"Water and electrolyte balance in the agamid lizard, *Amphibolurus maculosus* (Mitchell), and the structure and function of the nasal salt gland of the sleepy lizard, *Trachydosaurus rugosus* (Gray)."

by

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SUMMARY

The present study consisted of two parts, a study of the mechanisms by which the small dragon lizard *Amphibolurus maculosus* maintains its water and electrolyte balance, and a study of the structure and function of the nasal salt gland of the skink *Trochysaurus rugosus*.

A. *maculosus* inhabits some of the dry salt lakes in the north of South Australia. It is active during summer in temperatures above 40°C, and has a very short water supply the scarcity of which is heightened by the high salt content of the ants on which it feeds. During summer *A. maculosus* stores excess electrolytes from its diet in its body fluids. The electrolytes are excreted later with water that is obtained from rain.

Water is lost from lizards by two main routes, (i) by evaporation and (ii) through the excretion of wastes. Therefore I studied these two avenues of water loss.

The rate of evaporative water loss (E.W.L.) per gram of body weight for *A. maculosus* is very low (0.18 mg of H₂O/g per hr.) being the lowest recorded for a lizard of this size. This rate of E.W.L. is about half the rate of E.W.L. of another dragon of similar size *Amphibolurus pictus*. This lizard inhabits the sand dunes that surround some of the salt lakes.

The reduced rate of E.W.L. of *A. maculosus* could not
be explained by a lower metabolic rate in *A. maculosus* compared to *A. pictus* because both lizards had similar rates of oxygen consumption. Nor could it be explained by *A. maculosus* having a higher concentration of haemoglobin in its blood than *A. pictus* and thus being able to absorb more oxygen per unit volume of air inspired since both lizards had similar haemoglobin concentrations. The low rate of E.W.L. of *A. maculosus* must be due to other respiratory adaptations and also probably to a less permeable skin.

Both *A. maculosus* and *A. pictus* can tolerate high temperatures and both possess a weak panting response. However, whereas *A. pictus* becomes excited at temperatures above 40°C and begins panting at 40.5°C, *A. maculosus* passively tolerates high temperatures and does not begin panting till about 43.5°C.

In an effort to determine what mechanisms *A. maculosus* might possess for minimising its excretory water loss, lizards were injected with a hypertonic NaCl solution and blood and voided urine was collected. Similar to what was found for lizards in the field, a significant amount of the injected salt was stored in the body fluids. However, the urine that was voided by the salt-injected lizards was hypotonic to the blood; this is the first reptile known to be able to produce a hypotonic urine. To determine where the urine was concentrated, urine was collected before
and after it had entered the cloaca. This showed that the urine was concentrated after it left the ureters.

A micro- and ultrastructural study of the cloaca and rectum of *A. maculosus* and *A. pictus* showed that for the most part the mucosal epithelium of both organs had a similar structure both within and between species. However, parts of the anterior third or so of the mucosal epithelium of the rectum of *A. maculosus* were quite different from the rest of the rectum and the cloaca, and closely resembled the structure of the rectal pads and papillae of some insects. It is suggested that *A. maculosus* can produce a hyperosmotic urine in the anterior part of its rectum.

A study was also made of the water and salt content of the urinary and faecal pellets of *A. maculosus*. This showed that *A. maculosus* could produce fairly dry pellets (water composed 74% of the wet weight of the faecal pellet and 34% of the urinary pellet). It was also shown that *A. maculosus* could excrete significant amounts of Na\(^+\) and K\(^+\) in the urinary pellet, equivalent to excreting these electrolytes in a liquid urine at a concentration of about 2000 mEq/l.

b). *T. rugosus* were found in the field with a white encrustation around the nares. Subsequent analysis revealed that it was composed of Na\(^+\), K\(^+\) and Cl\(^-\) with little if any, HCO\(_3\)^\(^-\).
Morphological studies revealed that *T. rugosus* possessed a nasal salt gland similar in structure to those of terrestrial iguanids.

KCl and NaCl - loading induced the salt gland to secrete and the dried secretion was collected and analyzed. NaCl - loading increased the relative Na⁺ content of the secretion in all cases, but KCl increased the relative K⁺ content in some and decreased it in others. In this respect the salt gland of *T. rugosus* is similar to those of the terrestrial iguanids, i.e., they are adapted to eliminating that ion which is in excess in the diet.

KCl and NaCl - loading slightly increased the Na⁺ and K⁺ concentration of the plasma respectively. However, 2 days after the last salt-load there was no significant difference in the ion concentration between the control, NaCl and KCl - loaded animals. Since the salt gland of *T. rugosus* can secrete salt at a significant rate (about the same rate as the terrestrial iguanids) it is suggested that the gland was the major excretory system controlling the electrolyte concentration of the plasma.

Since there was no significant increase in the electrolyte concentration of the plasma in field animals during summer, I suggest that the salt gland enables *T. rugosus* at Goolwa to maintain their salt balance. However, the summer during which the samples were taken in the field
was fairly mild. In drier years or drier areas the salt gland may not be able to maintain a constant concentration of electrolytes in the plasma.

It is suggested that the salt gland of terrestrial lizards augments the renal-cloacal system in eliminating ions that are in excess in the diet.