

## Colour variations in the European tree frog, *Hyla arborea* (Linnaeus, 1758), from two small adjacent ponds in the Vojvodina province, Serbia

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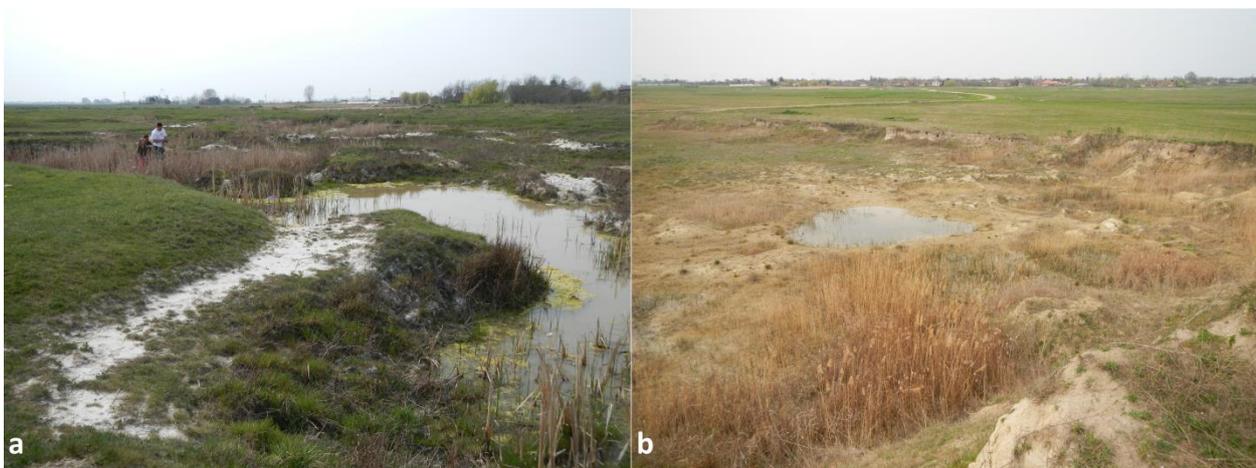
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Received 18 July 2015 | Accepted 13 January 2016 | Published online 16 January 2016.

The colour of amphibian skin results from the relative abundance and distribution of several types of pigment-bearing cells, chromatophores (Nielsen 1978; Vitt & Caldwell 2014). In addition to numerous permanent colours and patterns (both cryptic and aposematic), skin colour changes are quite common in amphibians. Quick changes can happen “in less than a minute” and are under hormonal or neural control; slow skin colour changes “may take weeks or months to occur” and their control mechanism is different (Vitt & Caldwell 2014). The rate of physiological colour changes depends, *inter alia*, on ambient temperature, background colour and environment light intensity, and on their interactions (Kats & Van Dragt 1986; Stegen *et al.* 2004). In general, dorsal colour changes in tree frogs enhance hydro- and thermoregulation, help in predator avoidance, and may act in sexual selection (Stegen *et al.* 2004; Choi & Jang 2014).

The dorsum of the European tree frog (*Hyla arborea*) is typically green: this enables it to blend into the – usually green – vegetation background, where it spends most of the daytime (Pinto *et al.* 2013). However, this colour varies strongly (Koren & Jelić 2011), depending on numerous factors (Nielsen 1980).

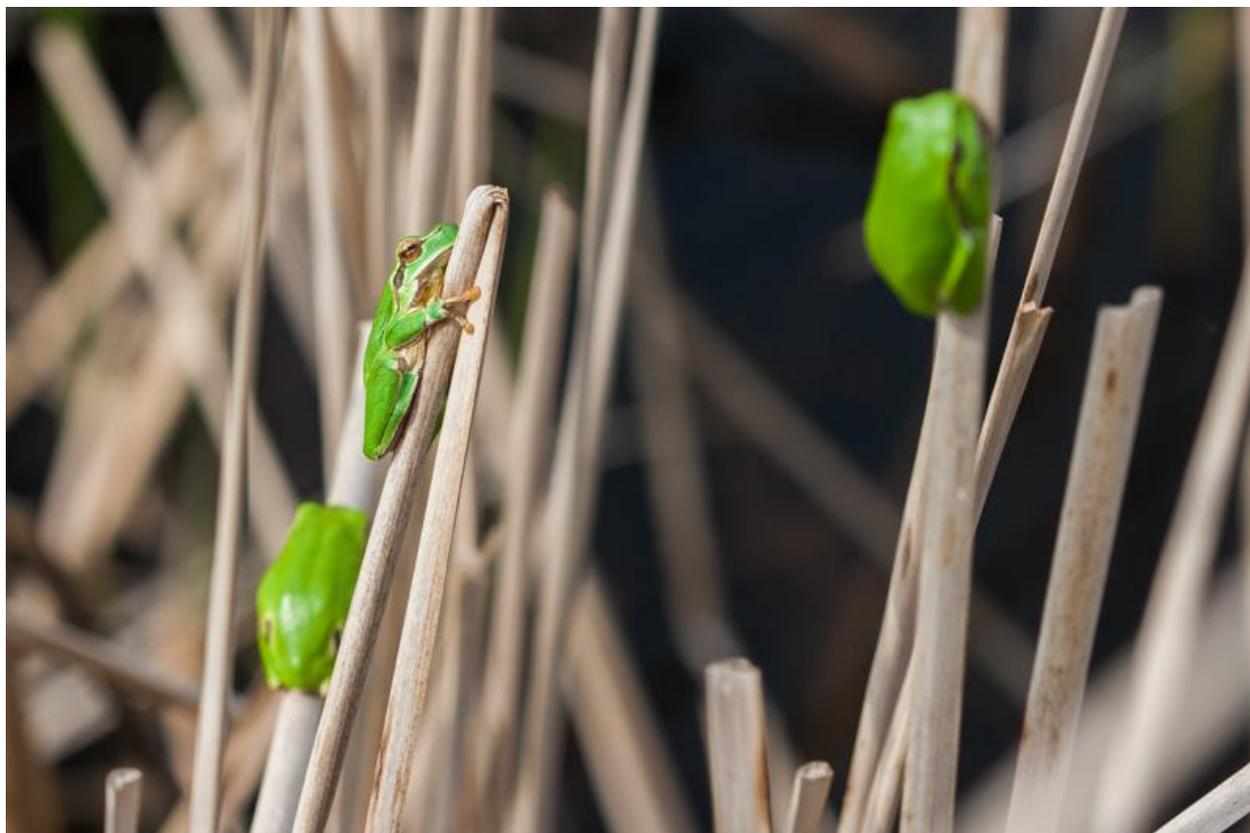


**Figure 1.** Two ponds where the frogs were observed: **a)** the larger one, near a settlement, overgrown with reeds; **b)** small, shallow pond with open water. Photos: Sonja Đorđević.

On March 31, 2014, near Horgoš (Vojvodina province, northern Serbia, 46.146237N, 19.949754E), on saline fields with several small ponds, we recorded four colour variants (and numerous transitional hues) in *Hyla arborea*. The observations were made between 1 PM and 3 PM, at app. 20°C, with light breeze. Four people patrolled the area in search for amphibians and reptiles: the observations we made concerning *Hyla* colours were merely incidental hence only the basic information was collected.

On dense reeds growing in and around a relatively small water body (Figure 1a, surface app. 1.2 ha) we made visual observation of numerous Tree frogs (Figure 2), of which the majority had the usual, more or less strong/bright green or yellowish colouration (Figure 3a,b). However, several individuals expressed some less frequently reported colours. Figure 4 shows individuals of grayish basic skin colour (these were two of app. ten individuals with such colour in the given pond). In Figure 5 we depicted one individual which was nearly black, with “golden” lateral stripes. However, it was not melanistic: ten to fifteen minutes after being taken out of the water, the frog started regaining its usual green colour.

The first three colour variants were found on the reeds growing in and around one small pool close to a settlement (Figure 1a). Disregarding the light yellowish colour of dry reeds, majority of frogs were green. The black individual (Figure 5) was resting on the bottom of a nearby small shallow pond (Figure 1b) with sparse tall vegetation (less than 0.2 ha in surface). The soil around this second pool, and its bottom, were light, yellow (Figure 1b). The distance between the two water bodies is app. 0.8 km.



**Figure 2:** Example of high density of Tree frogs on the reeds. Photo: Aleksandar Simović.

Similar findings concerning the Tree frog colour variants were recently published for several localities in Croatia (Koren & Jelić 2011): the authors recorded numerous hues of green and grey, but the individual in Figure 5 we found is darker than those previously reported.

Our finding is interesting due to high concentration of Tree frogs in small water basins, and because the very wide spectrum of their colour variants was observed within two hours of stable weather, i.e. under the same temperature, humidity and light conditions. Also, majority of the individuals we saw did not match the colour of their surroundings. Future detailed investigations of driving forces and mechanism of such changes are necessary, especially under unique environmental conditions, i.e. without “obvious” causes.



**Figure 3.** Two green colour variations: the typical, bright green a) and paler, yellowish b). Photos: Aleksandar Simović.



**Figure 4.** Two greyish individuals. Photos: Aleksandar Simović and Sonja Đorđević.



**Figure 5.** Almost completely black *Hyla arborea*. Photos: Aleksandar Simović and Sonja Đorđević.

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