for each species of anuran for each dilution was plotted on the graph. The n.s.w. used had a salinity of 32%.

**RESULTS**

*Bufo melanosticus* is the most tolerant of the species investigated. It continued to live in 35% n.s.w. even after a fortnight. In the same concentration, *Ramanella variegata* survived almost to the same period but died on the fourteenth day, while *Rana crassa* lived up to five days and *Rana hexadactyla* up to seven days. Hence the salinity tolerance of the two toads
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*Bufo melanosticus* and *Ramanella variegata* is higher than that of the frogs, *Rana crassa* and *Rana hexadactyla*. All the four species continued to survive in 25% n.s.w. even after two weeks. Thus 25% n.s.w. does not seem to be deleterious to the life of these anurans. From Fig. 1, it could be noted that 75% n.s.w. and above is decisively lethal to the life of all the four species. Below 75% n.s.w. the tolerance is variable for each species depending on their respective osmoregulatory capacities. In all the cases of longer survival copious amount of mucous was found to be secreted into the surrounding medium, perhaps as a means to protect themselves, from the hypertonic external medium. Slight changes in the intensity of pigmentation were observed in those that survived for more than two weeks.

**DISCUSSION**

During the experiments almost all the four species were observed to gulp in the hypertonic external medium to variable degrees. *Bufo melanosticus*, which showed a higher tolerance, revealed on dissection a highly inflated cloacal bladder (filled with the hypertonic external medium), occupying the entire abdominal region pushing other visceral organs like the gut, upwards. It is therefore clear that there is an intake of hypertonic external medium through the cloaca also. This is in agreement with the proven fact that the cloacal bladder is one of the osmoregulatory organs in the anurans. In the more successfully tolerant individuals parts of the gut like the thin-walled intestine were also distended to double or treble their normal dimensions, being filled with the salty external medium. Hence the gut in general, besides the cloacal bladder, must be osmoregulatory in anurans. In *Rana crassa*, *Rana hexadactyla* and *Ramanella variegata* considerable quantities of the external medium were found to accumulate under the skin in the trunk region, between the skin and musculature, showing perhaps active absorption of the external medium through the skin. *Bufo melanosticus*, the more tolerant species, has a tough, warty and glandular skin and hence absorption through skin is inconceivable. However, its bladder seems to be more functional as an osmoregulatory organ whereas in the other three species both skin and bladder seem to help in osmoregulation. By gradual acclimation to increasing grades of higher concentration and by feeding on suitable food, all the species may be able to withstand higher salinities. Apart from age and body size, sexual differences and breeding status seem to play some role in their capacities for salinity tolerance. In *Rana hexadactyla*, breeding females showed a significantly longer survival time than breeding males. Among males, breeding males survived longer than non-breeding males. Since *Bufo melanosticus* and *Rana crassa* can live long in 35% n.s.w. it may
be that eggs and larval stages of these two species can survive in such brackish-waters. However, the salinity tolerance of eggs and larvae of these species is worth investigating.

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