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Cover: Adult male Saunders Casemoth *Oiketicus elongatus*. See story on p. 175. Photograph by Arthur Farnworth.

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Australia's Flying Frogs?

A number of 'flying frogs' are known from around the world e.g. *Litoria graminea* from New Guinea (Tyler 1976), *Hyla miliaria* from Mexico (Pough *et al.* 1998) and *Rhacophorus pardalis* from Indonesia (Heusser 1974). A detailed analysis of gliding performance by two species of *Rhacophorus* frogs has been published (Emerson and Koehl 1990), but to my knowledge no-one has investigated the gliding (or parachuting) abilities of Australian frogs. If a frog is able to fall at an angle less than 45 degrees it is said to glide whereas if the angle is greater than 45 degrees it is said to parachute (Pough *et al.* 1998).

While examining a live specimen of a large Peron's Tree Frog *Litoria peronii* from north of Wagga Wagga, New South Wales, it took a flying leap off my desk and landed about a metre away on the curtain. There was nothing special about that except that it appeared to land a little higher on the curtain than what I thought it should have done, given the take-off velocity and initial trajectory. I decided to investigate further and observed several jumps. On close examination of the frog I found an axillary webbing which stretched from approximately mid-body almost to the elbows. The photograph (Fig. 1) shows this webbing which is slightly less than fully extended here. Furthermore, the spreading of this webbing appeared to be under voluntary control. As the muscle involved in the stretching of the axillary webbing has an origin in the lateral body wall and an insertion in the distal humerus area, it may represent a component of the pectoralis muscle. When subjected to a simple stretch reflex by drawing the foreleg forwards (as might occur naturally when a frog was in flight or about to land) the webbing was extended briefly and then partially relaxed. At maximum extension the webbing appeared to pull the sides of the abdomen out a little too, so that the effective increase in planing area stretched almost from the groin to the elbows.



Fig. 1. Peron's Tree Frog *Litoria peronii*, Wagga Wagga, N.S.W., showing axillary webbing. Photo by T. Annable.

The efficiency of gliding depends on a number of factors such as mass, velocity, drag, shape of planing surfaces, angle of attack as well as the dimensions and orientation of the planing area. The axillary webbing of *L. peronii* together with finger and toe webbing and the head, body and limb surface areas is significantly less than in the oriental flying frogs (e.g. *Rhacophorus* species) which are able to glide up to 15 m or more at an angle of about 18 degrees (Pough *et al.* 1998), but certainly sufficient in my opinion to give significant lift. Whether the frog was gliding or parachuting is not certain as the angle of fall appeared to be close to 45 degrees. Unlike *Rhacophorus* species the interdigital webbing is not extensive in *Litoria* species.

Whether the frog can actually steer in flight with this webbing is another interesting question. The fact that the webbing has voluntary muscle control suggests the possibility. The excellent diurnal and nocturnal vision of these frogs would certainly be a very useful adjunct to controlled gliding. Such an ability would be very useful in the high, swaying branches of trees in which the species lives. Examination of several other arboreal or semi-arboreal *Litoria* species (Green Tree Frog *L. caerulea,* Eastern Dwarf Tree Frog *L. fallax,* Bleating Tree Frog *L. dentata* and Jervis Bay Tree Frog *L. jervisiensis*) shows they all have extensible axillary webbing to varying degrees, but whether all *Litoria* species do is not known. Other questions needing investigation involve a comparison of the terrestrial and arboreal species of the genus *Litoria*, bearing in mind that the genus as currently accepted is probably

polyphyletic (Cogger 1996); also whether or not other hylid frogs possess a similar structure. More detailed research on structure and function with high-speed cinematography and moving targets is needed to clarify this interesting phenomenon.

Acknowledgement

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