Stormwater Management Considerations for Aquatic Species

Risks, benefits, and design considerations for stormwater ponds and ditches for wildlife

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Wetland Conservation in Eastern Vancouver Island: A workshop for municipal and regional stakeholders
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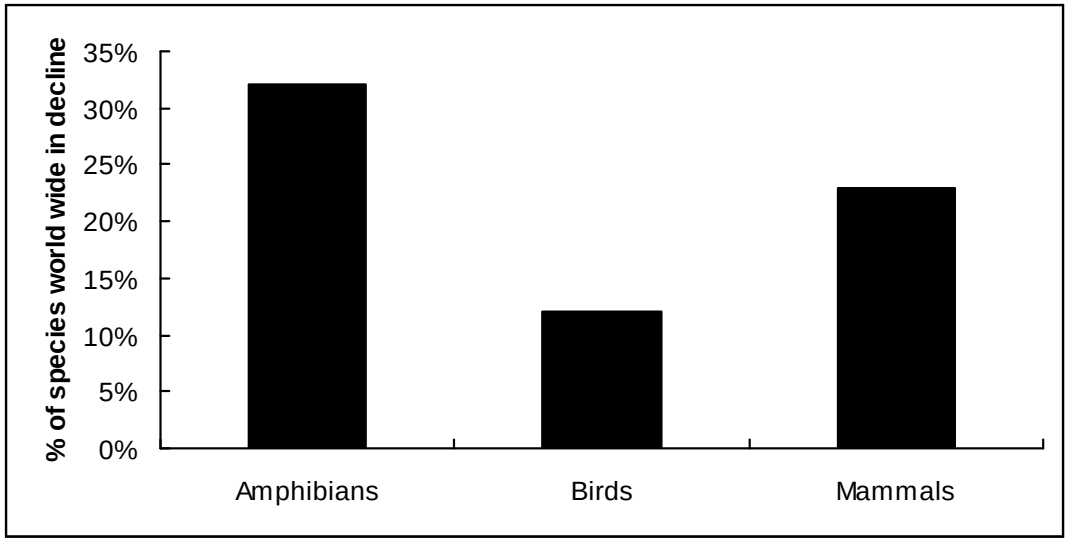
By:
Elke Wind
E. Wind Consulting
Nanaimo, BC
ewind@telus.net

Outline

- **Amphibian Ecology and Stormwater Management (SM)**
  - Amphibian declines
  - Build it and they will come...
  - Case Study – stormwater pond and amphibian study, WA State
- **Design and Maintenance of SM Features - Working with Native Amphibian Species**
  - Design – hydroperiod, vegetation, shape
    - inclusion or exclusion
  - Timing of works
  - Non-native species
  - Contaminants
  - Erosion and sediment control

Why Should We Care?
Amphibian Declines



- Of the almost 6,000 known amphibian species in the world, it is estimated that ***32% are threatened with extinction*** (vs. 12% of birds and 23% of mammals; Stuart et al. 2004)
- ***Habitat loss and degradation*** are the greatest threats to amphibians (along with pollution, invasive species, and disease; Stuart et al. 2004)

Amphibian Declines

Why are amphibians so vulnerable to habitat degradation and loss?

- semi-permeable skin (desiccation; contaminants) - require moist microsites
- dependent on both aquatic and terrestrial habitats
- low vagility (don’t move very much - can’t escape habitat impacts)
- high philopatry (faithful to sites)

Amphibian Declines

Amphibian Species on Vancouver Island (*9 native, 2 nonnative****)***

- **Red-legged Frog – *Special Concern* (AB)**
- **Western Toad – *Special Concern* (AB)**
- **Wandering Salamander – Special Concern (TB)**

- Long-toed Salamander (AB)
- Northwestern Salamander (AB)
- Rough-skin Newt (AB)
- Pacific Treefrog (AB)
- Western Redback Salamander (TB)
- Common Ensatina (TB)

- American Bullfrog – Exotic (AB)
- Green Frog – Exotic (AB)

Build It and They Will Come...

- We fill in natural wetlands and build a variety of artificial water features
  - e.g., stormwater ponds, dugouts, garden ponds, golf course ponds, livestock watering holes, ditch lines, water storage features for fire suppression, etc.

- Amphibians are attracted to water for egg laying, food, hydration, cover, and overwintering
- Flooding / high flows can also move amphibians and non-native species around (e.g., into or out of artificial water features)

Build It and They Will Come...

- *Issues for amphibians* – these artificial water features are often situated near roads, they may collect contaminants, contain non-native / invasive species, they are subject to mowing, herbicides, and / or dredging, etc.

- *Issue for municipalities, developers, etc.* – It is illegal to harm amphibians under the provincial *Wildlife Act*. To avoid a violation, a salvage operation for amphibians is needed (follow salvage BMPs)

Complex Interactions

Small wetland habitat loss

Creation of permanent water bodies

Golf course ponds
Water gardens
Storm water ponds
Ditches
Stock ponds

Amphibian Populations

Non-native aquatic predators
(fish, Bullfrogs, Green Frogs, slider turtles)

Fish stocking
Illegal introductions
Baitfish
Released pets
Children
Vehicles

Disease

Case Study – Stormwater Pond Study in King County, WA

Reference: Ostergaard et al. 2008. Amphibian Use of Stormwater Ponds in the Puget Lowlands of Washington, USA. In, *Urban Herpetology*. Herpetological Conservation 3.

Case Study – Stormwater Ponds in King County, WA

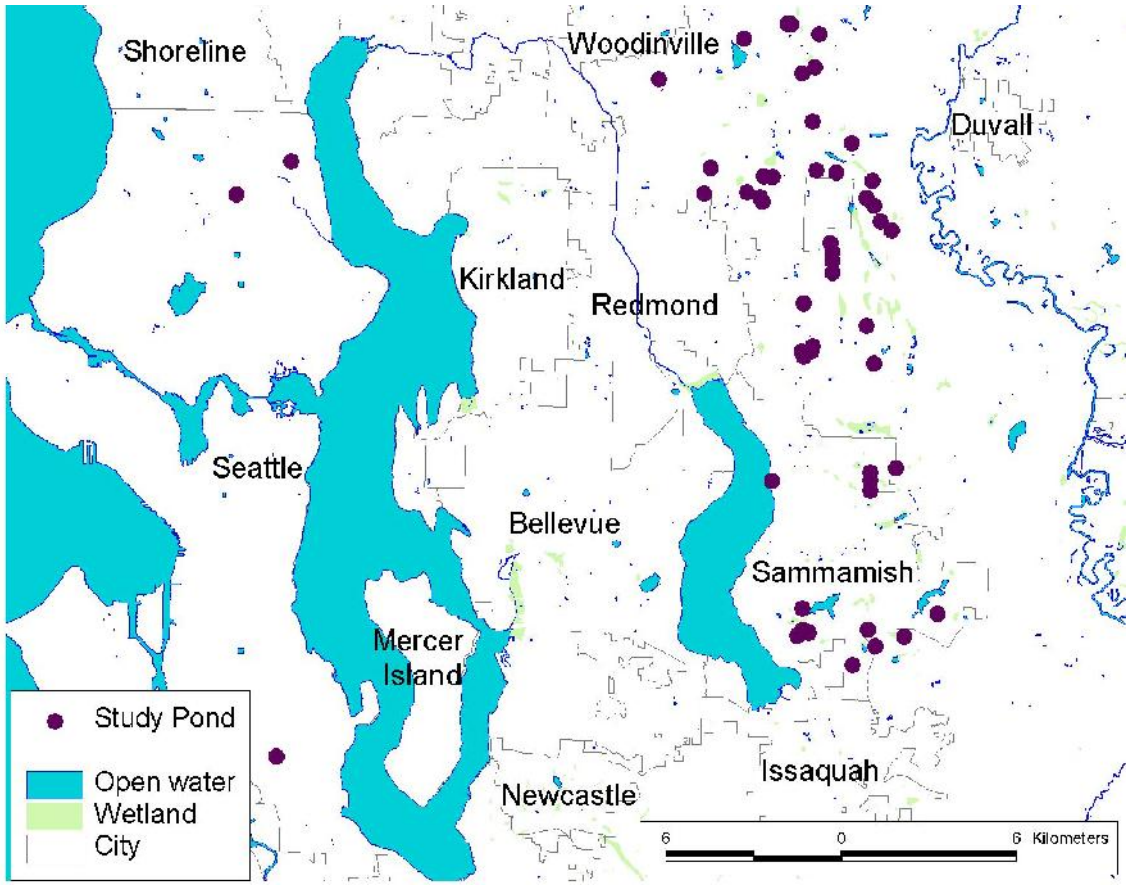
Rationale:

- SP may provide habitat and help compensate for wetland loss in urban areas, but they could also be death traps (amphibians breed but do not survive)
  - SP had not been studied

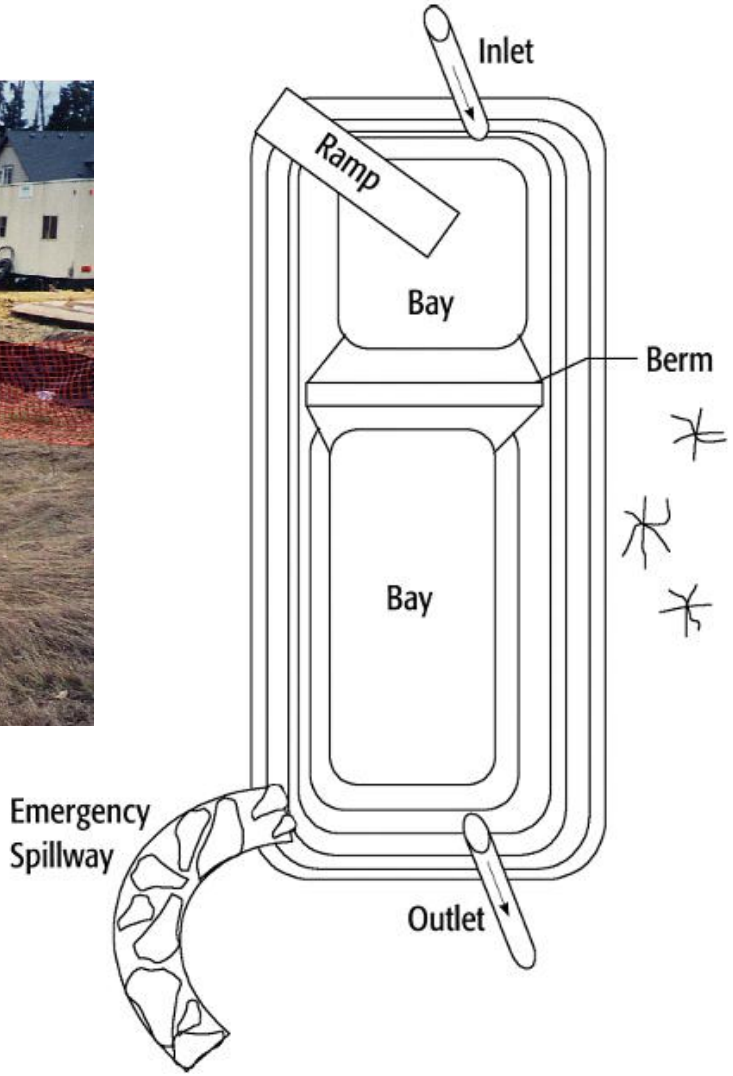
- SP are required by many municipalities, despite their potential impacts to wildlife, as such, **the overall goals were to**
  - find ways to better manage existing ponds and
  - to make recommendations for new pond construction and management based on amphibian species present

Case Study – Stormwater Ponds in King County, WA

- *Study sites and years:*
  - 52 SP in King County, WA,
  - Studied in 2000 and 2001
- *Variables measured:*
  - amphibian presence and abundance
  - aquatic habitat characteristics, and
  - landscape features



Case Study – Stormwater Ponds in King County, WA



Case Study – Stormwater Ponds in King County, WA

Results: ***Amphibians use stormwater ponds***

- Maximum of six species at a pond and mean native species richness of 3.1 species among ponds
  - Only slightly lower than the value of 3.6 for 19 natural wetlands in western Washington.
  - All but two stormwater ponds were used for breeding by at least one species.
- Pacific Treefrogs and Long-toed Salamanders were the most widespread species: in more than 82% of the stormwater ponds
- American Bullfrogs occurred in 54% of the ponds and was positively associated with native amphibian richness and evenness.

Case Study – Stormwater Ponds in King County, WA

Results: ***Aquatic-breeding amphibians need terrestrial vegetative cover and take advantage of newly built ponds quickly***

- "Species richness and abundance were negatively associated with total impervious surface area within a 1000 m radius of stormwater ponds."
  - More forest cover within 1 km of a pond = more amphibians
- "As many as five species reproduced in newer ponds less than 18 months old, especially in locations where forested tracts were nearby."

Case Study – Stormwater Ponds in King County, WA

Conclusions

- “Stormwater ponds currently support a diverse group of native amphibians and may benefit pond-breeding amphibians in urban areas in western Washington. However, long-term trends and impacts of water pollution and the amount and proximity of suitable terrestrial habitat remain to be evaluated.”

Case Study – Stormwater Ponds in King County, WA

Recommendations

- “If amphibians are of conservation or management interest at stormwater ponds, then we recommend
  - retaining forested tracts around or near them,
  - scheduling pond maintenance to avoid amphibians at their most vulnerable life stages, and
  - building ponds with varied topographies and hydroperiods.
- We suggest using barriers to keep amphibians out of ponds slated for dismantling and ponds with poor water quality.”

Design and Maintenance of Stormwater Management Features

Inclusion or Exclusion?

- Exclude amphibians
  - Measures are taken to exclude all amphibian species or primarily non-native species
- Include amphibians
  - If exclusion measures cannot be taken, you will have amphibians and you should be planning and managing for them

Design and Maintenance of Stormwater Management Features

Exclusion:

Fencing

- Will not exclude all species – some species are climbers
- Ideal in areas where fencing is already being installed
  - amphibian fencing is added to the bottom
- The entire water body must be fenced
- No gaps or holes can exist in the fencing or run underground
- Annual maintenance is required
  - vegetation control, repairs, etc.

Design and Maintenance of Stormwater Management Features

Exclusion:

Hydroperiod

- Create non-permanent water conditions
  - the area must dry completely
- Applicable to locations where water levels can be controlled or they drop naturally each year
  - native amphibians will use water bodies that retain some water until late July

Design and Maintenance of Stormwater Management Features

Design ponds that drain quickly

e.g., follow Low Impact Development (LID) design techniques

- Design of bioretention / raingardens
  - 6″ freeboard
  - 6″ pond allowed on surface
  - 2″ mulch
  - 18-24 ″ compost amended soil
  - Underdrain (if needed)
  - Woody plants (these are not wetlands)

From: Kirschbaum and Webb,
LID Technical Workshop

Design and Maintenance of Stormwater Management Features

Inclusion:

Naturalization:

- Hydroperiod – semi-permanent water bodies (dry in some years) will be attractive to native species, but exclude non-native species
- Where possible – avoid over-engineered designs and costly wetland creation / restoration practices
  - e.g., steep sided, deep, over planted, over use of rip rap, etc.

Design and Maintenance of Stormwater Management Features

Inclusion

<u>Naturalization:</u>

- Create gentle slopes (1:10)
  - Especially on south-facing shorelines
- Do not use rip rap
  - plant to native species, bioengineer shorelines
- Limit the amount of woody debris & native veg. added to the site
  - e.g., < 10 % cover of cwd
- Retain riparian vegetation and connectivity to upland habitat

Timing of Works – Aquatic Amphibians

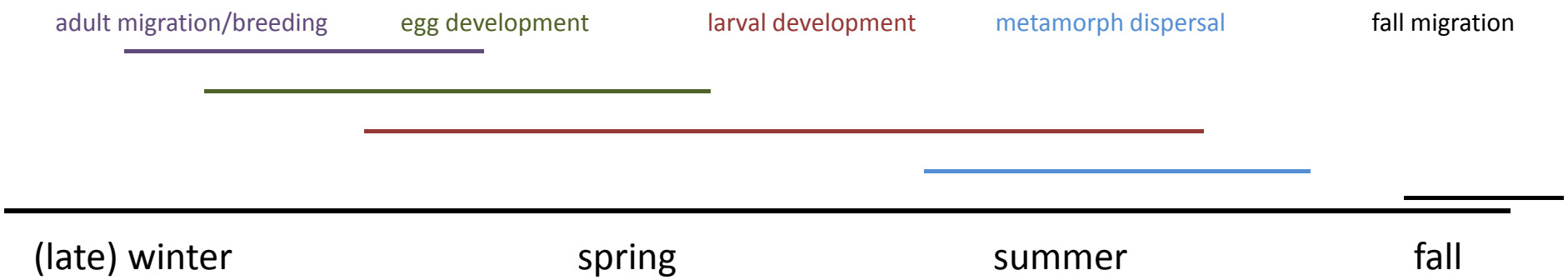
(e.g., dredging, vegetation management)

Critical Active Season = March to Aug.

Three critical life stages for aquatic-breeding amphibians

- breeding / egg laying and development (Feb.-April)
- larval development (March-June)
- metamorphosis and dispersal (June-Aug.)

- Timing of works is not always flexible – need to factor in salvage operations



Timing of Works

Other aquatic species critical life stages:

Turtles

- Western Painted Turtle (Red listed) and Slider (Exotic)
- Live in permanent water bodies, year round (overwinter in water)
- Salvage operations needed

Species Identification

Know what you have – these are very similar looking species

Western Painted Turtle

KIP LADAGE

No red mark behind eye

EAR MARK Does turtle have a red mark behind the eye?

Note: Both species have thin yellow stripes on head, neck, legs and tail.

YES

NO

Slider

JOHN WHITE

Red mark behind eye

Sometimes ear mark is yellow

What you saw was

MILDRED MCPHEE

Red vertical bars underneath

SHELL (CARAPACE) BORDER Underside of shell lacks red bars?

YES

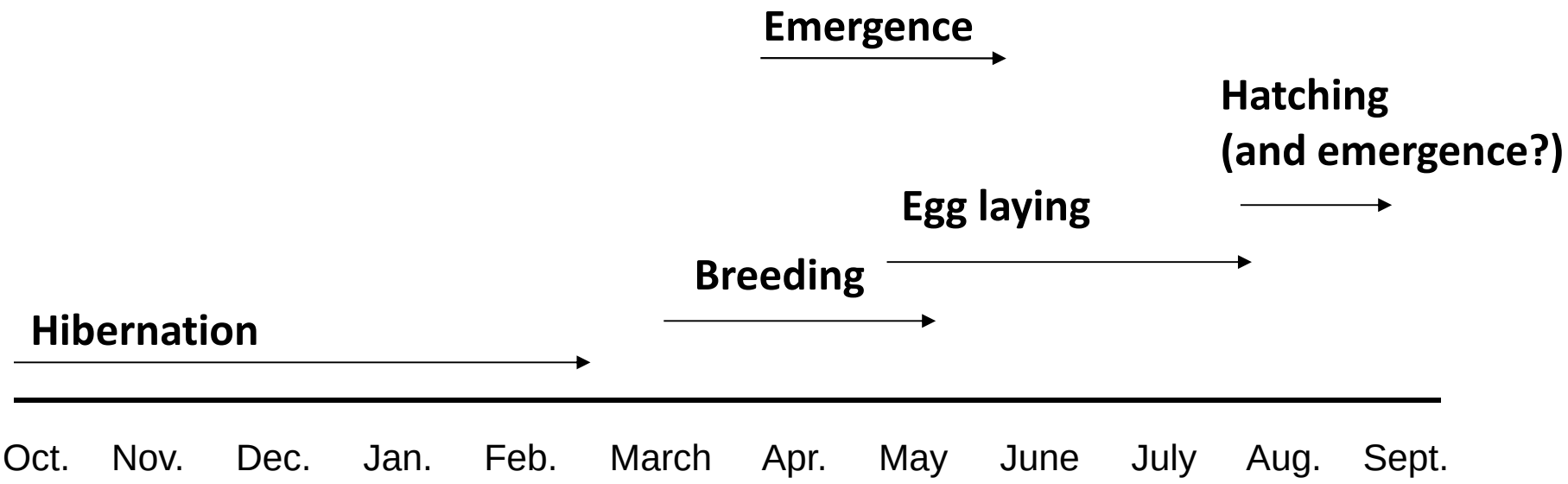
NO

CHRISTIAN ENGLESTOFT

No red bars underneath shell

Timing of Works – WPT

Active Season of WPT = March to Sept.



Issues - Contaminants

- Erosion and sediment control
  - *Impacts:* clogs gills, affects nutrient uptake, lowers oxygen levels, etc.
  - Can be an acute or chronic issue
- Chemicals (herbicides, insecticides)
  - *Impacts:* direct mortality, malformations, affects sexual development, etc.
  - Can be an acute or chronic issue

Issues - Erosion and Sediment Control
Chronic Inputs

e.g., housing development on Vancouver Island
  - highly fractured, brittle rock base

- All vegetation was cleared at once on this mountaintop development project
  - developer went bankrupt
- Sediments continue to flush into streams and down through the watershed
  - sediment / erosion control measures are ineffective
- Who is responsible?

We need to take a watershed-level approach to stormwater management (think about contaminant sources throughout the watershed, and over the long term)

Issues - Rip Rap

An “Unnatural” Approach to Erosion and Sediment Control

- Rock, rock, rock...a quick, inexpensive fix
- Unnatural looking
- Ineffective over the long term - it often takes years for vegetation to grow, if it will grow at all...
- May affect water quality

Solutions - Bioengineering

An "Natural" Approach to Erosion and Sediment Control

- Naturally stabilize slopes – using vegetation
  - *Strategy* - look at the native vegetation growing on local hillsides and slopes to see what species and densities stabilize those slopes
    - e.g., willow staking
  - This strategy has also been used to suppress shade-intolerant invasive plant species, such as Reed Canarygrass


Photo: Dave Polster


Photo: NRCS

Solutions - Bioengineering

- Bioengineering techniques to stabilize slopes and control erosion and sediment inputs
  - Wattle Fences
  - Brush Layers
  - Live Smiles and Gully Breaks

Solutions – Contaminants
Herbicides and Insecticides

- Public concern over mosquitoes, disease, etc. can affect wetlands
  - increase awareness / education (e.g., amphibians eat mosquitoes)
- Management of non-native, invasive vegetation
  - take measures to reduce the risk of introduction & spread
  - manual brushing
  - biocontrol
  - education
- Use and timing of treatment
  - follow label
  - biological basis (avoid critical periods)

Solutions - Natural Protection
Riparian Buffers

- Vegetation buffers are used to meet various objectives
  - sediment and erosion control
  - filter contaminants
  - shading (e.g., stream temp., non-native sp.)
  - wildlife habitat / connectivity
- Recommended widths vary by local regulators
  - water body type
  - slope / watershed
  - adjacent land use
  - species

Example Buffer Widths

Estimated in order to protect 80% of the population

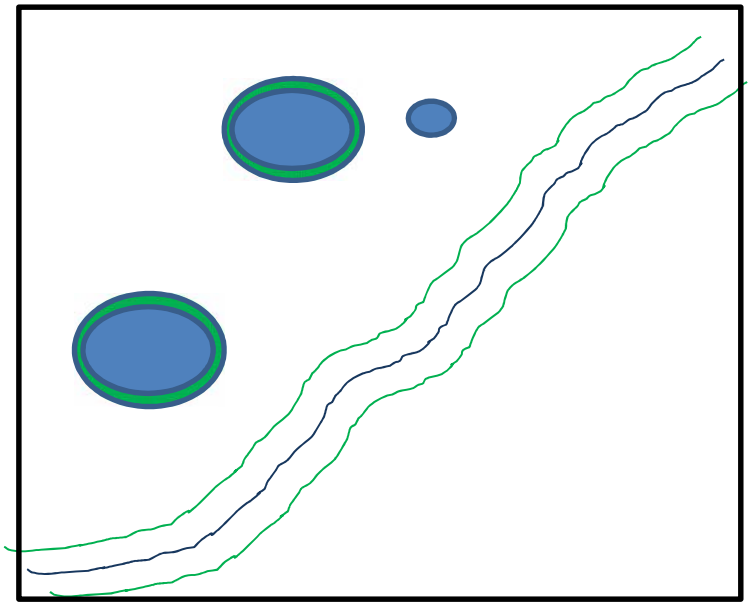
Semlitsch and Bodie 2003:

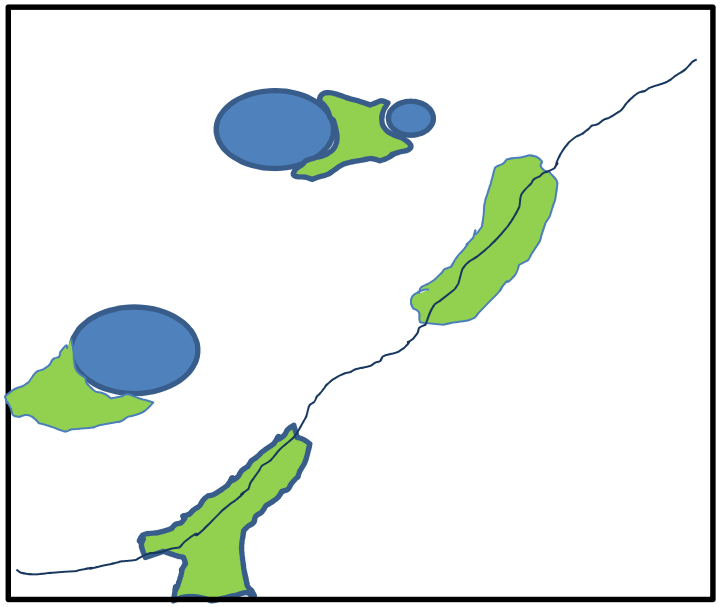
Group / range of recommended widths

- Frogs / 673-1207 (205-368 meters)
- Salamanders / 384-715 feet (117-218 meters)
- Amphibians / 522-951 feet (159-290 meters)
- Snakes / 551-997 feet (168-304 meters)
- Turtles / 404-942 feet (123-287 meters)
- Reptiles / 417-948 feet (127-289 meters)
- Herpetofauna / 466-948 feet (142-289 meters)
- Overall recommendation to cover most species: 98-197 feet (30-60 meters) aquatic buffer, 466-1276 feet (142-389 meters) core habitat (from stream), additional 164 feet (50 meters) beyond core for terrestrial buffer.

Think Outside the Box:
Creative Riparian Options

- Where possible (permissible) – creative, biologically informed riparian buffer and corridor design and allocation is encouraged
  - e.g., for small unprotected wetlands and streams
  - instead of narrow, wind-prone, tree buffers - create patches (on S. shore)
  - leave small trees, shrubs, and ground veg. as remaining buffer
- For habitat management - not necessarily for sediment control...





Solutions - Protection of Natural Wetlands & Streams

The best way to protect native amphibian populations is through the conservation of natural wetland habitat

- Small wetlands, streams, and seeps are often not protected
- Beaver control has changed the nature of streams and decreased the rate of creation of new, natural ponds and wetlands

Conclusions

- Amphibian declines are a serious issue for native species on the south coast
- Artificial water bodies (e.g., stormwater ponds) are utilized by native amphibians
  - negative or positive effects on local populations
- Measures can be taken to mitigate the negative effects of stormwater ponds, and improve the habitat conditions of amphibians (compensate for some habitat loss)
- But, the greatest conservation strategy is the protection of natural wetland habitats.