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Egg failure of *Rana temporaria* clutches from the N E of Galicia (Spain)

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Fecha de aceptación: 24 de marzo de 2009.

Key words: egg failure, *Rana temporaria,* Galicia.

Resumen: Este trabajo aporta datos sobre un episodio de baja viabilidad de puestas de *Rana temporaria* en un robledal situado en el noreste de Galicia cercano a Asturias. Se discuten posibles hipótesis para explicar este fenómeno.

Common brown frog (*Rana temporaria*) is a widely distributed species in Europe, reaching as far north as the Arctic Circle (Gasc *et al.*, 1997). In the Iberian Peninsula this species is restricted to the north of Spain, with an Atlantic distribution in Galicia region (Galan & Fernandez-Arias, 1993; Galan, 1999). This species inhabits terrestrial habitats outside the breeding season, occupying deciduous forests or grasslands, using shallow water areas for egg laying.

On 29th January 2009 a monitoring trip to the big oak forest near Baleira (Lugo) was performed. This forest consists in an old oak (*Quercus robur*) mass, with dense cover of fens and shrubs, i.e. bilberries (*Vaccinium myrtillus*). Up to 500 hundred clutches were detected in a small track inside the forest. Most clutches were laid on shallow water in old wheel tracks. When these clutches were examined carefully some anomalies were detected, at least 75% of the clutches had an abnormal egg shape (Figure 1A). Instead of the black embryo typical of a healthy egg, a white envelope was detected around the embryo (Figure 1B). This envelope was described as white hyphal nimbus by Petrisko *et al.* (2008). Also some of the clutches were developing a fungal coat on egg masses (Figure 1C).

Figure 1. A. Clutches with hyphal nimbus. B. Detail of the white nimbus. C. Fungal coat on egg mass.
Figura 1. A. Puestas con halo formado por las hifas. B. Detalle del halo blanco. C. Cubierta fúngica sobre la masa de huevos.

It remains unclear which factor could lead to such high percentage of egg failure in the study area. First *R. temporaria* clutches were detected in the oak forest on 13th January (M.J. Rozados pers. com.). Hakansson & Loman (2004) reported that eggs could not survive too high or too low temperatures. In our study area data from two meteorological stations (Pol, Xistro, Meteogalicia) were gathered, and two peaks of below zero temperatures were detected. One peak occurred between 18/01/09 and 20/01/01, maximum daily temperature decreased suddenly from 11.5º C to 0.3º C in 48 hours, minimum daily temperature also decreased from 7.3º C to -2.9º C. Temperature maximum rose again to 11º C on 22/01/09, but peaking down to 1.8º C on 25/01/09. Minimum temperature peaked down as well from 5.2º C to -0.3º C.

Thus, these high variations in daily temperatures could be the factor that leads to a high mortality of embryos in the *R. temporaria* clutches. Also shallow water in wheel tracks probably did not act as buffer for these low temperatures. Hakansson & Loman (2004) also reported that the proportion of spawn clumps with low survival was higher in the centre of the communal clump. This fact coincides with our findings, as viable clutches were only detected in the periphery of the communal clump. Nevertheless, these authors suggest that other factors could influence hatching success, oxygen availability could be important in big communal egg-laying sites.

Egg failure due to climatic conditions has been reported for many species, due to dessication (Kusano *et al*., 2005), or low temperatures (Waldman, 1982; Hakansson & Loman, 2004). In pond-breeding species of *Rana*, mortality seems to be highly variable (Richter *et al*., 2003). Egg mortality due to fungal outbreaks has been reported for common toad (*Bufo bufo*) populations in the south of Galicia region (Ayres, 2008).

Amphibian populations can buffer catastrophic reproductive failures due to persistence of adults, specially for long lived species (Taylor *et al*., 2005). The study population of *R. temporaria* appears to have a high number of breeding individuals, and inhabits an undisturbed forest. Thus, it seems that, if egg mortality due to below zero temperature occurs in isolated episodes, it may not have a negative effect on the population fitness. Further studies will be neccesary to assess if this hypothesis is true.

ACKNOWLEDGEMENTS: We thank to P. Galan, J. Loman, and A. Montori for their comments and information about egg failure in *Rana temporaria*. We also thank to M.J. Rozados for her data about first clutches, and J. Comesaña for his help .

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Utilización de un modelo simple de remoción para estimar el tamaño poblacional en larvas de anfibios

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Fecha de aceptación: 11 de febrero de 2009.
Key words: population size, removal method, tadpoles.

Las larvas de anfibios son muy sensibles a la hora de colocarles algún tipo de marca en el cuerpo debido principalmente a la fragilidad de los mismos y a la poca perdurabilidad de estas marcas. Por ese motivo son escasos los métodos adecuados para la estimación de la densidad en larvas de anfibios, haciendo que los de marcado-recaptura sean muy difíciles de usar. De ahí la importancia de los métodos de remoción para la estimación del tamaño poblacional. En general, estos métodos han sido utilizados con éxito en peces y en poblaciones acuáticas de invertebrados (Carle & Strub, 1978). En esta contribución queremos destacar la aplicabilidad del método de Moran-Zippin para calcular el tamaño de las poblaciones larvales de anfibios, resaltando la simpleza de su uso.

Método de remoción de Moran-Zippin

El procedimiento para estimar el tamaño de una población mediante el método de Moran-Zippin (Moran, 1951; Zippin, 1956, 1958; Brower *et al*., 1998) es fácil debido a que se basa en la recolección de solamente dos muestras.

Consideremos a N como el tamaño de la población, n_1 como el número de animales capturados y removidos durante la primera muestra, y n_2 como el número de animales capturados y removidos en la segunda muestra. La proporción de individuos capturados en la primera muestra sería de n_1 / N. Después que los n_1 animales fueron removidos del ambiente, $N - n_1$ representaría a los animales remanentes. La proporción de este