Turtle Guardians

“So guys…should we stay in or go out?” A Painted Turtle Hatchling Dilemma

Turtle species in Ontario lay their nests in the spring and eggs start to hatch at the end of summer into early fall. Small hatchling turtles are faced with many challenges once they leave the relative safety of their nests. First, there is the feat of actually breaking through the ‘nest plug’ of soil that overlays their nest cavity. This plug can be quite dry and crusted by the end of summer, making it difficult for small hatchlings to break through (Costanzo et al. 2008). Next, the hatchlings need to navigate to nearby water and somehow avoid being eaten by a hungry predator like a migratory bird who is stocking up on fuel before their long journey south, or a Mink who can catch them on land or in water.

The hatchlings that make it to water safely, then have to avoid aquatic predators such as Bass or Muskie, then need to find enough food to offset the energetic costs of leaving the nest, and to fuel themselves for winter hibernation. Their last challenge before winter sets in is then to find a hibernacula; a safe spot underwater where they can hibernate all winter. Therefore, the risk of being eaten or not getting enough to eat are both very high for new hatchling turtles that leave their nests in the fall.

What if turtle hatchlings just stayed in their nest? Would they be able to survive until spring and therefore avoid all the trouble of emerging later in the summer when all the predators are most active and food sources are decreasing? By overwintering in their nests and emerging in the spring, food sources would be on the rise instead of on the decline (Costanzo et al. 2008). Some of Ontario’s turtle specie’s hatchlings are in fact able to overwinter in their nests! (Although no species uses this strategy exclusively). Painted Turtles are the Ontario turtles that will most commonly overwinter in their nest, but hatchlings of Northern Map Turtles, Blanding's Turtles, and Snapping Turtles (in decreasing order) are also known to occasionally overwinter in their nests (Riley et al. 2014, Nagle et al. 2004, Paterson et al. 2011, Obbard and Brooks 1981).

To explain this “overwintering strategy” of remaining in their nests, let's explore the following questions about the Painted Turtle, *Chrysemys picta*.

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Do Painted Turtle hatchlings always spend their winters in the nest?

No they do not! Painted Turtle hatchlings can emerge in the fall or overwinter in the nest and emerge the next spring. Scientists believe that hatchlings can sense environmental cues when in their nest cavities, and these may dictate whether they emerge in fall or spring. However, even within the same area these cues can be different for individual nests because each nest is slightly different in aspect (slope), moisture etc., and so some nests even within close proximity to one another might use different strategies. Also, even in the same nest, there are differences in moisture and substrates. Therefore there have been some reports of hatchlings within the same nest using different strategies, meaning some will emerge and some will stay to overwinter (Carroll and Ultsch 2007).

Is it more common for hatchlings to emerge in fall or spring?

Patterns change from year to year, but in general the trend is that the majority of Painted Turtle hatchlings overwinter in the nest and emerge the following spring, (Lovich et al. 2014, Riley et al. 2014). For example, in Algonquin Provincial Park, Painted Turtle nests were monitored and in the cohort of 2010-2011, only 2 nests emerged in the fall, while 23 overwintered in the nest and emerged in the spring. However, in the following year 16 nests emerged in the fall and 20 overwintered and emerged in the spring (Riley et al. 2014).

What are the benefits of staying in the nest? What are the risks?

Benefits of staying in the nest include: avoiding emergence in the fall at a time of peak predator abundance and decreasing food sources; more time for small hatchlings to develop within the relative safety of the nest because predation of nests decreases with time; avoiding a year of hibernation and related risks of low oxygen and slowed metabolisms while they are small; and being able to emerge in the spring when food sources will be increasing and there are less predators too!

Costs of staying in the nest include: exposure to below freezing temperatures within the nest cavity and potential death due to cold temperatures, running out of energy stores and dying from energy depletion before spring, and drowning from nest flooding.

What factors influence whether hatchlings emerge in fall or spring?

These factors are not completely understood, but it seems that there are multiple factors at play. Presence of sarcophagid fly larvae which feed on turtle eggs and hatchlings is often associated with fall emergence as the flies will otherwise disturb the hatchlings. Also a nest on a steep slope facing towards water, especially southward slopes facing the sun, or nests in bare ground with less vegetation cover and therefore less shade seem to create circumstances for hatchings to emerge in the fall. This is perhaps because these situations increase nest temperatures which may encourage hatchlings to venture out of their nests in the fall (Riley et al. 2014). This would also explain why some hatchlings in other, potentially colder nests, wait until warmer temperatures in spring.

How do hatchlings survive sub-zero temperatures in the nest? (They are supercool)

Painted Turtle hatchlings are freeze tolerant to a certain degree and they are also capable of supercooling! For short periods, Painted Turtle hatchlings can tolerate their body tissues freezing at temperatures above -4℃.

But, even better than being able to tolerate body freezing, is to not freeze at all! Amazingly, Painted Turtle hatchlings are able to supercool their bodies to temperatures as low as -12 °C without actually having their body fluids freeze. The name for this process is supercooling. (Paukstis et al. 1989, Packard and Packard 1993, Costanzo et al. 1999) and Painted Turtle hatchlings are able to do this because they do not have any “ice nucleating agents” (INA’s) internally. INAs are particles that an ice crystal can form around. Therefore, for Painted Turtles, freezing isn’t triggered in their bodies (Packard and Packard 1993), unless they come into direct contact with ice crystals or INA’s within the nest. Even still, their skin offers some protection from this occurring. Ironically then smaller turtles with less surface skin exposed may fair better than larger ones. Also, different substrate within the nest can buffer against soil moisture better than others and can limit ice crystal formation.

How do the features of their nest affect hatchlings’ ability to survive the winter?

The type of soil a female Painted Turtle chooses to dig her nest in can play a big role in determining whether or not the hatchings make it through the winter. During the winter, higher moisture in soils where the nests are dug, may put hatchlings at risk of coming into contact with ice crystals. Therefore, soils and sites that can remain dry will contain fewer ice crystals and are preferred locations. In areas where soil moisture is unavoidable, female Painted Turtles

can still choose strategically in order to give the hatchings an advantage, by nesting in soils with more clay. Clay does not allow much water to infiltrate and provide the necessary buffer against excess moisture (Costanzo et al. 2001).

What do hatchlings eat all winter?

Nothing! Hatchlings that remain in the nest can't eat or digest yet. Instead they rely on stored energy reserves to fuel them through the winter. Scientists used to think that leftover egg yolk was their main source of nutrition while overwintering in nests (Costanzo et al. 2008). However, research has revealed that remaining yolk from their yolk sac is primarily used up within the first few weeks after hatching, and is almost gone by early Fall, so it cannot be the primary food source over the harsh winter months (Muir et al. 2013). Instead, energy reserves in their liver, other organs, and body tissues seem to play a key role in fueling hatchlings that remain in the nest over winter (Muir et al. 2013).

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