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
- Collapsable
- 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)
- Galvinized 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)

Cage Orientation

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

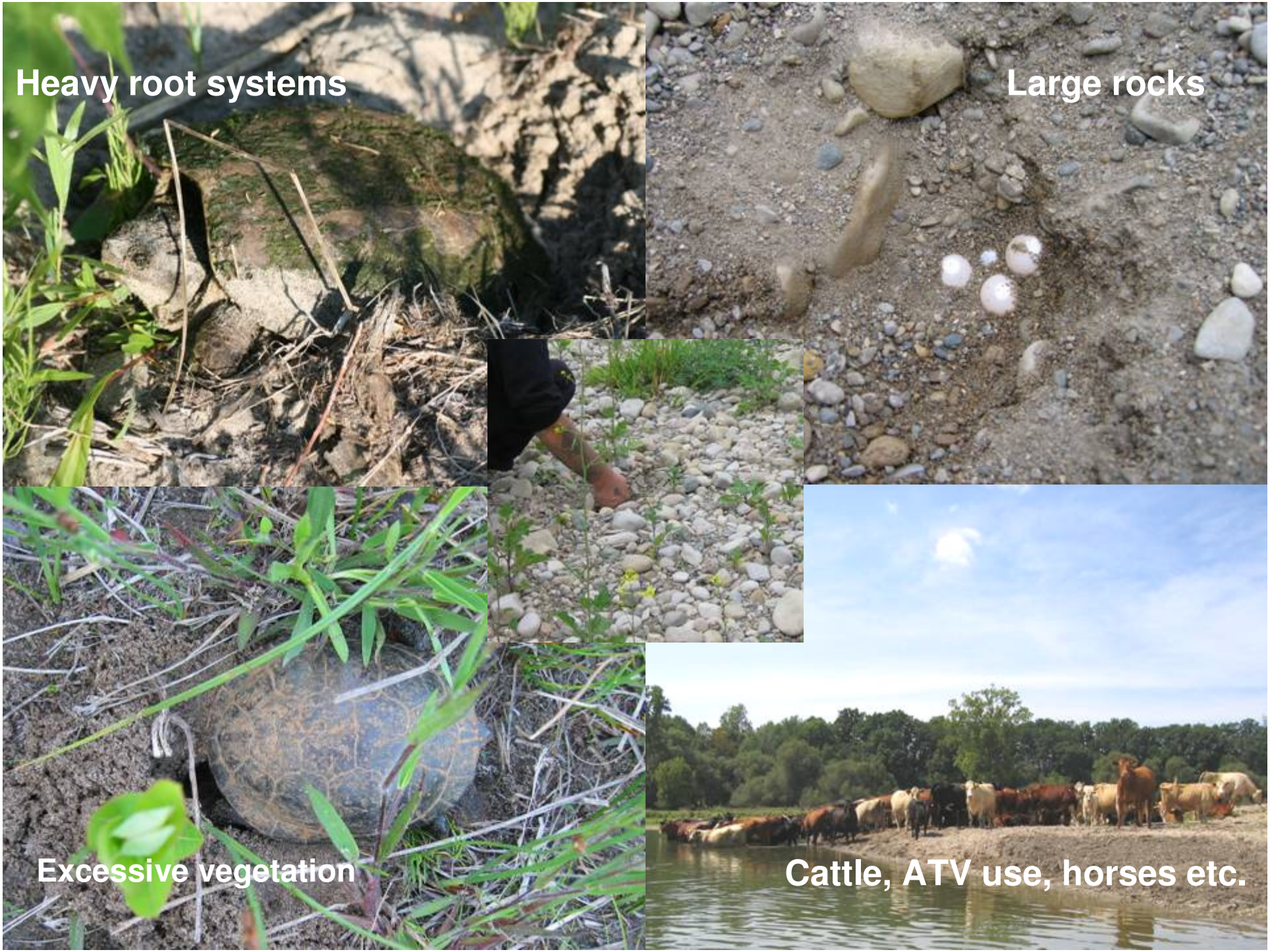
- Labor intensive
- Eggs can be turned if substrate collapses while digging
- Predators such as coyote and raccoon will still predate some cages each season, though effectiveness is still high
- Coyote, Racoon and Red Fox will learn to check each cage at a nesting site, regular maintenance of cages is 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
Large rocks
Excessive vegetation
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**

Incubation Medium

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

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 (ie 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

Breakdown of What Became of Protected* Eggs *refers to eggs that were either caged or artificially incubated	Artificially Incubated Eggs		Caged Eggs		Total Incubated & Caged Eggs	
	Number	%	Number	%	Total	%
Number of Protected Eggs	**327**	**35%**	**612**	**65%**	**939**	**100%**
Rotten Eggs (stopped developing at some point after being laid)	61	19%	254	81%	**315**	**33.5%**
Infertile Eggs	8	17%	39	83%	**47**	**5%**
Live Young-in-Egg predated by sarcophagid fly larvae	0	0%	8	100%	**8**	**0.9%**
Eggs predated by sarcophagid fly larvae	0	0%	36	100%	**36**	**3.8%**
Eggs stolen by humans	0	0%	16	100%	**16**	**1.7%**
Eggs and Hatchlings predated by mammals	0	0%	163	100%	**163**	**17%**
Live Hatchlings that emerged and were released	258	73%	96	27%	**354**	**38%**

Spiny Softshell Caged Nest Success (2002-2007)

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

- 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!**