Effectiveness of Nest Protection and Artificial Egg Incubation for Turtles in Ontario

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Egg Loss

- Despite the fact that some areas of significant turtle habitat remain in southwestern Ontario, declining egg survivorship is prevalent.

- The overwhelming loss of wild turtle nests may be partially remedied by nest protection techniques.

- In association with protection of adults and habitat, egg and juvenile protection plays a necessary role in species recovery.
Nest Predation

• Mammalian predators take up to 100% of turtle nests in some areas.

• Many mammal populations are now in higher densities due to agricultural crops and human food waste.

• Racoon, coyote, red fox, striped skunk, and Virginia opossum all predate nests.
Nest Protection

• In order to find nests, turtle tracks are followed and potential areas are carefully searched
• Once nests are found, caging is placed over the eggs
• In some areas, it is beneficial to rake over the sites after searches, allowing for easier identification of tracks
Ineffective Nest Protection Designs

- Wood base with mesh on top (moved or burned by people, predators dug under)

- Old tires with mesh attached on top (predators dug beneath, excessive radiant heat, used as campfire chairs on the beach!)

- Short wire cages (predators dug up or under)
An Effective Design

Needed:
• Lightweight
• Relatively Inexpensive
• Collapsible
• Self-anchoring
• Easy and quick to make
• Require few tools to make
• Very effective
• Adaptable depending on terrain

Design:
• 30cm diameter, cylindrical, ¼” galvanized hardware cloth (wire) cage
• Height – 15 to 20cm (if buried) 30cm (if exposed)
• Galvanized wire, for threading to seal cage and attach wire top
• Tools: Wire cutters, needle-nose pliers, (bandages, many bandages)
Nest Cage Placement
(above ground, for sites without people)

Locate Nest
Cage Orientation

Dig trench around nest

Place 60-90% of cage height into the trench

Tie a piece of flagging tape to the bottom of the cage. With permanent marker, provide identification information (ie species, date)
Filling The Gaps

• Place damp substrate into the trench around the cage
• Pack substrate firmly inside and outside of the cage
• Attach wire lid on to the cage
• Use foot to pack substrate firmly around the outside of the cage
• Ensure surrounding soil is relatively even
During Incubation

Routine checks throughout the duration of incubation are necessary

- Cages get crushed or buried
- Predators dig at cages
- People dig up cages
Big Mistakes

- Unless your sign states that you are conducting experiments with hazardous chemicals, DO NOT publicize your efforts.
- Even without signs, the cages are at risk of disturbance.
- We have had two large incidences of human idiocy and a number of smaller problems:
  1) 300 softshell, northern map and Blanding’s turtle eggs were smashed by vandals (in a relatively remote, provincially protected area).
  2) Over 150 eggs were stolen in one night along the Thames River.
Below Ground Cage Placement
(For sites with potential for human disturbance)

• similar placement as above ground cage
• use 15 - 20cm high cage instead
• place ~5cm below ground
• Use appropriate system to map cages
• Use metal detector to locate cages
• If moving nests, place cage in position prior to adding eggs
• Predators will often expose the tops of cages
• Regular maintenance is necessary
• Do not walk over cages, compaction will crack eggs
• Teach dog to protect nests
Hatching

• It is important to increase patrols just prior to the estimated time of hatching.

• Turtles have been known to perish within 20 minutes of hatching while trapped in cages.

• At sites with little protection from the sun, multiple daily checks may be necessary.
Associated Problems

- Labor intensive
- Eggs can be turned if substrate collapses while digging
- Predators such as coyote and raccoon will still predate some cages each season, though effectiveness is still high
- Coyote, Racoon and Red Fox will learn to check each cage at a nesting site, regular maintenance of cages is necessary
- Do not walk over nests, compaction can crack eggs
- Sand can cover above ground nest cages, purchase a metal detector
- Stakes near cages will alert poachers
Problems With Mesh Size

- Any mesh above ¼ inch in size will allow hatchlings to put their head through the wire, multiple decapitations at research sites have occurred as a result
- Raccoons will exploit very small holes along the cage seams
- Chicken wire is too large, some raccoons can get through
- Small mesh size influence incubation temperatures or humidity
- Galvanized wire breaks down after 2 to 4 seasons of heavy use
Caging is Ineffective in Some Situations

- Fly larvae infestation common at some sites
- Caging will not prevent larvae from entering nest chamber
Heavy root systems

Excessive vegetation

Large rocks

Cattle, ATV use, horses etc.
Artificial Incubation of Turtle Eggs

• Many nests face imminent loss due to a number of natural and human-related factors.
• Artificial incubation provides an alternative when nest caging is less effective.
• Artificial egg incubation is still in its infancy, but thus far is proving highly effective.
The Aid of Experience

- Rescued non-native species provided a wealth of information to me many years ago, information that is proving useful today.

- Through initial trial and error, I have experimented with temperature and humidity, incubation times, diapauses and general egg care for various European, Asian, African, and U.S. species.
• Success with difficult species such as black-breasted leaf turtles meant adapting typical incubation conditions to meet the needs of the eggs

• Information on temperate zone species such as box turtles provided more relatable data for native Ontario turtles

• At the same time, data have become available from biologists across North America

• Information on Temperature Sex Determination and the associated temperature thresholds

• Information on thermal maximums and minimums for the proper development of many species
Incubation Issues

• A number of issues related to incubation methods manifest in shell and/or colour abnormalities or in a failure to thrive

• Some of these mutations are genetic, while others relate to improper temperature or humidity during incubation
• Lack of colour, or absence of specific pigments are well known in commercial turtle farms

• Red-ear sliders are often intentionally incubated at higher temperatures to produce “pastel” sliders, a light coloured “designer” animal in the pet trade

(However, some genetic issues in nature also cause colour loss: albinism, leucism, melanism)
Incubators

• A number of choices are available
• Incubation methods will bring about varying degrees of success
• From placing the eggs on a shelf in a warm room, to high-tech incubators worth thousands of dollars, the method must fit the need
Advanced Incubation

- Recent innovations have improved incubation methods, providing more effective and reliable results
- Factors such as humidity and temperature control can be further developed to include night time temperature drops, fail-safe electronic thermostats and overall control of environmental conditions

http://spyderrobotics.com/
http://www.nsreptiles.com
http://www.bigappleherp.com/
http://www.reptileincubator.us/
Thermometers and Hygrometers

- Use more than one thermometer per incubator
- Test thermometers regularly
- Choose digital thermometers with extendable probes
- Choose thermometers with Minimum and Maximum temperature memory
- Some digital thermometers can be programmed to sound alarm if temperatures rise too high
The Verdict

• All beach sand and beach sand mixtures dry out quickly
• Organic soil and detritus is very dirty and moisture levels are not consistent
• Sphagnum moss and vermiculite both provide ease of use and good moisture retention
Egg Candling

Monitor egg development
Yolk Absorption

• Turtles may exit the egg shell prior to full absorption of the yolk sac
• Place the turtle in a small, clean container lined with wet paper towel
• Create a divot in the centre of the paper towel wad, allowing the hatchling to limit the weight placed on the yolk sac
• In most cases, the yolk sac will be absorbed within 48 hours
Keep it Clean

- Do not mix species
- Do not use the same equipment for species from different locales
- Disinfect all equipment between egg batches
- Do not re-use incubation medium (i.e., vermiculite)
- Never keep non-native species or associated equipment near native species
- Wash hands regularly
Collect Data

• Keep clear records on oviposition date, incubation temperatures, development times
• Note any changes in procedures
• Measure and weigh all young
• Sex (softshells) and mark animals (hard-shelled species) when appropriate
Release

- Release near nesting site when possible or safe
- Do not just dump all turtles in a pile and head off
- Choose release sites very carefully
- Take the time to ensure most young are hidden
- Avoid high traffic areas (for people and predators)
- Spread animals out
Success?

- Ex-situ artificial incubation methods for the spiny softshell have resulted in far higher nest success than in-situ nest protection, thus ensuring hundreds of turtles at risk are released into the environment each season.
## 2006 Spiny Softshell Nest Caging vs. Artificial Incubation

<table>
<thead>
<tr>
<th>Breakdown of What Became of Protected* Eggs</th>
<th>Artificially Incubated Eggs</th>
<th>Caged Eggs</th>
<th>Total Incubated &amp; Caged Eggs</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Number of Protected Eggs</strong></td>
<td>Number</td>
<td>%</td>
<td>Number</td>
</tr>
<tr>
<td></td>
<td>327</td>
<td>35%</td>
<td>612</td>
</tr>
<tr>
<td>Rotten Eggs (stopped developing at some point after being laid)</td>
<td>61</td>
<td>19%</td>
<td>254</td>
</tr>
<tr>
<td>Infertile Eggs</td>
<td>8</td>
<td>17%</td>
<td>39</td>
</tr>
<tr>
<td>Live Young-in-Egg predated by sarcophagid fly larvae</td>
<td>0</td>
<td>0%</td>
<td>8</td>
</tr>
<tr>
<td>Eggs predated by sarcophagid fly larvae</td>
<td>0</td>
<td>0%</td>
<td>36</td>
</tr>
<tr>
<td>Eggs stolen by humans</td>
<td>0</td>
<td>0%</td>
<td>16</td>
</tr>
<tr>
<td>Eggs and Hatchlings predated by mammals</td>
<td>0</td>
<td>0%</td>
<td>163</td>
</tr>
<tr>
<td>Live Hatchlings that emerged and were released</td>
<td>258</td>
<td>73%</td>
<td>96</td>
</tr>
</tbody>
</table>
## Spiny Softshell Caged Nest Success (2002-2007)

<table>
<thead>
<tr>
<th>Year</th>
<th># of Caged Nests</th>
<th># of Caged Eggs</th>
<th># of Hatchlings That Emerged</th>
<th>Hatching Success (%)</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>2002</td>
<td>41</td>
<td>802</td>
<td>221</td>
<td>28%</td>
<td>Most nests flooded at the end of July for at least 48 hours</td>
</tr>
<tr>
<td>2003</td>
<td>39</td>
<td>753</td>
<td>444</td>
<td>59%</td>
<td>~</td>
</tr>
<tr>
<td>2004</td>
<td>30</td>
<td>616</td>
<td>251</td>
<td>40.7%</td>
<td>149 eggs stolen by humans</td>
</tr>
<tr>
<td>2005</td>
<td>37</td>
<td>726</td>
<td>77</td>
<td>10.6%</td>
<td>Very hot summer resulting in overly dry substrate at nest sites</td>
</tr>
<tr>
<td>2006</td>
<td>35</td>
<td>612</td>
<td>96</td>
<td>16%</td>
<td>15 nests were flooded for an extended period of time</td>
</tr>
<tr>
<td>2007</td>
<td>17</td>
<td>301</td>
<td>233</td>
<td>77%</td>
<td>~</td>
</tr>
</tbody>
</table>

- Success varies widely each season
- 2007 had less flooding, poaching and depredation of eggs and thus a higher hatch rate from protected nests
- Both nest protection and artificial incubation work, though if done correctly, artificial incubation is more productive
- In all cases we take some degree of natural selection out of the equation
• Both nest protection and artificial incubation are useful in SAR turtle recovery

• Knowledgeable staff and attention to detail are necessary to achieve positive results and to avoid problems

• Should not be promoted as the answer to species at risk recovery, this is still only a band-aid solution to a much bigger problem!