THE MAGICAL, VITAL VERNAL POOL

BIODIVERSITY IN OUR BACKYARDS

MARK SOUTHERLAND

SEPTEMBER 26, 2019

SAFE SKIES MARYLAND

SIERRA CLUB

OUTLINE

What Are Vernal Pools?

- Definition
- How they are created
- Who lives there

Why Should We Care?

- Values to ecosystem and biodiversity
- Values for people

What Can You Do?

- Educate and enjoy
- Support inventory and preservation
- Build a backyard vernal pool

BY ANY OTHER NAME

- Vernal ponds
- Temporary ponds
- Ephemeral ponds
- Spring ponds
- **Seasonal pools**
- Semi-permanent pools
- Woodland pools
- Geographically isolated wetlands





La Aguada
Seasonal
Water Pools

DEFINITION

"Vernal pools are dynamic habitats with cycles of standing water and periodic dry downs that exclude permanent populations of predatory fish"

CHARACTERISTICS

- Isolated from permanent surface waters
- Small size and shallow depth
- Periodic drying hydrology
- Distinctive biological communities
- Woodland context (in our region)

ISOLATION

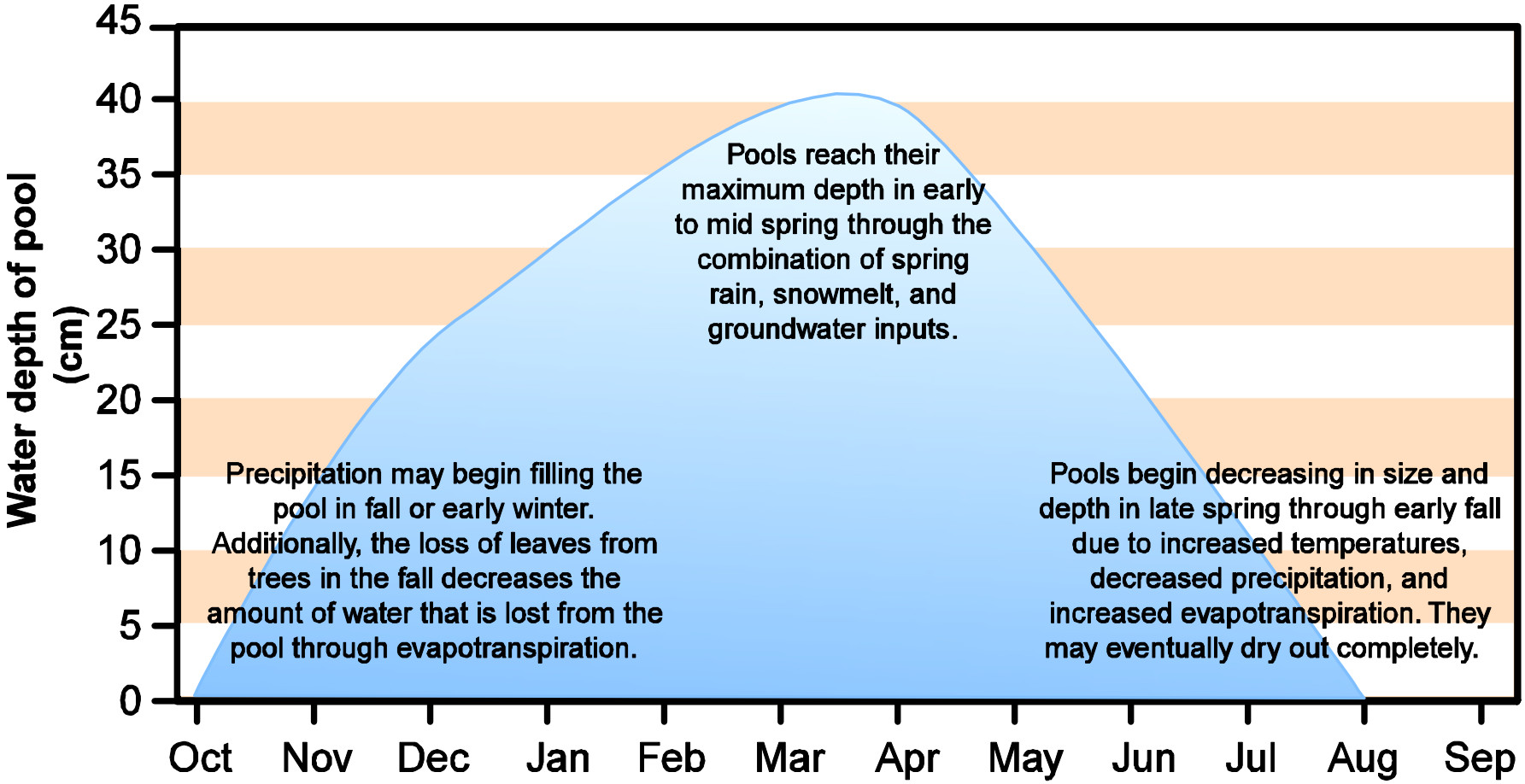
- **No permanent surface water connections** to other water bodies
- Depressions
  - Former stream channels
  - Floodplain ponds
  - Swales
  - Perched basins on relatively impermeable soils or bedrock
  - Woodland hollows
  - Pit-and-mound topography within woodland swamps
  - Human excavations e.g., cattle ponds
  - Rarely
    - Windthrow of forest tree
    - Roadside ditches

SMALL SIZE

- **Small and shallow** compared to lakes and other wetlands
  - Mixed by wind and oxygenated throughout
  - Warms rapidly which speeds amphibian development
- Size
  - Max area varies from 1m^2 to 20,000m^2 (5 ac)
  - Median max area 500m^2 (0.25 ac)
- Depth
  - Max depth 7 to 200 cm (3 in to 6 ft)
  - Median max depth 100 cm (3 ft)
- Patuxent Refuge
  - Max area of 78% < 0.1 ac
  - Max depth of 69% < 40 cm

HYDROLOGY

- **Water regime with alternating wet and dry periods** that fluctuate by season
  - Frequency varies from every year to only drought years
  - Wet of 2 month minimum (rainwater pools max at 2 weeks)
  - Deepest in spring but may fill in fall
- Regime varies with:
  - Regional climatic differences
  - Characteristics of depression and watershed
- Fills with water from:
  - Rainfall
  - Surface runoff
  - Intermittent stream flow
  - Groundwater
  - Overland flooding from nearby waterbodies
- Dries with increased temperature and evapotranspiration through vegetation


Water depth of pool (cm)
45
40
35
30
25
20
15
10
5
0
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Pools reach their maximum depth in early to mid spring through the combination of spring rain, snowmelt, and groundwater inputs.
Precipitation may begin filling the pool in fall or early winter. Additionally, the loss of leaves from trees in the fall decreases the amount of water that is lost from the pool through evapotranspiration.
Pools begin decreasing in size and depth in late spring through early fall due to increased temperatures, decreased precipitation, and increased evapotranspiration. They may eventually dry out completely.

DISTINCT BIOTA

No permanent fish populations

- Support animals that breed without fish (i.e., with vulnerable eggs or larvae)

Animals adapted to vernal pool drying

- Animals that leave on drying or with eggs/cysts that resist drying (cryptobiosis)

Plants are usually typical wetland species

- but some rare (e.g., swamp pink and Virginia sneezeweed)

DISTINCT BIOTA

Invertebrates

- Fairy shrimp, clam shrimp, seed shrimp
- Cladocerans, isopods, amphipods, copepods
- Caddisfly, midge, and mosquito larvae, beetles
- Snails, clams, mites, planaria, leeches, worms

Amphibians

- Breeding habitat for mole salamanders, wood frogs, and eastern spadefoots

Facultative Vertebrates

- Spotted turtle

WOODLAND CONTEXT

3 Life Zones

- Vernal pool depression
  - Maximum standing water
- Vernal pool envelope
  - 100 foot radius
  - Local effects on water quality
  - Where marbled salamanders lay in fall
  - High density of juveniles
- Vernal pool terrestrial habitat
  - 1000 foot radius
  - 95% of populations of vernal pool breeding amphibians
  - Watershed effects on water quality

HOW THEY ARE CREATED

Geologic processes

- Glacial
- Local erosion
- Migration of stream channels

Human alteration (especially in working agricultural landscapes)

- Quarries
- Farm ponds
- Detention basins
- Logging roads
- Ditches
- Clear cuts

Soils

- More organic with longer wet period and less decomposition
- Mud
- Emergent vegetation
- Sphagnum

Mid-Atlantic

- Delmarva Bays in Delmarva peninsular Coastal Plain
- Sinkhole ponds in Shenandoah Valley

HYDROLOGY TYPES

- Ephemeral < 2 months
  - Support only clam shrimp and toads
- Annual 2-12 months
- Semi-permanent > 12 months
- But also classify on two gradients:
  - Short or long cycle
  - Spring or fall filling

VEGETATION TYPES

- Vernal open-canopy pools (sedges, rushes, duckweed, ferns, sphagnum)
- Vernal scrub-shrub pools (spicebush, highbush blueberry, buttonbush)
- Vernal forest pools (yellow birch, ashes, oaks, hemlock, slippery elm)
- Vernal forested wetland pools
  - Buffer
  - Detritus
  - Shade
  - Evapotranspiration




WHY SHOULD WE CARE?

Ecological Services for Species

- Important breeding habitat for amphibians
- Support of aquatic and terrestrial food webs
- Stepping stones within the landscape

Ecological Services for People

- Pollution removal
- Groundwater replenishment
- Natural mosquito control
- Connection to nature

REMOVES POLLUTION

Removing pollutants from our water supply like kidneys for the landscape, vernal pool anoxic, wet soils capture and cleanse nitrogen pollution that originates from fertilized lawns and golf courses

REPLENISHES GROUNDWATER

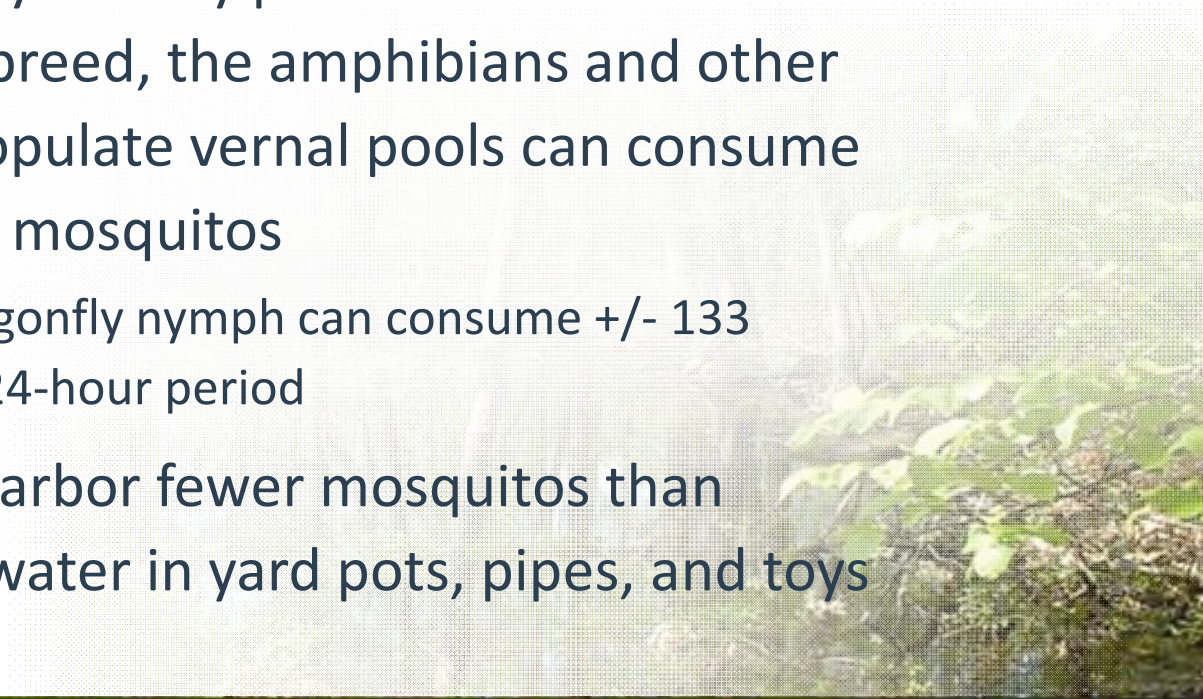
Vernal pools help recharge the groundwater that feeds our local wells by capturing and retaining snowmelt and rain water, so it infiltrates into the soil, replenishing groundwater resources.

NATURAL MOSQUITO CONTROL

While they may initially provide water for mosquitos to breed, the amphibians and other insects that populate vernal pools can consume any remaining mosquitos

- a single dragonfly nymph can consume +/- 133 larvae in a 24-hour period

Vernal pools harbor fewer mosquitos than smaller open water in yard pots, pipes, and toys



CONNECTION TO NATURE

Biodiversity

- Unique amphibians
- Unique invertebrate community
- Connectivity for metapopulations and genetic diversity

Rare species

- Tiger salamander is state-listed endangered in NJ, MD, DE, and VA
- 26% of all state-listed amphibian species in Mid-Atlantic depend on vernal pools

BIODIVERSITY




INVERTEBRATES



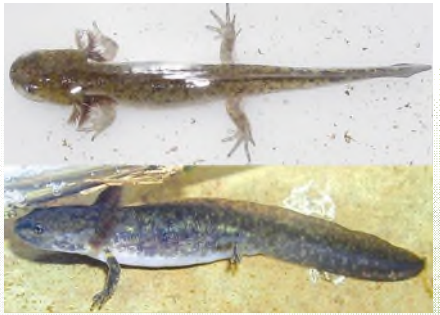




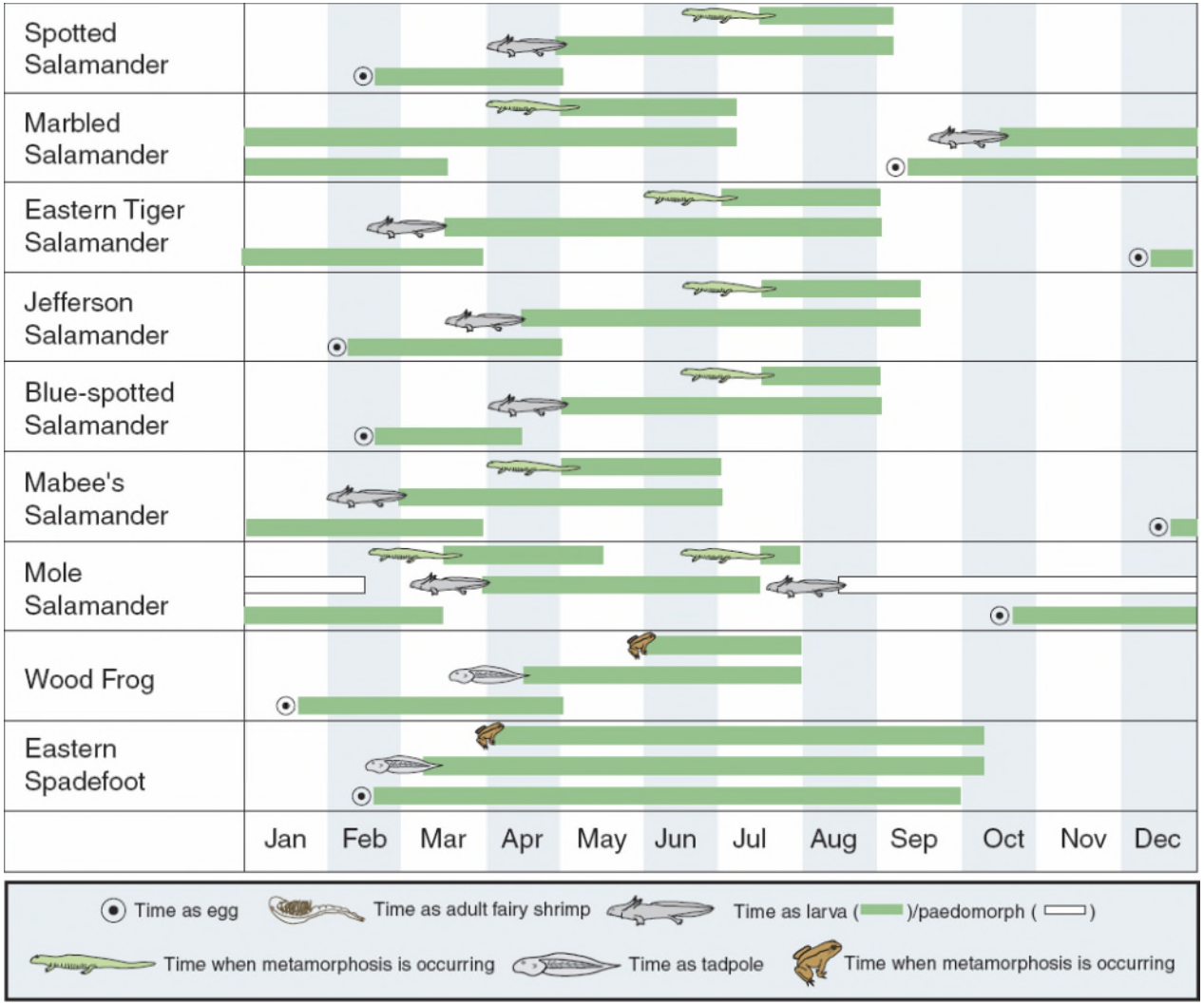


AMPHIBIANS




WHY SHOULD WE CARE?



SPOTTED SALAMANDER

(Ambystoma maculatum)

Indicator Species

4.4 – 7.8 inches
(11 – 20 cm)

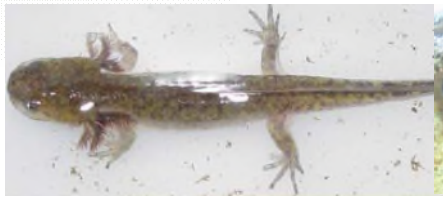
Bright yellow to orange spots on black to bluish-black body

Habitat includes deciduous, mixed deciduous-coniferous, and coniferous forests; breeds in seasonal pools

Protected: Del., N.J., Va.

Description: p. 49

75 to 110 eggs per mass; clear or opaque white; globular and very firm; attached to vegetation



Hatchlings dull olive with no markings

Older larvae greenish-yellow, light ventrally; no markings on chin and throat; tail fin mottled with black

MARBLED SALAMANDER

(Ambystoma opacum)

Indicator Species

3.5 – 4.3 inches
(9 – 11 cm)

Silvery-white or gray markings or bands on black body

Habitat includes deciduous, mixed deciduous-coniferous, and coniferous forests; breeds in seasonal pool beds

Note: Unlike the other *Ambystoma spp.* that breed during spring, *A. opacum* breeds during fall

Protected: Del., N.J., Va.

Description: p. 50

WHY SHOULD WE CARE?

37 to 130 eggs per mass; often appear black from clinging dirt; egg mass not held together by an outer envelope, but grouped in a cluster

Hatchlings light gray, becoming brown; row of light spots on sides below limbs; older larvae light olive to brown or black; pale spots on head and light yellow-green blotches on back and tail; throat and underside pigmented; row of light spots on sides below limbs

EASTERN TIGER SALAMANDER

(Ambystoma tigrinum tigrinum)

Indicator Species

Photo: John F. Bunnell

7 – 8.3 inches
(17 – 21 cm)

Yellowish markings on dark brown or black body

Habitat includes moist deciduous, mixed deciduous-coniferous, and coniferous forests; breeds in seasonal pools or fishless permanent pools; favors sandy soils

Endangered: Del., N.J., Va. Extirpated: Pa.
Threatened: Md.

Description: p. 51

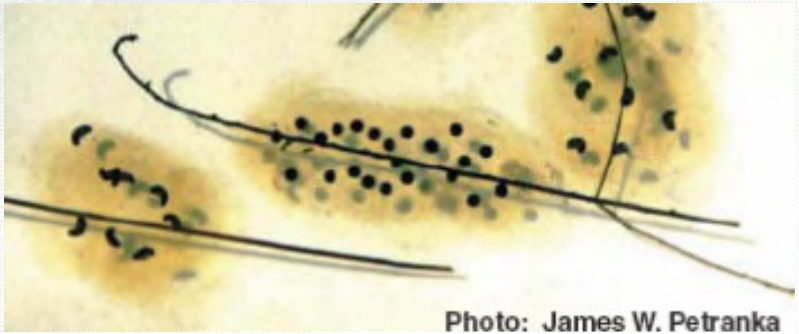


Photo: James W. Petranka

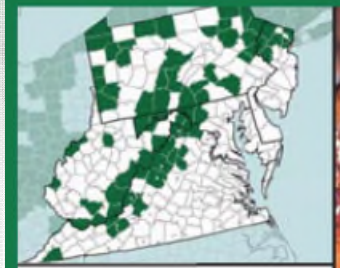
30 to 60 eggs per mass; masses 2 to 2.8” diameter; globular or oblong; initially firm but becoming loose; attached to twigs or vegetation in water

Hatchlings gray or yellow-green; dark bands along back; older larvae olive-green or dark brown with black markings; light undersides; throat

JEFFERSON SALAMANDER

(Ambystoma jeffersonianum)

Indicator Species



4.3 – 7.5 inches
(11 – 19 cm)

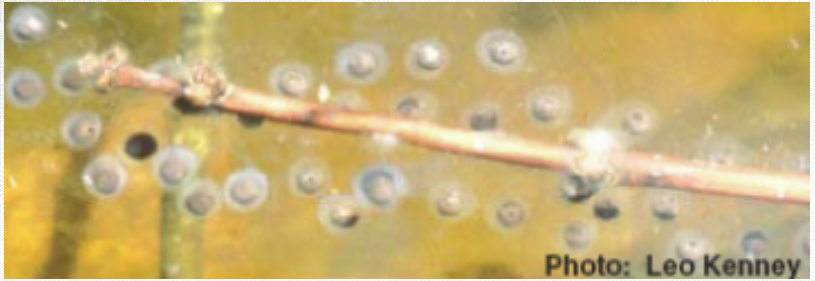
Light blue-gray flecks on brown or gray body

Habitat includes deciduous forests; breeds in seasonal pools or fishless permanent pools

Protected: N.J., Va. Watch list: Md., W. Va.

Description: p. 53

WHY SHOULD WE CARE?



10 to 75 eggs per mass; egg masses clear and cryptic; cylindrical on branches and irregular on grasses; intermediate firm matrix

Olive green to brown; hints of yellow on sides of neck, head, and dorsal fin; older larvae grayish with heavy mottling on dorsal fin

WOOD FROG
(Rana sylvatica)
Indicator Species

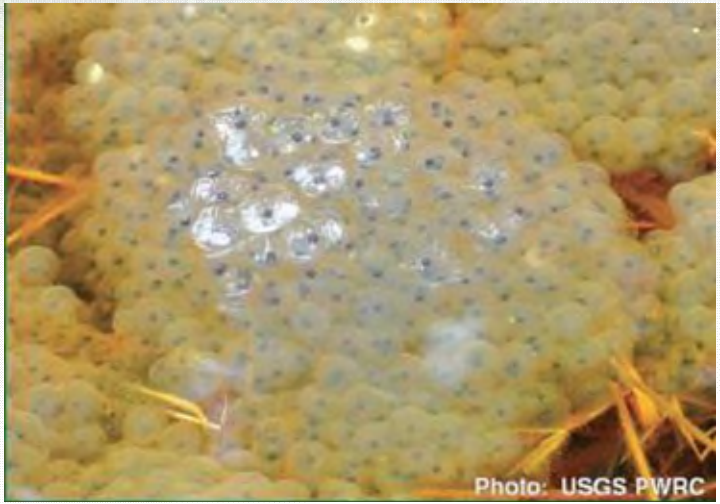
1.4 – 2.8 inches
(3.5 – 7 cm)

Brown or red-brown with characteristic chocolate mask; white underbelly; two ridges extend along sides of back

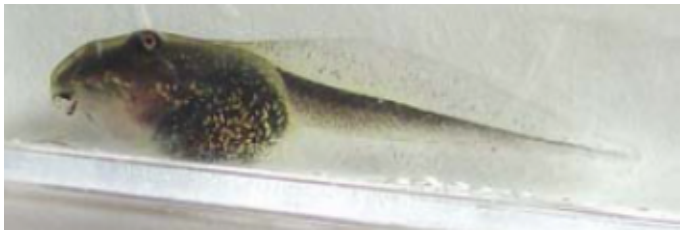
Habitat includes moist or lowland deciduous woods; breeds in fish-free seasonal and sometimes permanent pools

Protected: Del., N.J., Va.

Description: p. 57



500 to 1000 eggs per mass; clear globular masses with no outer jelly matrix; grape cluster appearance; often attached to twigs and stems and deposited communally



Hatchlings black; older larvae dark with gold flecking; pale underbelly; TL to 50-mm

EASTERN SPADEFOOT

(Scaphiopus holbrookii)

Indicator Species

1.8 – 3 inches
(4.4 – 7.3 cm)

Smooth skin with scattered warts; sharp black spades on hind feet; vertical pupils and yellow eyes

Habitat includes floodplains of streams and rivers, woods, meadows, or fields with loose, sandy soils; breeds in seasonal pools

Note: Eastern spadefoots primarily breed in seasonal pools with short hydroperiods, including ephemeral pools.

Protected: Del., N.J., Va.
Watch List: W. Va.

Description: p. 59

WHY SHOULD WE CARE?

Up to 2500 eggs per mass; strands or bands 1-2” wide and up to 12” long; attached to underwater or floating vegetation in shallow pools

Dorsal close set eyes; pointed beak-like snout; broad body, dark bronze to brown; belly translucent to yellow internal organs visible; tail short and rounded; TL to 35-mm

FACULTATIVE FROGS

Spring Peeper

Gray Treefrog

American Toad

Pickerel Frog

Green Frog

American Bullfrog

RARE FROGS IN MARYLAND

Barking Treefrog
Endangered

Eastern Narrow-mouthed Toad
Endangered

Carpenter Frog
In Need of Conservation

MOLE SALAMANDERS NOT IN MARYLAND

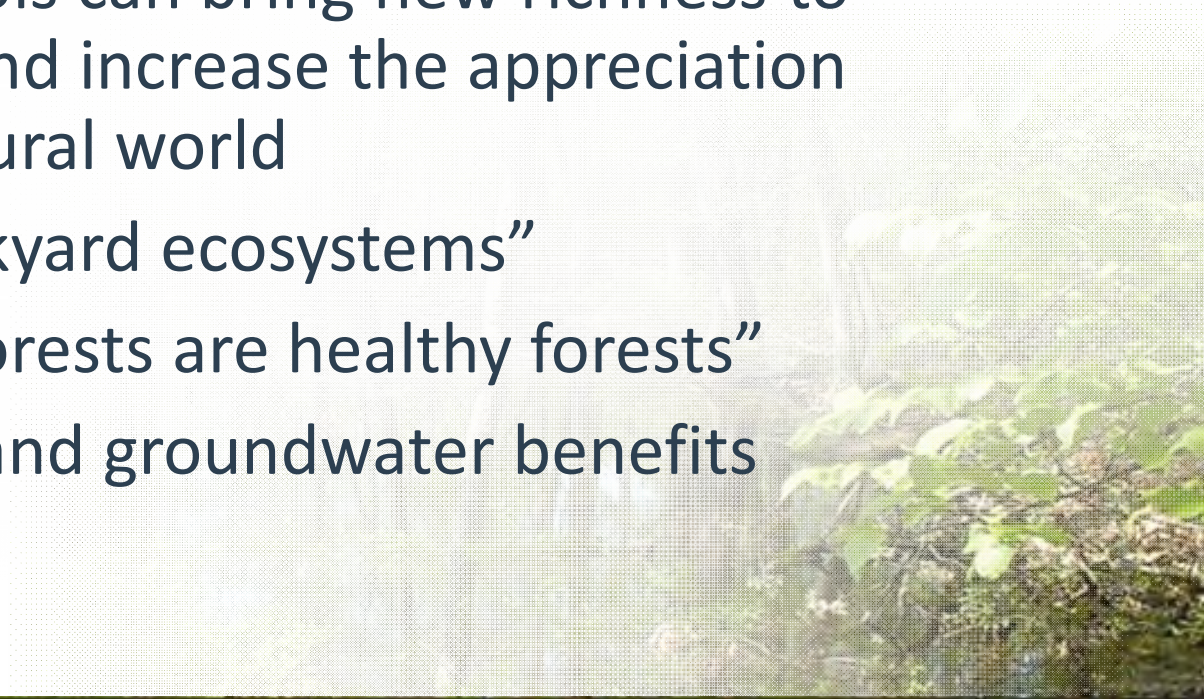
Blue-spotted salamander

Mole salamander

Mabee's salamander

OUR QUALITY OF LIFE

- Vernal pools can bring new richness to your life and increase the appreciation of the natural world
- “True backyard ecosystems”
- “Singing forests are healthy forests”
- Pollution and groundwater benefits
- Ethics



WHAT CAN YOU DO?

No one cares about what they don't understand

- The more we know, the more we care

Vernal pools exist in woods near you

- Get out and enjoy them

Do your part to protect vernal pools

- Support inventories and preservation
- Create pools to replace lost biodiversity

EDUCATE AND ENJOY

- Visit vernal pools in your neighborhood or parks—both day and night
- See the IMAX movies at Maryland Science Center—”Backyard Wilderness”
- Tell your friends

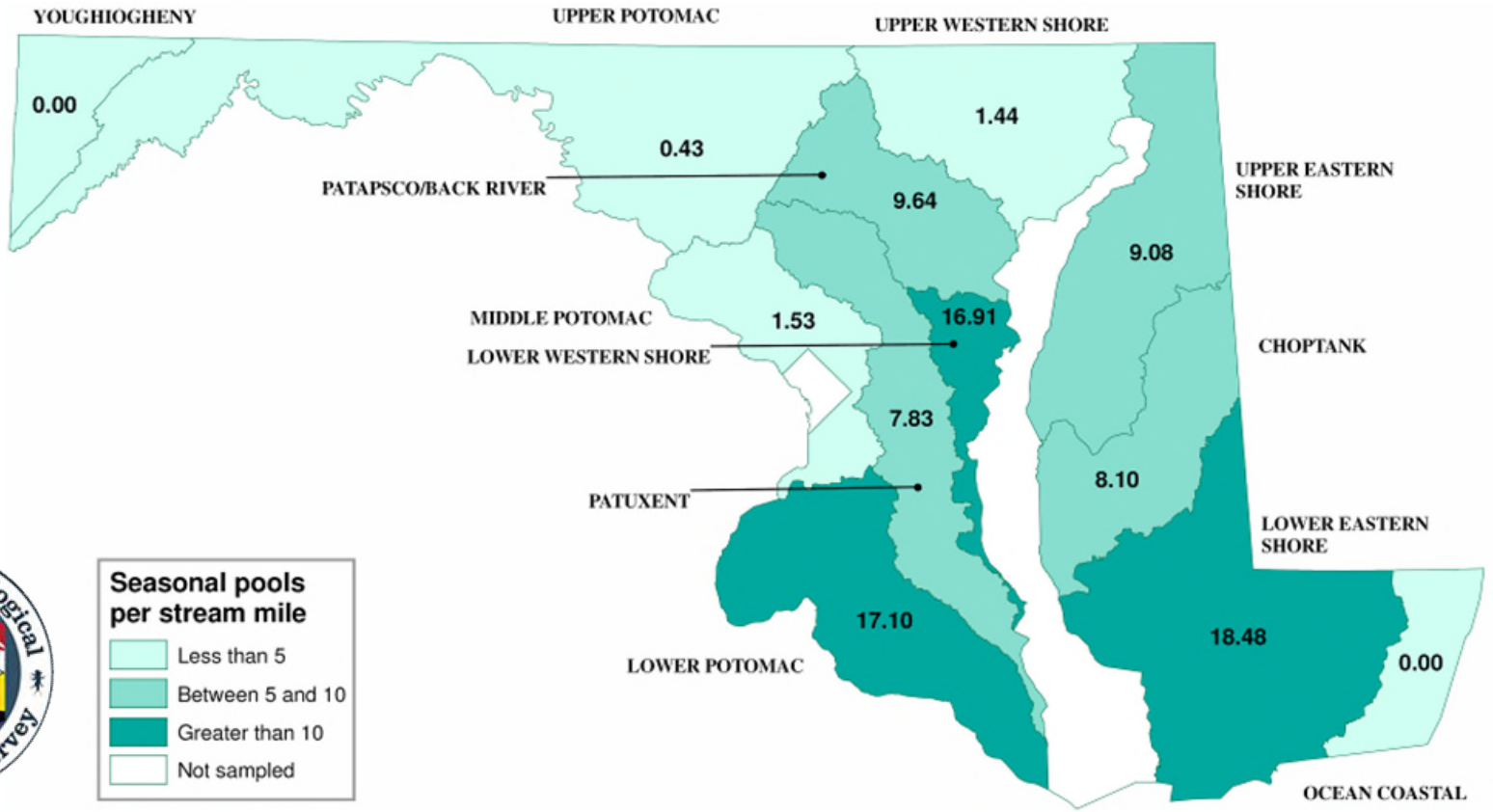
CONSERVE AND CREATE

- How many vernal pools do we have, where are they, and how can they best be conserved?
- How can vernal pools be created to replace lost pools and biodiversity?

INVENTORY AND CONSERVATION

- Many states, including California, Maine and Massachusetts, have robust inventories and strict laws protecting vernal pools from destruction
- Trump administration's new WOTUS rules would eliminate any federal protections for vernal pools
- Maryland and Howard County can take action to inventory and protect vernal pools

NUMBER OF SEASONAL POOLS IN STREAM CORRIDORS BY TRIBUTARY BASIN

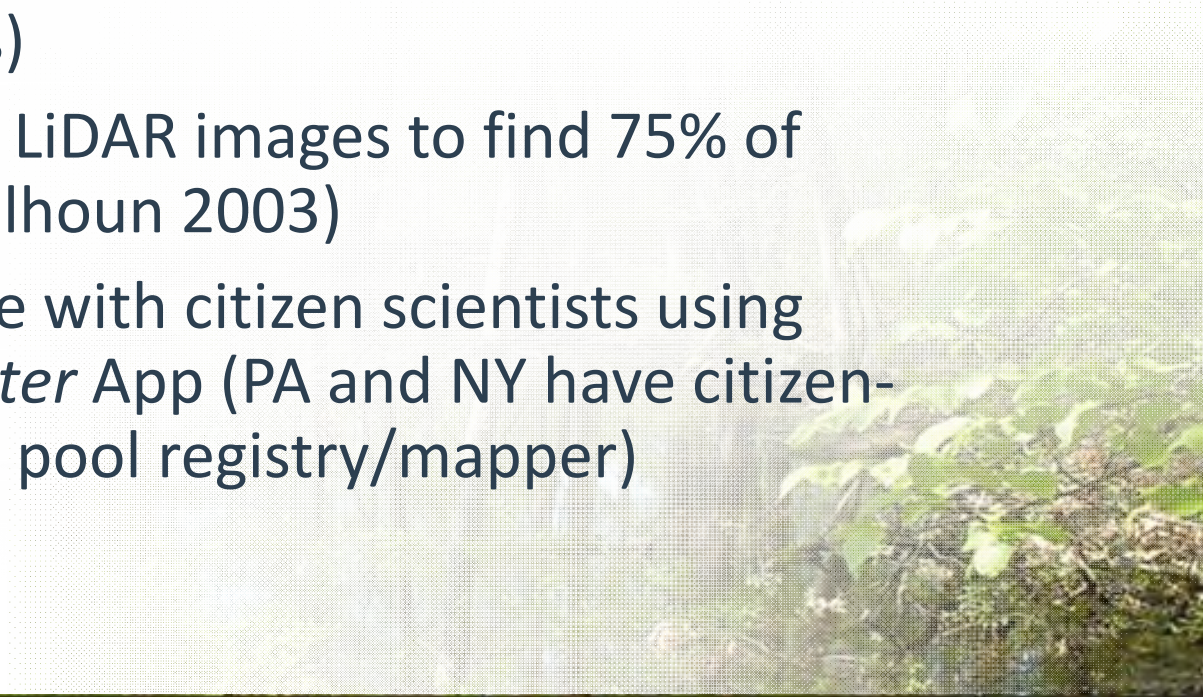


SEASONAL POOL OCCUPANCY

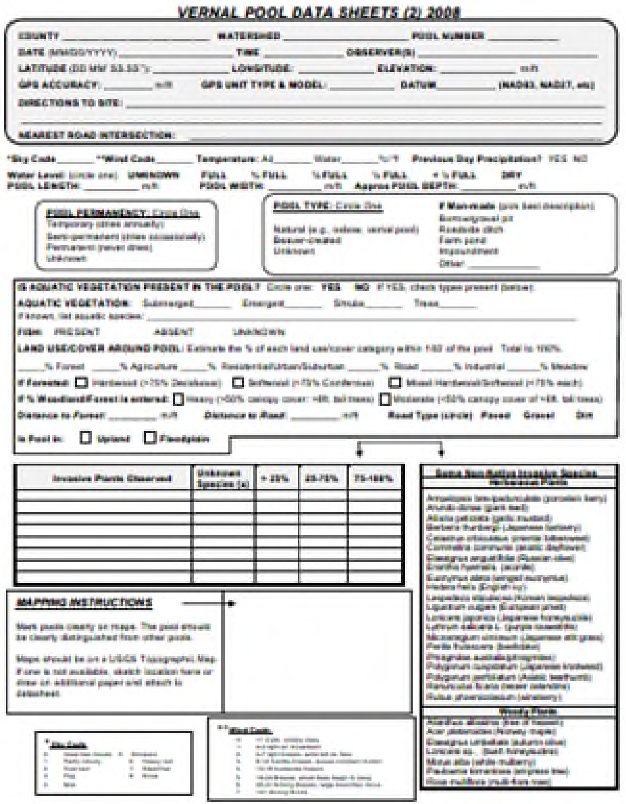
- About 25% were occupied (38% in Piedmont)
  - amphibian, turtle, fish, or fairy shrimp species
- Only 10% occupied by obligate species (24%)
  - Wood frog, spotted and marbled salamanders, fairy shrimp
- Wood frog was the most common

NEW PROPOSED INVENTORY

- Estimate overall abundance from streams (NJ and VA studies show 10% more vernal pools in upland areas)
- Use aerial or LiDAR images to find 75% of locations (Calhoun 2003)
- Crowd source with citizen scientists using *Water Reporter* App (PA and NY have citizen-based vernal pool registry/mapper)



WHAT CAN YOU DO?


VERNAL POOL DATA SHEETS (2) 2008

COUNTY ______ WATERSHED ______ POOL NUMBER ______
DATE (MM/DD/YYYY) ______ TIME ______ OBSERVER(S) ______
LATITUDE ______ LONGITUDE: ______ ELEVATION: ______ m/ft
GPS ACCURACY: ______ m/ft GPS UNIT TYPE & MODEL: ______ DATUM ______ (NAD83, NAD27, etc)
DIRECTIONS TO SITE: ______
NEAREST ROAD INTERSECTION: ______

POOL PERMANENCY: Circle One
POOL TYPE: Circle One

MAPPING INSTRUCTIONS

BUILD A VERNAL POOL

WHAT CAN YOU DO?

Scope out your site

- Any permits?
- Level ground

Size your vernal pool

- 5 to 30 foot diameter
- Max depth of 14 in in shade and 20 in sun

Dig out the site

- 10% or less slope
- Remove sharp sticks and stone to protect liner

Line the bottom

- Sandwich liner between geotextile pads
- Anchor the edges of liner with stacks every 18 in
- Add 6 in of soils to liner, maintaining slope

Fill your vernal pool

- Plant native seeds and mulch edges
- Add branches and logs for habitat
- Fill with hose to ensure it holds water and let it dry naturally


Magma Design Group - Pond Build

SOURCES

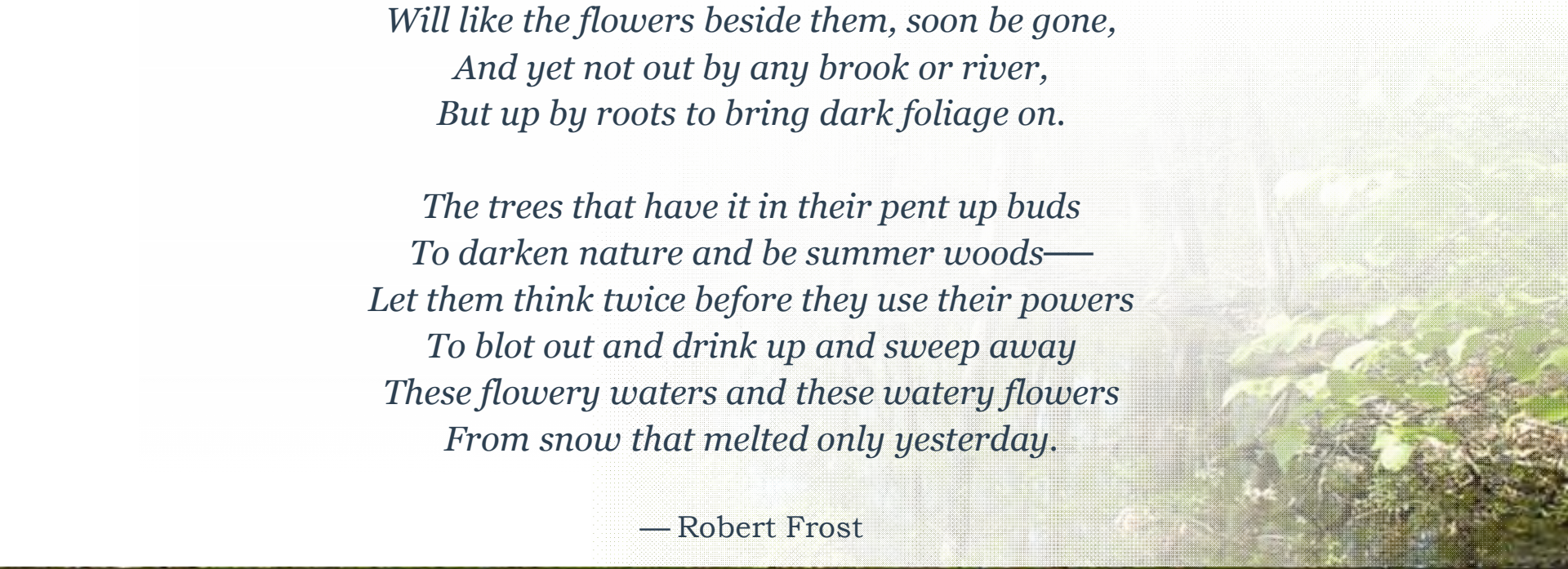
- **Lesley Brown and Robin Jung, *An Introduction to Mid-Atlantic vernal Pools,* EPA, 2005**
- Elizabeth Colburn, *Vernal Pools: Natural History and Conservation*, 2004
- *Maine's Citizen's Guide to Locating and Documenting Vernal Pools*, 2003
- Thomas Biebighauser, *A Guide to Creating Vernal Ponds*, 2003
- Henry Wilbur, Complex life cycles, *Annual Review of Ecology and Systematics* 11:67-93, 1980

SPRING POOLS

These pools that, though in forests, still reflect
The total sky almost without defect,
And like the flowers beside them, chill and shiver,
Will like the flowers beside them, soon be gone,
And yet not out by any brook or river,
But up by roots to bring dark foliage on.

The trees that have it in their pent up buds
To darken nature and be summer woods——
Let them think twice before they use their powers
To blot out and drink up and sweep away
These flowery waters and these watery flowers
From snow that melted only yesterday.

— Robert Frost



JUST OUTSIDE IN YOUR BACKYARD