Top Five Pond Inquiries

…or Is That Seven?

…or Maybe Even Eight?!

Eugene Braig, Program Director, Aquatic Ecosystems Extension

THE OHIO STATE UNIVERSITY

COLLEGE OF FOOD, AGRICULTURAL, AND ENVIRONMENTAL SCIENCES

School of Environment & Natural Resources

Some Pond Management References

- Austin, M. et al. 1996, 2015. Ohio pond management handbook: a guide to managing ponds for fishing and attracting wildlife. Ohio Department of Natural Resources, Division of Wildlife, Columbus, OH.
  - https://ohiodnr.gov/wps/portal/gov/odnr/discover-and-learn/safety-conservation/stewardship-citizen-science/pond-management
- USDA. 1982, 1997. Ponds—planning, design, construction: agriculture handbook 590. U.S. Department of Agriculture, Washington, DC.

- Many older pond-management fact sheets available via correspondence:
  - braig.1@osu.edu
- My virtual open “office” hours (by appointment):
  - https://senr.osu.edu/extensionoutreach/ponds-fisheries-aquatics/open-pond-clinic-zoom
- Occasional newsletter articles:
  - https://senr.osu.edu/extensionoutreach/ponds-fisheries-aquatics
- My listserv:
  - https://lists.osu.edu/mailman/listinfo/pond-management-news

Consultations with my office

General topic	Percent frequency				
	2015 (*N* = 247)	2016 (*N* = 294)	2017 (*N* = 278)	2018 (*N* = 253)	2019 (*N* = 260)
Aquatic plant management	14	18	19	21	17
General pond/lake management	17	12	7	13	13
Filamentous green algae	6	13	9	7	—
Harmful algal blooms	15	8	7	—	11
Wild aquatic organisms	—	—	9	10	6
Fish kills	—	10	—	7	5
Fisheries management	6	—	—	—	—

- Top five per year.

Relatively high rankers that didn't quite make the cut

- Aquatic invasive species
- Construction/Dredging
- Pond leaks/Levee erosion
- Persistently muddy water
- Specifically, *Euglena* blooms (recent, substantial upswing)

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- Pond leaks/Levee erosion
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- Specifically, *Euglena* blooms (recent, substantial upswing)

Top Five (Seven?) Pond Inquiries

The Outline (and ranking):

- General pond/lake management (2)
- Managing aquatic plants (1)
- Filamentous green algae (3)
- Harmful algal blooms (4)
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- Fish Kills (6)
- Wild aquatic organisms (5)
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Managing aquatic plants

- Prevention:
  - Pond construction: max depth (typically at least 8 or 12 feet) and slope (3:1).
  - Manage nutrients proactively (external vs. internal sources).
  - Dyes applied in early season (greatest benefit with increasing depth and retention time).

(Eugene Braig 2016)

Managing aquatic plants

- Tolerance:
  - Beneficial competition against nuisance organisms and serves as valuable habitat (two considerations: 1. species diversity and 2. natives).
  - Ordinarily **5–20% in ponds with fisheries considerations** (literature recommendations vary widely: certainly, higher is possible for ponds without fisheries concerns and much higher is possible for ponds without fish).
  - Drawback: excessive coverage contributes to wide oxygen fluctuations and can stunt fish.
  - Drawback: requires active management and some savvy.

(Eugene Braig 2016)

Managing aquatic plants

- Treatment:
  - **Only use herbicides specifically labeled for aquatic applications.**
  - **Read, understand, and strictly adhere to the label, including use restrictions and safety info.**
  - Treatment generalizations (there are exceptions):
    - **Submerged spp.**: treat as early (1. target present and 2. effective temperature reached) and conservatively as possible.
    - **Emergent perennials**: later in season, after inflorescences have largely matured.
  - Whole water vs. spot treatments.
  - **Warm-water caveat** (as surface-water temperatures approach low–mid 70s°F).

(Scott Heidrich 2011).

Managing aquatic plants

- Treatment:
  - Mechanical harvest/Weeding.
  - **Triploid Grass Carp/white amur (2–10 per acre)** are not silver bullets.
    - Diet preference.
    - Relationship to nuisance algae.
    - Long lived.
    - Dense stocking and beneficial vegetation.
    - A clearly subjective opinion (forgive me)…

(Scott Heidrich 2011).

Aquatic herbicide chemical Name	Absorption	Selectivity	Water-Use Restrictions
Copper (copper sulfate and copper chelates)	Contact	Broad	Minimal
Sodium carbonate peroxyhydrate	Contact	Broad	Minimal
Diquat	Contact	Broad	Moderate
Flumioxazin*	Contact	Broad	Moderate
Carfentrazone-ethyl*	Contact	Broad	Moderate
Endothall (amine salt and potassium salt)	Contact	Broad	Moderate
Glyphosate	Systemic	Broad	Minimal
Imazamox	Systemic	Broad	Moderate
Topramezone*	Systemic	Selective	Moderate
Fluridone	Systemic	Selective	Moderate
Florpyrauxifen-benzyl*	Systemic	Selective	Moderate
Bispyribac*	Systemic	Selective	Extensive
Imazapyr	Systemic	Selective	Extensive
Penoxsulam*	Systemic	Selective	Extensive
Triclopyr	Systemic	Selective	Extensive
2,4-D	Systemic	Selective	Extensive

For details, see OSU fact sheet "**Chemical Control of Aquatic Plants**" (Lynch 2009) excepting *.

Contact herbicides

- **Carfentrazone-ethyl*** (e.g., Stingray): misc. floating and emergent plants.
- **Copper sulfate** and **copper chelates** (a vast many: e.g., Cutrine brands, etc.): mostly algae (some submersed).
- **Diquat** (e.g., Reward, Weedtrine-D, Aquastrike [Endothall-dipotassium blend], etc.): submersed plants and some filamentous algae.
- **Endothall** (e.g., Aquathol, Hydrothol, Evac Biocide, Aquastrike [Diquat blend]): submersed plants and algae.
- **Flumioxazin*** (e.g., Clipper, Pond-Klear, Propeller, Flumigard): misc. submersed and free-floating plants, especially **duckweeds** and **watermeal**.
- **Sodium carbonate peroxyhydrate** (e.g., GreenClean, Pak 27, Phycomycin, etc.): near-surface and shallow algae.

- **Karmex*/Diuron***, etc.: **Do not use!** Not labeled for aquatic applications.

For details, see OSU fact sheet "**Chemical Control of Aquatic Plants**" (Lynch 2009) excepting *.

Systemic herbicides

- **2,4-D** (e.g., AquaKleen, Navigate, Aquacide, Sculpin G, Weedar 64, etc.): specific plant species such as Eurasian watermilfoil, coontail, and limited effectiveness on waterlilies.
- **Bispyribac*** (e.g., Tradewind): misc., esp. floating and submersed.
- **Florpyrauxifen-benzyl*** (e.g., ProcellaCOR): Select free-floating, emergent, and submersed species, especially **watermilfoils** and several invasives.
- **Fluridone** (e.g., Sonar, Avast, Whitecap, etc.): primarily submersed and free-floating plants.
- **Glyphosate** (e.g., Rodeo, Aquamaster, AquaPro, Eraser AQ, Shore-Klear, etc.): emergent plants.
- **Imazamox** (e.g., Clearcast): very broad effectiveness, including several submersed invasives.
- **Imazapyr** (e.g., Habitat, Arsenal, etc.): emergent (esp. grasses) & some floating weeds.
- **Penoxsulam*** (e.g., Galleon): emergent and some floating weeds including on exposed pond sediments.
- **Topramezone*** (e.g., Oasis): Select submersed, floating, and emergent species including several grasses.
- **Triclopyr** (e.g., Renovate, Vastlan, Garlon 3A, Navitrol, etc.): selective aquatic effectiveness similar to 2,4-D.

For details, see OSU fact sheet "**Chemical Control of Aquatic Plants**" (Lynch 2009) excepting *.

Useful plant management references

- For ID and management recommendations (common things only):
  - Texas A&M: aquaplant.tamu.edu/
  - Lembi, C. A. 2009. Identifying and managing aquatic vegetation: https://www.extension.purdue.edu/extmedia/ws/ws_21.pdf

- For new developments and current info:
  - Aquatic Plant Management Society (APMS): http://www.apms.org/
  - Midwest Aquatic Plant Management Society: http://www.mapms.org/

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Filamentous green algae

(Don’t call it “moss”!)

(Sarah Noggle 2016)

(Eugene Braig 2016)

Filamentous green algae
(Don't call it "moss"!)

- Prevention:
  - Manage nutrients: fertilize watershed conservatively or not at all (avoid P), manage against Canada Geese, aerate with diffusers (i.e., bottom bubblers: reduces the ability of phosphorus to dissolve), etc.
  - Provide competition (i.e., tolerate plants in watershed and within pond).

Filamentous green algae

(Don't call it "moss"!)

- Treatment:
  - Elemental copper is standard algaecide (**copper sulfate** or **chelates**): follow label.
  - Some herbicides are effective on some algal species (**diquat** or especially **endothall** or **flumioxazin**).
  - Copper-resistant algae (especially *Pithophora* spp.) are less common and difficult to manage.
    - Often treated with **copper chelates** blended with **diquat** (1:1, 2 gallons/acre-foot) or **endothall** (2:1, 1 gallon/acre-foot) with nonionic surfactant (1–2 gallons/surface acre).
  - Warm-water caveats apply to algaecide applications.
  - Blue tilapia (a tropical fish) increasingly used in region.
    - Assuming Largemouth Bass present, stock 7"–10" tilapia at 10–100 lbs./acre (depending on algae coverage).
    - Harvest fish in fall as metabolism slows.

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Harmful algal blooms

(Cyanobacteria or “blue-green algae” aren’t really algae)

(Eugene Braig 2015)

(Frank Gibbs 2015)

Common planktonic taxa:

- *Microcystis*
- *Planktothrix* (one cold-blooming sp. looks reddish brown)
- *Aphanizomenon*
- *Dolichospermum* (prev. *Anabaena*)

Common benthic taxa:

- *Oscillatoria*
- *Microseira* (prev. *Lyngbya*)

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Harmful algal blooms

(Cyanobacteria or “blue-green algae” aren’t really algae)

- Often indicate nutrient enrichment (especially by excessive phosphorus or a low N:P ratio.
- Many species can produce toxins, but variably so.
  - Single point-in-time tests don’t reveal much; meaningful toxin monitoring of a bloom site over time becomes prohibitively expensive.
  - Give monitoring priority on sites used for commercial purposes (like irrigation or aquaculture), domestic water supplies, or with public contact/access.
  - Less so (like probably not at all) on sites used for casual recreation or aesthetics (instead, limit human contact and restrict access by domestic animals).

Harmful algal blooms

(Cyanobacteria or "blue-green algae" aren't really algae)

- Prevention:
  - Manage nutrients and provide competition (as previously discussed).
  - Aerate! …with diffuser aeration (i.e., blowing bubbles from deep water).

Maximum depth:	6 feet	8 feet	12 feet	16 feet	20 feet	24 feet
Approx. coverage*:	1/8 acre	1/4 acre	1/2 acre	1.0 acre	1.5 acre	2.0 acre

* Per diffuser plate: can vary with atypical diffuser designs.

  - For example, a 2-acre site with a maximum depth of 12 feet should consider installing up to 4 diffuser plates. A 2-acre site at 16 feet deep can probably get by on 2 diffusers.
  - Seasonal operation (ordinarily warm months only).
  - Target two turnovers/day for ponds; perhaps one turnover/day for small lakes.

Harmful algal blooms

(Cyanobacteria or “blue-green algae” aren’t really algae)

- Treatment caveats:
  - Tend to be late-season bloomers…
  - Standard warm-water caveat applies.
  - Cyanotoxins will ordinarily be both in solution and contained within particulate organisms.
    - Treatment won’t add additional toxins but can lyse cells placing more of the concentration in solution.
    - It’s easier to filter out particulate organisms than to treat water to remove soluble chemicals.
    - Successful application of algaecides to kill a bloom will end the production of additional toxins.
  - If present, toxins will persist for some time after the bloom is eliminated. You can’t know the toxins are gone unless you test for them.

Harmful algal blooms

(Cyanobacteria or “blue-green algae” aren’t really algae)

- Treatment:
  - Apply algaecides as necessary (with caveats).
    - Typical/Planktonic blooms: formulae of **copper** or **copper chelates**.
    - Tricky benthic blooms:
      - **Sodium carbonate peroxyhydrate** followed the next day (or so) by **copper chelates** + **surfactant** or…
      - **Copper** (or **chelates**) + **diquat** + **surfactant**.
    - Surface scums concentrated by breeze: repeat treatments with **sodium carbonate peroxyhydrate**.

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Pond fisheries

- The essence is the nature of smallness: limited space and lack of habitat diversity. **A pond cannot function like Lake Erie in supporting a self-sustaining fishery!**
  - Very small areas (perhaps less than ½ acre) are likely to require more active management, possibly supplemental feeding.
  - Keep fisheries extremely simple! …Usually a single level of predator–prey interaction.
  - Largemouth Bass–Bluegill (supplementing with Channel Catfish if desired) is our region's tried and true.
  - Alternative species not necessarily appropriate for the pond novice. Ask questions if ya gots'em.

A Delaware Co., OH pond (Steve Collignon 2014).

Pond fisheries

Stocking new or renovated ponds

	Number to stock per acre			
Stocking strategy	Bass	Bluegill	Redear	Catfish
Largemouth Bass–Bluegill Sunfish	100	500		
Largemouth Bass–Bluegill–Channel Catfish	100	500		100
Largemouth Bass–Redear Sunfish	100		500	
Largemouth Bass–Bluegill and Redear Sunfish	100	350	150	
Largemouth Bass–Bluegill–Redear–Catfish	100	350	150	100
Recommended size (can go larger)**:**	3–5 in.	2–3 in.	2–3 in.	3–5 in.

- New-pond ideal: Stock with Fathead Minnows and spawning habitat in spring. Follow with game species in fall.

Pond fisheries

The self-sustaining-pond-fishery quiz:

- Do you get to have both lots of fish and big fish?
- Do you get to have both trophy-sized Bluegills and trophy-sized Largemouth Bass?

- Not likely, eh?

Pond fisheries

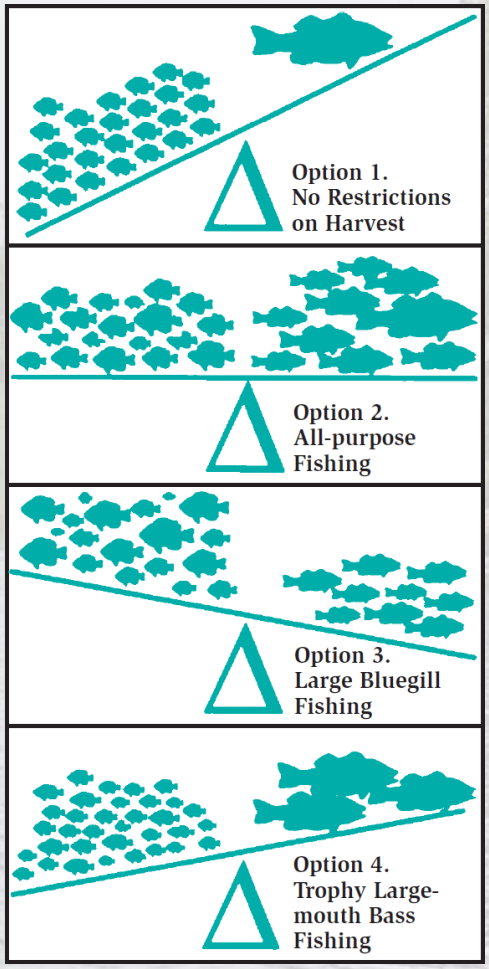

Figure credit: Austin et al. 1996, 2015

Common management strategies:

- 1. **Do-nothing** option rarely yields good fishing.
- 2. **Balanced/All-purpose** populations provide fair numbers across different size classes for both species. (Surprisingly fleeting.)
- 3. **Big-Bluegill strategy** is excellent for families and children.
- 4. **Big-bass strategy** is really for the fishing purist; not necessarily a child- or family-friendly option.

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Fish kills on ponds

- The essence: almost always caused by low-oxygen events.
  - Following the event, determine cause and mitigate against repeats in future.
  - If restocking is needed, allow time for pond to recover and wait for a cool season to follow.
- Functional age (trophic status) tends to increase the amount of organic muck accumulated in bottom sediments, biological oxygen demand, and thus risk of fish kills.

Fish kills on ponds

- **Warm-season kills caused by low-oxygen stress**: usually occur at night, often observed in early morning.
  - Susceptibility:
    - Excessive area covered by aquatic plants or algae in excessively shallow water.
    - Complete cover by duckweeds or watermeal.
    - *Treating too extensive an area with herbicide/algaecide.*
  - Prevention:
    - Tolerate *moderate* vegetative cover.
    - Treat potentially weedy coverages of submerged vegetation as early in season and conservatively as possible.
    - Aerate.

Yes, that's total coverage by duckweed: fish = dead (Eugene Braig 2017).

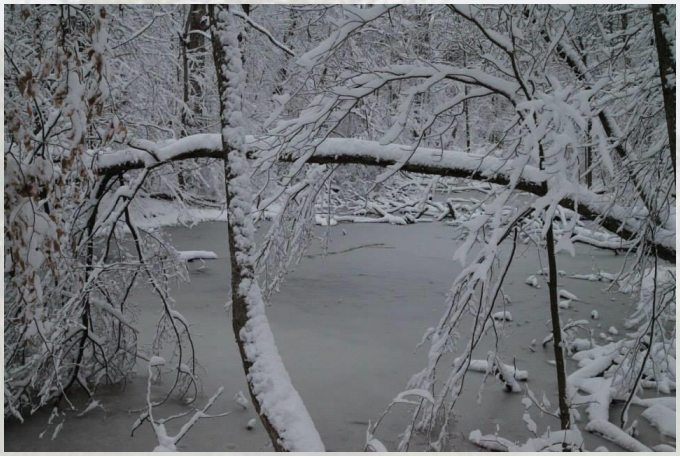
Fish kills on ponds

- **Summer kill**: usually follows premature turnover induced by late-summer rainstorm. Can be indicated by opaque, grayish water following rain.
  - Susceptibility:
    - Increases with depth relative to surface area or degree of sheltering from wind (relatively small, deep ponds at increased risk).
  - Prevention:
    - Plan new-pond construction to allow input of wind energy and delay sunlight exposure (align fetch with prevailing wind, trees to the east and north, etc.).
    - Manage to slow pond aging and muck accumulation.
    - Aerate throughout warm months, beginning before onset of warm-season stratification.

Storm's a brewin' (Eugene Braig 2011).

Fish kills on ponds

- **Winter kill**: caused by prolonged cover by opaque or snow-covered ice. Caused by prolonged isolation from the atmosphere (by ice) and sun (by snow accumulation on ice).
  - Susceptibility:
    - Shallow ponds prone to routine, prolonged ice cover during winter.
  - Prevention:
    - Shovel snow from ¼ of pond surface.
    - Aerate from shallow water to erode a hole in ice (with waterfowl caveat).
    - …But not both!
    - Tolerate *moderate* vegetative cover.
    - *Avoid large herbicide/algaecide treatments late in the previous season.*



Brrr… (Donna Braig 2013).

Fish kills on ponds

Misc. causes:

- **Low-oxygen stress** will affect all fish species (albeit differentially).
- **Spawning** is hard work! Resultant stress will cause some mature fish to die, especially in late spring. That's totally natural.
- Substantial kills resulting from **disease** are relatively uncommon and may only affect a single species.
- Substantial kills resulting from **toxic events** are frankly rare to ponds: toxins will affect all species (albeit differentially), typically affecting small fish (susceptible to lower effective doses) first.

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Wild organisms to commonly colonize ponds

- These dudes are cool and can indicate healthy oxygen concentrations.

Giant floater *Pyganodon grandis* (OSU Museum of Biological Diversity 2018)

(Non-native, but harmless) freshwater jellyfish *Craspedacusta sowerbii* (Great Lakes Scuttleutt 2018)

Freshwater bryozoan *Pectinatella magnifica* (Ohio Dept. of Natural Resources 2018)

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Pond succession

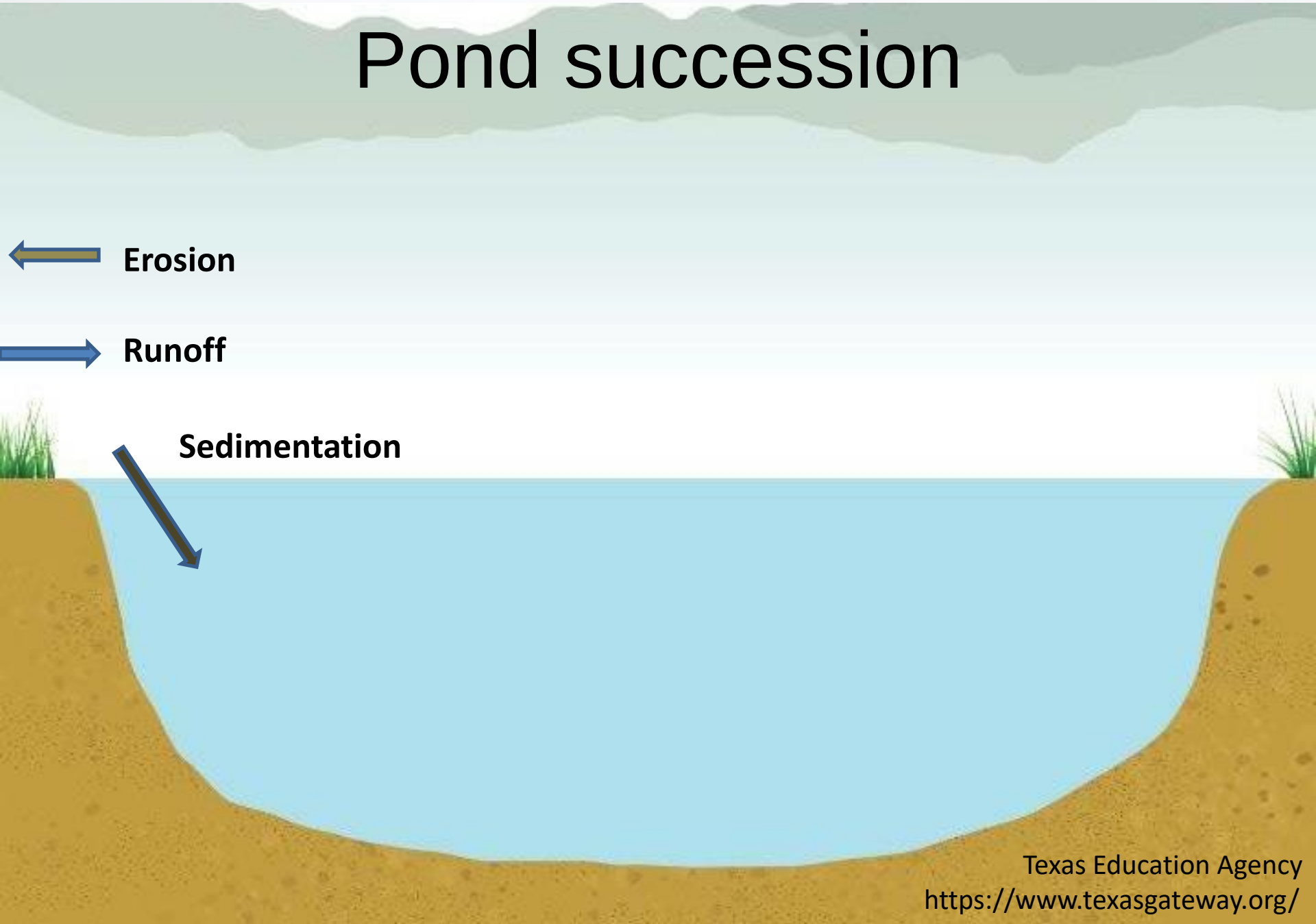
Pond succession

- Disturbance!

City of Toledo Engineering Services (2015)

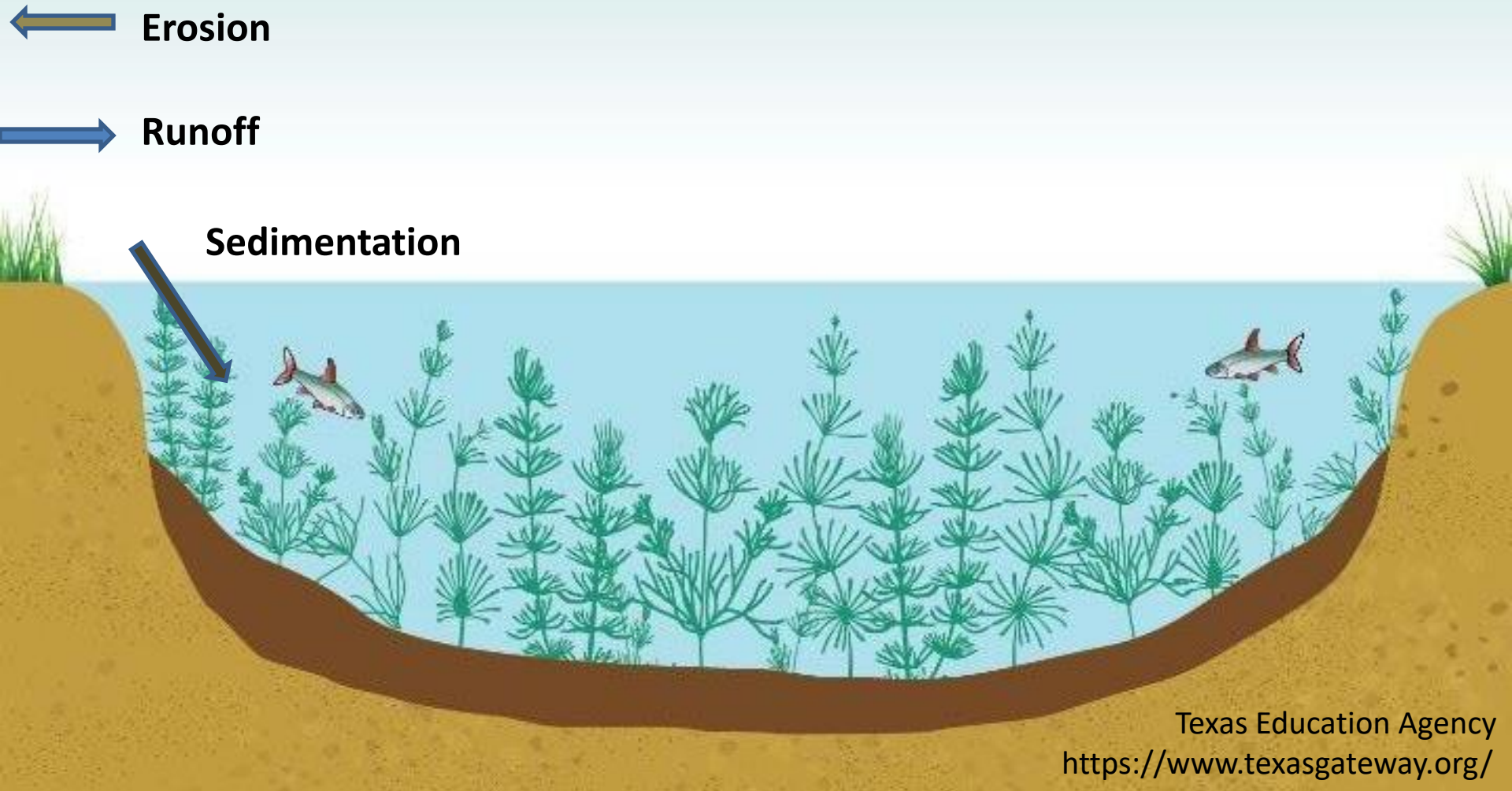
wikipedia.org

Pond succession



Texas Education Agency
https://www.texasgateway.org/

Pond succession



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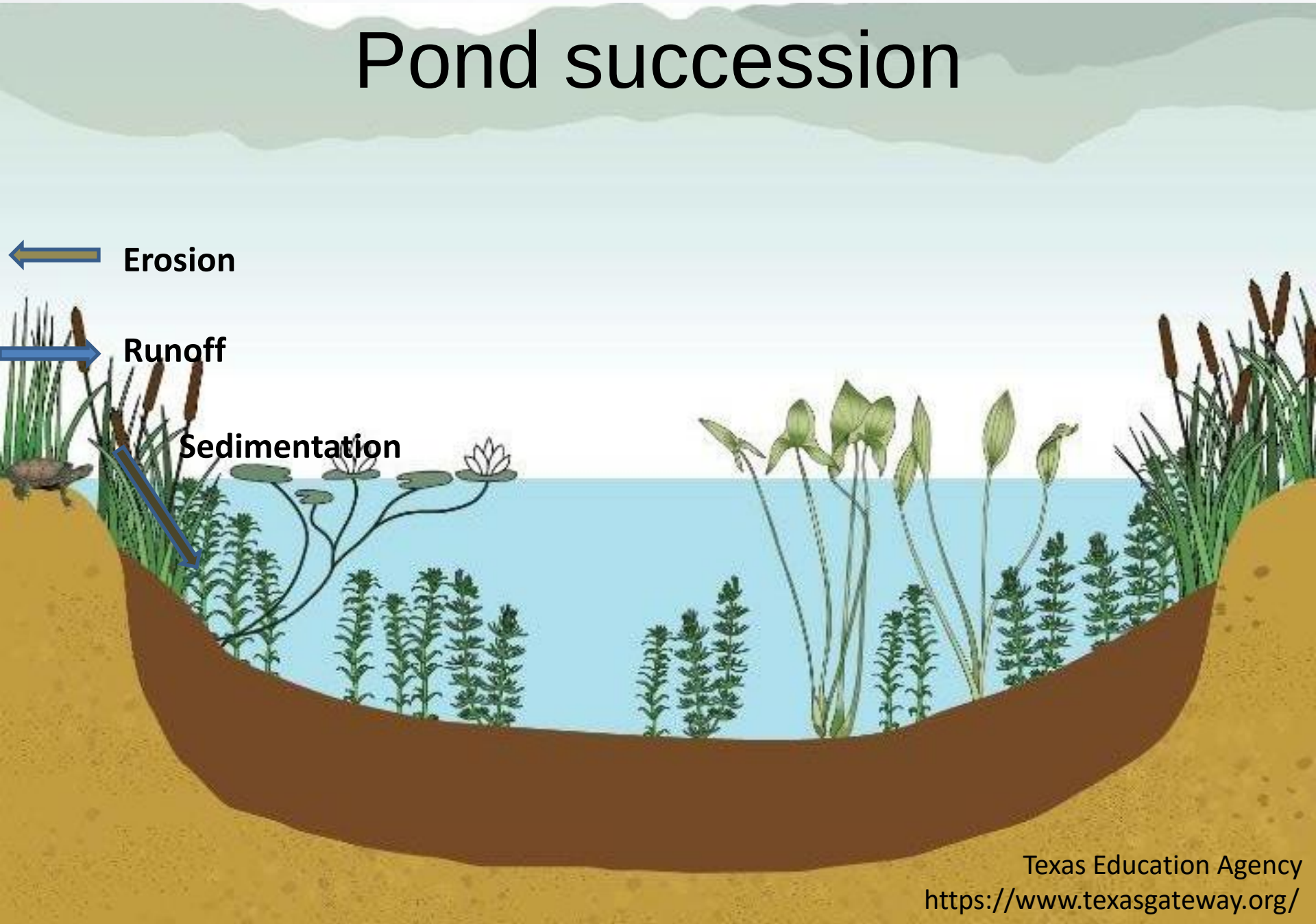

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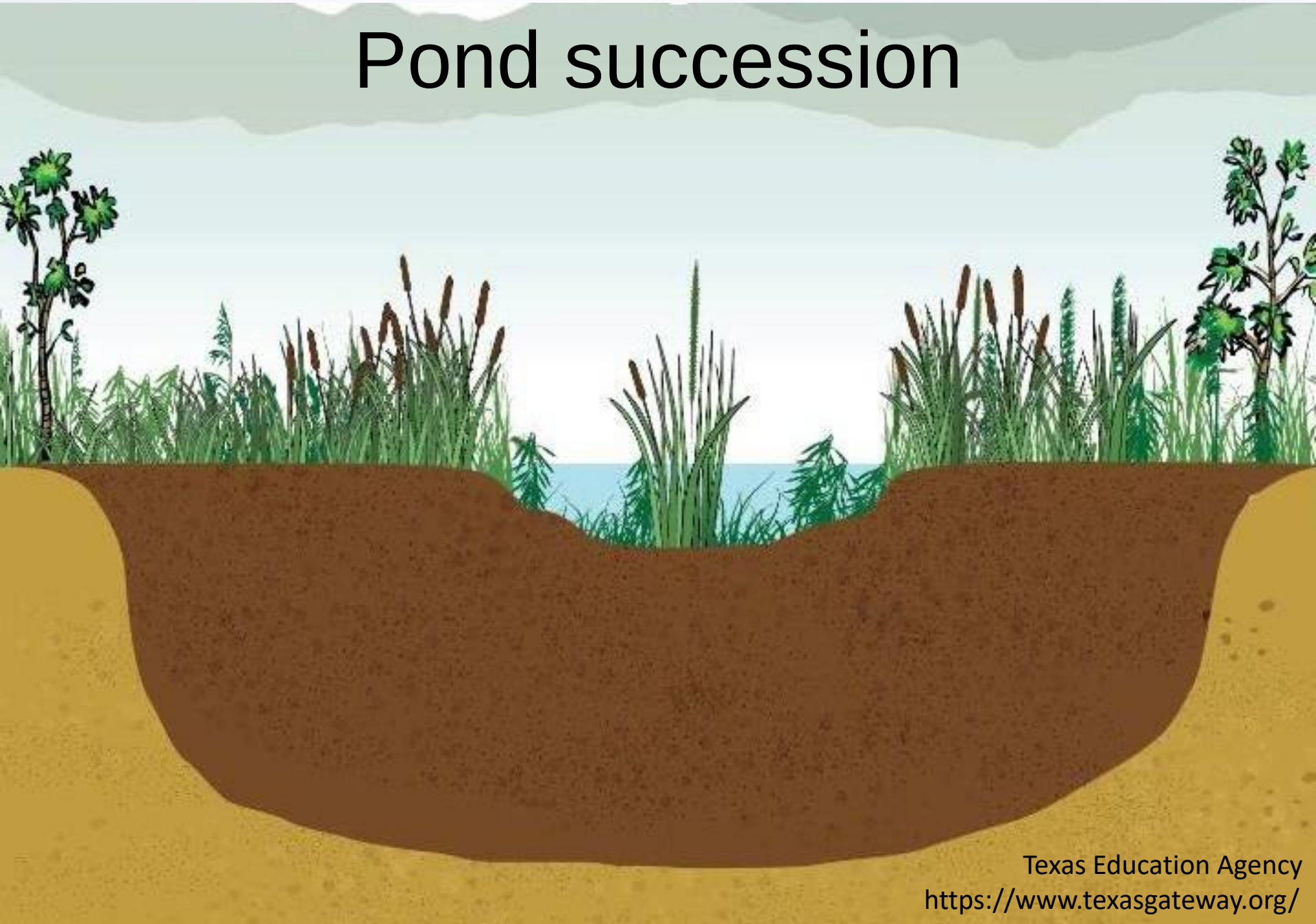

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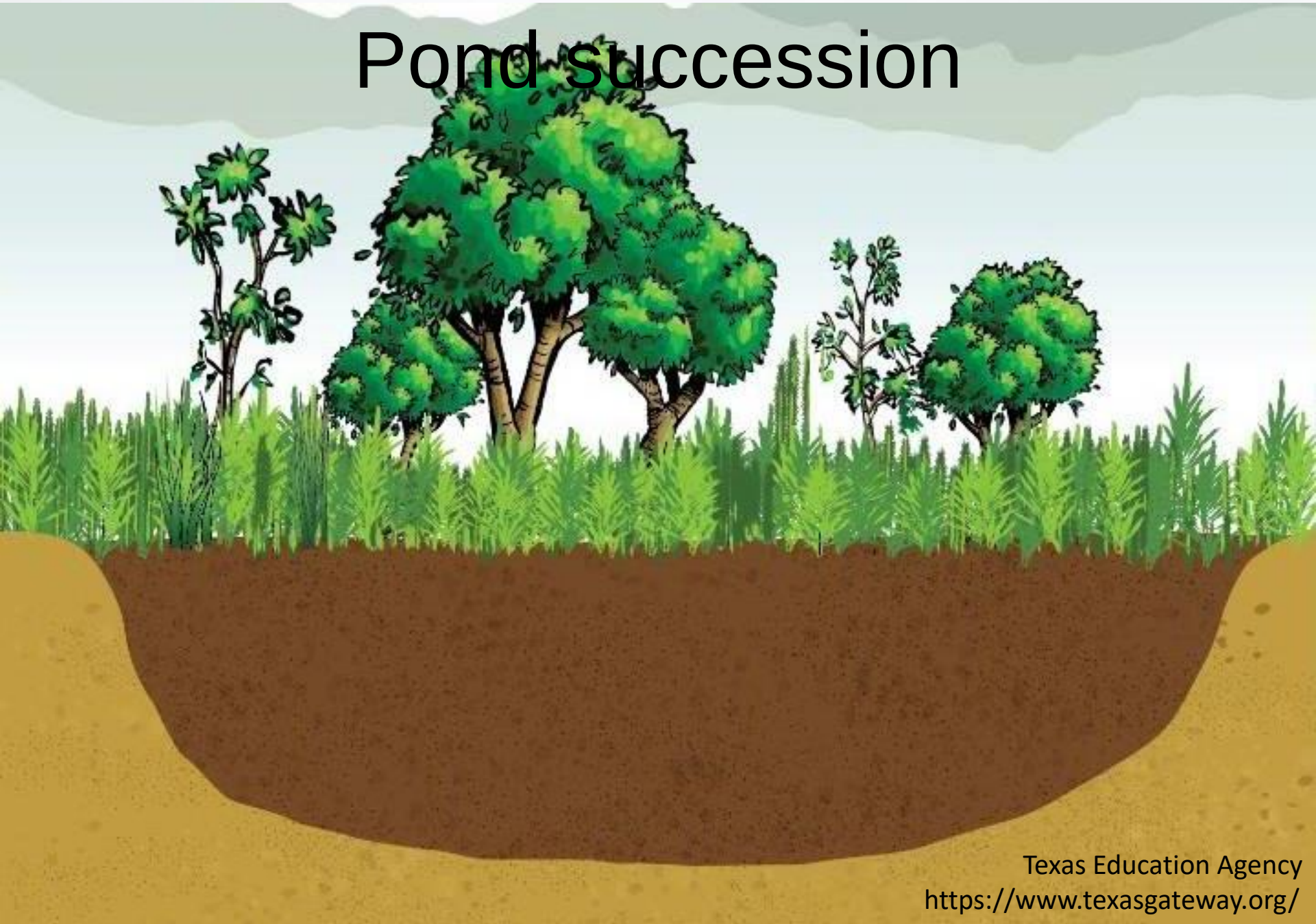

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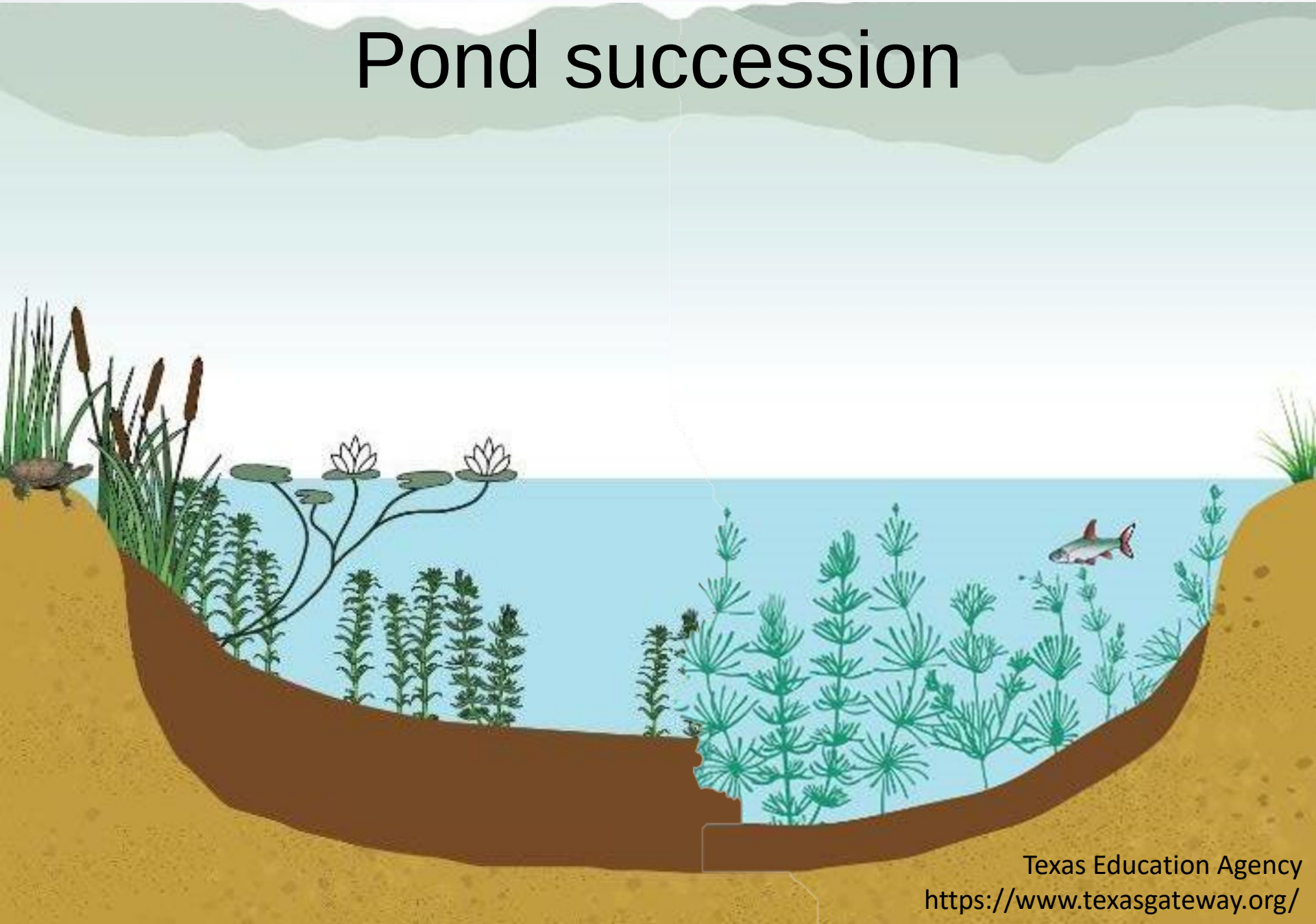

Texas Education Agency
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Erosion, sedimentation, and dredging

- The essence:
  - Organic sediment can be broken down, its accumulation thus slowed:
    - Diffuser aeration!
    - Minimize the input of organic matter (leaf litter, grass clippings, etc.)
  - Inorganic sediment will not break down—can only be manually removed.
- Prevention:
  - Aquatic, wetland, and terrestrial plants reduce erosion and particulate runoff. Tolerate (or even encourage) where possible and appropriate!
  - Rock riprap (e.g., USDA 1997):
    - Expensive: prioritize downwind shorelines and engineered infrastructure (e.g., earthen dikes/dams).
    - Lay and staple erosion-control fabric or lay gravel to prep area.
    - 6”–12”-diameter stone is common to low-energy environments like ponds (bigger stone on steeper slopes).
    - Lain to 2’–3’ below low-water level will also deter muskrat burrows.
    - If underlain by gravel, can tolerate herbaceous vegetation to naturalize look (or not), but do not tolerate woody spp. (USDA 1997).

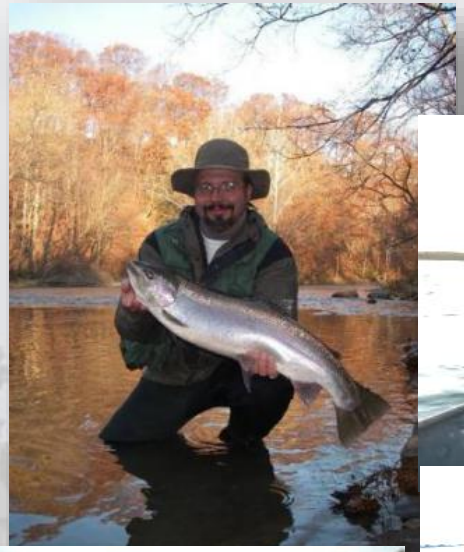
Erosion, sedimentation, and dredging

- Treatment/Dredging:
  - No hard–fast rule for when it becomes necessary.
  - Perceived loss of pond function:
    - Loss of depth and storage capacity.
    - Loss of depth increases area of photic zone: more frequent weed/algae issues.
    - Reduced volume of fish habitat: loss of top predators.
    - Smaller reservoir of dissolved oxygen to endure prolonged ice cover: greater risk of winter fish kills.
    - Excessive organic sediment may generate anoxic funk!

Erosion, sedimentation, and dredging

- Treatment/Dredging:
  - Moving earth is expensive!
    - Impossible to estimate cost without on-site consultation: not a simple function of area.
    - For smaller sites, suction dredging is often cheaper to regain some function.
    - Excavation equipment more expensive to deploy but will more likely regain more youthful function.
    - Be certain job estimate accounts for disposal of dredge material, especially if you cannot accommodate on site.
    - Work with local Soil and Water Office to identify local contractors.

Questions?

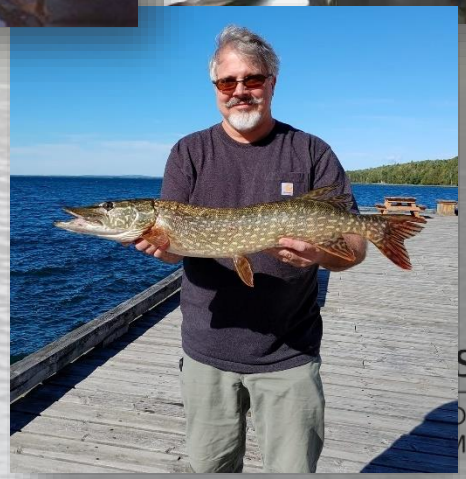











Top Five Pond Inquiries

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braig.1@osu.edu

Misc. pond clinics and events,
diverse OH locations,
2025

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