Phase II: Detailed assessment
Stream assessment method

- Kevin Miller (EEP)
- Mark Brinson (ECU)
- Rick Rheinhardt (ECU)
- Bob Christian (ECU)
- Greg Meyer (ECU)
- Chris Bason (ECU)

Contributors to riparian aquatic condition

A. Condition of stream channel
B. Condition of near-channel riparian zone (buffer zone)
C. Condition of contributing drainage basin

List of indicators intended to evaluate condition of riparian systems

- Riparian zone condition (~100 foot-wide)
- Near stream condition (0-10 ft.)
- Instream woody structure
- Sediment regime
- Channel riparian zone connection
- Off/on site factors affecting stream channel
- On/off site factors affection riparian zone
- Composition and structure of vegetation in riparian zone
- Bank stability (high order only)

Riparian ecosystem functions

- Hydrology
  - surface water storage and transport
  - groundwater discharge/recharge
- Biogeochemistry
  - carbon production and storage
  - nutrient cycling (storage, transformation, uptake)
- Habitat
  - aquatic habitat for fishes, amphibians, invertebrates, etc
  - terrestrial habitat for mammals, birds, reptiles, etc

Mega-Indicator of Condition: BIOMASS

Biomass is indicative of:

- Hydrologic functions
  - stabilizing channel
  - maintaining soil structure for infiltration and interflow (reducing direct runoff to stream channel)
  - evapotranspiration (ET)
- Biogeochemical functions
  - storing and recycling nutrients (especially C and N)
  - producing labile organic matter for denitrification
- Habitat functions
  - providing 3-dimensional structure
  - controlling microclimate
  - detritus (litter) complexity for diverse detrital food webs

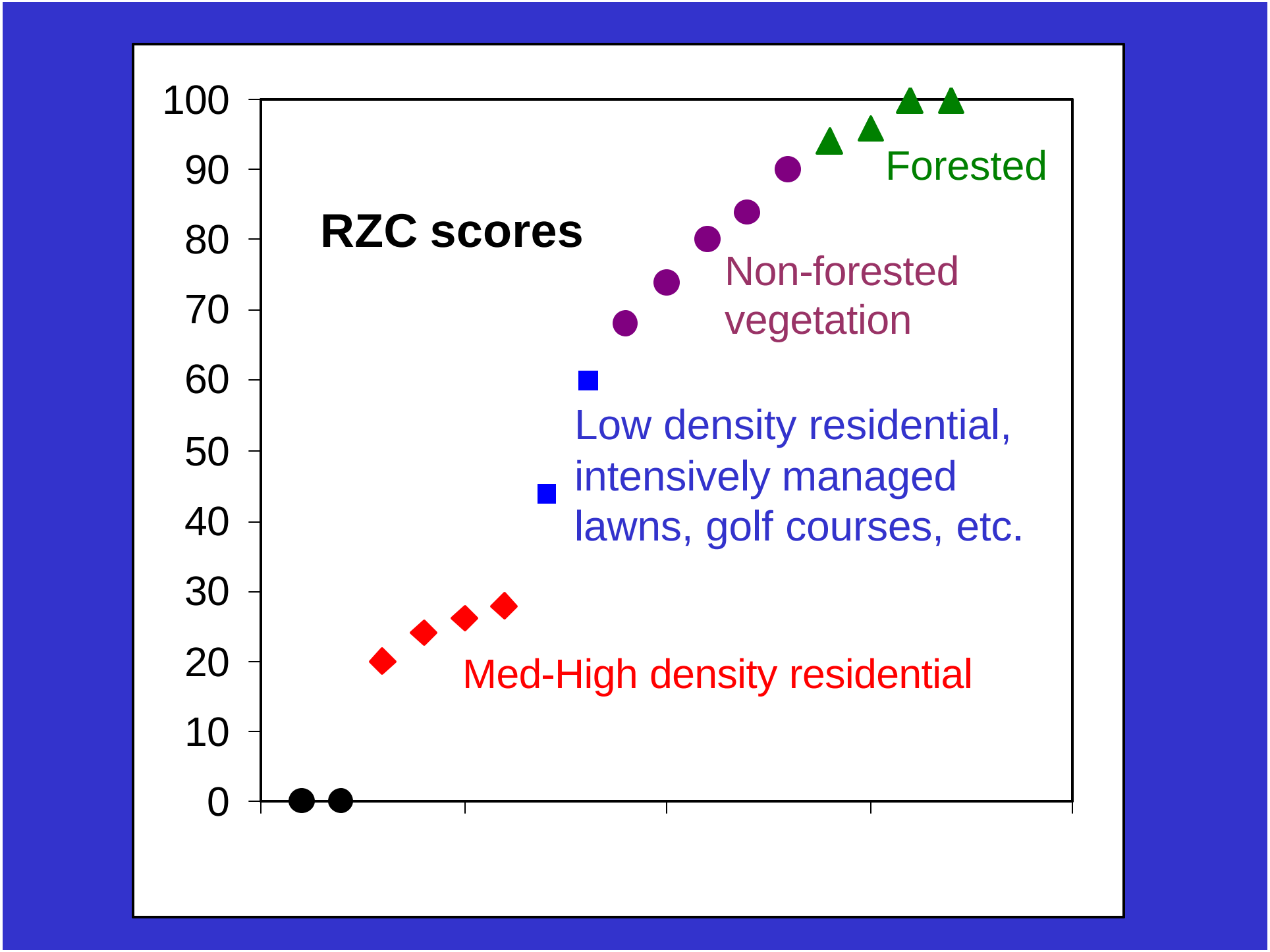
Cover types in reference reaches (repeatable on the landscape)

1. Old forest (>75 years old)
2. Mature forest (> 50 years old)
3. Young forest (25-50 years old)
4. Successional forest (5-25 years old)
5. Recently clear-cut (0-5 years old)
6. Shrub/saplings
7. Perennial herb (fallow fields, lawns, pasture)
8. Annual rowcrop agriculture
9. Impervious (suburban)

Urban Land Use by Cover Type

(not in rural--adapted from Mark Brown's eMergy analysis)

- Low density residential, single family (< 2 houses per one side of 100 yd reach within 90 ft of channel)
- Intensely managed lawns, golf course, recreation field, etc.
- Medium density residential, single family (3-5 houses per...)
- High density residential, single family (>5 houses per…)
- Medium density mobile home (3-5 units per….)
- High density mobile home (>5 units per…)
- High density building, multi unit: strip mall, commercial mall, motels, etc.
- Impervious surface


100
90
80
70
60
50
40
30
20
10
0
RZC scores
Forested
Non-forested vegetation
Low density residential, intensively managed lawns, golf courses, etc.
Med-High density residential

Channel-riparian zone connection

- ability of high stream flows to overflow banks into floodplain
- affects all functions in both stream channel and riparian zone
  - connection between stream channel and riparian zone is fundamental to riparian ecosystem functioning
- determined by degree of incision and evidence of overbank flow

Channel-riparian zone connection

- Hydrology
  - greater channel capacity; higher flow to reach overbank
  - higher flow velocity; more rapid transport of water, sediment during high flow
  - greater groundwater slope during low flows; reduced groundwater storage
  - whole-system storage volume, residence times decreased
- Biogeochemistry
  - lower water table reduces contact between groundwater and organic soils, reduces denitrification, increases soil aeration, inhibits anaerobic processes
  - greater oxidation: reduces accumulation of organic matter
- Habitat
  - terrestrial habitat: dryer, fewer hydrophytes
  - aquatic habitat degraded: more sediment (scour, resuspension

Instream woody structure

- presence of large downed wood of various sizes and stages of decay within channel and along banks
- affects hydrology: energy dissipation and water storage (may be live tree roots in small, unchannelized streams)
- affects biogeochemistry: surface for microbial activity, potential source of dissolved organic carbon (energy source for denitrification and other microbial processes)
- affects habitat: structural habitat complexity for epifauna and epiphytes; shelter for fish and invertebrates in larger streams

Sediment regime

- evidence of stream transport of excessive sand and silt derived from upstream erosion
- affects biogeochemistry: sediment-bound phosphorus—primary mechanism for phosphorus (and heavy metals) transport in fluvial systems
- phosphorus enrichment alters N/P ratio; heavy metal enrichment may harm intolerant aquatic biota
- affects in-stream habitat: excess sediments reduce water transparency, suppress primary production and bury benthic and epiphytic organisms

On/off site factors affecting stream channel

- presence of point sources discharging to or affecting stream channel within or upstream of reach (stormwater, roadside ditches, ag ditches, livestock access)
- relates to all three functions, but only for stream channel riparian zone

On/off site factors affecting riparian zone

- presence of point sources discharging to or affecting floodplain within reach (stormwater, roadside ditches, ag ditches, livestock access, filling/excavating/grading riparian zone)
- relates to all three functions, but only for riparian zone

Composition and structure of riparian zone vegetation

- presence of native vegetation with all strata intact (canopy, midstory understory, herb layers); absence of exotic species
- affects riparian habitat only

Indicators → Condition → Functioning

- Riparian zone condition - riparian
- Near stream condition (0-10 ft.)
- Instream woody structure
- Sediment regime
- Channel riparian zone connection
- Off/on site factors affecting stream channel
- On/off site factors affection riparian zone
- Composition and structure of vegetation in riparian zone

	HYDROLOGY		BIOGEOCHEM		HABITAT	
INDICATORS	**CHANNEL**	**RIPARIN**	**CHANNEL**	**RIPARIN**	**CHANNEL**	**RIPARIN**
Riparian zone cover (RZC), p. 3.						
Near-stream cover (NSC), p. 3.						
Instream woody structure (SRC #1, p. 5)						
Sediment regime (SRC #2, p. 5)						
Channel-riparian zone connection (SRC #3 score, p. 5)						
On/off site factors affecting stream channel (SRC #4, p. 6)						
On/off site factors affecting riparian zone reach (SRC #5, p. 6)						
Composition and structure of vegetation in riparian zone (SRC #6, p. 6)						
Function Score: For each function and location (stream vs. riparian zone), obtain mean of all appropriate indicator scores.						
FUNCTION INDEX (divide above mean by 100)						

Selection of sampling reaches

- USGS 1:24,000 scale hydrography (from 7½ minute quads)
  - misses significant portion of headwater streams
- Sources for additional headwater streams
  - soil surveys
  - predict additional streams from DEMs (LIDAR)
  - predict additional streams from topography
- Random sampling approach

Additional streams from topography

- topographic signature of linear depression
  - two or more contours
  - intersection of tangent lines <90°
  - connecting stream at downstream end
- slope >0.5%
- not adding excessive short low order streams to high order streams (n-2 rule)

Criteria for accepting/rejecting randomly assigned reaches

- Channelized streams vs. ditches
  - proper topographic position
  - hydric soil type
  - high organic soil layer from former floodplain
  - may retain some of original stream sinuosity
  - field ditches may have some features

Criteria for accepting/rejecting randomly assigned reaches

- Intermittent vs. ephemeral streams
  - definition based on hydrology
    - groundwater flow component vs all surface water flow
  - intermittent streams develop fluvial geomorphic features similar to perennial streams
    - channels, stream beds, banks, point bars, sinuosity
    - usually less evident than on perennial streams; discontinuous or sporadic
  - floodplain (usually narrow)
    - evidence of overbank flow (sediment deposits, silt-stained leaves, wrack)
  - usually some aquatic biota (plants or animals)

Cow Swamp—Final stream network with random points