

Attachment: 2

**Long-Term Ecological Monitoring Workshop
North Cascades National Park Service Complex**

March 10th thru 12th, 1998

Workshop Objectives:

1. Provide current, relevant literature references for long-term ecological monitoring.
2. Review resource inventories and issues.
3. Select indicators or "vital signs" (WHAT should be monitored?) for the early detection of change and identification of abnormal conditions.
4. Justify or explain WHY the indicators of change were selected, and prioritize them.
5. Determine appropriate spatial and temporal scales (WHERE and WHEN).
6. Recommend strategies and metrics for implementation (HOW).

Workshop Products:

1. Provide guidance for a draft LTEM Conceptual Plan with prioritized Project Statements.
2. Have an updated, more inclusive LTEM bibliography.
3. Document LTEM Workshop recommendations.
4. Consider establishing a LTEM Scientific Review Committee.

Subsequent Products:

1. Obtain peer review of Workshop draft LTEM Conceptual Plan.
2. Finalize LTEM Conceptual Plan and submit to the I & M Program Coordinator & BRD.
3. Create a LTEM Scientific Review Committee.

NOCA LTEM COMPONENT IDENTIFICATION TEMPLATE

WORKGROUP_____

MONITORING COMPONENT:

MONITORING/RESEARCH QUESTION:

STRESSORS AND RELATED FACTORS:

WHAT TO MONITOR?:

WHERE TO MONITOR?:

JUSTIFICATION AND OTHER INFORMATION (Related monitoring and research programs, publications, methods, potential partners, etc.):

CONTACTS:

ATTACHMENT 1

NOCA RESOURCE ISSUES

Social Issues and Park Management

- Recreational needs/expectations/resource conflicts (fish stocking, grazing, horse use, eagle disturbance, bear management, boating, LWD)
- Population growth and visitor use patterns
- Private inholdings
- Resource extraction and harvest (fish, mushrooms, firewood, gravel)
- Fire management
- Park development and operations
- Other agency management activities

Environmental Issues

- Climate change
- Threatened and endangered species
- Keystone species
- Non-native species
- Adjacent land use and development
- Hydropower operations
- Air and water pollutants
- Fire Ecology
- Biodiversity, refugia, conservation priorities
- Fragmentation, connectivity
- Isolation and barriers
- Stream channel alterations
- Reference reaches and physical templates for stream channel restoration
- Erosion
- Vegetation impacts

Affected Processes

- Landscape vegetation patterns and seral stages
- Habitat/community stability, resilience, resistance
- Fire
- Hydrological changes (glaciers, floods, low flow, stream habitat)
- Water quality
- Mass wasting and erosion
- Productivity and trophic linkages
- Species abundance and distributions
- Colonization and local extinction rates
- Isolation and barriers
- Community composition and diversity
- Competition and predation
- Disease and insect infestations
- Genetics and metapopulation characteristics

NOCA LTEM GOALS

1. Determine status and trends in the condition of park biological and environmental components and processes.
2. Utilize multiple indicators and metrics for early detection and identification of anthropogenic stressors.
3. Enhance basic resource knowledge of the park species, communities, habitat associations, and important environmental attributes.
4. Maximize utility of monitoring program protocols, data, and results (from NOCA to surrounding lands to Regional concerns and initiatives).

Criteria for Meeting Monitoring Goals

1. Monitoring components should be easily and reliably measured.
2. Should be capable of providing an assessment along a gradient of impairment and provide for early detection of impairment.
3. Monitoring ecosystem health should be based upon a variety of measures interpreted by experts.
4. Monitoring should reflect our knowledge of expected sequential changes that occur naturally and normal ranges of variation.
5. Measures should have defined means and variances wherever possible.
6. Monitoring must be designed to incorporate the wide range of spatial and temporal scales.
7. Where possible, data should be additive going from smaller scales to larger ones, increasingly adding to the definition of condition or integrity.
8. Designed to account for catastrophic changes.
9. Monitoring must be based on the concept of ecosystem boundaries - not just park boundaries.
10. Park monitoring protocols should incorporate or be calibrated to existing protocols used by surrounding land management agencies.
11. Monitoring program should be evaluated according to specific criteria on a regular basis.
12. Monitoring program should be capable on incorporating improved methods and new knowledge.

Table IV-2 . Primary relationships of sampling components to watershed ecological attributes.

SAMPLING COMPONENTS	WATERSHED FUNCTIONAL ATTRIBUTES								WATERSHED STRUCTURAL ATTRIBUTES				WATERSHED COMPOSITIONAL ATTRIBUTES	
	Disturb. Process	Sediment Regime	Nutrient Cycling	Hydro. Regime	Resource Product.	Colonization Local Extinct.	Population Fluctuation	Growth Rate	Habitat Pattern	Physical Character.	Distribution	Population Structure	Species/Guilds Identity and Abundance	Species/guilds Richness, Evenness, Diversity
Climate and Hydrology														
Meteorology	X	X	X	X					X	X				
Snow cores	X			X										
Glacier mass balance	X	X		X					X	X				
Discharge	X	X		X					X	X				
Air Quality														
Snow chemistry	X		X		X									
Rainwater chemistry	X		X		X									
Cloudwater chemistry	X		X		X									
Water Quality														
Temperature	X				X			X		X	X			
Turbidity	X	X		X	X									
Chemistry	X		X	X	X									
Habitat														
Slope and riparian	X	X	X	X	X		X		X	X	X	X	X	X
Riparian transects	X	X		X	X	X	X	X	X	X	X	X	X	X
Stream habitat	X	X		X	X				X	X				
Lake habitat	X	X		X	X				X	X				
Biota														
Plankton and periphyton	X	X	X	X	X	X	X				X		X	X
Aquatic macroinvertebrates	X	X	X	X	X	X	X				X		X	X
Riparian macroinvertebrates	X		X		X	X	X				X		X	X
Amphibians	X			X		X	X				X	X	X	X
Fish	X	X		X	X	X	X	X			X	X	X	X

WATERSHED ATTRIBUTES:

Disturbance Processes - erosion/slope stability, global/regional climate change, air and water quality, floods, fire, visitor use impacts, park development, exotic species impacts.

Sediment Regime - sediment character, source, transport, storage.

Nutrient Cycling - aquatic system sources, seasonal and episodic inputs and outputs.

Hydrological Regime - Glacial/precipitation/snowpack inputs, seasonal regimes and flood frequency, duration, and magnitude.

Resource Productivity - aquatic indicators (nutrients, chlorophyll, macroinvertebrate density, zooplankton density), growth and production of riparian tree species.

Colonization/Local Extinction - spatial and temporal changes in species abundance and distribution.

Population Fluctuation - abundance of vegetation and faunal components through time.

Growth Rate - riparian trees, lichens and fish.

Habitat Pattern - watershed plant community; aquatic and riparian habitat - heterogeneity, fragmentation, succession.

Physical Characteristics - canopy, layering, snags, woody debris, channel and lake habitat units, substrate, depth, flow, area, temperature.

Distribution - spatial patterns in species abundance/occurrence.

Population Structure - size and age structure of populations.

Species/Guilds Compositional Attributes - identity, relative and absolute abundance, richness, evenness, diversity, biotic integrity, and proportion of rare, threatened, endangered, and indicator species.

ecological
impact of
human-induced
alteration



1. food (energy) source

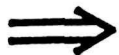
- type, amount and particle size of organic material entering a stream from the riparian zone versus primary production in the stream
- seasonal pattern of available energy



- decreased coarse particulate organic matter
- increased fine particulate organic matter
- increased algal production

2. water quality

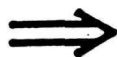
- temperature
- turbidity
- dissolved oxygen
- nutrients (primarily nitrogen and phosphorus)
- organic and inorganic chemicals, natural and synthetic
- heavy metals and toxic substances
- pH



- expanded temperature extremes
- increased turbidity
- altered diurnal cycle of dissolved oxygen
- increased nutrients (especially soluble nitrogen and phosphorus)
- increased suspended solids
- increased toxics
- altered salinity

3. habitat structure

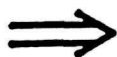
- substrate type
- water depth and current velocity
- spawning, nursery, and hiding places
- diversity (pools, riffles, woody debris)
- basin size and shape



- decreased stability of substrate and banks due to erosion and sedimentation
- more uniform water depth
- reduced habitat heterogeneity
- decreased channel sinuosity
- reduced habitat areas due to shortened channel
- decreased instream cover and riparian vegetation

4. flow regime

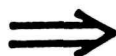
- water volume
- temporal distribution of floods and low flows



- altered flow extremes (both magnitude and frequency of high and low flows)
- increased maximum flow velocity
- decreased minimum flow velocity
- reduced diversity of microhabitat velocities
- fewer protected sites

5. biotic interactions

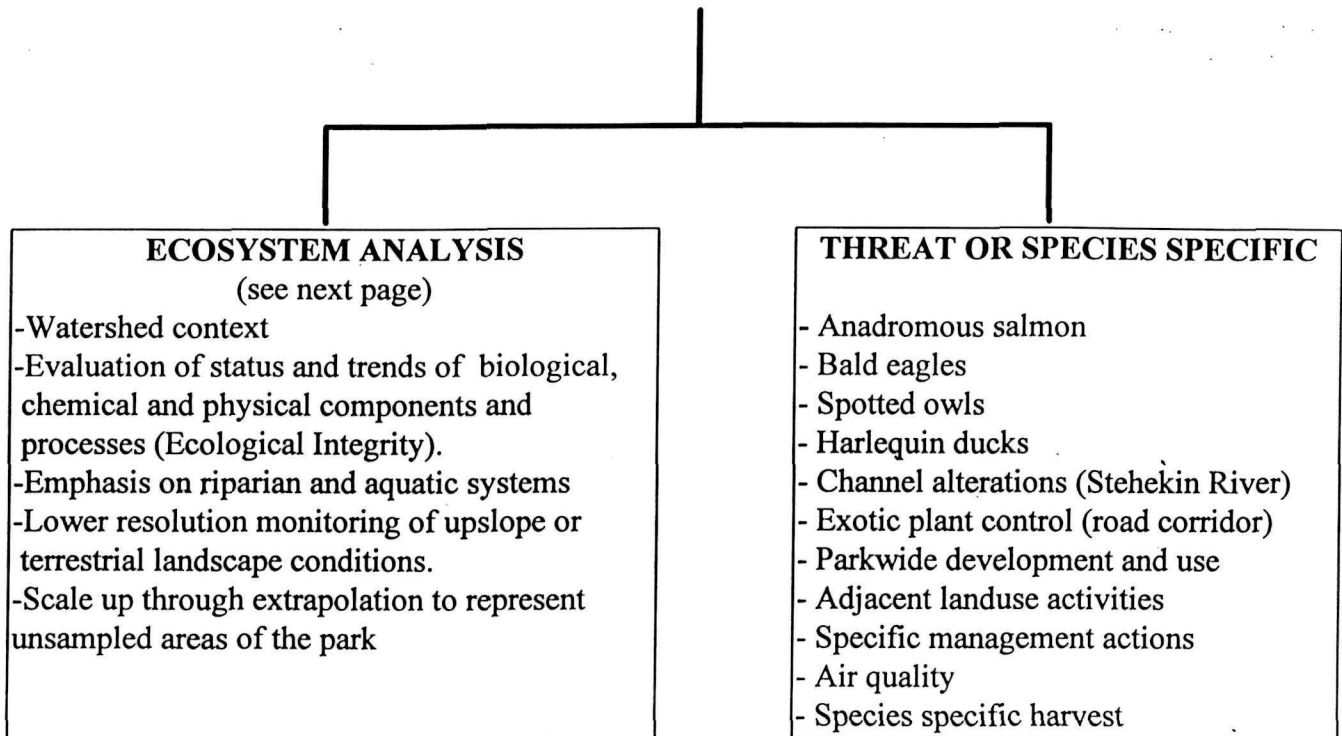
- competition
- predation
- disease
- parasitism



- increased frequency of diseased fish
- altered primary and secondary production
- altered trophic structure
- altered decomposition rates and timing
- disruption of seasonal rhythms
- shifts in species composition and relative abundances
- shifts in invertebrate functional groups (increased scrapers and decreased shredders)
- shifts in trophic guilds (increased omnivores and decreased piscivores)
- increased frequency of fish hybridization
- increased frequency of exotic species

Figure IV-1. Ecological impacts of human-induced alterations (Karr 1991).

NOCA LTEM

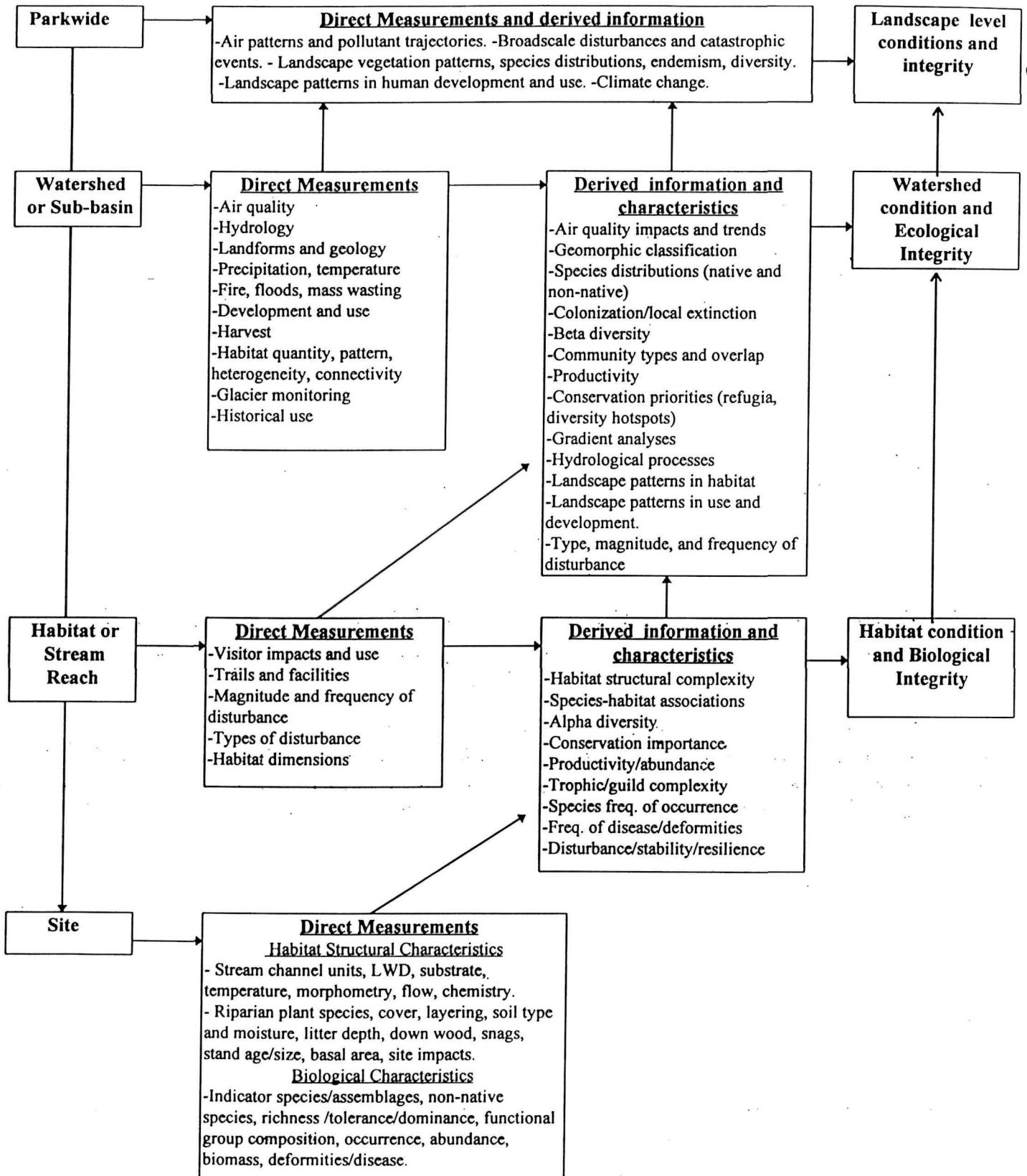


Ecosystem Analysis = Process to characterize human, aquatic, riparian and terrestrial features, conditions, processes and interactions within a watershed. Provides a context for resource protection, restoration, sustaining natural processes and conditions, and implementing management decisions (Federal guidelines for watershed analysis, 1995)

Threat/Species Specific Monitoring = Monitoring where there are existing or potential known stresses or effects, or monitoring of heroic or key species. Monitoring boundaries set by distribution of the stressors or species of interest.

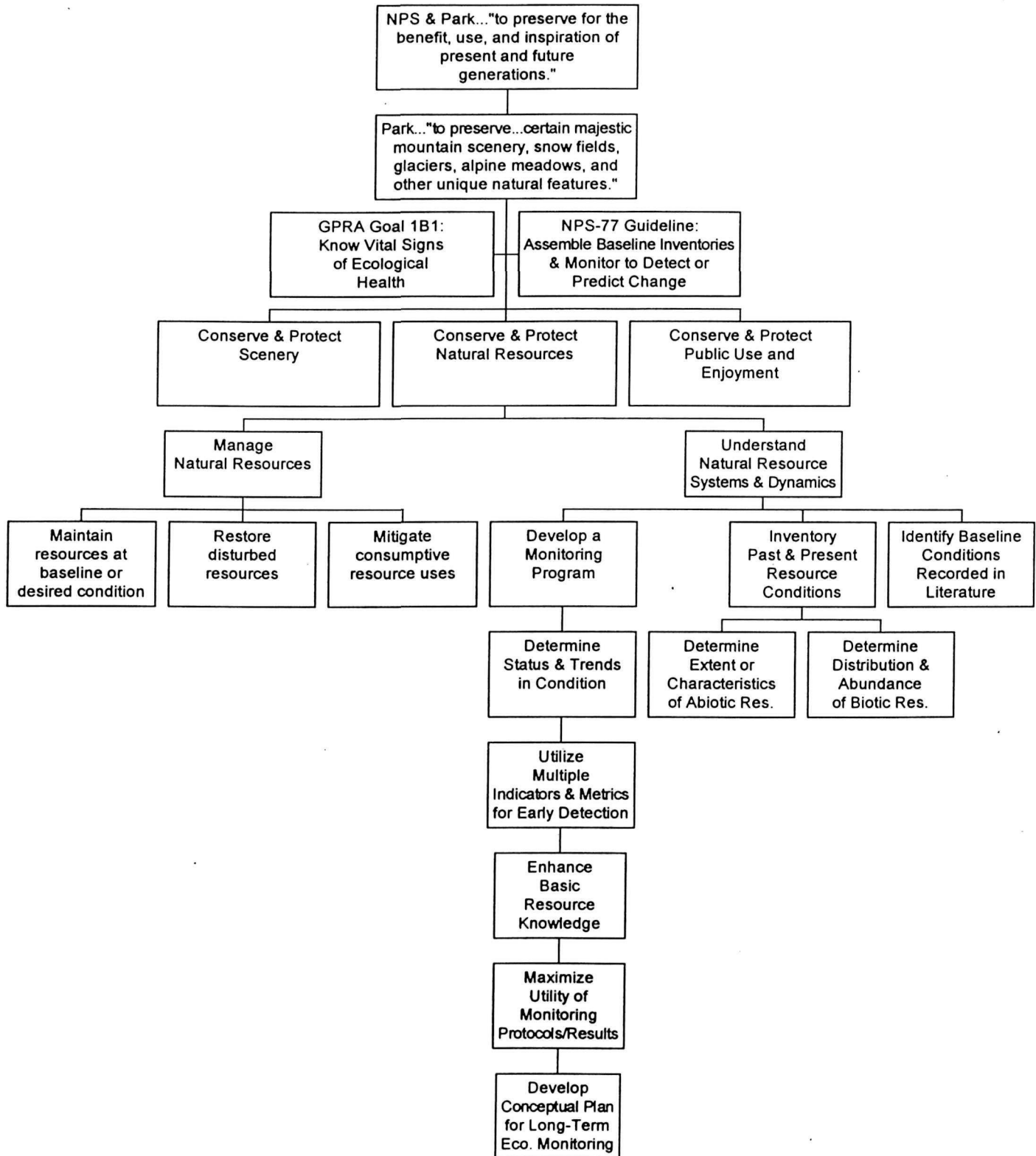
Ecosystem Analysis

North Cascades National Park Conceptual Model For LTEM at the Watershed Scale.



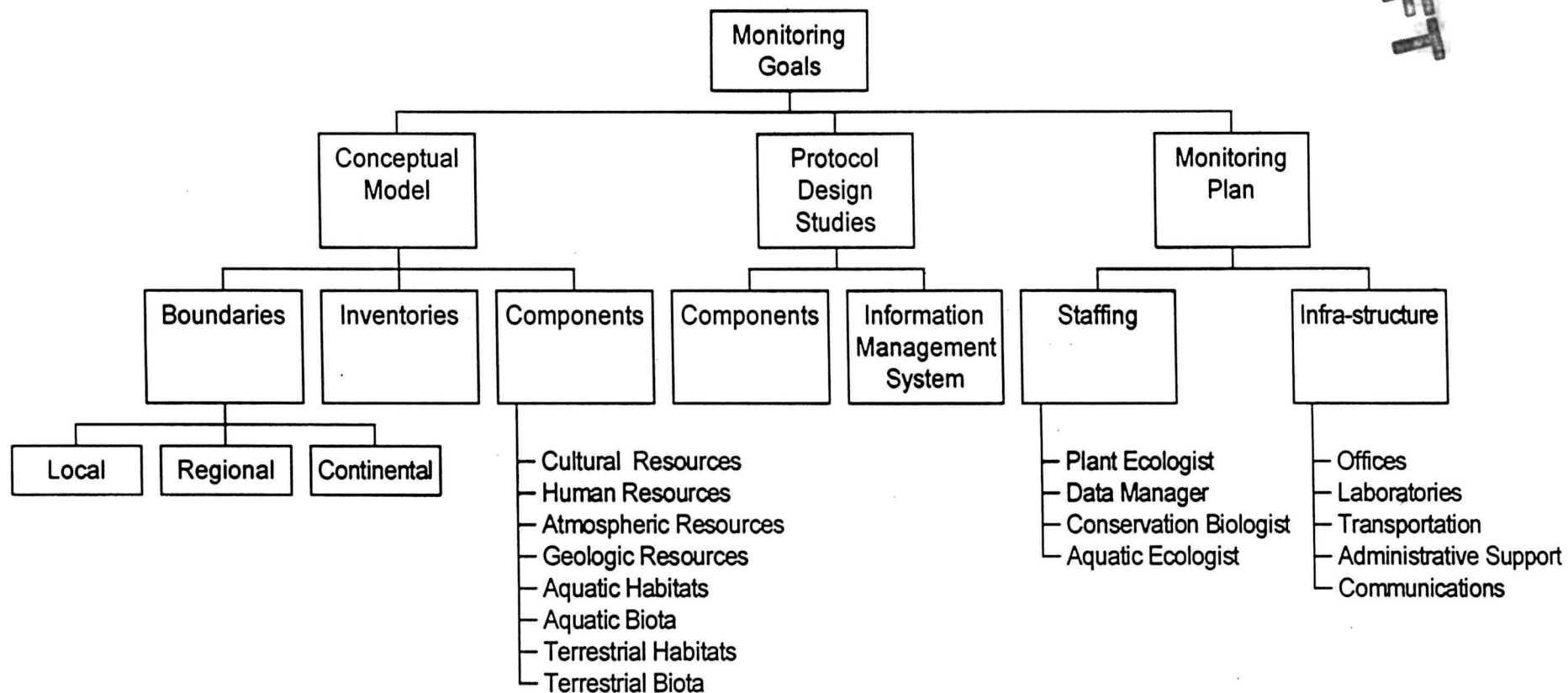
DRAFT

Long-Term Ecological Monitoring
North Cascades NPS Complex



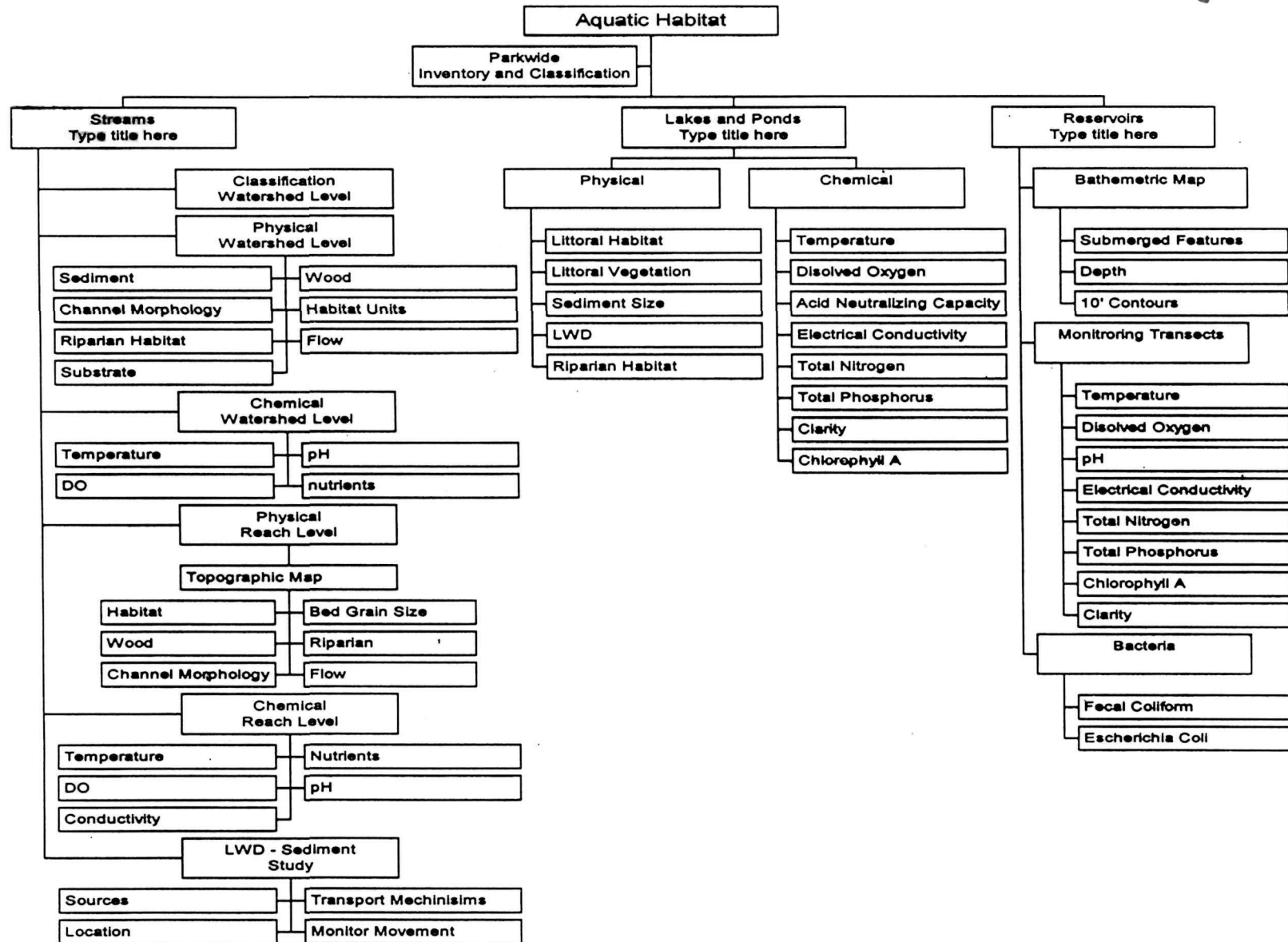
DRAFT

Long-Term Ecological Monitoring--North Cascades



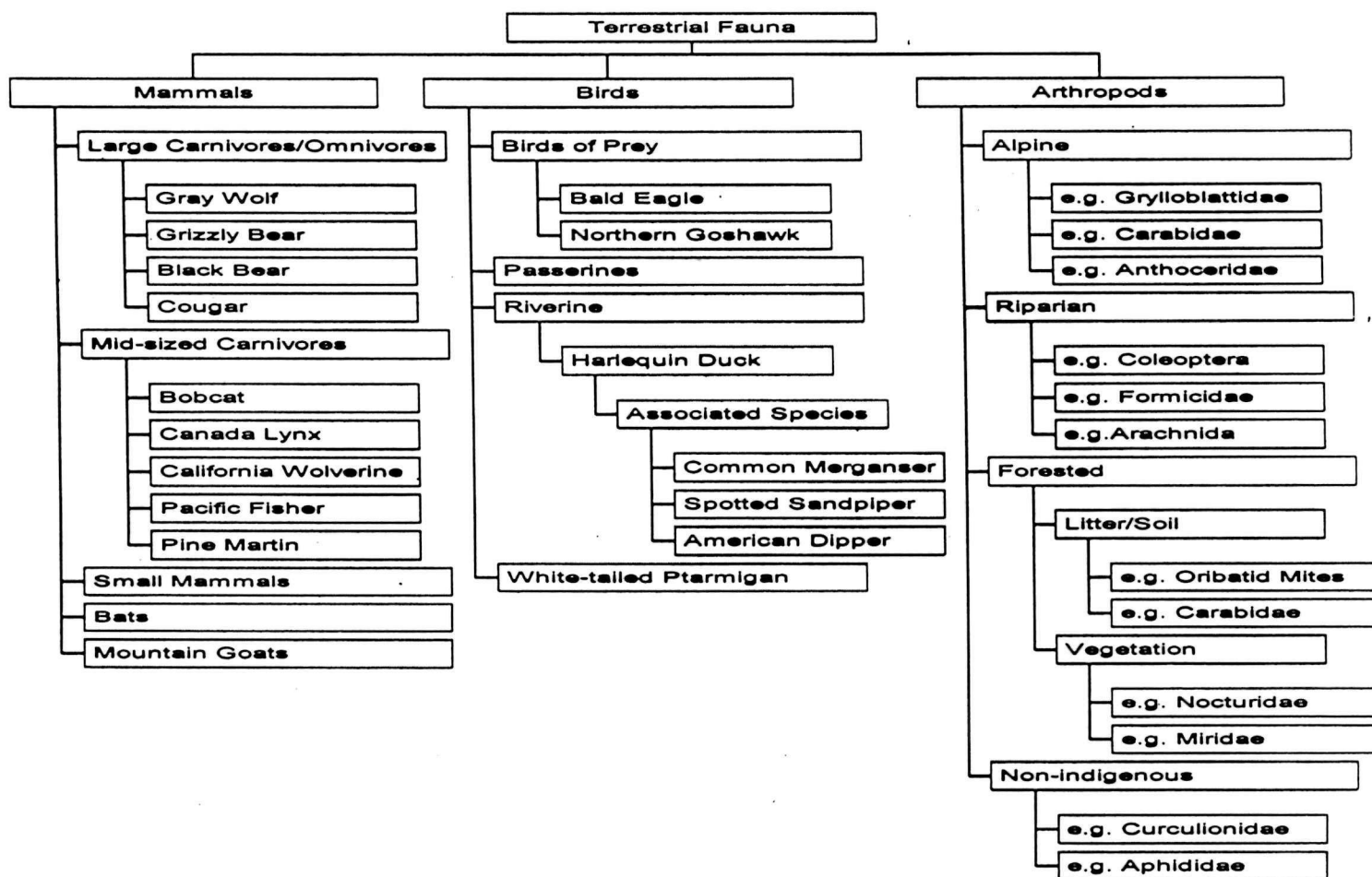
Aquatic Habitat Monitoring Components

DRAFT



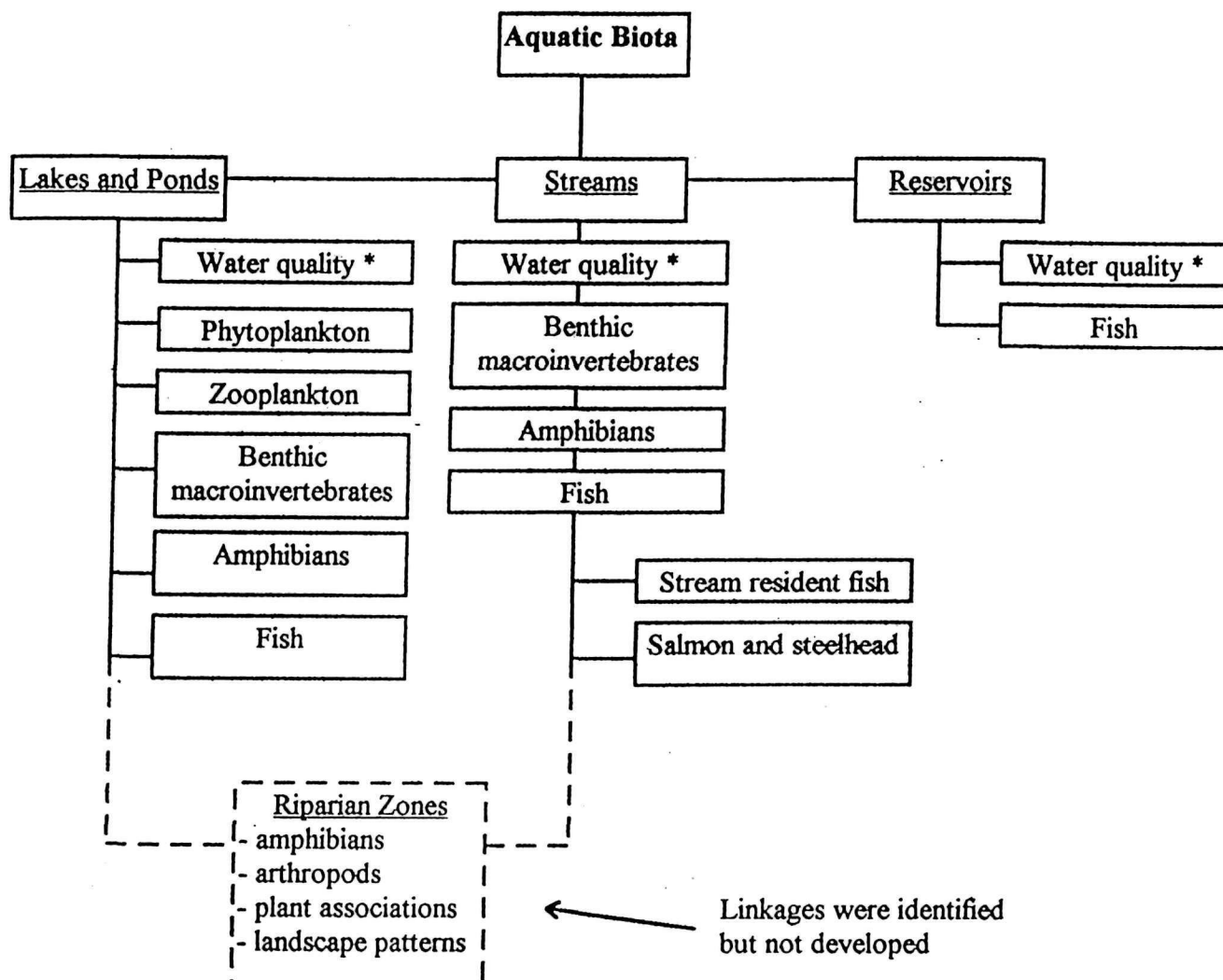
Terrestrial Fauna Monitoring Components

DRAFT



Aquatic Biota Monitoring Components

DRAFT



* Water quality includes basic parameters for all waters, and coliform bacteria for reservoirs and selected mainstem sites on the Stehekin and Skagit Rivers.

Monitoring parameters for habitat and biological components

Genetic integrity - population, meta-population scales

Biological integrity - site, habitat, landscape

Physical -chemical integrity - site, habitat, landscape

Distribution (species to communities), immigration-emigration, colonization (multi-spatial and temporal scales)

Definition of communities and associated habitats

Species -habitat associations

Occurrence (species to community assemblages)

Habitat heterogeneity

Isolating mechanisms

Habitat connectivity

Habitat quantity

Habitat quality (physical -chemical integrity - site, habitat, landscape)

Rare and/or important habitats (biodiversity hotspots)

Biodiversity (site to landscape scales)

Functional groups and guilds

Number of trophic links

Non-indigenous species

Productivity

Age/size structure

Harvest

Natural mortality

Recruitment

Species richness

Presence/absence

Relative abundance/density

Community similarity

Redundancy

Dominance

Tolerance

Disease, deformities

Condition factors - Growth rates

Selection criteria for monitoring components

- represents important functional group
- threatened species
- components representing broader and more complex ecological processes (indicators, keystone species, umbrella species)
- provide for early warning of impairment, and sensitive to management actions
- flagship species
- commodity species
- taxonomy well known
- abundant
- short generation times
- low spatial and temporal variability
- application to NOCA management needs (current issues and future needs)
- application to other agency management and monitoring programs
- ecology of species or assemblage well known
- monitoring methods well developed
- methods accepted and used by other agencies
- known impacts or susceptibility to
- available expertise
- important environmental attribute data