
Aspects of the thermal ecology of the European tree frog *Hyla arborea* Linnaeus, 1758 (Anura : Hylidae) in Western France

By Roger Meek

The body temperatures of ectotherms are a key factor in their ecology since many physiological functions are temperatures dependent – e.g. locomotory movement, digestion and growth. However, in amphibians the permeable integument and subsequent high rates of evaporative water loss imposes the dual regulation of attempting to maintain body temperatures that are optimal for physiological processes whilst maintaining water balance. This may constrain body temperature selection but in the presence of water many amphibians are able to bask with evaporative water losses contributing to body temperature control. Thermoregulation and field body temperatures in the European tree frog *Hyla arborea* was measured over a six-year period during overcast and sunny weather in the Vendée of Western France. Body temperatures were higher during sunny weather but there was no difference in body temperature variance. Body temperature variance was lower in comparison to the variance of leaf temperatures in sunlit areas but in agreement with leaf temperature variance in shaded areas irrespective of weather conditions. Regression analysis of body temperatures with leaf temperatures in shade or open locations during both sunny and cloudy weather indicated the closest association was with shaded leaf temperature regardless of weather conditions. However *t*-tests indicated thermoconformity only with shaded leaf temperature when the weather was overcast.

Frogs were located in trees at median distances of 12 – 9.5m from the nearest water mostly in shaded areas, but a smaller number were observed in sunlit areas

during sunny weather in mid-afternoon. The results suggest control of body temperature in *H. arborea* by microhabitat selection, with shaded areas selected to avoid potentially critical high temperatures during sunny weather. However, occasional basking in open locations, even during hot weather, suggests an attempt to elevate body temperature. The mean diurnal body temperatures of *H. arborea* in sunny weather were almost identical to those found in sympatric *Pelophylax lessonae* that were mainly basking beside ponds or on pond surfaces (*mean ± standard deviation* = 25.9±2.5°C, *n* = 23) and higher than in a small sample of *Rana dalmatina* measured whilst foraging in woodland (*mean ± standard deviation* = 24.1±4.6°C, *n* = 9). The ability of *H. arborea* to operate in arboreal habitats presumably reduces predation and competition from sympatric terrestrial anurans, for instance from *Pelophylax lessonae*, which are abundant around water bodies throughout the active year. Based on data from road mortalities longer distance movement takes place during October and November and mostly after rain.

R. Meek, *Bull. Soc. Herp. Fr.* **138**, 1 (2011).



The European tree frog *Hyla arborea* is a heliothermic species regulating body temperatures mostly by closely tracking shaded leaf temperatures. This avoids overheating during sunny weather but occasional basking to elevate body temperatures during cool or overcast weather was also observed.

Patterns of amphibian road-kill in the Vendée region of Western France

By Roger Meek

Amphibian life history characteristics in temperate climates make them particularly susceptible to road-kill. Levels of risk may vary and include migratory movements and foraging versus sedentary behaviour. In the Vendée region of Western France amphibians may be active throughout the year with migration a late

autumn event. To test if migration is the main period for road-kill risk, mortalities were monitored over a six-year period (2005 – 2010). In theory risk should be lowest when amphibians are in their aquatic phase, increase during the terrestrial phase and peak when major migration takes place. The notion that species that forage widely outside the migratory period should be a risk was also tested. Finally the study sought to examine spatial and habitat-associated road-kill.

The results indicated a strong temporal aspect to road-kill, which was associated mostly with migratory movements and highest in the common toad *Bufo bufo* (39% of all mortalities) and agile frog *Rana dalmatina* (25.4%) during both migration and summer foraging. The lowest road-kill was found in *Pelophylax lessonae* (4% of total), which was attributed to a sedentary lifestyle around ponds. Three species of urodeles constituted 26% of the sample but these may have been under represented due to rapid carcass deterioration. Greater than expected road-kill was found in *T. marmoratus*, *P. lessonae* and *B. bufo* in urban areas with only *Triturus cristatus* higher than expected on road segments alongside pastureland. Road-kill per kilometre was higher than expected on low traffic roads bordered by woodland and/or wetlands in *R. dalmatina*, *L. helveticus* and *B. bufo*. Generally, mortalities were spatial and clustered mostly in areas that flood during late autumn and winter; the road segment with the highest mortalities is shown in the photographs.

Road-kill was more numerous following rainfall but during dry weather in summer relatively more common in *R. dalmatina* and *P. lessonae*. This was attributed to foraging activity in *R. dalmatina* and movement due to pond desiccation during late summer in *P. lessonae*. Traffic intensity and road-kill on different roads was not correlated and hence traffic volume was not a good predictor of road-kill. Regression analysis was used to test the notion that road-kill is dependent on extent of migratory distance. The dependent variable was total road-kill counts of different species and independent variable migratory distances taken from the literature. A positive regression coefficient (0.09) that differed significantly from 0 and high *r*² value (0.87) supported the prediction. In the area shown in the photographs, road vehicles may have killed around 11% of the adult *R. dalmatina* population during 2010 and overall road-kill had greater impact on the biomasses of very large *B. bufo* and *R. dalmatina* during the migratory period. Amphibian road casualties were higher than those of reptiles on the same roads.



Amphibians, particularly urodeles, are active throughout the winter months in Western France. Despite having the lowest traffic volume the road and adjacent habitat shown here had the highest road-kills in the study area, including throughout the winter months.

In reptiles road-kill was in general lower and increased with increases in traffic volume and were not clustered spatially as in amphibians (Meek, R. (2009). Patterns of reptile road-kill in the Vendée region of Western France. *Herpetological Journal* 19, 135 – 142). Temporary road closures on low traffic volume roads with high amphibian mortalities during the migratory period would substantially reduce mortalities.

R. Meek, *Herpet. J.* **22**, 51 (2012).