FIRE AND HERPETOFAUNA IN GRASSLAND ECOSYSTEMS

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WHAT'S A HERPETOFAUNA?

- Amphibians
  - Frogs, Toads, Salamanders, Caecilians
- Non-avian Reptiles
  - Snakes, Lizards, Amphisbaenians, Tuataras
- Turtles/Tortoises
- Crocodilians

QUESTION:

- If grassland herpetofauna coevolved with grasslands, and grasslands evolved with fire, then are grassland herpetofauna adapted to fire on a grassland?

  - “It is illogical that animals associated with fire vegetation are not themselves at least behaviorally adapted to resist mortality by fire”

    -- Means and Campbell, 1981

GRASSLAND HERPETOFAUNA ADAPTATIONS

- Amphibians
  - High-arched frog leaps (Leopard frogs, chorus frogs)
  - Short aquatic larval stages (Spadefoots, chorus frogs)
  - Burrowing ability (Great Plains toads, spadefoots, barred tiger salamanders)
  - High desiccation tolerance (all)

GRASSLAND HERPETOFAUNA ADAPTATIONS

- Reptiles
  - Leglessness/serpentine locomotion (Snakes, glass lizards)
  - “Tank” locomotion (Turtles, skinks, horned lizards)
  - Noisy snakes (Rattlesnakes, bullsnakes)
  - Burrowing ability (Box turtles, hognose snakes, horned lizards)

ANOTHER QUESTION:

- How many land managers consider amphibians and reptiles when employing fire as a tool for managing grasslands…or any other ecosystem for that matter?
  - T&E species (i.e. massasauga, crawfish frogs)
  - Keystone species (i.e. gopher tortoise)

- ANSWER: Not enough. As a result, little is known about herpetofaunal population and community responses to fire.

IMMEDIATE EFFECTS OF FIRE ON HERPETOFAUNA

- Mortality – most studies show that direct mortality is rare and of little significance to most populations
  - 68 marked eastern diamondback rattlesnakes in a 600-ha pine forest subjected to 5 burns in 5 years (Means and Campbell 1981)
  - Only 2 mortalities (both snakes in ecdysis)
  - Other studies showed similar results, though eastern glass lizards exhibited high mortality during prescribed burns (Means and Campbell 1981)
- Adaptations assist with escape (burrowing, locomotion specialties)




IMMEDIATE EFFECTS OF FIRE ON HERPETOFAUNA

- Dispersal – leaving the immediate area to avoid mortality from fire
  - Amphibians may find themselves far from water
  - Unfamiliar and inhospitable habitat
    - Unable to find adequate safety/cover
    - Predators often hunt fire fronts (i.e. raptors)
  - Suboptimal habitat
    - Depending on how far they move to escape fire

SHORT-TERM EFFECTS OF FIRE ON HERPETOFAUNA

- Reduced litter layers/natural cover
  - Exposed to predators (-)
  - Loss of prey base (-)
    - Due to immediate mortality or dispersal
  - Increased risk of desiccation (-)
  - No protection from temperature extremes/anomalies (-)
  - Reduced dispersal and foraging capabilities (-)
    - Increased distance between “safe zones”

SHORT-TERM EFFECTS OF FIRE ON HERPETOFAUNA

- Change in hydroperiod
  - Reduced vegetation = reduced evapotranspiration
    - Increased soil saturation (+)
    - Elevated water tables (+)
      - Massasaugas, crawfish frogs benefit especially
    - New temporary pools may form (+)
    - Old temporary pools hold water longer (+)

SHORT-TERM EFFECTS OF FIRE ON HERPETOFAUNA

- Increase in temperature and solar radiation exposure
  - Intensifies desiccation in amphibians (-)
  - Increases water temperature in aquatic habitats (-,+)
    - Faster growth/development of amphibian larvae
  - Higher UV-B exposure to amphibian eggs/larvae
  - Can increase reptile abundance in burned plots (+)
    - Thermoregulatory advantage
  - May result in premature emergence from hibernation (-,+)

LONGER-TERM EFFECTS OF FIRE ON HERPETOFAUNAL COMMUNITIES

- When fire is used to improve/restore degraded habitat…
  - Numerous studies outside the US (Africa, Asia, Australia) reported overall increases in herpetofaunal abundance and diversity resulting from natural and prescribed fires
  - In FL, fire in xeric pine forests results in increased abundance and diversity (Mushinsky 1985)
    - Especially for some endemics
  - In general, herpetofaunal diversity increases

LONGER-TERM EFFECTS OF FIRE ON HERPETOFAUNAL COMMUNITIES

- When fire is used a management tool…
  - Renken (2006), Russell et al. (1999), Pilliod et al. (2003) conducted exhaustive literature reviews
  - Consensus:
    - Despite short-term negative effects, existing herpetofaunal abundance and diversity are not significantly affected by prescribed fire
    - Diversity and abundance in burned and unburned plots are similar

LONGER-TERM EFFECTS OF FIRE ON HERPETOFAUNAL COMMUNITIES

- When fire is suppressed…
  - Isolated wetlands, bogs, swamps succeed into hardwood, closed canopy forests
    - Amphibian diversity and abundance decline
  - Grasslands succumb to red cedar (among other trees) succession
    - Shades out snake hibernacula
  - Savanna canopies close up
    - Reduces reptile basking sites – esp for gravid females
  - In general, abundance and diversity decline

WHY SHOULD YOU CONSIDER HERPETOFAUNA WHEN MAKING LAND MANAGEMENT DECISIONS?

- They comprise a significant amount of biomass
  - EX: Burton and Likens (1975) – report biomass of salamanders alone = 2.6 times that of birds and approximately equal to that of mice and shrews combined
- Moisture is much more important to herpetofauna (especially amphibians) than to mammals, birds
  - Reproduction, respiration, desiccation
- They have substantially shorter dispersal ranges
  - Often forced to adapt to landscape changes (or disappear) since relocation to more favorable conditions is difficult or impossible

MANAGEMENT CONSIDERATIONS

- *Primum non nocere*
  - First, do no harm
  - Prior to burning, managers should decide:
    - What species occur on the landscape?
    - Are there any conservation concerns for any species?
    - Will fire be beneficial, detrimental, or have a neutral effect on herpetofauna – especially species of concern?
    - What is an acceptable mortality rate – especially for species of concern?

MANAGEMENT RECOMMENDATIONS

- From Midwest Partners for Amphibian and Reptile Conservation (MWPARC)
- Adopted by the MWPARC Advisory Board in 2009
- Based on reviews of scientific literature, current research, and contributions from herpetologists and prescribed fire managers
- General guidelines
  - Consider your specific management objectives and then compromise if necessary

1. HERPETOFAUNAL SURVEYS

- Identify species diversity AND ecosystem diversity
  - Are there any features you may not have considered…i.e. small vernal pools, caves, rocky outcrops that can be used as communal hibernacula?
- Determine if any species are rare, sensitive, or otherwise of conservation concern
- Estimate population sizes and geographic extents for species of concern
- If necessary, seek out herpetologists for assistance

2. SEASONAL AND TEMPORAL CONSIDERATIONS

- Herps are ectotherms and normally inactive in winter
- Burning during winter (November 1st – March 1st) is optimal for herps
  - Understandably, this may NOT be optimal for land managers or for desired landscape goals
  - Hence the need for population surveys and estimates of acceptable losses
- **IF** burning after April 1st is unavoidable, consider choosing cool (less than 50^0F), overcast days for burning – preferably if there have been several such days in succession – and early in the day
- Summer burning activity should consider costs vs. benefits
  - It's nesting and gestation season
- Fall burns (prior to November 1st) should be avoided; burn oak savannas in cool weather but before leaf fall

3. AVOID SPRING SEASON BURNS NEAR COMMUNAL HIBERNACULA

- In temperate climates winter hibernation is necessary
- Many snake species hibernate communally in “hibernacula”
  - South-facing slopes/formations offer thermal advantages during winter
  - Snakes are concentrated in small areas
- Upon emergence (spring) snakes “linger” around the hibernaculum
- Poorly planned burns could be devastating to snake populations
- Burns should be conducted before emergence, or not at all

4. FIRE INTENSITY AND SPEED SHOULD ACCOMMODATE SPECIES ON THE LANDSCAPE

- Backfires vs. headfires
- Understand how species on the landscape respond to fire
  - Most herp species are unable to outrun fire
  - Slow fires may allow some species to get ahead of the fire
    - Larger snakes and lizards, frogs
  - Fast fires may leave cover objects unscathed (i.e. logs, clumps of dense litter, etc.) so animals that take cover will be safe
    - Salamanders, toads, smaller snakes and lizards

5. SIZE MATTERS

- Consider burning large areas in smaller sections during different years
  - Annual, large-scale burns can be just as detrimental to diversity as fire suppression
- For smaller areas that are isolated from nearby similar habitats, burning the entire site may result in the loss of entire species
  - Break up into sections
  - Burn on different days (if management constraints allow)
  - Burn during alternating or rotating years

6. INCOMPLETE BURNS ARE OK

- Consider leaving some landscape features intact
  - Snags, downed trees/logs
  - Patches of vegetation
    - Provide safe harbor for herps and habitat for prey

7. IS RESTORATION TO INCREASE BOTANICAL DIVERSITY REALLY NECESSARY?

- One person's botanically poor field is another person's herpetologically rich haven
- Areas with low botanical diversity may be functional, animal-rich systems
- If it ain't broke, don't fix it – especially if it's because you just don't like how it looks.

8. IF YOU BUILD IT, THEY WILL COME

- Landscape management often includes mechanical brush/tree clearing
- Large piles of woody debris/brush make attractive habitat for snakes and lizards
- These activities should be avoided if possible
  - If unavoidable they should be burned…
    - …ASAP
    - …in cold weather

9. AS MUCH FUN AS IT CAN BE, RESIST BURNING REPEATEDLY

- K-selected species are sensitive to even the slightest mortality
  - Turtles
  - Long-lived, usually large snakes (i.e. rattlesnakes)
- Annual burns with even a few mortalities can hit some species hard
- Cumulative effects of annual burns may push some populations beyond recovery
- Burned grasslands often make surveys easier for biologists (i.e. massasauga surveys)…plan ahead
  - Burn early to avoid ANY mortality

10. ALWAYS SHOOT FOR MOSAIC CONDITIONS

- Heterogeneity = greater diversity
- Corridors between patches – especially for sensitive species
- Retain edges and ecotones whenever possible
- Consider more than one fire regime
  - Rarely is a single fire regime optimal for all fauna in a region (Braithwaite 1987)

RESEARCH NEEDS – IF YOU ARE SO INCLINED

- Herpetofaunal surveys of areas maintained by fire
  - Species present
  - Demographic status
  - Habitat requirements
- Sadly these data are lacking in most areas

RESEARCH NEEDS

- Studies that investigate the effects of…
  - Fire frequency
  - Fire intensity
  - Fire season
- …on herpetofauna

RESEARCH NEEDS

- Using chemical and/or mechanical methods of grassland maintenance in place of fire
  - Mowing/cutting
  - Herbicidal application
  - Grazing
- How are herps affected?
- Especially around *Typha*-infested wetlands

RESEARCH NEEDS

- What effects would using fire to maintain temporary wetlands have on herps that use them?
  - Mostly amphibians
  - Fine balance between woody encroachment and maintaining enough “junk” around a wetland for warm season cover
    - Logs
    - Leaf litter

RESEARCH NEEDS

- Long-term studies that investigate the direct and indirect effects of fire on herpetofauna
  - Baseline and post-burn population estimates
  - Species occurrence
  - Spatial and temporal distributions pre- and post-burn
- Requires well-designed, well-planned experiments including treatment replications, controls, etc.

FINAL WORDS

- Information is lacking…but that is changing
- Think more about herps when planning your fire schedules
- Consider surveys of your properties
  - Herpetologists have low self-esteem and work very cheap ☺
  - Many states have herpetological societies that are looking for field trip locations…they usually work free ☺ ☺
- Ultimately, consider your resources:
  - No action is still an action…don't abandon fire for the sake of a single species…find another way.

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MWPARC PRESCRIBED BURNING GUIDELINES FOR AMPHIBIANS AND REPTILES


Thank you!
Questions?