Ecology, Restoration, and Management of Hawaiian Stream and Riparian Systems

Windward Community College,
Hale Akoakoa, Rooms 101 & 103
20-22 May 2008

Opening Oli

Dr. Samuel ʻOhukaniʻāhiʻa Gon III

Ecology, Restoration, and Management of Hawaiian Stream and Riparian Systems

Welcome !!!

- Logistics
- Agenda

Scheduling

- Workshop begins at 0800 each morning
- Ending times are
  - 4pm Tues
  - 5 pm Wed
  - 3 pm Thurs
- Lunch and breaks

BUT FIRST A WORD FROM OUR SPONSOR

- The workshop you are attending (free of charge and worth every penny) was brought to you by:
  - The U.S. Army Corps Of Engineers WATER OPERATIONS TECHNICAL SUPPORT (WOTS) program


What are Riparian Areas?

Is there a Universally Accepted Definition of Riparian?

Riparian (ri per' e n) adj. [< L. *riparius* < ripa, a bank < IE. *reipa*, a steep edge] 1. of, adjacent to, or living on, the bank of a river or, sometimes, of a lake or pond, etc.

Root for such words as:

River

Rip-rap

Bank swallow (*Riparia riparia*)

Brush rabbit (*Sylvilagus bachmani riparius*)

U.S. Army Corps of Engineers
(33 CFR:1984)

"Jurisdictional wetlands"

"Those areas that are inundated or saturated by *surface or ground water* at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of *vegetation* typically adapted for life in *saturated soil* conditions. Wetlands generally include swamps, marshes, bogs, and similar areas."

Riparian Definitions

"associated with water courses. Riparian may refer to vegetation associated with large rivers or with small, even intermittent drainages such as arroyos."--
Dick Peddie and Hubbard (1977)

"environs of freshwater bodies, watercourses, and surface-emergent aquifers (springs, seeps, and oases) whose *transported waters* provide *soil moisture* in excess of that otherwise available through local precipitation to potentially support the growth of mesic *vegetation*."

--Warner and Hendrix (1984)

"a distinct ecological site, or combination of sites, in which soil moisture is sufficiently in excess of that otherwise available locally, due to *run-off* and/or subsurface seepage, so as to result in an existing or potential soil-*vegetation* complex that depicts the influence of that extra *soil moisture*."

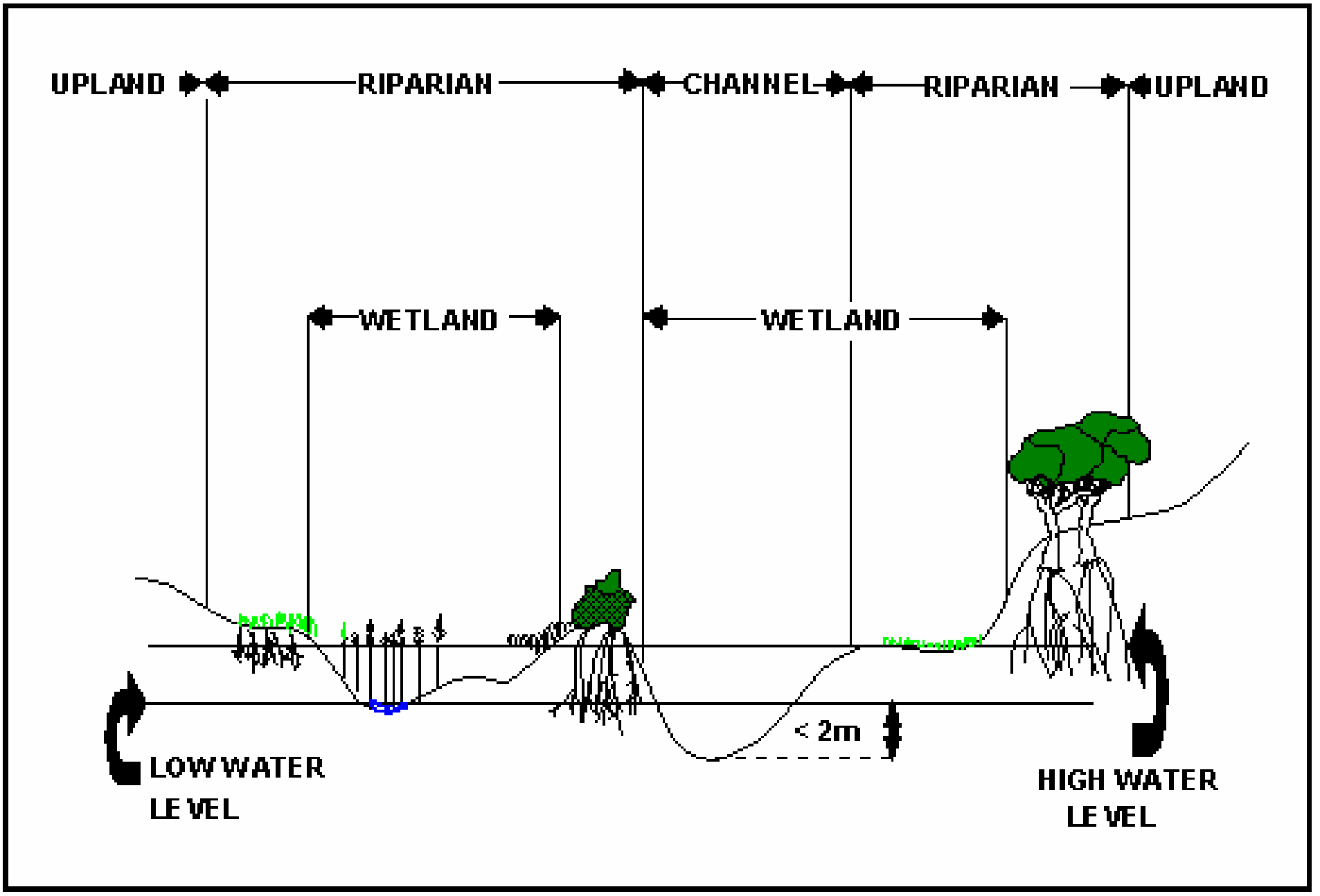
-- Anderson (1987)

"Riparian areas are three-dimensional ecotones of interaction that include terrestrial and aquatic ecosystems, that extend down into the groundwater, up above the canopy, outward across the floodplain, up the near-slopes that drain to the water, laterally into the terrestrial ecosystem, and along the water course at a variable width"

-- Ilhardt et al. (2000)

"Riparian areas are transitional between terrestrial and aquatic ecosystems and are distinguished by gradients in biophysical conditions, ecological processes, and biota. They are areas through which surface and subsurface hydrology connect waterbodies with their adjacent uplands. They include those portions of terrestrial ecosystems that significantly influence exchanges of energy and matter with aquatic ecosystems (i.e., a zone of influence). Riparian areas are adjacent to perennial, intermittent, and ephemeral streams, lakes, and estuarine-marine shorelines."

-- National Research Council (2002)


UPLAND
RIPARIAN
CHANNEL
RIPARIAN
UPLAND
WETLAND
WETLAND
< 2m
LOW WATER LEVEL
HIGH WATER LEVEL

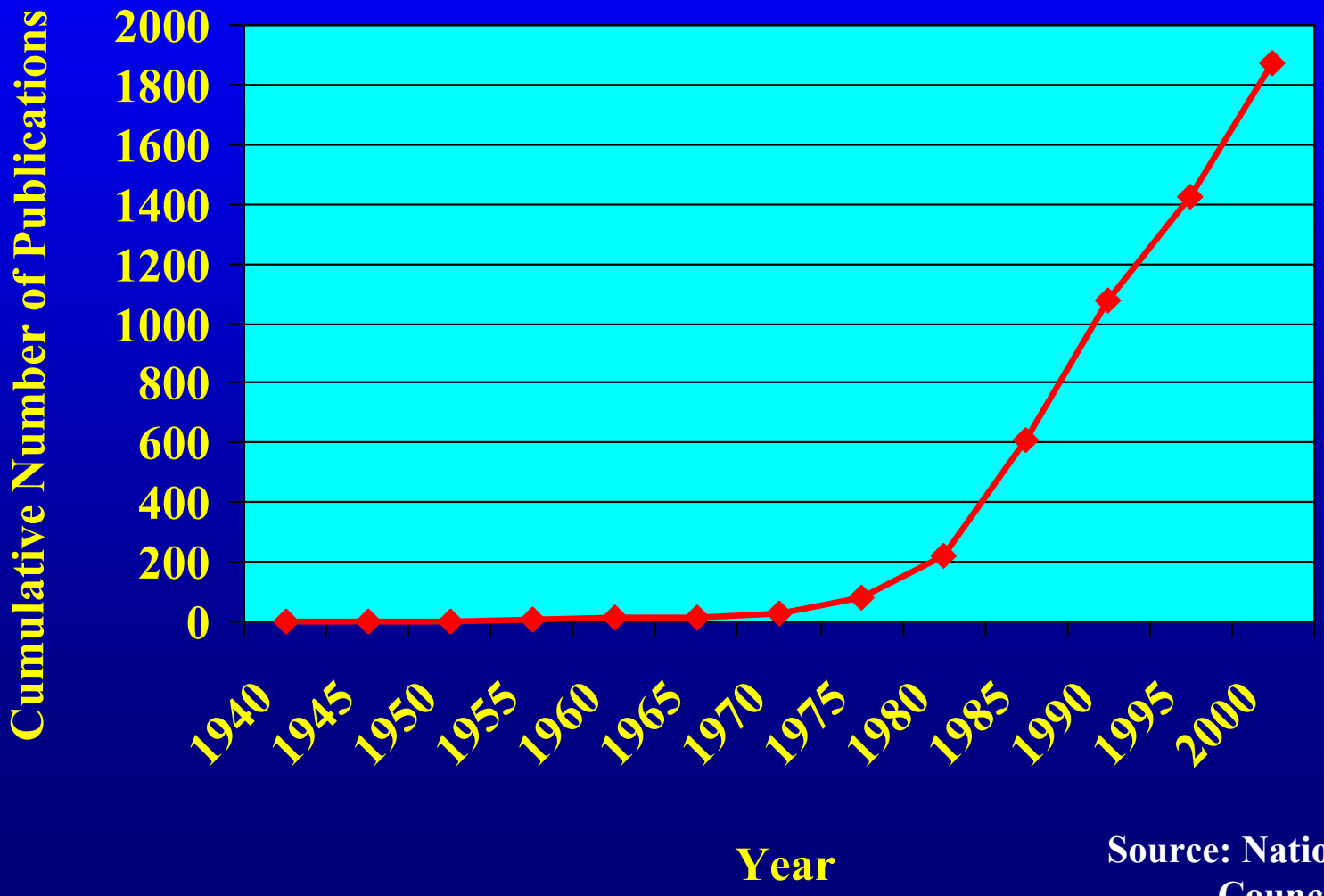
“Riparian areas generally do not satisfy regulatory and other definitions of “wetland,” and thus are not encompassed by regulatory programs for wetland protection.”

National Research Council, 2002

The federal Clean Water Act requires that wetlands be protected from degradation because of their multiple, important ecological roles including maintenance of high water quality and provision of habitat for fish and wildlife.

However, protection of wetlands generally does not encompass riparian areas- the lands bordering waterbodies such as rivers, lakes, and estuaries-even though they often provide many of the same functions as wetlands.

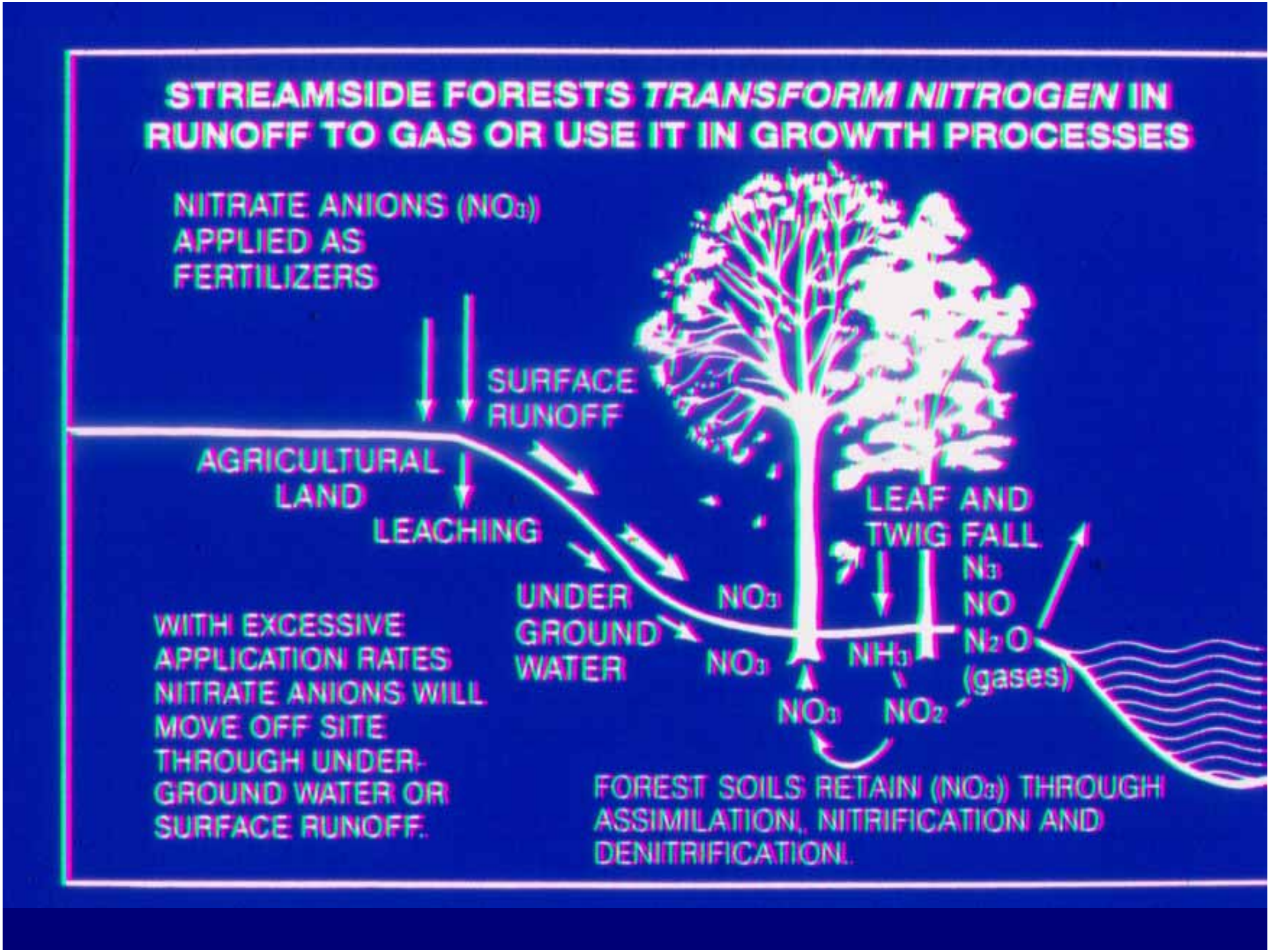
Cumulative Number of riparian/wetland publications for the Western United States



Source: National Research Council 2002

Riparian Vegetation

intercepts sediment, pesticides, herbicides, and other materials in surface runoff


STREAMSIDE FORESTS *TRANSFORM NITROGEN* IN RUNOFF TO GAS OR USE IT IN GROWTH PROCESSES
NITRATE ANIONS (NO_3) APPLIED AS FERTILIZERS
SURFACE RUNOFF
AGRICULTURAL LAND
LEACHING
UNDER GROUND WATER
NO_3
NO_3
LEAF AND TWIG FALL
NH_3
N_3
NO
N_2O
(gases)
NO_3
NO_2
WITH EXCESSIVE APPLICATION RATES NITRATE ANIONS WILL MOVE OFF SITE THROUGH UNDER-GROUND WATER OR SURFACE RUNOFF.
FOREST SOILS RETAIN (NO_3) THROUGH ASSIMILATION, NITRIFICATION AND DENITRIFICATION.

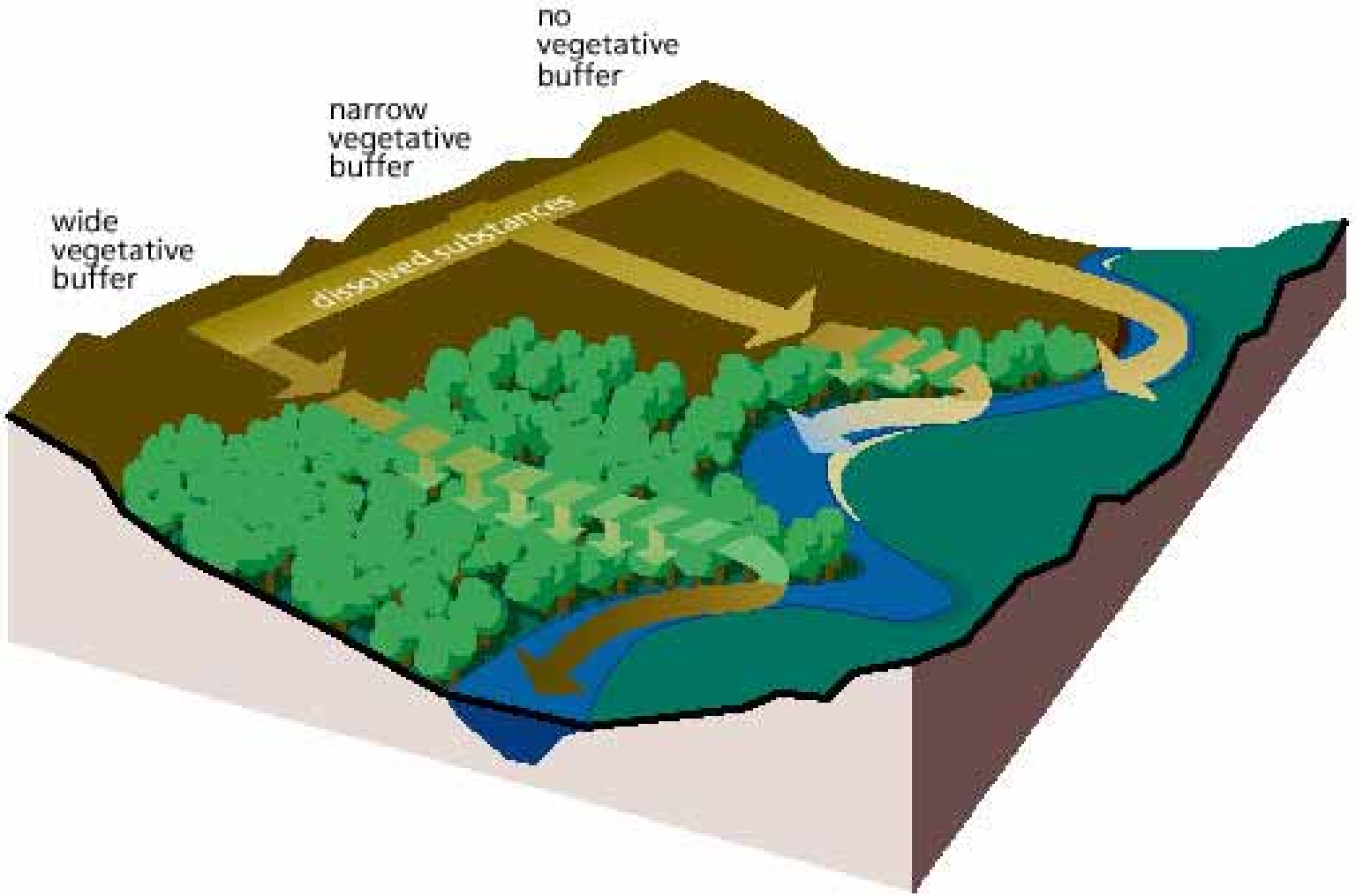


Figure 2.40: The width of the vegetation buffer influences filter and barrier functions.
Dissolved substances, such as nitrogen, phosphorus, and other nutrients, entering a vegetated stream corridor are restricted from entering the channel by friction, root absorption, clay, and soil organic matter.
***Adapted from* Ecology of Greenways: Design and Function of Linear Conservation Areas.**
Edited by Smith and Hellmund. © University of Minnesota Press 1993.

Riparian Buffer Strip Widths Recommended for Water Quality Concerns

Objective	Width (m)
Reducing P Concentrations	15m
Remove 80% of excess N and P	5 m
Improve quality of stormwater runoff	25 m
Remove sediment	61 m
Remove Nitrates and Phosphorus	18 m
Reducing suspended solids	9 m

Note: These are site-specific studies and aren't intended to be general recommendations

Riparian Buffer Strip Widths Recommended for Bird Communities

Objective	State	Width (m)
Neotropical migrants	VA	50m
Neotropical migrants	KY	100m
Include 90% of bird species	VT	150m
Maintain complete avian community	SC	500m
Maintain functional bird community	GA	100m
Breeding habitat for yellow-billed cuckoo	CA	100m
Reduce edge-related predation	ME	150m
Breeding habitat for area-sensitive species	NH	100m

Riparian Buffer Strip Widths Recommended for Amphibians, Mammals, and Plants

Objective	Width (m)
Support Diverse Herpetofaunal Community	100m
Year-round Amphibian Habitat	165m
Year-round cottonmouth habitat	94m
General Herpetofaunal Habitat	30m
Maintain Gray Squirrel Populations	50m
Include 90% of Vascular Plant Species	30m
Maintain Unaltered Microclimate Gradient	45m
Maintain Benthic Invertebrate Habitat	30m

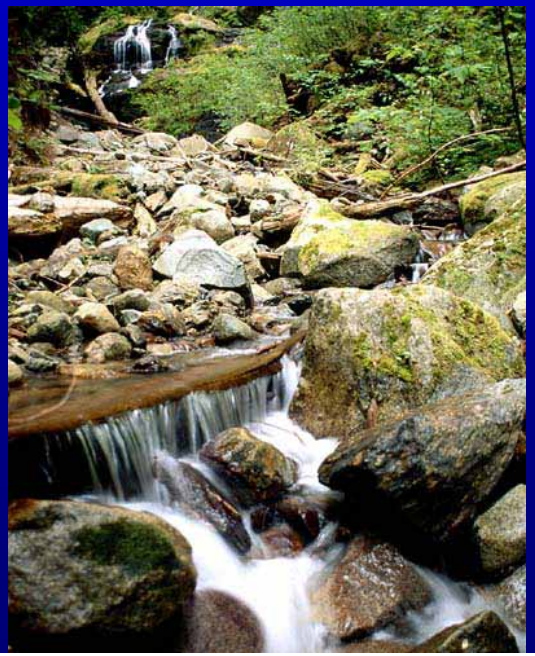
Riparian Vegetation

Tree and shrub roots increase bank and shoreline stability

Riparian Vegetation

Effects on Streams

Provides litter and large woody debris important to aquatic organisms



Riparian Vegetation

Vegetation removal can cause:

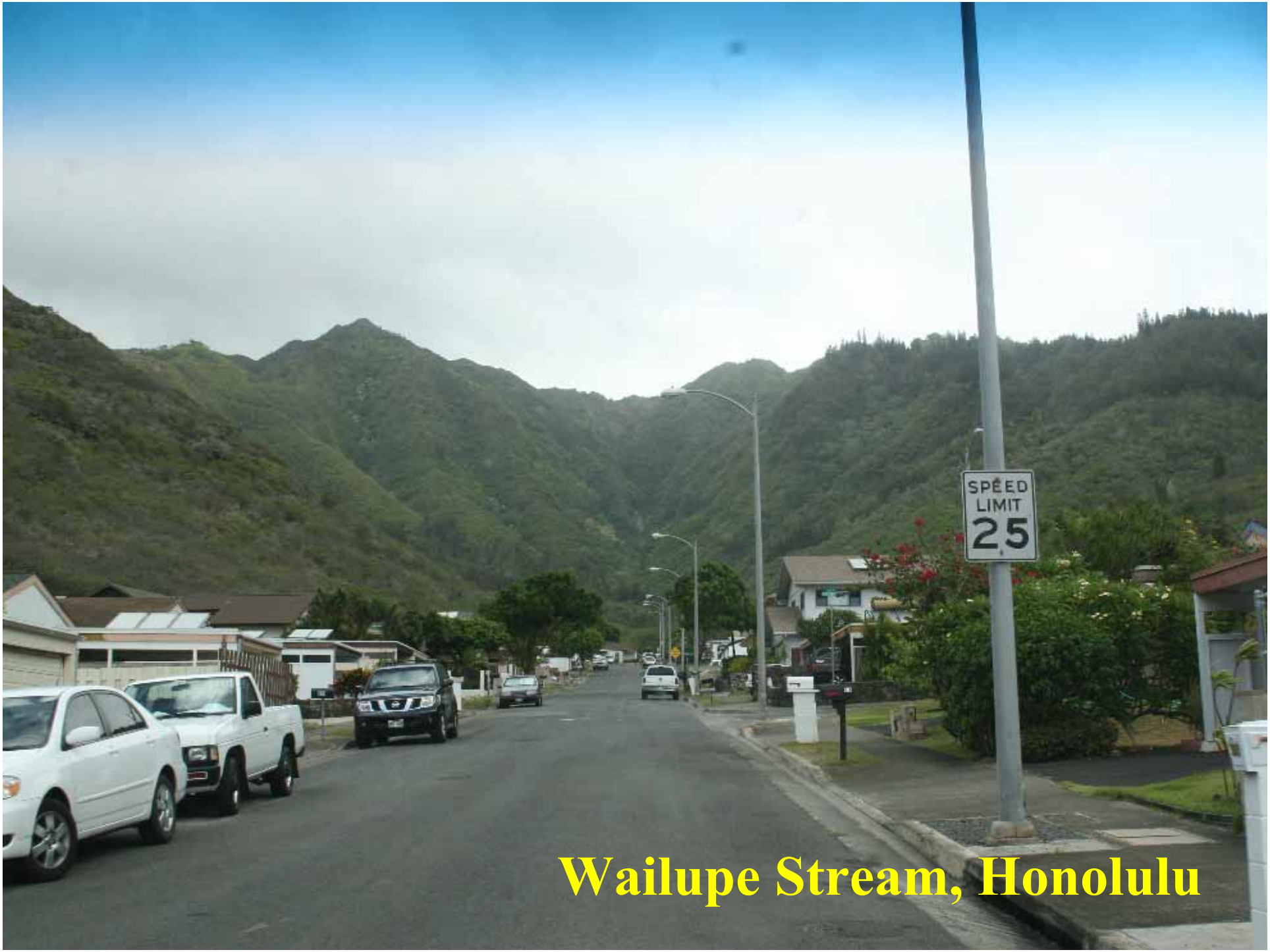
- **Increased water temperature through loss of shading**
- **Increased surface runoff**
- **Sedimentation**
- **Reduced infiltration**
- **Altered stream flow**

Removing key buffers

- Contemporary problems occur because of the removal of upstream buffers in and along tributaries (e.g. wetlands that act as infiltrators, brakes/spreaders) and the exploitation of riparian buffers to bank edge (wetland drainage for agriculture, floodplain urbanization, and placement of terrestrial transportation arteries along stream corridors to replace historic water transport).

Removing key buffers

- In larger river systems, increasing impermeability of the watersheds (forest removal, soil compaction and urbanization) coupled with the loss of buffering capacity increases both the volume and arrival speeds of stormwater from sub-watersheds to the main stem.
- Removal of riparian buffers eliminates the rivers natural ability to safely accommodate flows above main stem conveyance capacity by permitting bank overflow onto floodplain terraces



Wailupe Stream, Honolulu


Wailupe Stream, Honolulu

Lihue, Kaua'i


Lihue, Kaua'i


Poipu, Kaua'i

Riparian Vegetation

slows out of bank flood flows

Floodplain loss contributes to urban and suburban flooding problems

Riparian Vegetation

slows out of bank flood flows

Manoa Stream, Oah'u

Floodplain loss contributes to urban and suburban flooding problems

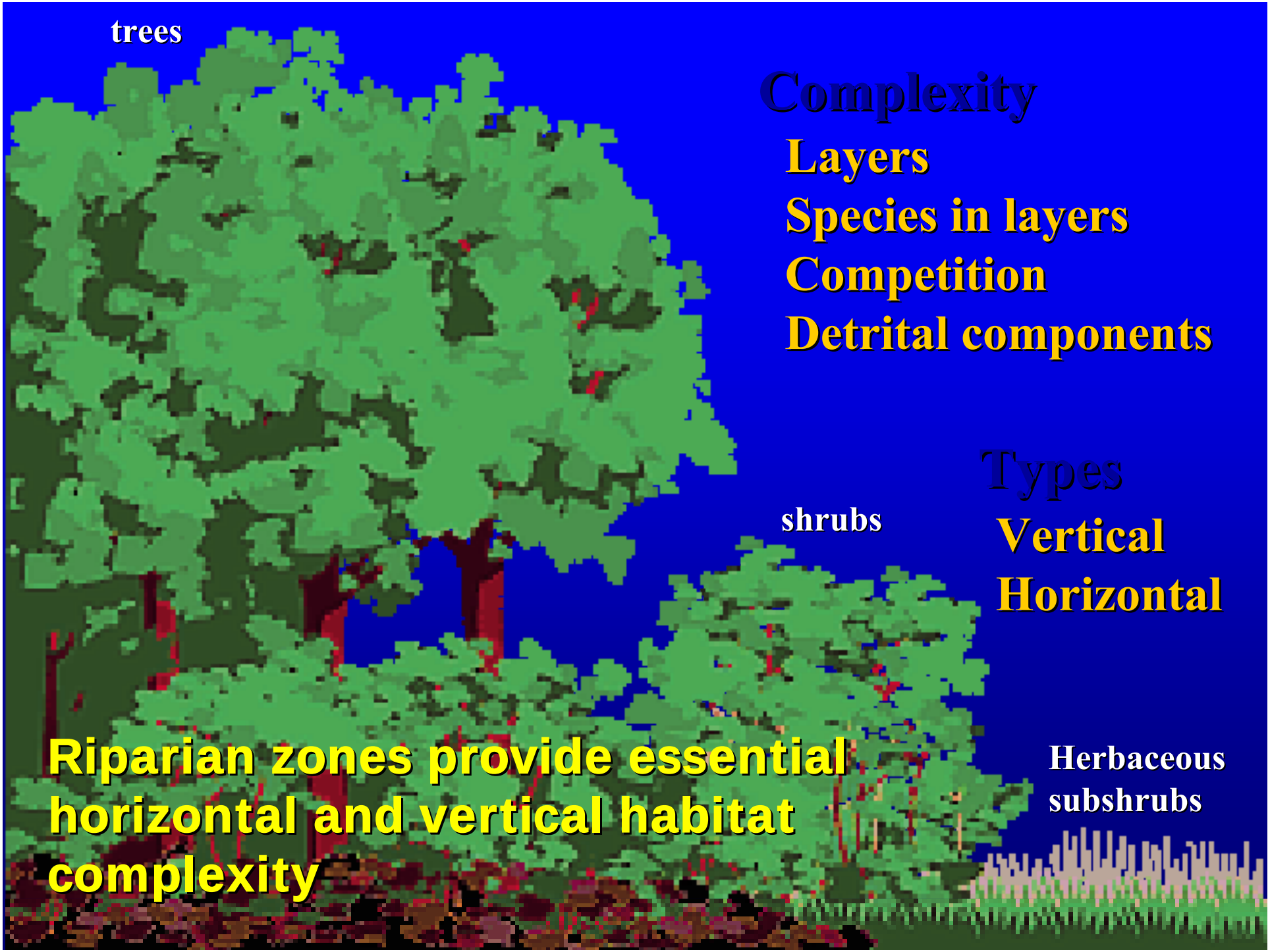
Terrestrial Fauna

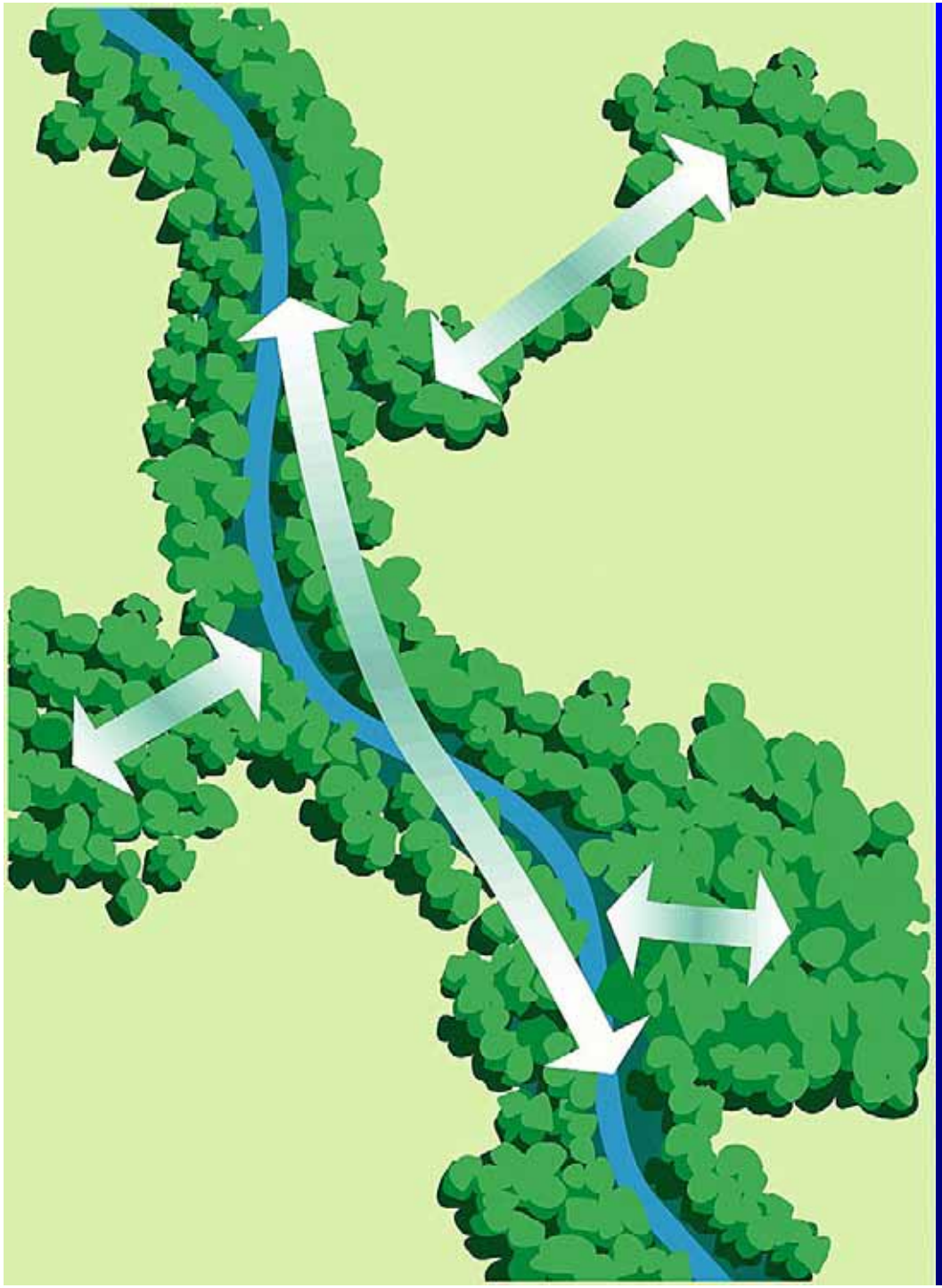
Stream and riparian corridors are used by wildlife more than any other habitat type

Riparian areas offer in proximity all three critical resources for wildlife

The presence of surface water provides essential breeding habitat for reptiles, amphibians and aquatic invertebrates; and foraging areas for many other animals.

Riparian vegetation usually provides the woody structural components required by many wildlife species for roosting, perching, and nesting.


trees
Complexity
Layers
Species in layers
Competition
Detrital components
Types
Vertical
Horizontal
shrubs
Herbaceous subshrubs
Riparian zones provide essential horizontal and vertical habitat complexity



Riparian zones provide movement corridors between the remaining blocks of fragmented woodland habitat.

Riparian zones provide migration corridors for birds and many large mammals that use different summer and winter ranges.

Riparian Impacts, Issues & Current Status

Major threats to Riparian Ecosystems

- Agriculture
- Livestock operations
- Silvicultural practices
- Water developments
- Urbanization/development
- Mining
- Road construction

Problems Associated with Riparian Disturbances

- Bank erosion
- Biodiversity loss
- Flooding
- Non-native species
- Food scarcity
- Fragmentation
- Nutrient loss
- Pollution
- Siltation
- Vegetation modification
- Water quality/quantity
- Genetic deterioration

Regional Trends

Region	Percent Loss
Northern U.S. floodplain forests	70%
Mississippi Delta	82-85%
Southern U.S. Bottomland Hardwoods	80-90%

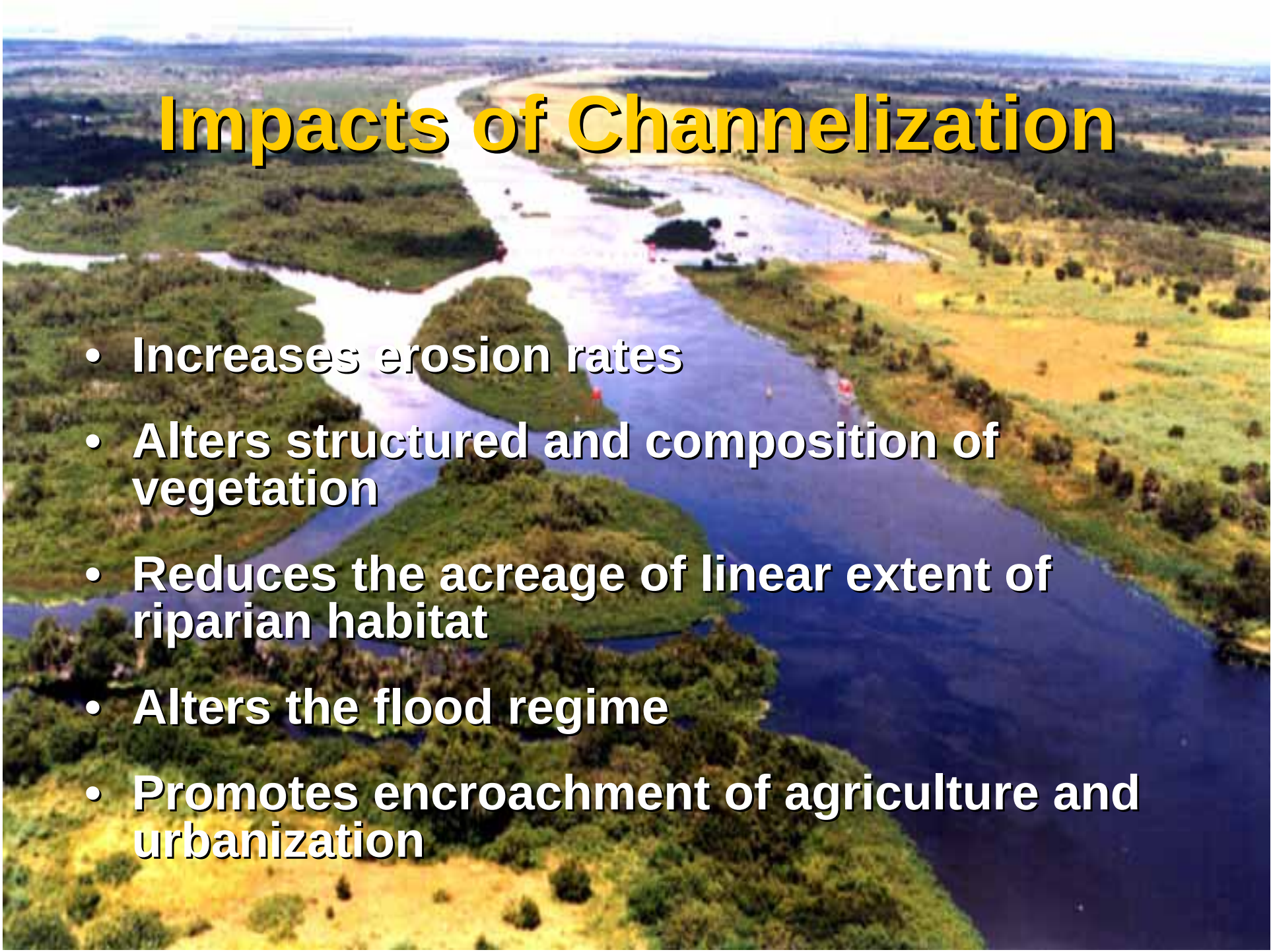
Regional Trends

Region	Percent Loss
Northern U.S. floodplain forests	70%
Mississippi Delta	82-85%
Southern Bottomland Hardwoods	80-90%
Arizona	90-95%
New Mexico	90%
California	95-96%
Sacramento Valley, CA	98%

Impacts of Agriculture

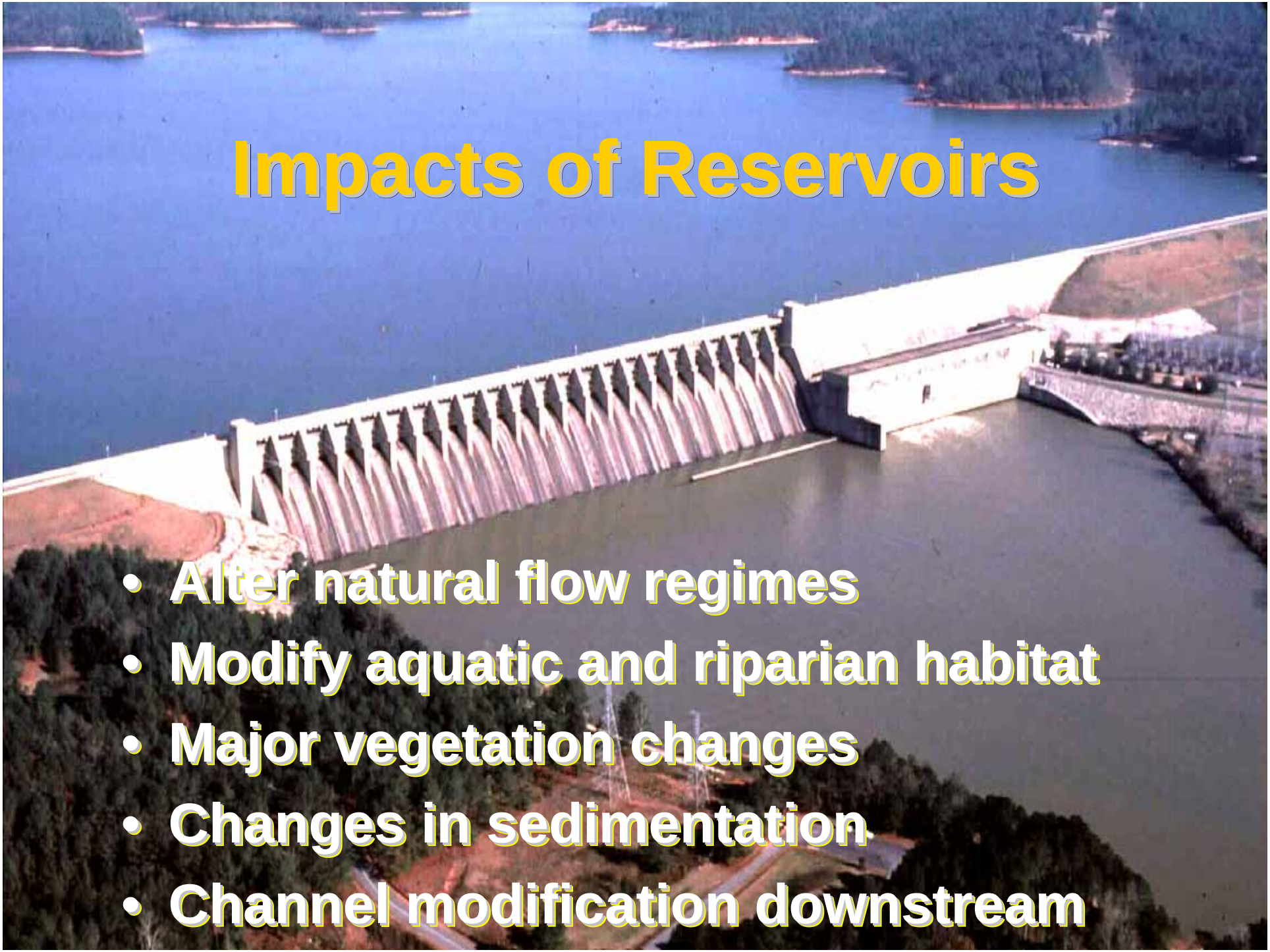
- Nutrient and pesticide runoff
- Erosion and sedimentation
- Habitat loss
- Alteration of hydrologic patterns


Caved streambanks
Decreased bank undercuts
Increased channel widths
Changes in vegetation
Trampling and soil compaction
Fecal contamination of water
Degradation of fish and wildlife habitat
Impacts of Overgrazing



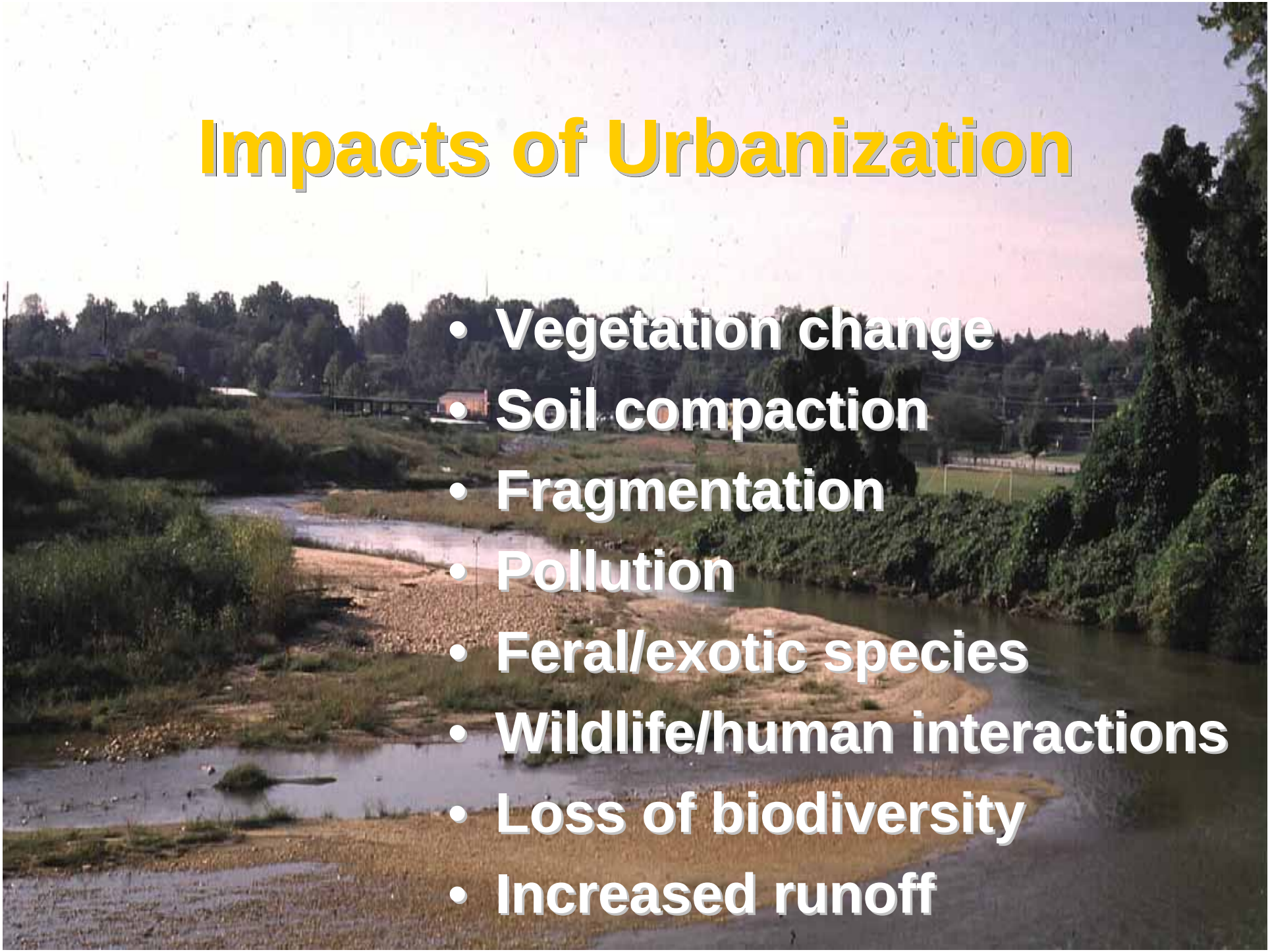
Impacts of Channelization

- Increases erosion rates
- Alters structured and composition of vegetation
- Reduces the acreage of linear extent of riparian habitat
- Alters the flood regime
- Promotes encroachment of agriculture and urbanization



Impacts of Reservoirs

- Alter natural flow regimes
- Modify aquatic and riparian habitat
- Major vegetation changes
- Changes in sedimentation
- Channel modification downstream



Impacts of Urbanization

- Vegetation change
- Soil compaction
- Fragmentation
- Pollution
- Feral/exotic species
- Wildlife/human interactions
- Loss of biodiversity
- Increased runoff

Impacts of Roads

- Alteration of vegetation structure & composition
- Increased mortality and habitat loss from road construction
- Modification of animal behavior
- Increased mortality from collision with vehicles
- Alteration of the chemical environment
- Alteration of physical environment
- Increased fragmentation
- Traffic noise
- Increased alteration and use of habitats by humans


Non-native and Invasive Species


DIE DEVELOPERS DIE!
ALOHA PO'IPU, IT'S BEEN NICE KNOWING YOU. AUWE!
T100
HAWAII
JUN
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KTG 633
ALOHA STATE