

A NOTE ON THE UNKENREFLEX AND SIMILAR DEFENSIVE POSTURES IN *RANA TEMPORARIA* (ANURA, AMPHIBIA)

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Many species of amphibians are protected by antipredator adaptations, such as cryptic or aposematic colouration, noxious skin secretions and antipredator vocalizations (Altig 1972, Brodie 1978, 1981, Brodie et al. 1979, Formanowicz and Brodie 1979). They often adopt a defensive posture when threatened or handled (Dickerson 1908, Hinsche 1926, 1928, Noble 1955, Smith 1964, Duellman and Trueb 1994). *Bufo bufo*, for example, when meeting a snake, will inflate its body, raise itself off the ground and even gulp, as well as producing bufotoxin. Many frogs show antipredator adaptations to a less dramatic degree.

The classic "unkenreflex" takes its name from the European *Bombina*s ("Unken" in German) of the family Discoglossidae, and is a response to perceived threat. It is mostly restricted to species with ventral warning colouration. The lifting of all four legs and arching of the back in order to draw attention to the bright ventral colours is very characteristic. The typical unkenreflex is characterized not only by this distinctive posture and immobility but also by a closure of the eyes, a slowing down of respiratory movements and an increase in skin secretion (Hinsche 1926, Noble 1955). Captive-bred *Bombina variegata* demonstrate the unkenreflex from soon after metamorphosis and retain it throughout life, despite having been bred in captivity for many generations, and being completely used to the presence of humans (J.W. Wilkinson, pers. obs.). Other species of the genus (eg. *B. orientalis*, *B. bombina*) will demonstrate this behaviour only after they have been separated from human influence for some while or are extremely provoked.

The term "unkenreflex" has been used more generically to describe a range of defensive postures in various species. Duellman and Trueb (1994) cite Brodie's (1978, Brodie et al. 1979) work, where he uses the term to describe the defense postures of salamanders, which differ slightly to the posture adopted by *Bombina*s, the emphasis frequently being placed on the bright ventral surface of the tail (which *Bombina*s lack). This type of unkenreflex has been observed for example in the newt *Taricha granulosa* (Johnson and Brodie 1975, Halliday and Adler 1986) and a variety of other North American urodeles, as well as the European *Triturus cristatus* and *T. helveticus* (Denton 1990). Production of the posture in salamanders may follow tail undulation or thrashing, which directs the attention of a predator away from the head. A complete, or "high-intensity" unkenreflex in these species has the effect of inhibiting the attack reflexes of predatory birds (Halliday and Adler, 1986).

Hinsche (1926) has shown that the same reflex is present in the drab-coloured Midwife Toad (*Alytes*, also of the family Discoglossidae) and further states that various species of *Rana* and *Bufo* exhibit more or less of the reaction (also see Villa, 1969, Altig 1972,

Formanowicz and Brodie 1979), which perhaps could be termed a “partial unkenreflex”. S. Grenard (pers. comm.) states that he has seen the “unken-” or “defensive posture” (“... a head-down posture to deflect attention away from the area of the head...”) in many anuran amphibians (Bufonidae, Leptodactylidae and Hylidae) save for *Pipa*, *Xenopus* and some other strictly aquatic forms. G. Cline (pers. comm.) observed the behaviour in the treefrog, *Hyla versicolor*. In the same species, however, Brodie (1981) describes the posture on encountering a small predator (*Blarina brevicauda*, Soricidae) as “flexing the head forward and extending the hind legs, usually tilting and orientating the side of the body towards the shrew”.

When escape is not possible, the Ranidae often shrink to the ground with the head low when threatened, but there is only very little literature on the unkenreflex or similar defensive postures in this family. It is not mentioned for *Rana temporaria* in Smith (1964), who in fact records merely that “... the frog seeks escape in flight” when in danger. It seems, however, that the phenomenon is found more widely than is generally known. The behaviour seems fairly common in the American Bullfrog (*Rana catesbeiana*) (J.N. Stuart, pers. comm.). If cornered, it will sometimes thrust out its arms and flatten its body. The back is not curved as in *Bombina* but otherwise the reaction has a considerable resemblance to the unkenreflex (S. Grenard, pers. comm.). The Northern American Leopard Frog (*Rana pipiens*), when unable to escape, also responds by covering its eyes with the “hands”. D. Hoag (pers. comm.) describes that almost every Leopard Frog of more than 200 he picked up to remove from a pit would “cower, hands over its head, the position varying individually”. The posture has also been observed in *Rana chircahuensis* on a few occasions (J.N. Stuart, pers. comm.), in *Rana holtzi* (Teynié 1991) and (especially) in European *Rana* of the Green Frog complex (P.-A. Crochet, pers. comm.).

The first author observed *Rana temporaria* engaging in a defensive posture that seems to be more than simply shrinking away from apparent danger and yet not quite a true unkenreflex (Figs. 1 and 2). Burny and Parent (1984) and Garcia-Paris and Esteban (1989) have also recorded a form of unkenreflex in this species. They present photographs showing a posture very similar to those given here. H. Strijbosch (pers. comm.) confirms the existence (in the Netherlands) of an antipredator behaviour similar to the unkenreflex for *Rana temporaria*, but points out that it is a very rare phenomenon in this species, as he has seen it “only some 4 or 5 times in his 25 years of working on amphibians”. The pose is characterized by the raising of the hands to both sides of the head, covering the eyes. This is especially significant, as P.-A. Crochet (pers. comm.) states, the defensive posture in *Rana* differs from the “unkenreflex” in respect that the hands are usually not raised at or above eye-level. (Note that the figured frog is looking through between the first and second digit and exposes the bright colouration of the underside of its limbs).

The animal was captured in a pitfall trap set for small mammals in the surroundings of Schönbach (Lower Austria) on April 21st, 1989. It took up this posture when placed in the grass and photographed and kept this pose when turned onto its back. At that time, the ambient temperature was very low (0-5°C), which may account for the production of this behaviour. J.N. Stuart (pers. comm.) mentions that his “impression was that they perform it more commonly when cold...”, and it may be that in the absence of sufficient body warmth (frogs being poikilothermic), the more usual means of predation avoidance (escape) was unavailable to the frog at that time. Burny and Parent (1984) have also suggested that low temperatures are a factor in provoking the unkenreflex in *R. temporaria*, and that the species produces the posture just before and after hibernation. This is in contrast to at least one of the specimens found by Garcia-Paris and Esteban (1989), which was observed following the reproductive period (during June).



Plate 1 and 2: The unkenreflex in *Rana temporaria*. (Photos by W. Haberl)

CONCLUSIONS

A number of anurans other than *Bombina* engage in antipredator postures similar to the unkenreflex to a varying degree. However, since this is usually not a "true unkenreflex" which includes a marked curvature of the spine to facilitate exposure of the ventral surface, it is probably preferable to use the term "partial unkenreflex". While the behaviour seems to be fairly common in North American Ranids, it has only rarely been observed in the European *Rana temporaria*, although the behaviour observed here seems to be closer to a true unkenreflex than is generally recorded (with the notable exceptions of Burny and Parent 1984 and Garcia-Paris and Esteban 1989). At low temperatures the reflex in *Bombina* can be incomplete and resemble that of *Rana*, which suggests that the postures have the same neural pathways and neuromuscular basis in both species (S. Grenard, pers. comm.). The non-specialized, "partial" unkenreflex of *R. temporaria*, however, has probably not developed further because of the absence of vivid, contrasting ventral colouration, and because of the species' normal recourse to flight when confronted. The species also lacks the vertebral articulations found in *Bombina* (Garcia-Paris and Esteban 1989) which facilitate the "full" unkenreflex in this genus. We can therefore tentatively postulate that the partial unkenreflex observed in *Rana temporaria* serves, when flight is unavailable for temperature or other reasons, as a means of momentarily startling a potential predator, at the same time perhaps causing disorientation by the covering of the eyes. Further observations in the field will be necessary to confirm or refute this assertion.

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