Development of a Best Management Practices Manual to Conserve Wetland Herpetofauna in Michigan

David A. Mifsud, PWS, CPE, CWB

(517) 522-3524 Office
(313) 268-6189 Mobile
DMifsud@HerpRMan.com
www.HerpRMan.com

Why A BMP?

- MI amphibian and reptile populations are declining
- Over 60% Species of Greatest Conservation Need (SGCN) Michigan Department of Natural Resources Wildlife Action Plan
- Greatest impacts to herpetofauna are from habitat loss and fragmentation (from development) and poor land management

Wetland Herps...

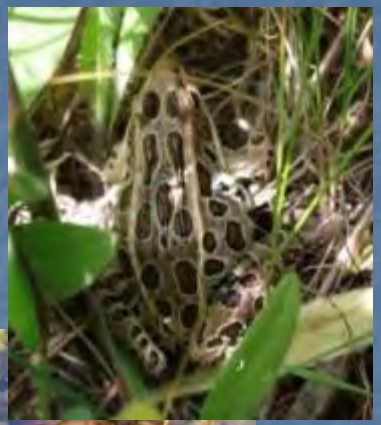
- Are sensitive to environmental disturbance.
- Aquatic and terrestrial life cycles.
- Mid-level position in food webs.
- High degree of sensitivity to toxins and other environmental stressors.
- Bioaccumulators of toxins and contaminants.
- Many species are seasonally wetland dependant.
- Need a mosaic of different wetland types with intact upland habitat joining them.

Wetland Herps...

- Can be used as gauges of environmental health (bioindicators).
- Are often not specifically considered when determining the environmental impacts from development and management practices.

Herpetofauna in Michigan

- 18 species of Snakes
- 10 species of Turtles
- 2 species of Lizards
- 15 species of Frogs and Toads
- 14 species of Salamander and Newts

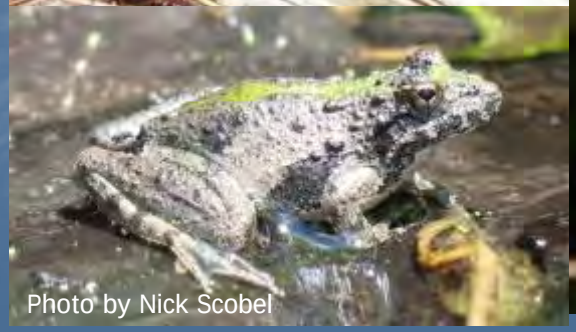


Herpetofauna in Michigan

- 18 species of Snakes
- 10 species of Turtles
- 2 species of Lizards
- 15 species of Frogs
- 14 species of Salamander and Newts
- **MORE THAN HALF ARE SPECIES OF GREATEST CONSERVATION NEED !!!**

Frog and Toad Status

Frog and Toad Species	State Rank	Wildlife Action Plan
American Toad		
Fowler's Toad		SGCN
Green Frog		
Mink Frog		
Bullfrog		
Pickerel Frog		SGCN
Leopard Frog		SGCN
Wood Frog		
Cope's Gray Treefrog		
Eastern Gray Treefrog		
Blanchard's Cricket Frog	T	SGCN
Spring Peeper		
Western Chorus Frog		SGCN
Boreal Chorus Frog	SC	SGCN
Western Chorus Frog		

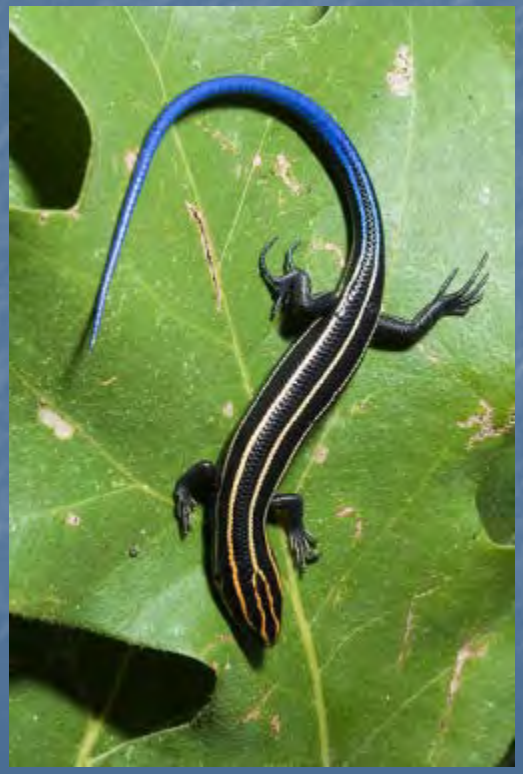


Salamander Status

Salamanders Species	State Rank	Wildlife Action Plan
Western Lesser Siren	SC	SGCN
Mudpuppy		SGCN
Blue-spotted Salamander		SGCN
Unisexual Hybrids	N/R	
Spotted Salamander		SGCN
Marbled Salamander	T	SGCN
Small-mouthed Salamander	E	SGCN
Eastern Tiger Salamander		SGCN
Red-spotted Newt		
Central Newt		
Four-toed Salamander		SGCN
Red-backed Salamander		
Dusky Salamander	N/R	
Two-lined Salamanders	N/R	

Lizard Status

Lizard Species	State Rank	Wildlife Action Plan
Five-lined Skink		
Six-lined Racerunner	T	SGCN



Snake Status

Snakes	State Rank	Wildlife Action Plan
Kirtland's Snake	E	SGCN
Queen Snake	SC	SGCN
Butler's Garter Snake		
Eastern Ribbon Snake		
Eastern Garter Snake		
Copper-bellied Water Snake*	E	SGCN
Northern Water Snake		
Northern Brown Snake		
Northern Red-bellied Snake		
Northern Ring-necked Snake		SGCN
Eastern Smooth Green Snake		SGCN

Snakes	State Rank	Wildlife Action Plan
Eastern Smooth Green Snake		SGCN
Eastern Milk Snake		
Blue Racer		SGCN
Black Rat Snake	SC	SGCN
Western Fox Snake		SGCN
Eastern Fox Snake	T	SGCN
Eastern Hog-nosed Snake		SGCN
Eastern Massasauga Rattlesnake**	SC	SGCN

* Federal Protected Status –Threatened

** Proposed for Federal Status

Turtle Status

Turtles Species	State Rank	Wildlife Action Plan
Common Snapping Turtle		
Common Musk Turtle		
Western Painted Turtle		
Midland Painted Turtle		
Blanding's Turtle	SC	SGCN
Spotted Turtle	T	SGCN
Wood Turtle	SC	SGCN
Eastern Box Turtle	SC	SGCN
Red-eared Slider		
Common Map Turtle		
Eastern Spiny Soft-shell		

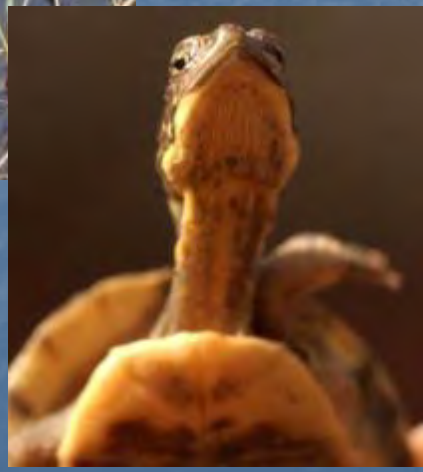


Photo: James Harding

How will the BMP Manual Help?

- Address threats to herp communities posed by development and landuse/management practices
- Provides alternative methods and techniques
- Address timing of activates to minimize impacts MI herp Based on the best available science
- Protect and conserve critical habitat and help keep common species common, stem the decline of imperiled species, and reducing the likelihood of species becoming listed as threatened or endangered
- Target audience developers, environmental, planning and construction consultants, land managers, regulators, restoration practitioners, and those interested in protecting amphibians and reptiles in Michigan.

Development

- Current State of Herpetofuana in MI
- Overview of Natural Histories
- Threats
- Recommendations for Management, Development, Restoration, and Conservation
- Comprehensive Bibliography
- Anticipated publishing January 2014

Development

1. Introduction

Purpose and Intended Use of This Manual

This manual was created for the Michigan Department of Environmental Quality (MDEQ) to provide a comprehensive guide of Best Management and Development Practices (BMDPs) to help maintain the viability of native Michigan amphibian and reptile populations. This manual addresses threats to herpetofauna communities posed by development and management practices and provides alternatives based on the best available science that facilitate the conservation and expansion of herpetofauna communities. These BMDPs are designed to guide land management, maintenance, development, and conservation activities. This BMDP manual is a Michigan based guide that provides site-specific management recommendations to regulators, agencies, land managers, consultants, developers, and citizens to protect and restore herpetofauna in Michigan.

BMDPs must be supported by scientifically sound information, and as such, must also be monitored to assess the effectiveness of the BMDPs and revised to reflect new information. As they are assessed and new information becomes available, BMDPs will progress to improve protection for herpetofauna and increase cost-effectiveness. This manual, while primarily targeted at specific amphibian and reptile communities, also aligns with the ecosystem management approach as described in the Michigan DNR Wildlife Action Plan (WAP) (Eagle et al. 2005).

Spotted Turtle are a Threatened Species and a Species of Greatest Conservation Need in Michigan.

The creation of this manual is part of the response to the need for conservation of over 60% of Michigan herpetofauna, as identified by the MDNR Wildlife Action Plan (Eagle et al. 2005) most of which are wetland dependent at some phase of their life. Habitat destruction, degradation, and fragmentation are the main factors for decline of some Amphibian and Reptile species in Michigan and the United States (Dodd et al. 2003; Marchand and Litvaitis 2004; Weyrauch and Grubb 2004). Decreases in water quality, habitat area, and connectivity coupled with invasive species, environmental contaminants, pathogens, and illegal collection pose a significant threat to many herpetofauna species in Michigan (Harding 1997; Roe et al. 2003; Bell 2005; Moore and

Development

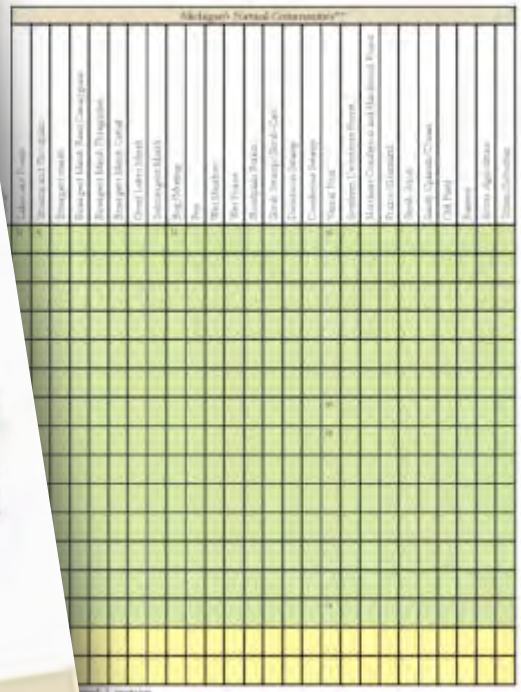
Gillingham 2006; Ryan et al. 2008; Michigan Natural Feature Inventory 2012). The unique natural history and biological characteristics of Amphibians and Reptiles make these animals vulnerable to aquatic and terrestrial disturbances. The guidelines proposed in this manual will help to reduce pressures on herpetofauna communities in Michigan and contribute to their long-term conservation.

It is our intent that this manual be used a quick-reference throughout all phases of site development and construction, mitigation, restoration, and management. Specific laws and applicable permitting for mitigation of impacts to herpetofauna are listed and described within BMDP to limit arduous these matters as project move into implementation.

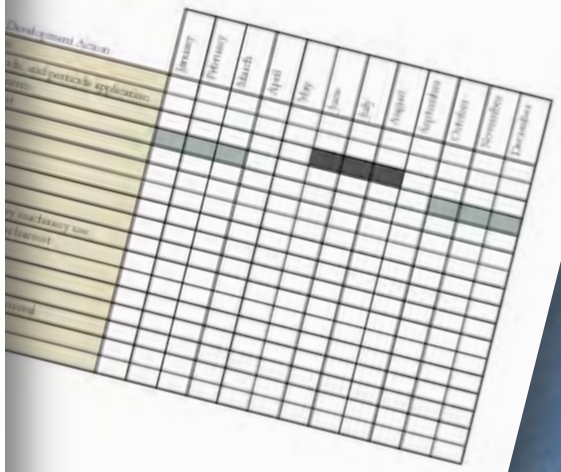
Herpetological Resource and Management (HRM) would like to acknowledge that the MDEQ funded this work through an Environmental Protection Agency (EPA) grant. Numerous other organizations and individuals have contributed information, photographs, and resources instrumental in the creation of this BMDP. Partners in development include The Nature Conservancy, Michigan Department of Natural Resource Wildlife Division MDNR Fisheries Division, MDNR Forest and Mineral Division, MDEQ Office of the Great Lakes, Michigan Department of Transportation, Michigan Natural Features Inventory West Michigan Shoreline Regional Development Commission, Daniel

Copper-bellied Watersnake is a State Endangered Michigan species. This species is one of many likely to benefit from conservation efforts through the implementation of Best Management and Development Practices.

Appendix A: Community Matrix



Appendix B: Management and Development Action Timeline



Problems Facing Herps in MI





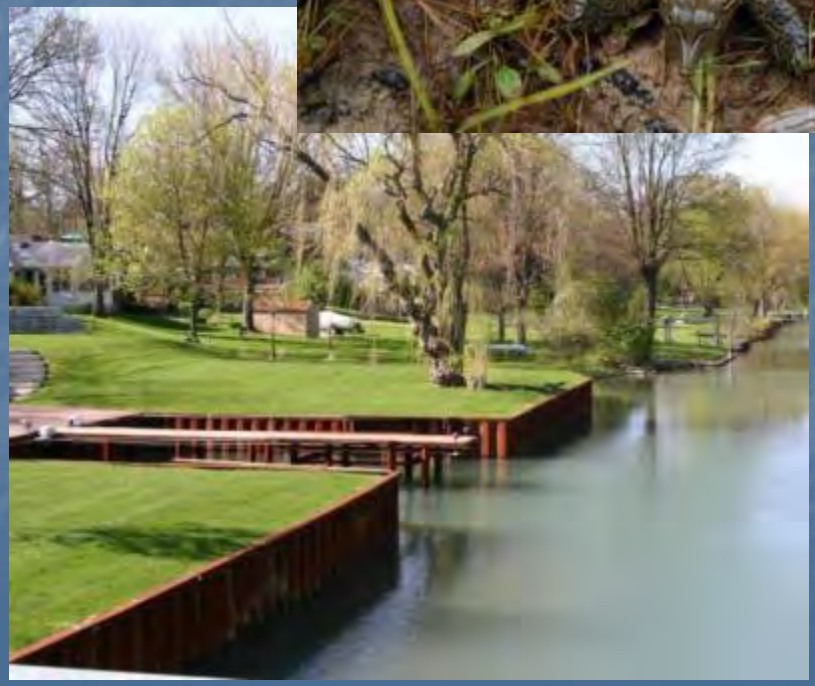

Habitat Loss, Degradation, & Fragmentation

- MI: 50% of wetlands lost increasing fragmentation.
- Connectivity is essential for viability.
- Results in:
  - increased mortality
  - reduced genetic diversity,
  - disrupted metapopulation structure
  - increased predation pressures
  - increased edge habitat
  - reduced habitat quality
  - reduced critical zones
  - invasive species colonization

Dahl 1990, Fahrig and Merriam 1985; Petranka, Harp et al. 2007; Bennett, Keevil et al. 2010; Bennett and Litzgus 2012; Row, Blouin-Demers et al. 2012

Barriers: Seawall Impacts

- Intended to reduce shoreline erosion, but prevent amphibians and reptiles from accessing upland habitat for basking, nesting, and foraging.
- Leads to reduced breeding success, greater competition for available resources, and reduced species richness.



Barriers: Erosion Control

Although important for reducing soil erosion and degradation to adjacent areas, erosion control measures can result in significant problems for herpetofauna including:

- Trapping animals in mesh resulting in death
- Creating wildlife barrier

Chemical Pollution

- Urbanization, agriculture, & industry introduces
  - acidification, heavy metals, salts, hydrocarbons, excess nutrients, pesticides, herbicides, & pharmaceuticals
- highly permeable skin + high sensitivity + extensive contact with water = weakened immune system, mortality, deformations, altered behavior, bioaccumulation
- Impacts entire ecosystem/food web – herps are indicators

Johnsonet al. 1999; Unrine et al. 2007; Fontenot et al. 2000

Invasive Species

- *Phragmites*: prevents movement, thermoregulation, nesting opportunities, and food sources. Results in habitat loss and reduction in species richness.
- Goldfish: increases competition for food and resources, reduce water quality for native herpetofauna species & feed on eggs and larvae of amphibians.
- Feral swine: create unsuitable wetland conditions for herps by digging, rooting, and wallowing. Also consume snakes and eat turtle eggs in large numbers.

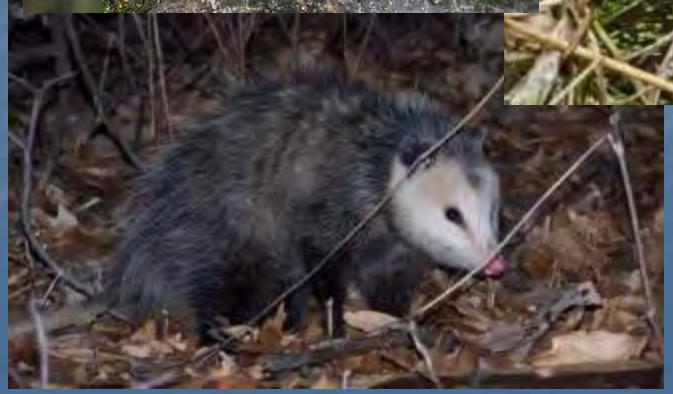
http://www.fishingfury.com/wp-content/uploads/2011/07/frog-ride.jpg

www.nwrc.usgs.gov

Campbell 2009

Subsidized Predation

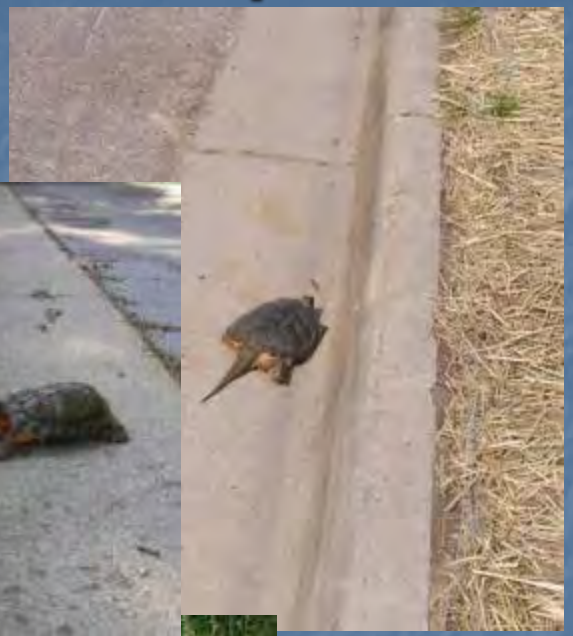
- As habitat becomes increasingly urbanized predator accessibility and numbers increase
- This leads to increased predation of herps (particularly turtle eggs).
- Reduction in overall population size, viability and skewed age class and sex ratios.



The usual outcome

Roads: Curb and Gutter Impacts

- Barrier: reduces ability to travel across roads resulting in greater road mortality
- Altered wetland hydrology: Gutters redirect surface water flow away from wetlands
- Pollution: discharged water is often contaminated with hydrocarbons, heavy metals and salt

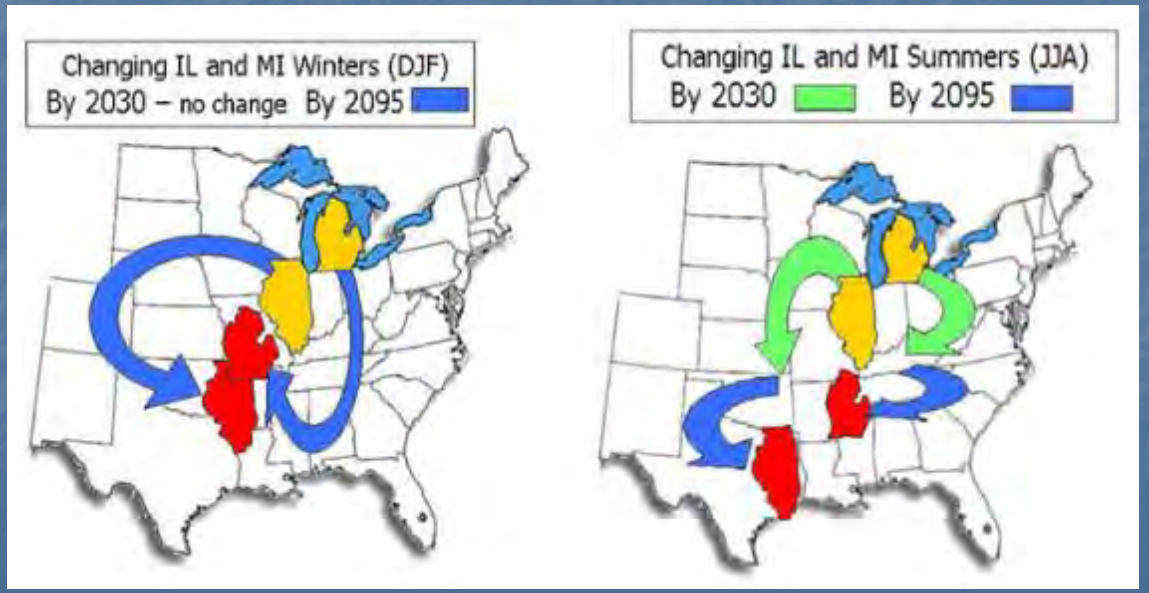


Road Mortality

- Habitat loss & fragmentation: increases the risk to herps as they try to access seasonal habitat. They also serve as sinks for snakes seeking warm basking spots
- Predation: increase predation by providing a corridor for nest predators

Climate Change

- Models show shifts in plant communities and wetland conditions in Michigan.
- May result in changes in the development, spatial distribution, abundance and species interactions of herps.
- Amphibians call and breed earlier in years with warmer temperatures.
- May affect reptile timing and nesting success.

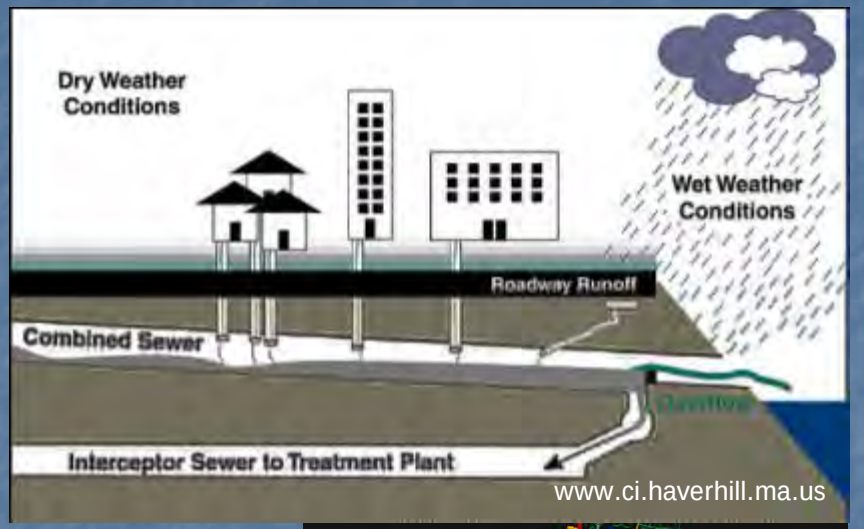


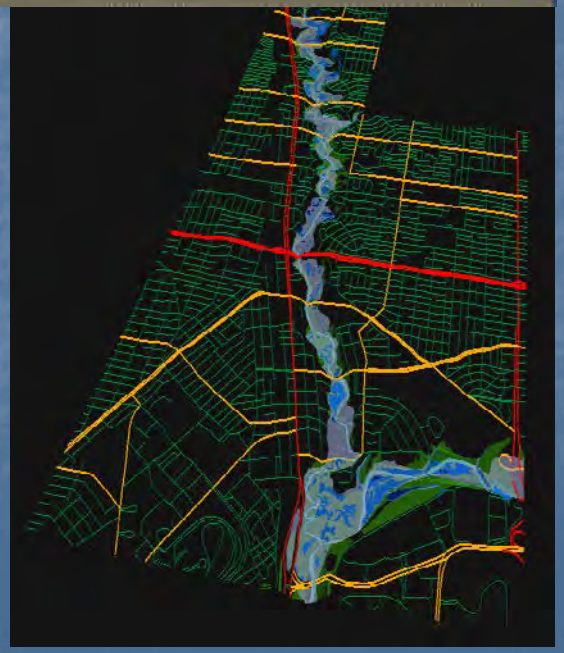
Hayoe et al. 2010, Hellmann et al. 2010, Prasad et al. 2010, Nelson et al 2011Pounds et al., 1999

www.globalchange.umich.edu

Altered Hydrology

- Reasons:
  - Undersized or too few culverts/pipes
  - Draining or tiling
  - Removals for irrigation & manufacturing
  - Impermeable surfaces prevent recharge & increase runoff & erosion
  - Stream channelization



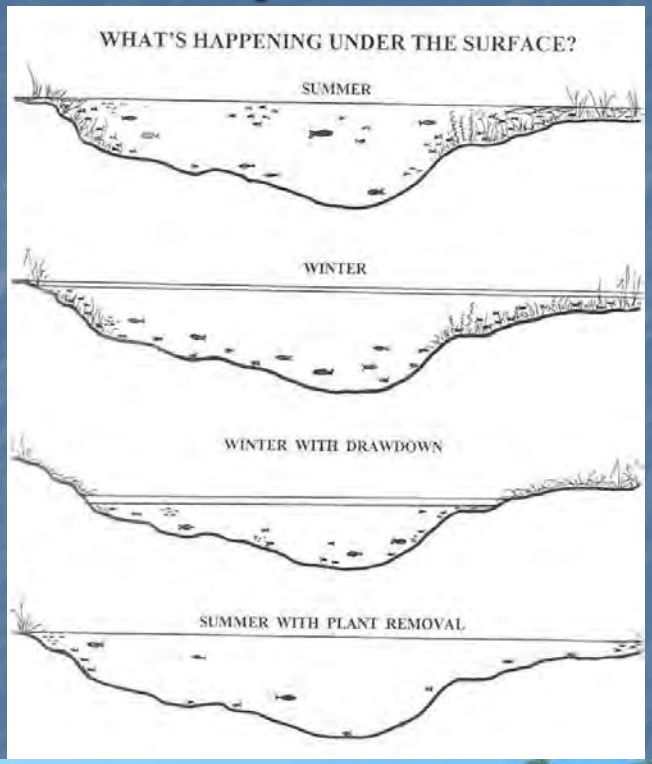


Altered Hydrology

- Impacts:
  - Altered hydroperiod, habitat & connectivity loss, colonization of invasives
  - Reduced habitat suitability & breeding and recruitment success
  - Changes in the wetland community dynamic and structure.
  - Changes in herp community composition

Lake Level Alteration Impacts

- Fall drawdowns:
  - significant mortality of hibernating amphibians and turtles.
  - exposes shoreline and removes the insulating layer of ice.
- Adding water in early spring:
  - may drown overwintering herpetofauna.
- Adding water to a shallow wetland may allow for fish to become established.



Aquatic Nuisance Control Impacts

- Aquatic Weeds: Removal of aquatic vegetation removes critical habitat for larval amphibians, hatchling turtles.
- Reduces available prey items for multiple species.
- Direct mortality to herpetofauna.

Aquatic Nuisance Control Impacts

- Lampreys: Lampricide application can impact herp communities.
- Rotenone used for fish studies and eradication.
- Chemical developed to kill nuisance mollusks.
- Herbicides used to control unwanted aquatic vegetation.
- Documented non-target mortality and bioaccumulation impacts to aquatic herps.

Controlled & Prescribed Burns

- Most MI herps are not adapted to frequent & intense burns.
- Limited opportunity for connectivity and migration to restored habitats.
- Vulnerable & rare species can be negatively impacted from burns.
- Growing body of evidence that it may also threaten resident herp populations.

Other Threats

- Persecution
- Disease
- Illegal Collection
- Insufficient Assessment

Solutions: Techniques & Strategies for Land Management, Development, & Conservation Planning & Design

Plan to Maintain Structure & Function at the Ecosystem Level

Minimize Impacts to Herps

- First assess the herp community present!!!
- Prioritize areas to protect/avoid critical areas.
- Preserve habitat to maintain connectivity and mosaic character.
- Weigh methods/techniques and consider alternatives.
- Time action to avoid herps and minimize impacts based on species' natural history and best available science.

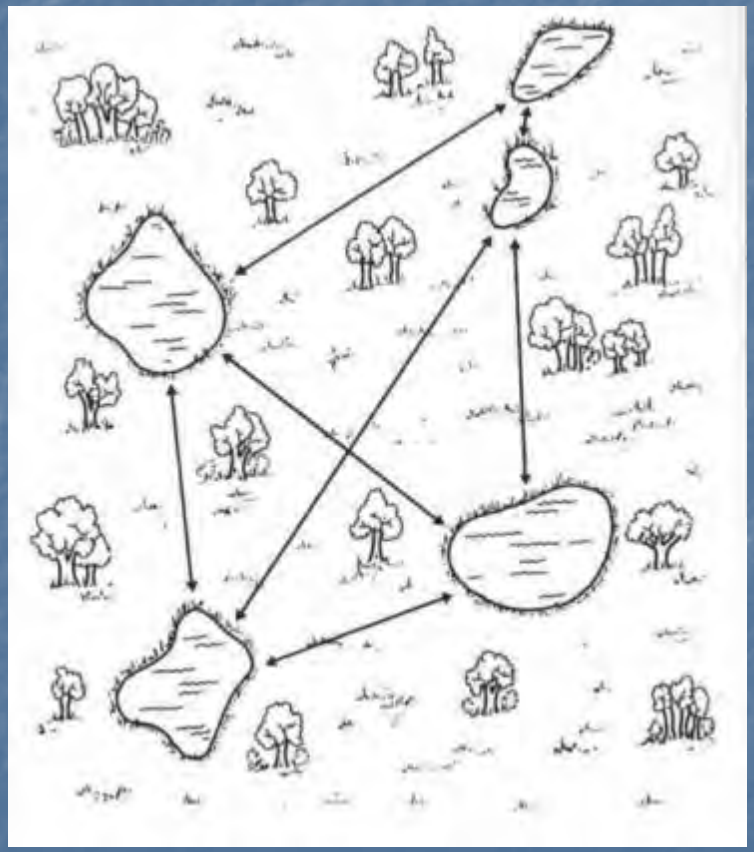
Maintaining Landscapes

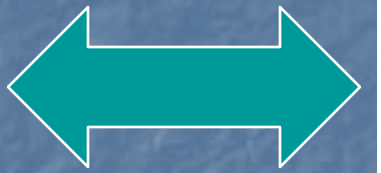
- Mow, burn, herbicide? Which will reduce fragmentation and habitat degradation?
- Avoid impacting an ample buffer around wetlands.
- If mowing, mow after turtle nesting season & avoid peak foraging & migration times.
- Set mower decks high (>6”) to avoid snakes and frogs or low (<2”) to discourage movement of herps into mowed areas.

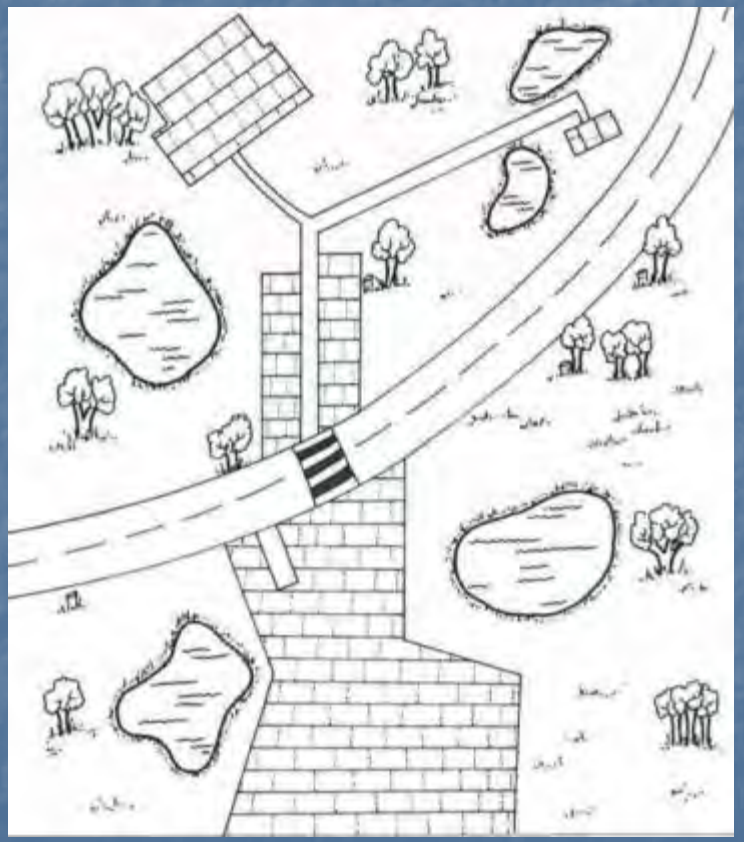
Managing Through Burning

- Inventory before burning to understand species using the site.
- Carefully consider potential impacts to vulnerable native animals populations and whether the actions can be modified or timed to reduce or eliminate mortality.
- Burn only when seasonally appropriate.
- Avoid burning brush piles and provide burn breaks around logs as these provide refugia in a fire.

Planning to Avoid & Reduce Fragmentation

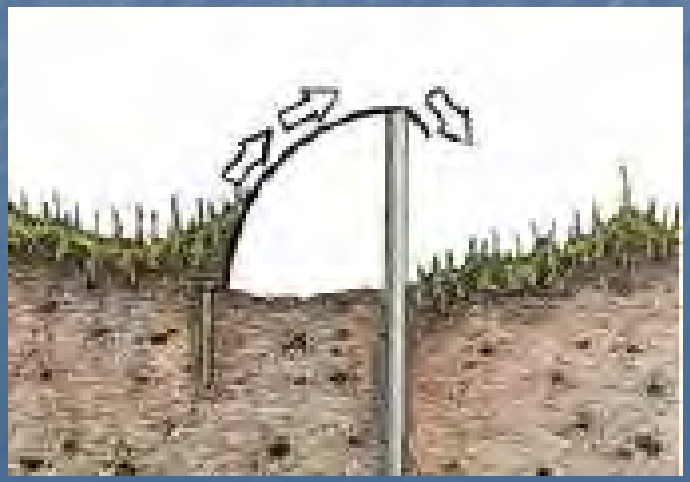


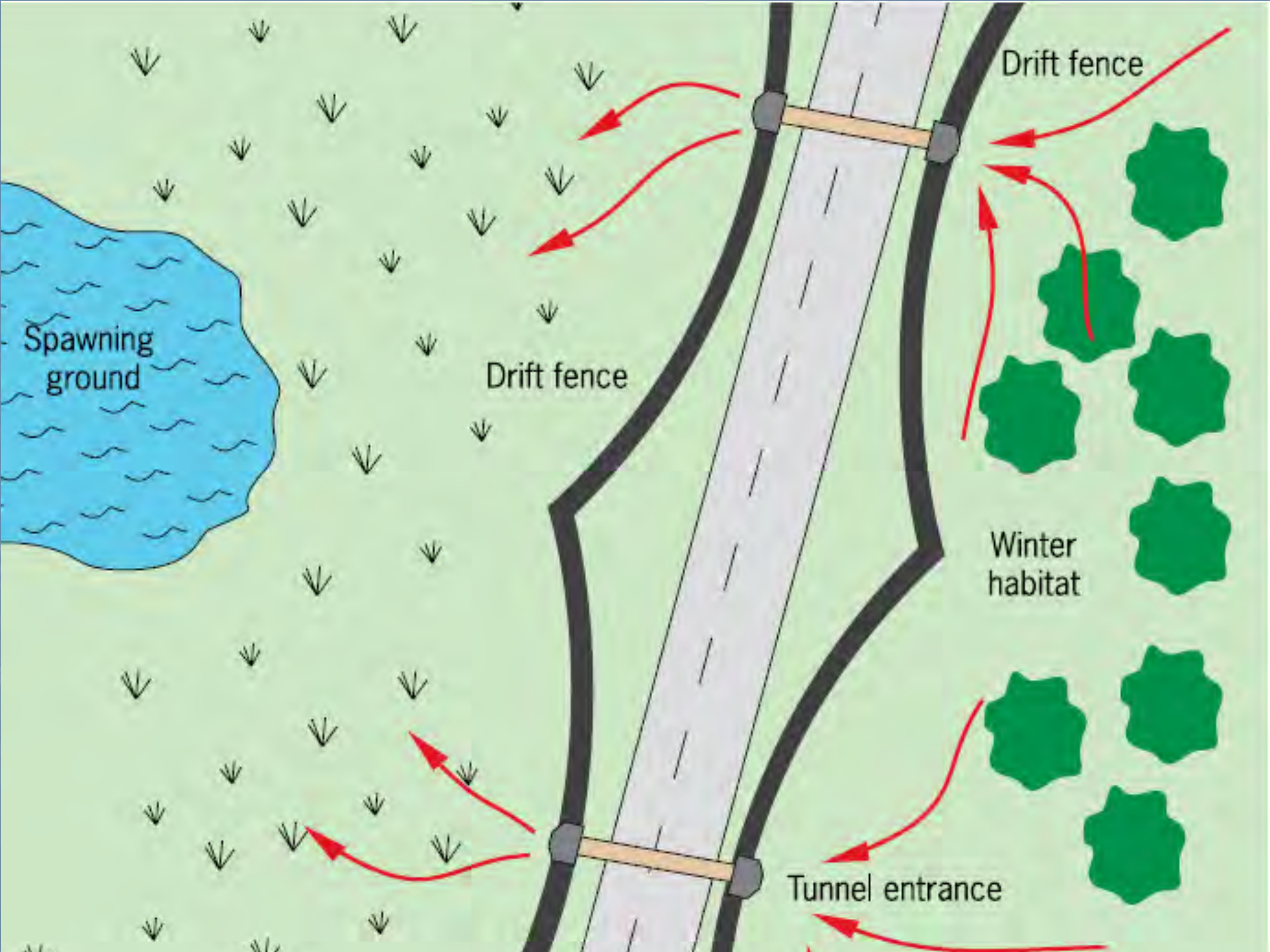




Increase Connectivity & Decrease Road Mortality

Tunnels and fence systems can alleviate some threats from roads



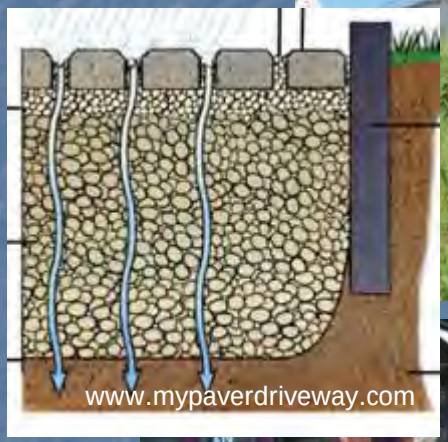

Drift fence
Spawning ground
Drift fence
Winter habitat
Tunnel entrance

Increase Connectivity & Decrease Road Mortality

After 220 millions years of success, human activities now threaten over two-thirds of all turtle species. It's time to give turtles a "brake"!!

Mitigate Runoff Pollution & Wetland Degradation

- Vegetated buffer
- Adequate buffer widths
- Stop it at the source: Rain gardens, bioswales, permeable pavement, green roofs, detention basins
- Increased vegetation canopy can help to increase herp habitat & wetland water quality

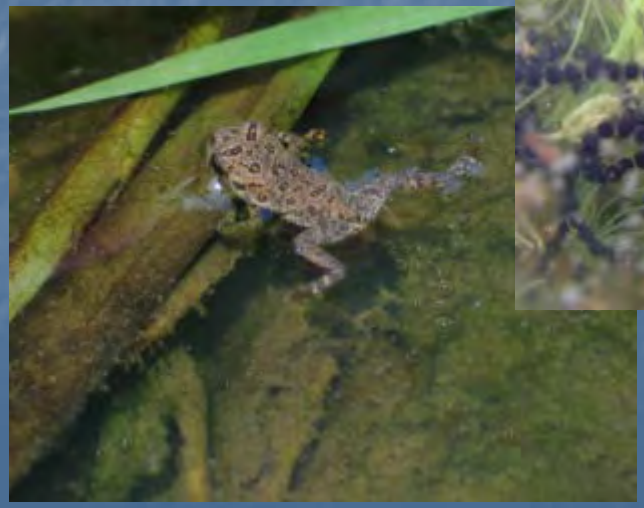


Invasives Control

- If chemical treatment is necessary, target areas without amphibians and reptiles or time application to minimize negative impacts.
- Use alternatives or know the true impacts prior to use.

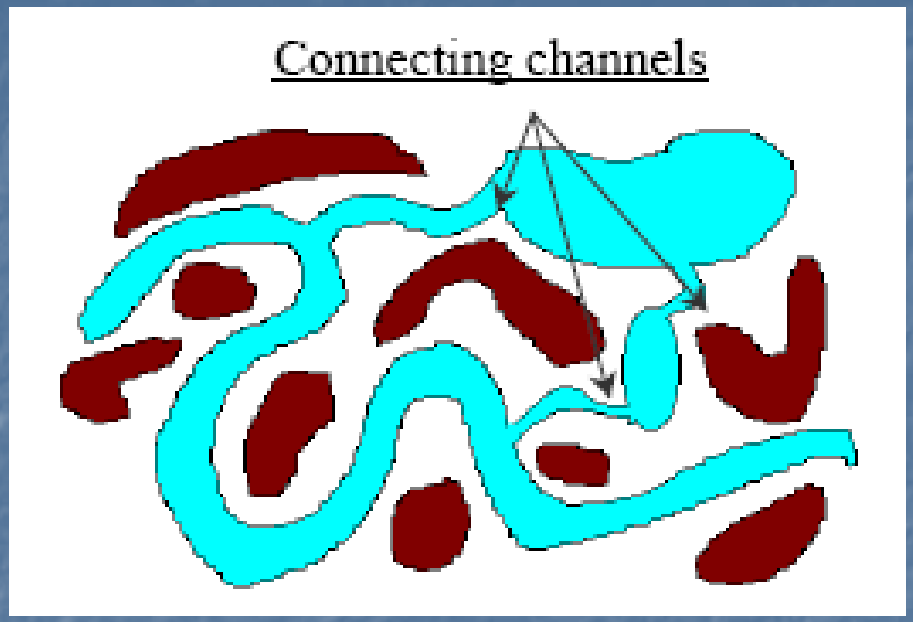
Wetland Mitigation & Restoration

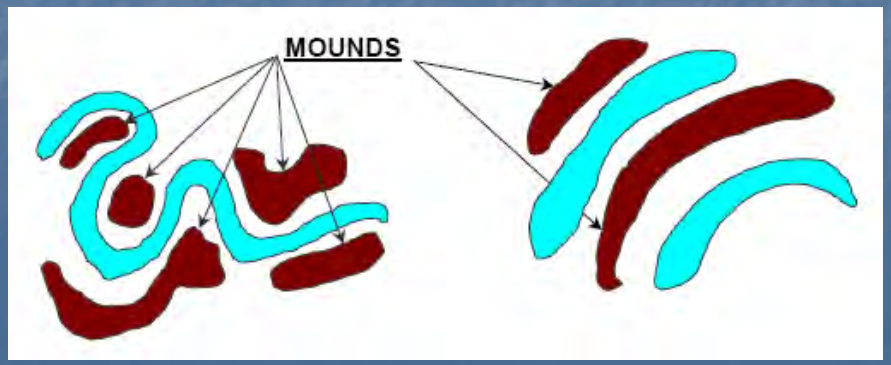
- Design using shallow gradients (1:15 to 1:20) to support a variety of herpetofauna and their prey items.
- Create microtopography to provide a variety of niches with unique hydroperiods.
- Focus on vegetative diversity to **drive** wildlife diversity.
- Consider reestablisment of previously extirpated species and translocation from sites slated for destruction.

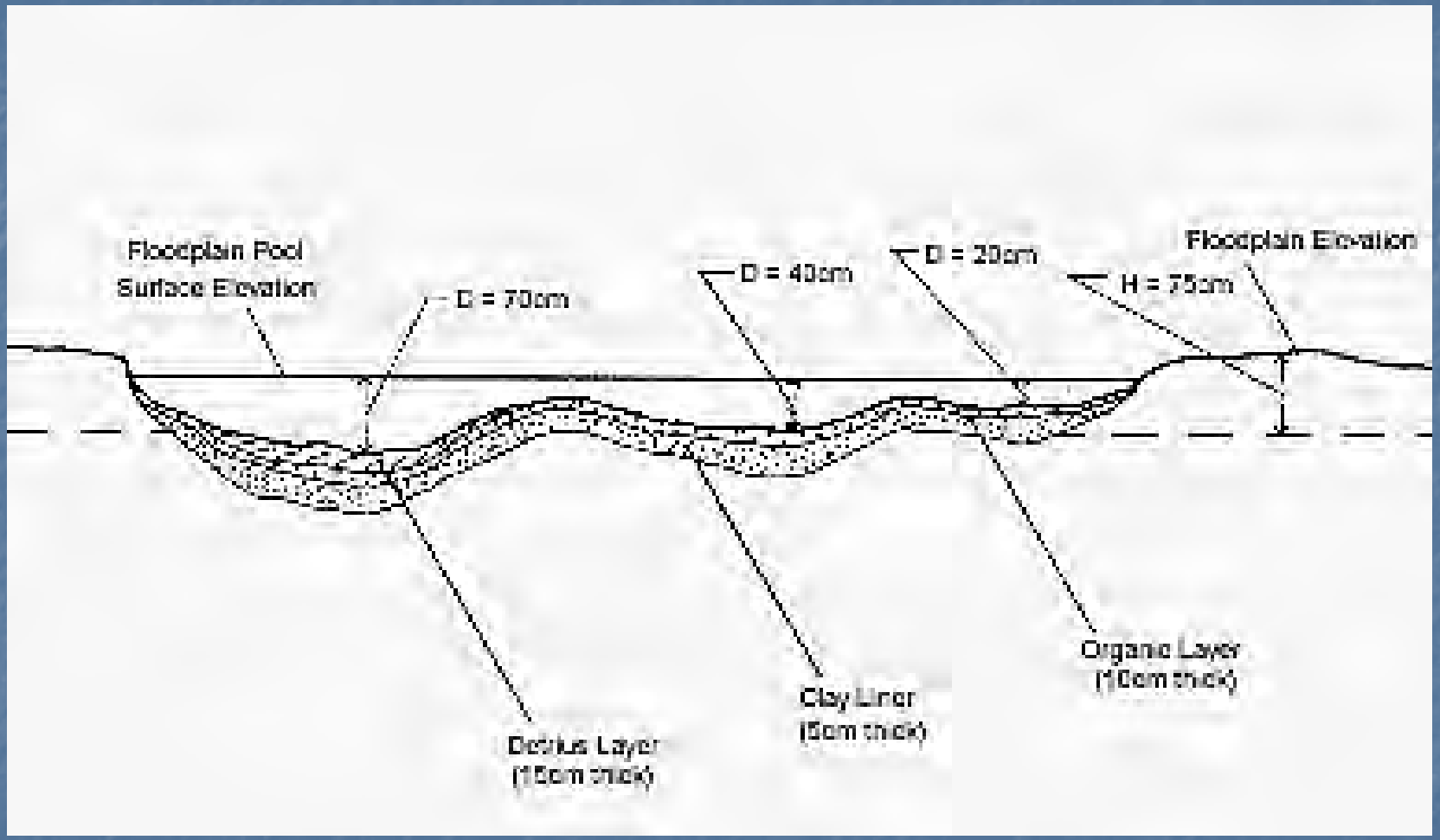


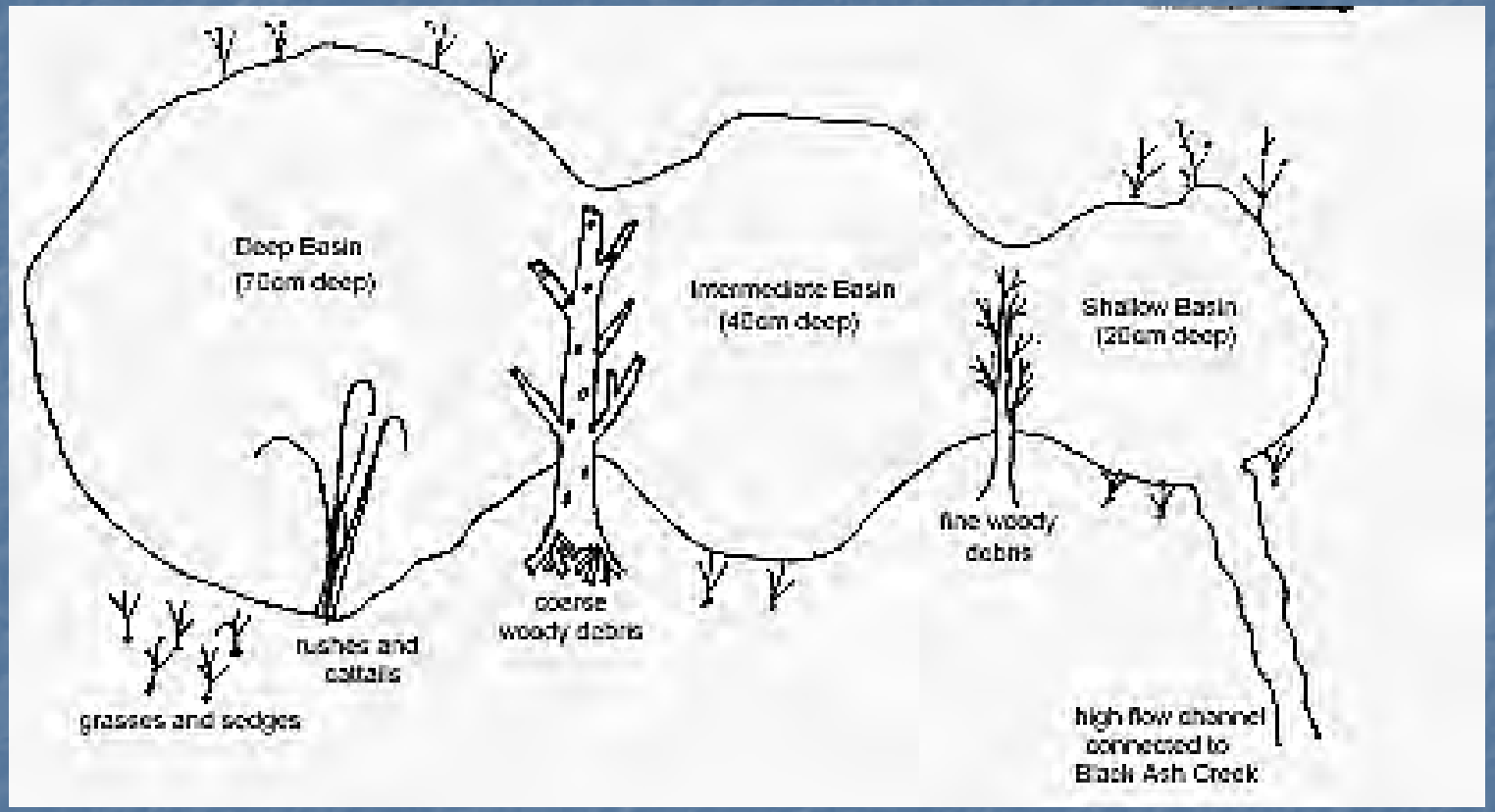
Topograhpy

- Excavate to change macrotopography and microtopography to create habitat suitable for a variety of herps
- Connect channels and change water levels
- Create habitat mounds, denning sites, nesting areas, greater plant diversity

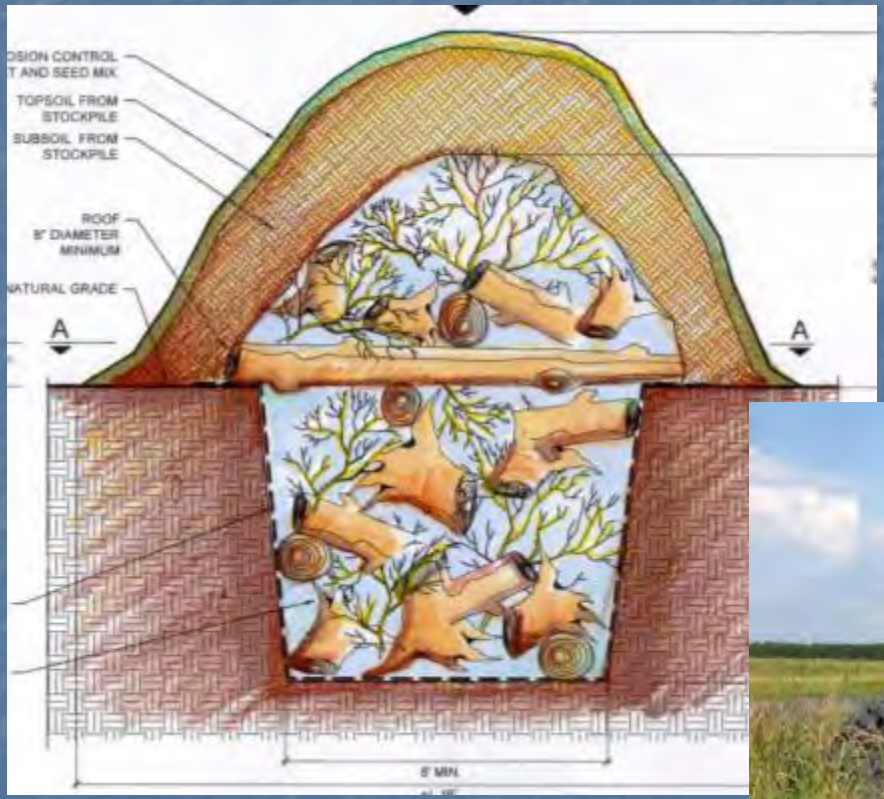




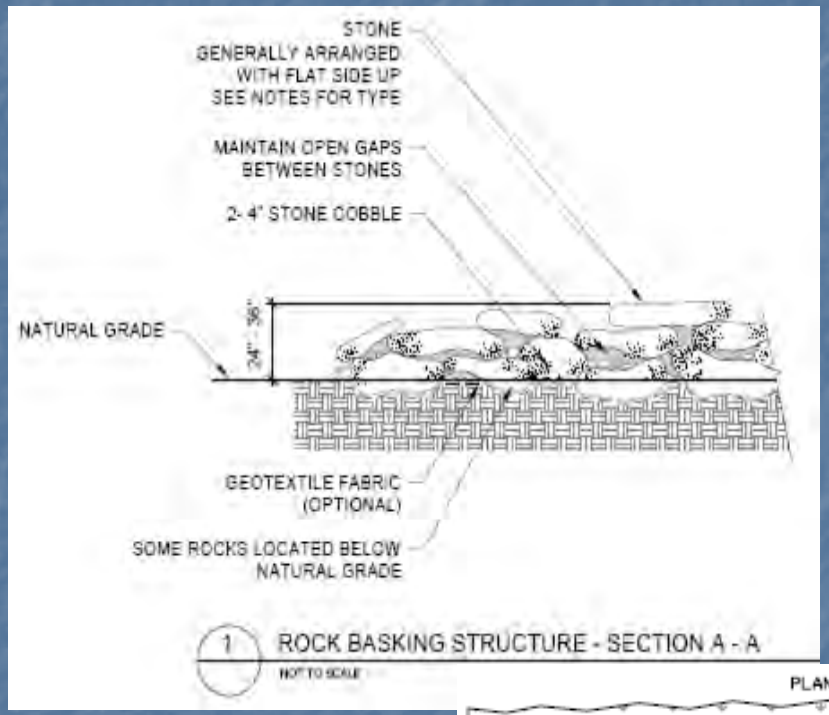

Floodplain Pool
Surface Elevation
D = 70cm
D = 40cm
D = 20cm
H = 75cm
Floodplain Elevation
Detritus Layer
(15cm thick)
Clay Liner
(5cm thick)
Organic Layer
(10cm thick)

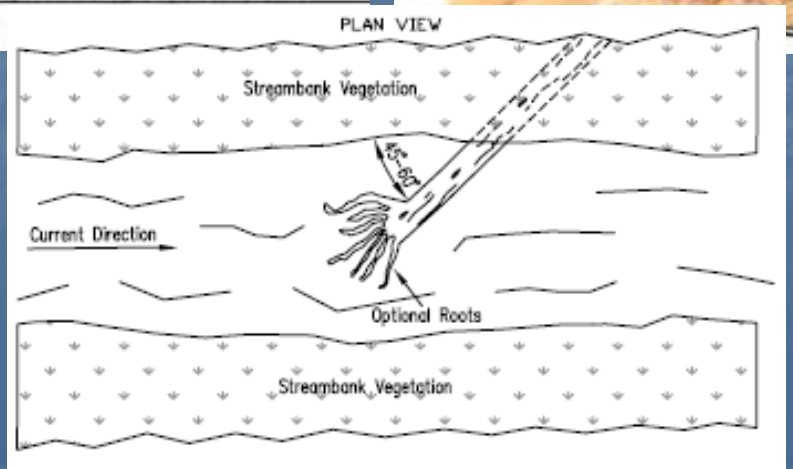

Deep Basin
(70cm deep)
Intermediate Basin
(40cm deep)
Shallow Basin
(20cm deep)
fine woody
debris
coarse
woody debris
rushes and
cattails
grasses and sedges
high flow channel
connected to
Black Ash Creek

Create Habitat Features: Refugia/Hibernacula

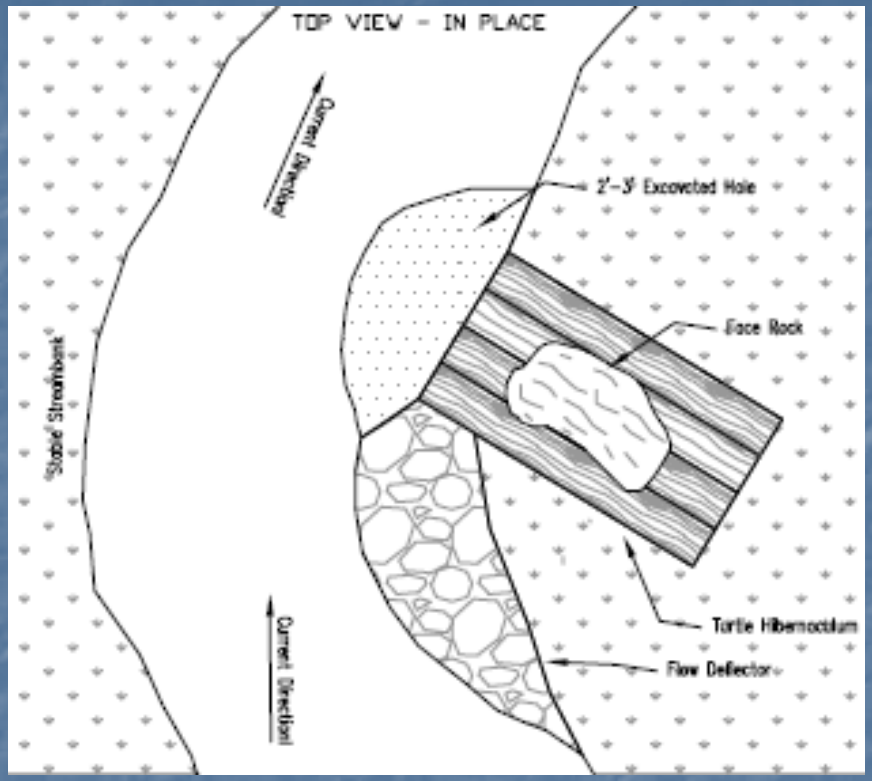


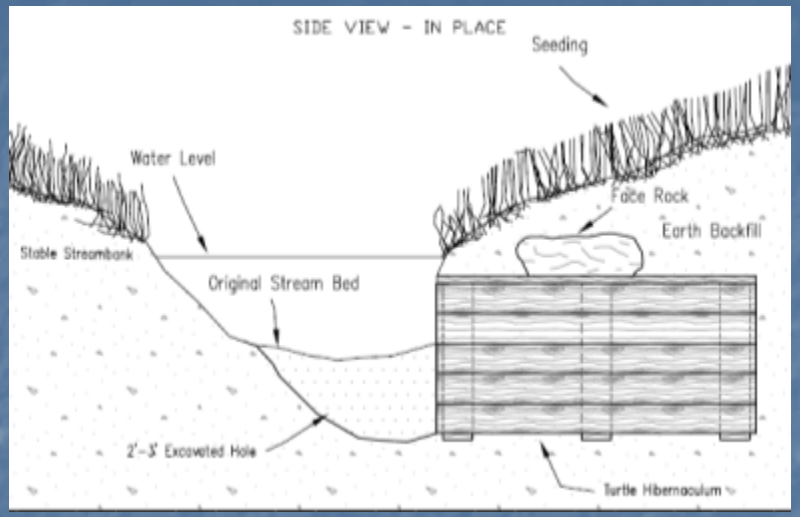
Basking & Escape Structures



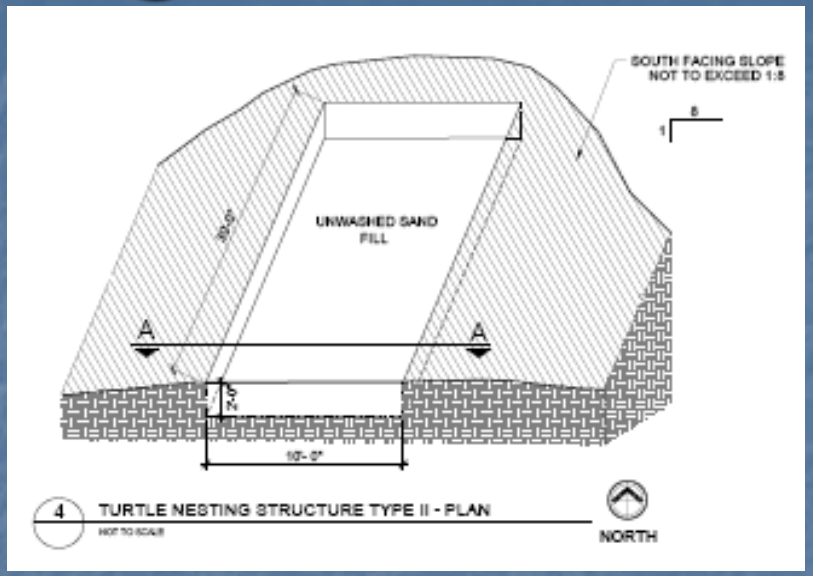


Turtle Hibernaculum





Turtle Nesting Site

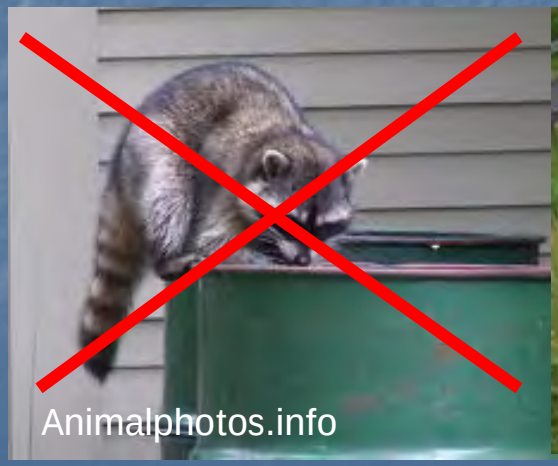


Conservation Strategy: Headstarting

Thoughtfully designed and properly overseen captive hatching and head-starting programs can increase the success of rare and declining herps.

Control Subsidized Predators

- Use aggressive control techniques to manage subsidized predator populations
- Educate the public about ecological and human safety concerns



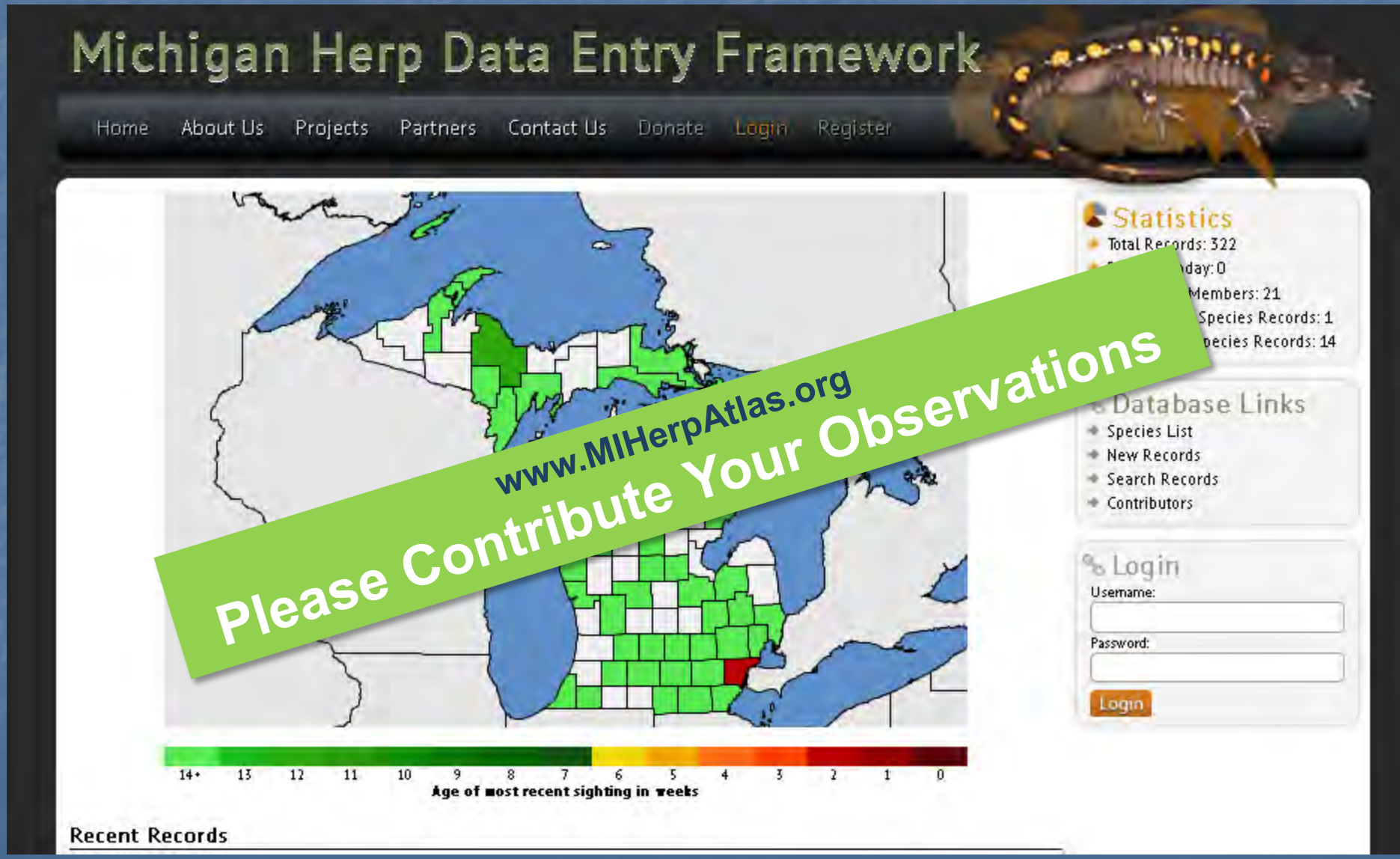
Public Awareness

- Simple strategies, such as placing signs, can inform the public about local species conservation needs
- MI Herp Atlas can bring information to the public, and the public can contribute information
- www.miherpatlas.org

Future Needs and Goals

- As data continues to be collected, BMP's will be updated to reflect current science
- Improved species protection and enforcement.
- Improved collaboration and data sharing.
- Greater understanding of species habitat use and needs
- Communication among various groups on historic, current, and future projects.
- Contributions by EVERYONE to build on species data for MI herps and resolve NUMEROUS data gaps statewide on amphibian and reptile species, distribution, viability, and stressors.
  - Its not what we know about MI herps that is alarming, it is what we don't know that should scare us!

Michigan Herp Atlas Online
www.miherpatlas.org



The BMP is a Community Effort

- A collaboration for herp conservation and best management.
- Contributions are welcome and encouraged.
- Suggestions for improving or adding sections
- Photos for highlighting various BMP components.
- Examples of herp friendly management and development techniques.

Questions?

Thank You!!!

(517) 522-3524 Office
(313) 268-6189 Mobile
DMifsud@HerpRMan.com
www.HerpRMan.com