alterations in food habits.

REFERENCES

Caut, S., Angulo, E. & Courchamp, F. (2008). Dietary shift of an invasive predator: rats, seabirds and sea turtles. *J. Appl. Ecol.* **45**, 428-437.

Course, D.T., Crownder, L.B. & Caswell, H. (1987). A stage-based population model for loggerhead sea turtle and implications for conservation. *Ecology* **68**, 1412-1423.

Draud, M., Bossert, M. & Zimnavoda, S. (2004). Predation on hatchling and juvenile diamondback terrapins (*Malaclemys terrapin*) by the Norway rat (*Rattus norvegicus*). *J. Herpetol.* **38**, 467-470.

Ferreira, J.R., Malvásio, A. & Guimarães, O.S. (2003). Influence of geological factors on reproductive aspects of *Podocnemis unifilis* (Testudines, Pelomedusidae) on the Javaés Rivers, Araguaia National Park, Brazil. *Chel. Conserv. Biol.* **4**, 626-634.

Garla, R.C., Setz, E.Z.F. & Gobbi, N. (2001). Jaguar (*Panthera onca*) food habits in Atlantic Rain Forest of Southeastern Brazil. *Biotropica* **33**, 691-696.

Gonçalves, F.A., Cechin, S.Z. & Bager, A. (2007). Predação de ninhos de *Trachemys dorbigni* (Duméril e Bibron) (Testudines, Emydidae) no extremo sul do Brasil. *Rev. Bras. Zool.* **24**, 1063-1070.

Heithaus, M.R., Frid, A., Wirsing, A.J., Dill, L.M., Fourqurean, J.W., Burkholder, D., Thomson, J. & Bejder, L. (2002). State-dependent risk-taking by green sea turtles mediates top-down effects of tiger shark intimidation in a marine ecosystem. *J. Anim. Ecol*. **76**, 837-844.

Pough, F.H, Heiser, J.B. & McFarland, W.N. (1993). A vida dos vertebrados. Atheneu Editora. São Paulo (SP), 839 pp.

Salera Junior, G., Malvasio, A. & Portelinha, T.C.G. (2009a). Avaliação e predação de Podocnemis expansa e Podocnemis unifilis (Testudines, Podocnemididae) no rio Javaés, Tocantins. Acta Amaz. **39** (1), 207-214.

Salera Junior, G., Portelinha, T.C.G. & Malvasio, A. (2009b). Predação de fêmeas adultas de Podocnemis expansa Schweigger (Testudines, Podocnemididae) por Panthera onca Linnaeus (Carnivora, Felidae), no Estado do Tocantins. Biota Neotrop. **9** (3), 387-391.

Spencer, J.R. (2002). Experimentally testing nest site selection: fitness trade-offs and predation risk in turtles. Ecology **83** (8), 2136-2144.

Waechter, J.L. & Jarenkow, J.A. (1998). Composição e estrutura do componente arbóreo nas matas turfosas do Taim, Rio Grande do Sul. Biotemas **11** (1), 45-69.

Low survivorship of *Rana dalmatina* embryos during pond surface freezing

ROGER MEEK

7 rue Georges Clemenceau, Chasnais, France.
Rogermeek85@aol.com

In western France one of the earliest breeding anurans is the agile frog (*Rana dalmatina*), which arrives at ponds during the first weeks of February depositing spawn soon after. The spawn may be laid on the bottom of ponds or attached to the stems of water plants or fallen twigs although most clumps gradually float to the surface and remain there until the tadpoles emerge (Fig 1a). This takes advantage of the warmer surface temperatures for increased speed of embryo development (Anacona & Capietti, 1996) but during February freezing conditions are not uncommon and spawn may be at least partially enclosed in ice. A mild local climate (46º27`N) inevitably results in the ice melting the following day and hence the impact is usually minimal. The present note was prompted by the occurrence of abnormally low temperatures beginning February 2nd 2012 that lasted for around 10 days when daily air temperatures of around –9°C were experienced. This resulted in spawn clumps already present on the surface of ditches being encased in ice (Fig 1b).

To examine if the prolonged freezing impacted on embryo survivorship, two of three spawn clumps that were deposited previous to the cold spell were cut out of the ice on 9th February. These had been deposited in a ditch at a distance of around 100 metres from woodland. The third clump was laid in a large pond and had not yet moved to the water surface. The two clumps were placed in aquaria with water temperatures of around 10-12°C where after 5 days the first tadpoles emerged and began to swim freely. To estimate any mortalities that might have occurred due to freezing, approximate volumes of the spawn clumps were first calculated using a measuring beaker and gave spawn volumes of 308 & 360ml. Egg number per spawn clump was then estimated using N = 2.35V+127.45, where N is egg number and V spawn volume (Ponsero & Joly, 1998) giving 851 and 973 eggs respectively. Mortalities were then determined by calculating the number of surviving embryos that emerged successfully as a percentage of the total egg estimate for each spawn clump (n = 29 & 26). This gave 3.4% and 2.7% respectively. The embryos that survived appeared have been positioned at the centre/bottom regions of the spawn clumps and hence may have received a degree of insulation from the ice. Their development proceeded normally with no unusual defects except in two individuals from the same clump that began swimming abnormally in circles. A further sample of 16 spawn clumps deposited in the large pond nearby after the cold spell was examined for empty egg sacks and indicated around 95% hatching success.

Arriving early to deposit eggs is assumed to gain an advantage for the offspring by increasing the time available for growth (Lyapkov et al., 2000), which enhances survivorship potential during the first winter (Ryser, 1996). If most *R. dalmatina* females only reproduce once during their lifetime (Guarino et al., 1995) they are risking potential loss of reproduction if the embryos freeze. Fixing egg clumps to plant stems or fallen twigs has been cited as a method of preventing the spawn floating to the surface (Ficetola et al., 2006). However, most clumps in the study locality broke from the fixing plant and slowly moved to the surface (Fig 1c). This suggests the potential benefit of shortening development time when spawn floats on the water surface is adaptive and outweighs the risks from doing so.

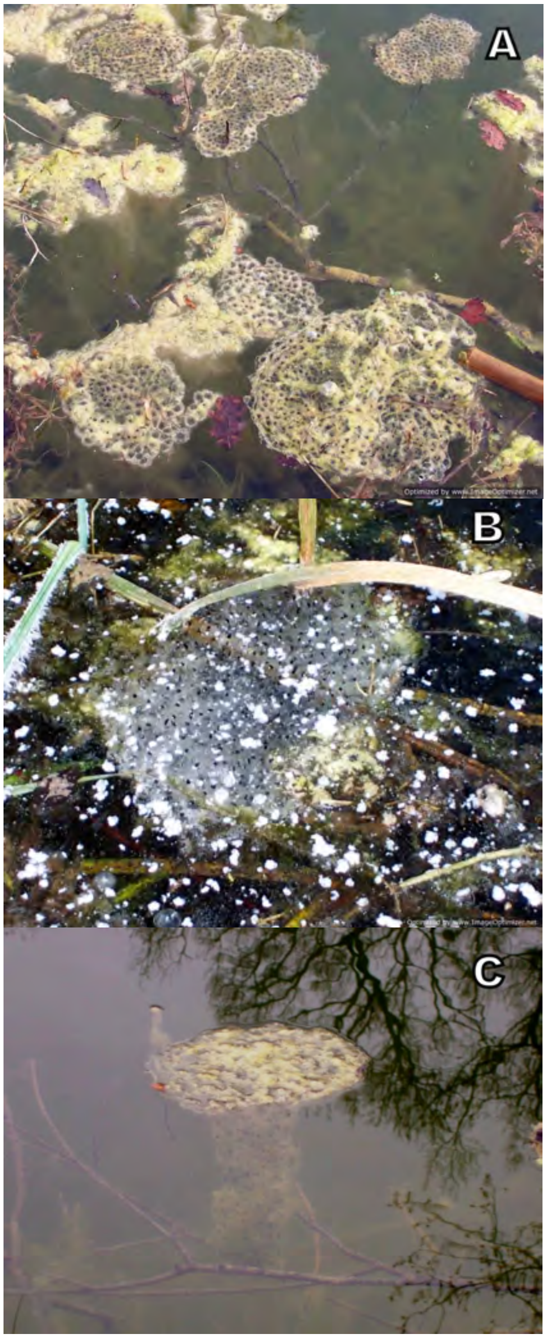

Figure 1. Typical location of *R. dalmatina* spawn on pond surface during development (A). Spawn clump encased in ice is shown in (B) and a spawn clump in the process of moving to the pond surface after breaking from a broken tree twig on which it had been deposited in (C).

REFERENCES

Anacona, N. & Capietti, A. (1996). Osservazioni sulla disposizione di uova e girini di *Rana temporaria* e *R. dalmatina* in un`area prealpina. *Studi Trdentini di Scienze Naturali – Acta Biologica* **71**, 177 – 181.

Ficetola, G. F., Valota, M. & De Bernardi, F. (2006). Within-pond spawning site selection in *Rana dalmatina*. In, *Atti del Congresso Nazionale Societas Herpetologica Italica*. Zuffi, M.A.L. (Ed) Firenze, Firenzi University Press.

Gaurino, F. M., Anelini, F & Cammota, M. (1995). A skeletochronological analysis of three syntopic amphibian species from Southern Italy. *Amphibia–Reptilia* **16**, 297-302.

Ponsero, A. & Joly, P. (1998). Clutch size, egg survival and migration distance in the agile frog (*Rana dalmatina*) in a floodplain. *Arch. Hydrobiol.* **142**, 343-352.

Ryser, J. (1996). Comparative life histories of a low- and a high-elevation population of the common frog *Rana temporaria*. *Amphibia–Reptilia* **17**, 183-195.

Lyapkov, C. M., Cherdanteseva, V.G., Cherdanteseva Y.M. & Severtsov, A. S. (2000). Survival and growth of brown frog juveniles dispersing from breeding pond. *Entomol. Rev.* **80**, (Suppl.1) 167-180.