EDYS-L

Ecological DYnamics Simulation Model – Lite

Dr. David Price (Co-developer)
Dr. Terry McLendon (Original developer)
Dr. Cade Coldren (Co-developer)
Dr. Michael Childress (Co-developer)

EDYS-L and EDYS Models

Describe full EDYS Model

- **ecological processes**
- **site-specific data**
- **intensive training**

Provide a variety of applications

- **alternative formulation**
- **objectives/endpoints**
- **validation**

Describe EDYS-L

- **based on full EDYS**
- **simplified data inputs**
- **reconnaissance**
- **feasibility**

Accuracy

EDYS Model

- PC-based, mechanistic model
- DELPHI (Pascal) language
- MS Windows format
- Multi-scale, spatially-explicit
- Climate, soil, plant, animal, hydrology, stressor, management modules

EDYS Applications

Applied at 36 locations throughout North America and in Australia and Indonesia.

Validation studies conducted with USACE, USGS, NRCS, LADWP, SERDP, and CSIRO.

Model results published in 39 scientific publications and technical reports and presented at 25 scientific meetings.

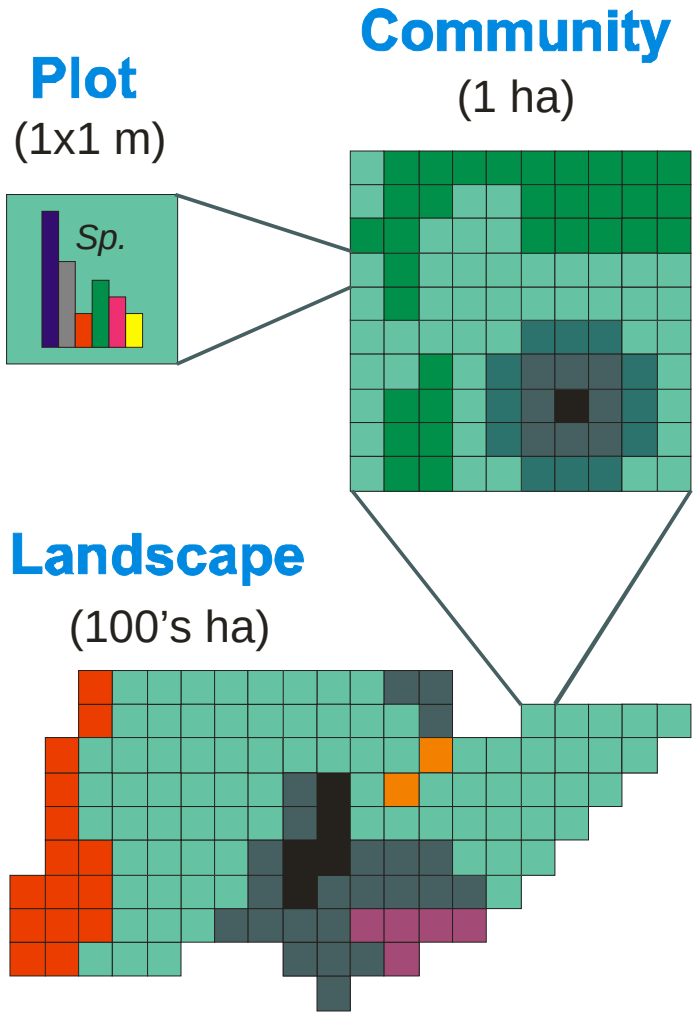
Used in environmental compliance projects in CO (NEPA, USAFA) and MT (Mineral Hill Mine Closure, MT DEQ).

Primary terrestrial model in USACE System-Wide Water Resources Research Program (SWWRP).

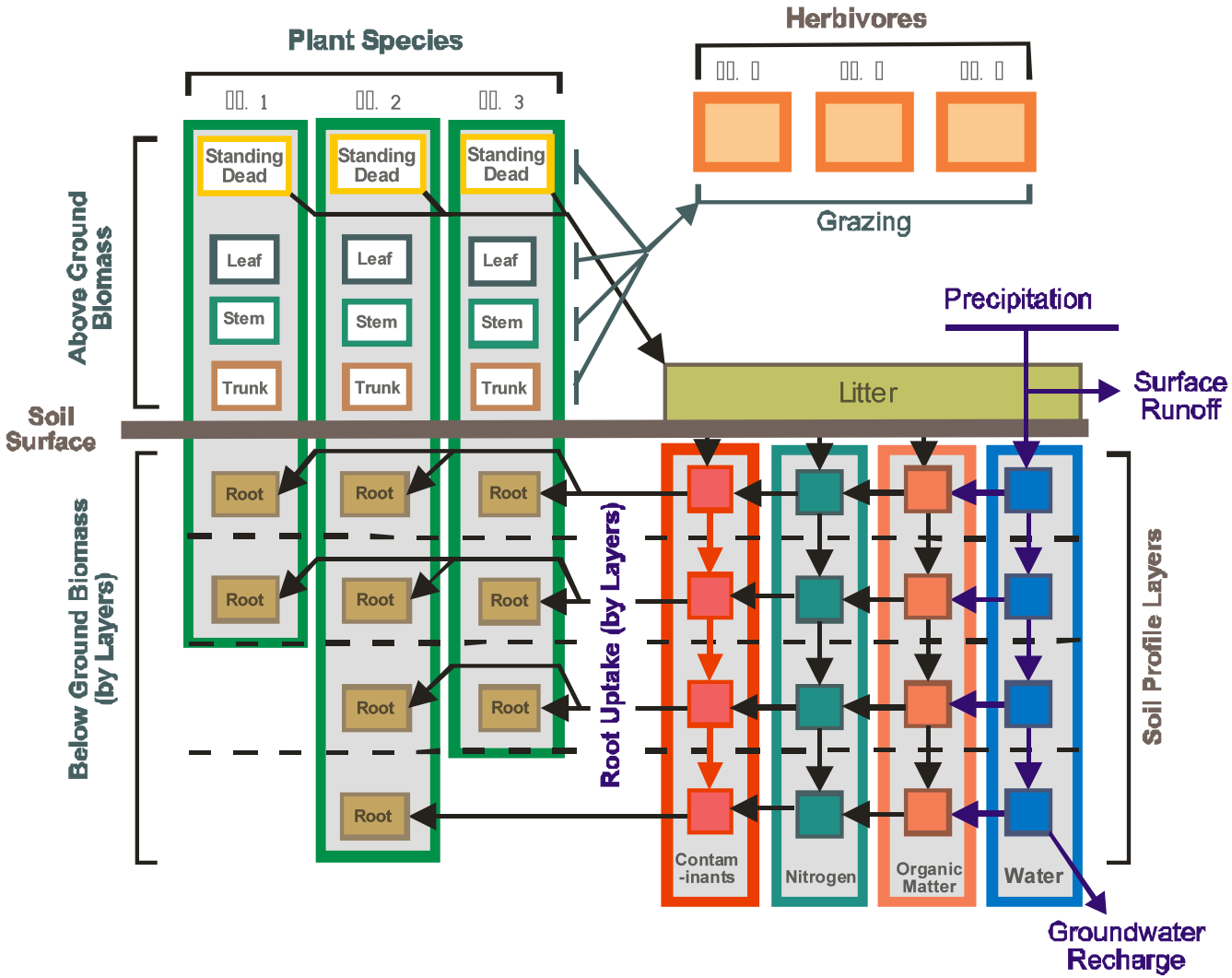
EDYS Applications

Impacts of vegetation change on water balance
Invasion dynamics of exotic plant species
Land management impacts on soil erosion and hydrology
Land management impacts on T&E species habitat
Livestock and wildlife diets
Military training impacts on ecological dynamics
NEPA compliance
Plant and soil microbial succession
Revegetation dynamics following mine closure
Revegetation dynamics following road closure
Vegetation response to drought and climate change
Vegetation response to fire
Vegetation response to livestock and wildlife herbivory
Vegetation response to soil nutrient availability
Water balance cover designs

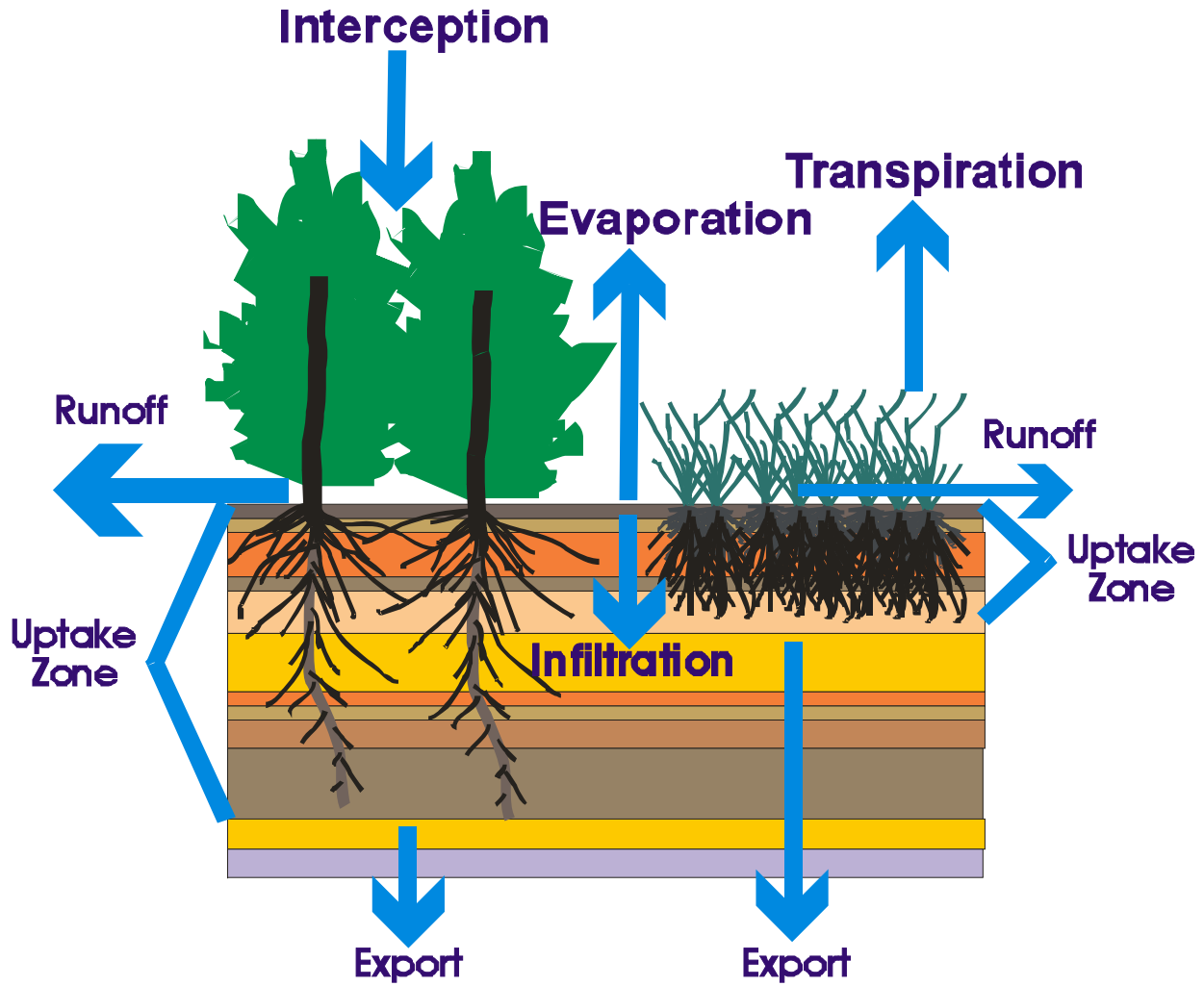
Multiple Spatial Scales



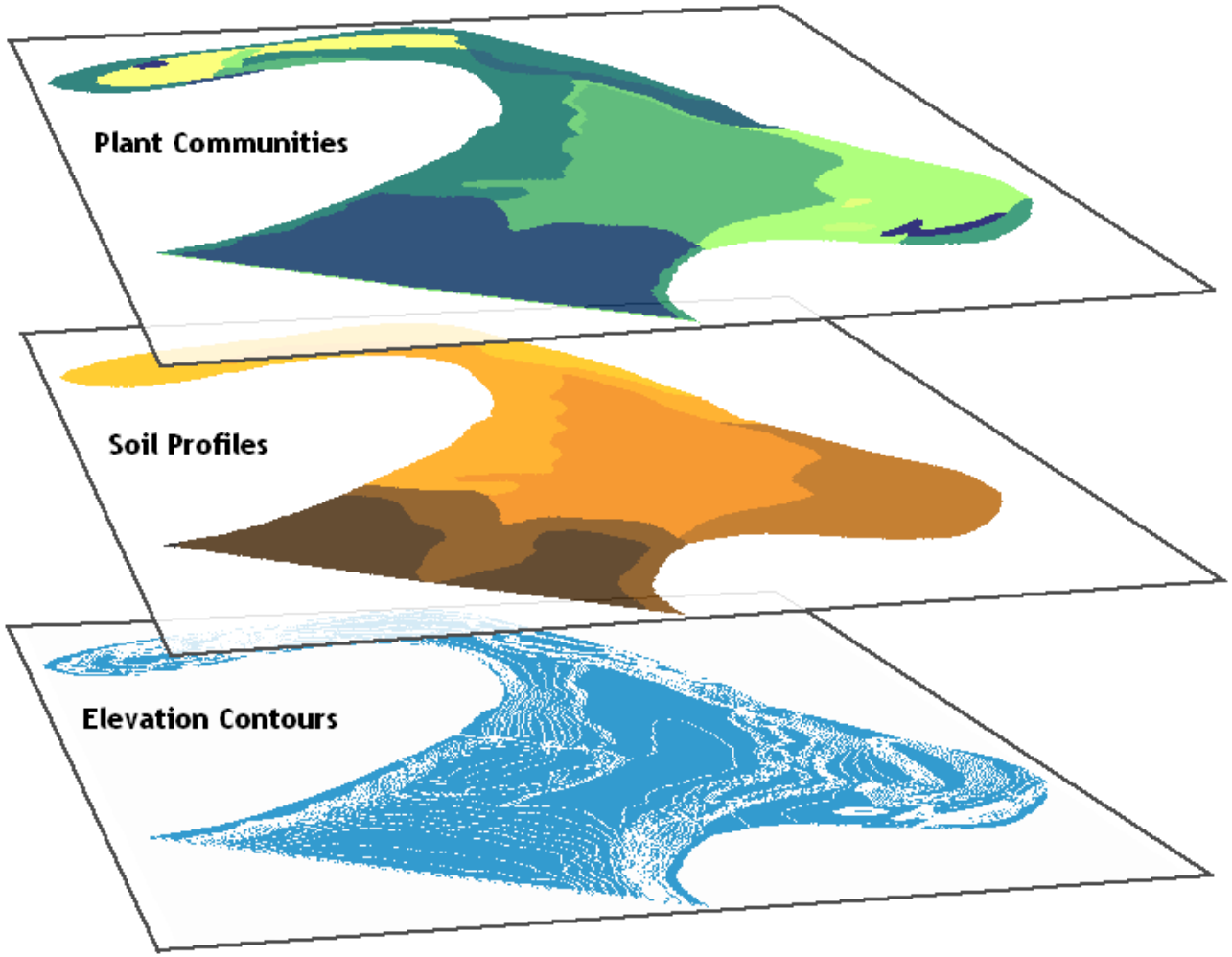
EDYS Plot Structure



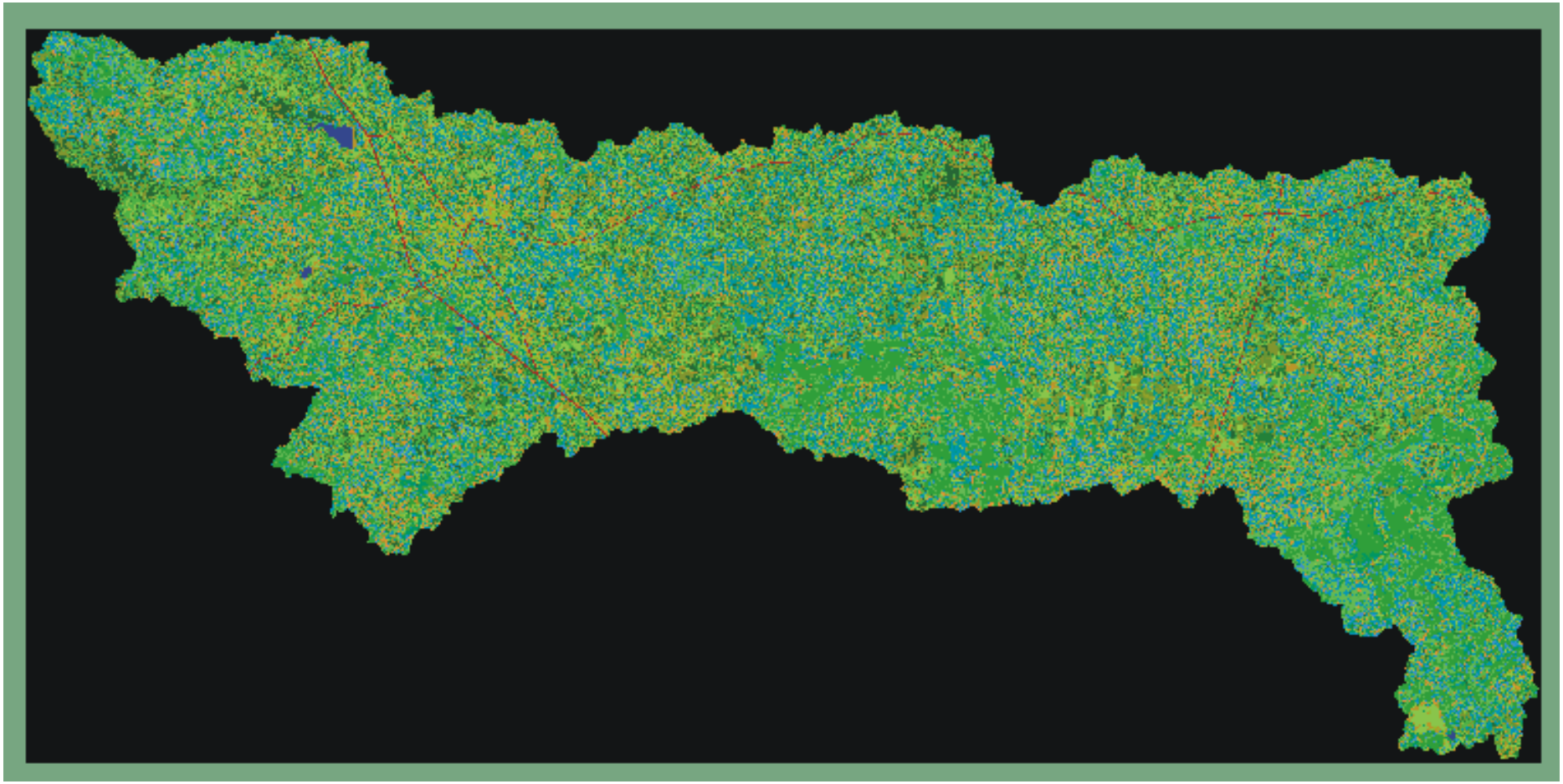
EDYS Plot-Level Hydrology



Spatial Layering



Initial Vegetation Map



Management Activities and Stressors

Management Activities

- Natural Fire
- Prescribed Fire
- Fuel Reduction
- Timber Thinning
- Chemical Weed Control
- Road and Trail Closure
- Fertilization
- Seeding
- Seedling Planting
- Trail Use
- Brush Management
- Burning Brush Piles
- Cultivation
- Urbanization
- Landscaping
- Sugar Addition
- Microbial Inoculation
- Camping
- Livestock Grazing
- Movable Stock Tanks
- Irrigation
- Leafy Spurge Beetle Stocking

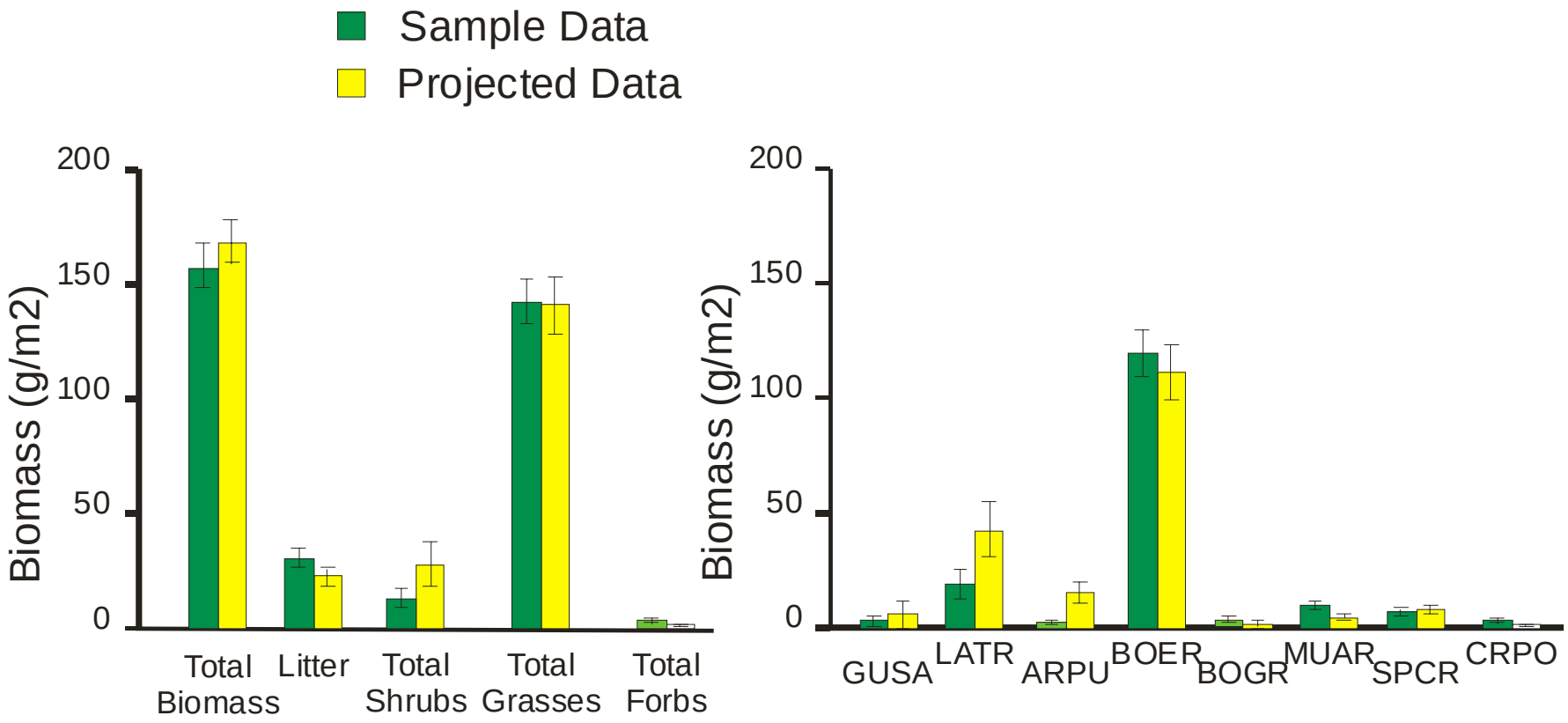
Stressors

- Drought
- Nutrient Limitations
- Flooding
- Beetle Infestation

Military Training

- Armored Vehicle Training
- Patriot Missile Training
- Foot Soldier Training
- Bivouac
- Bombing with Movable Targets

Validation Results: Aboveground Biomass



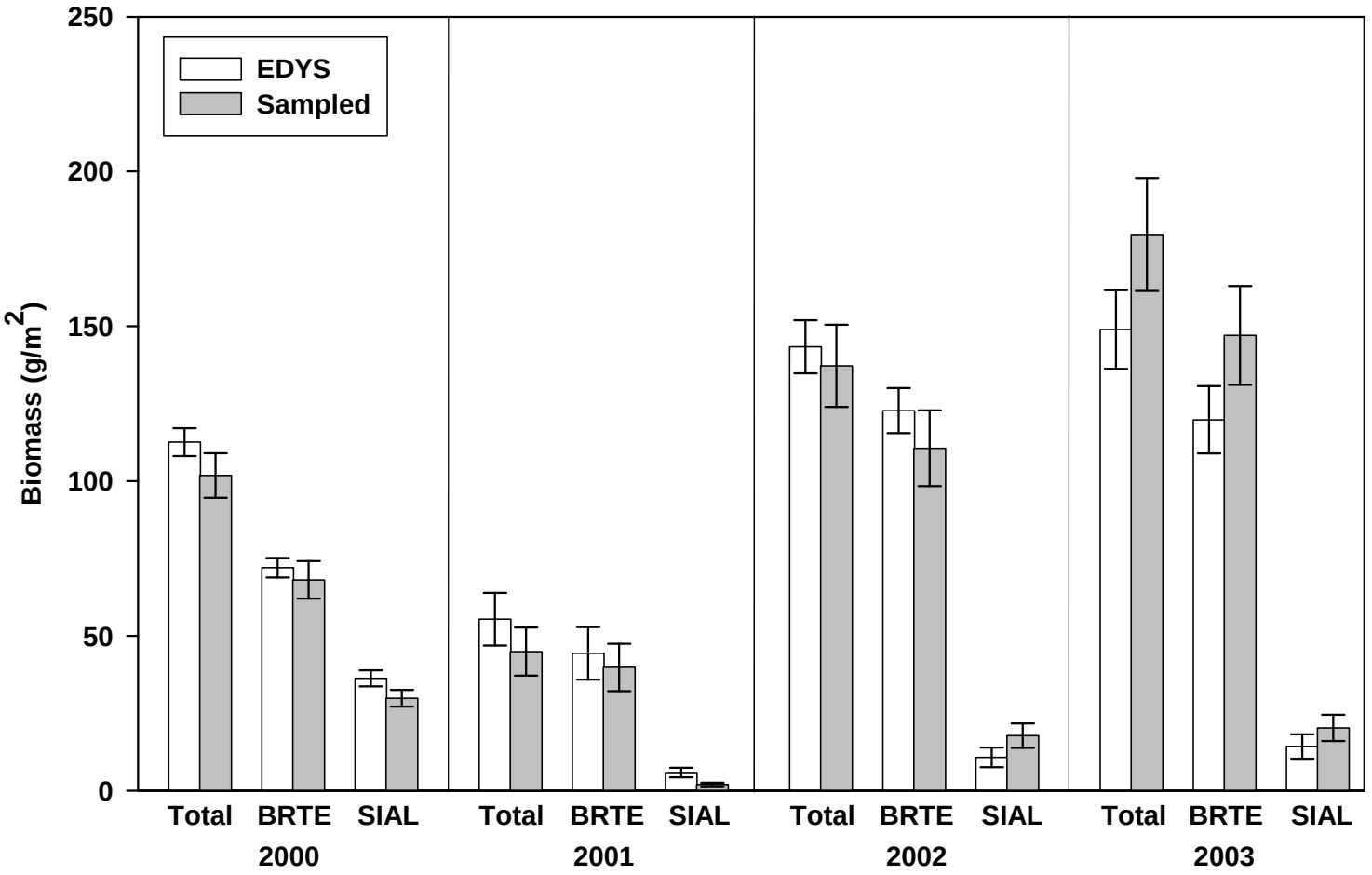
Fort Bliss

Validation Results: Aboveground Biomass (g/m^2)

	Year 1	Year 9
EDYS	**49**	**124**
Actual	**50**	**111**
Accuracy (%)	**98**	**90**

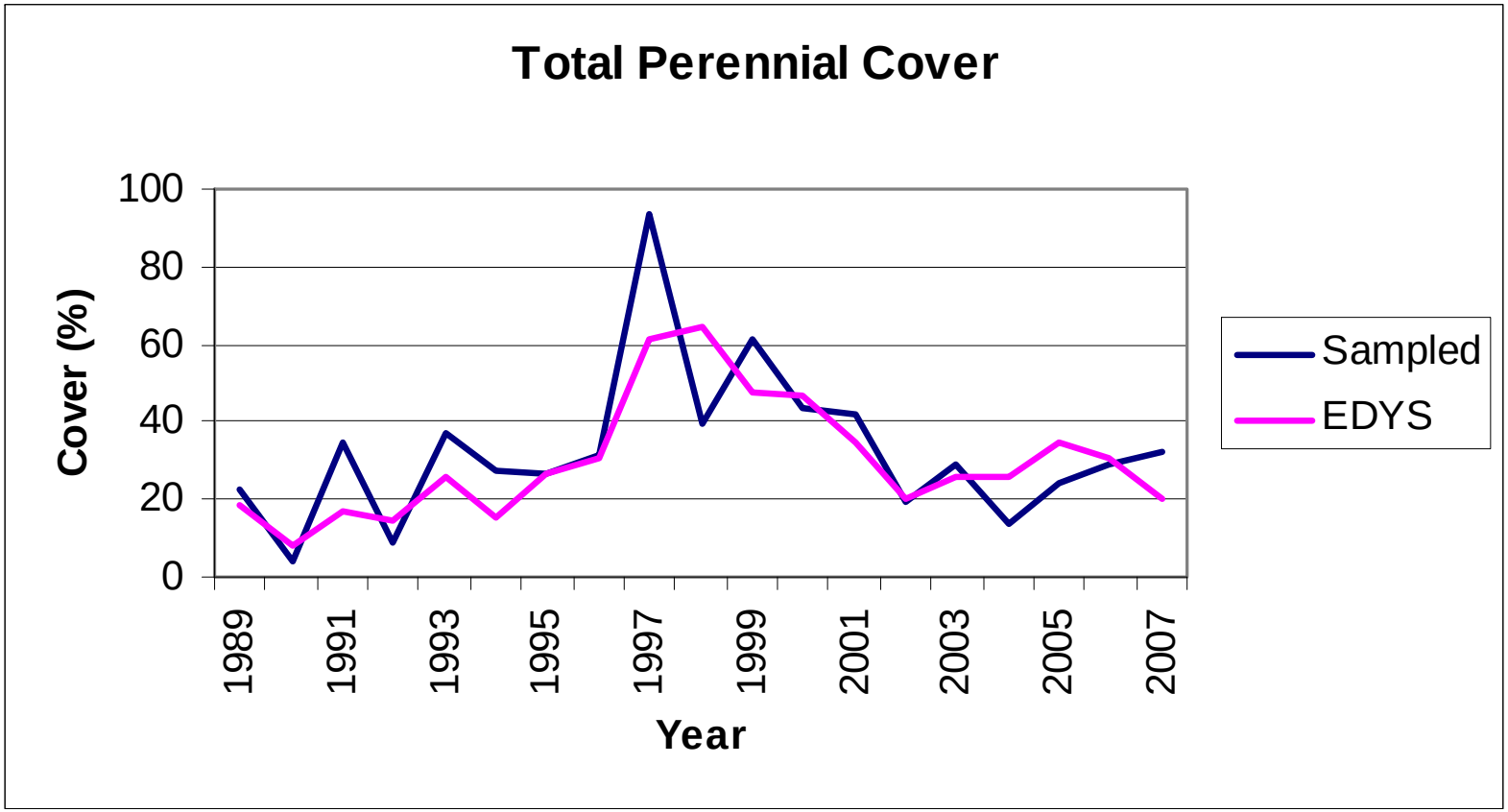
Mineral Hill Mine, Montana

Validation Results: Clippable Biomass



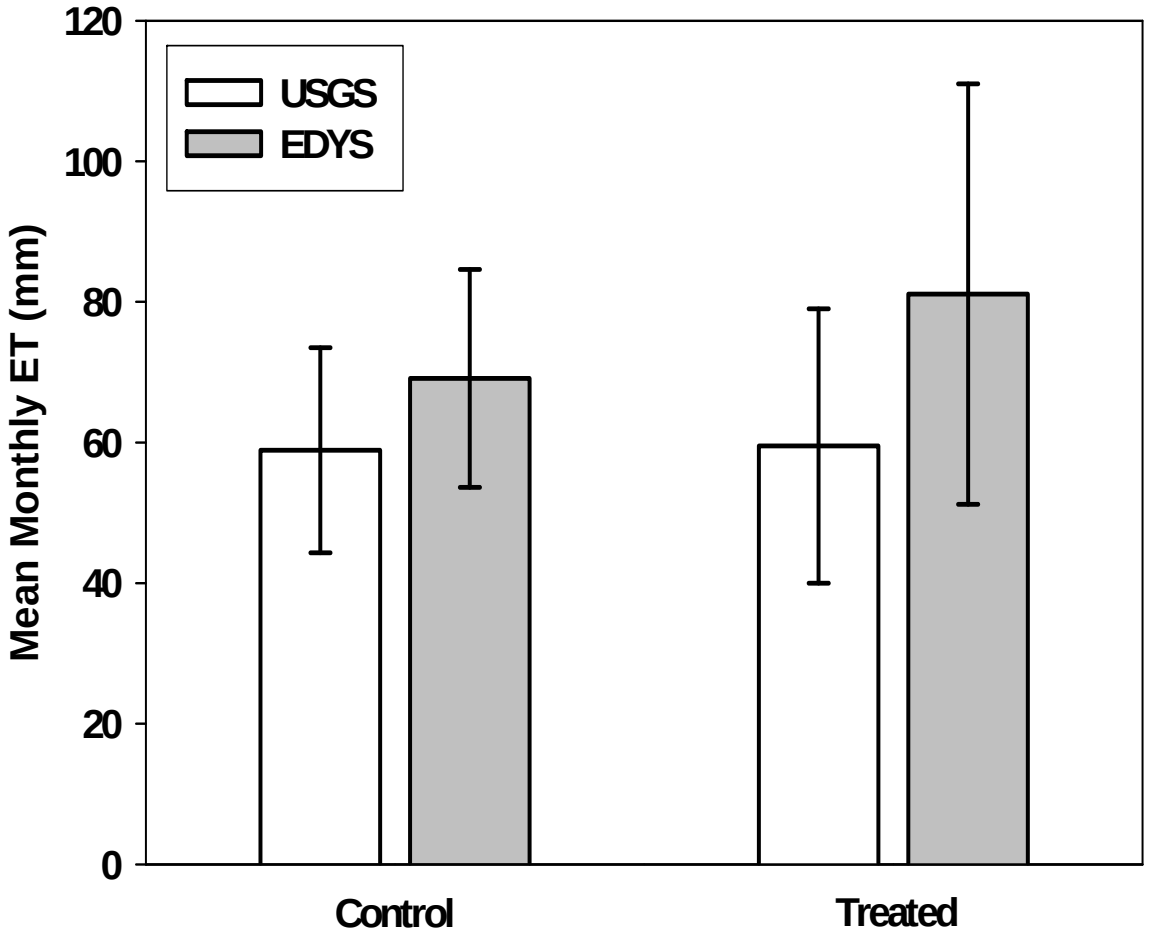
Yakima TC, Washington

Validation Results: Vegetative Cover



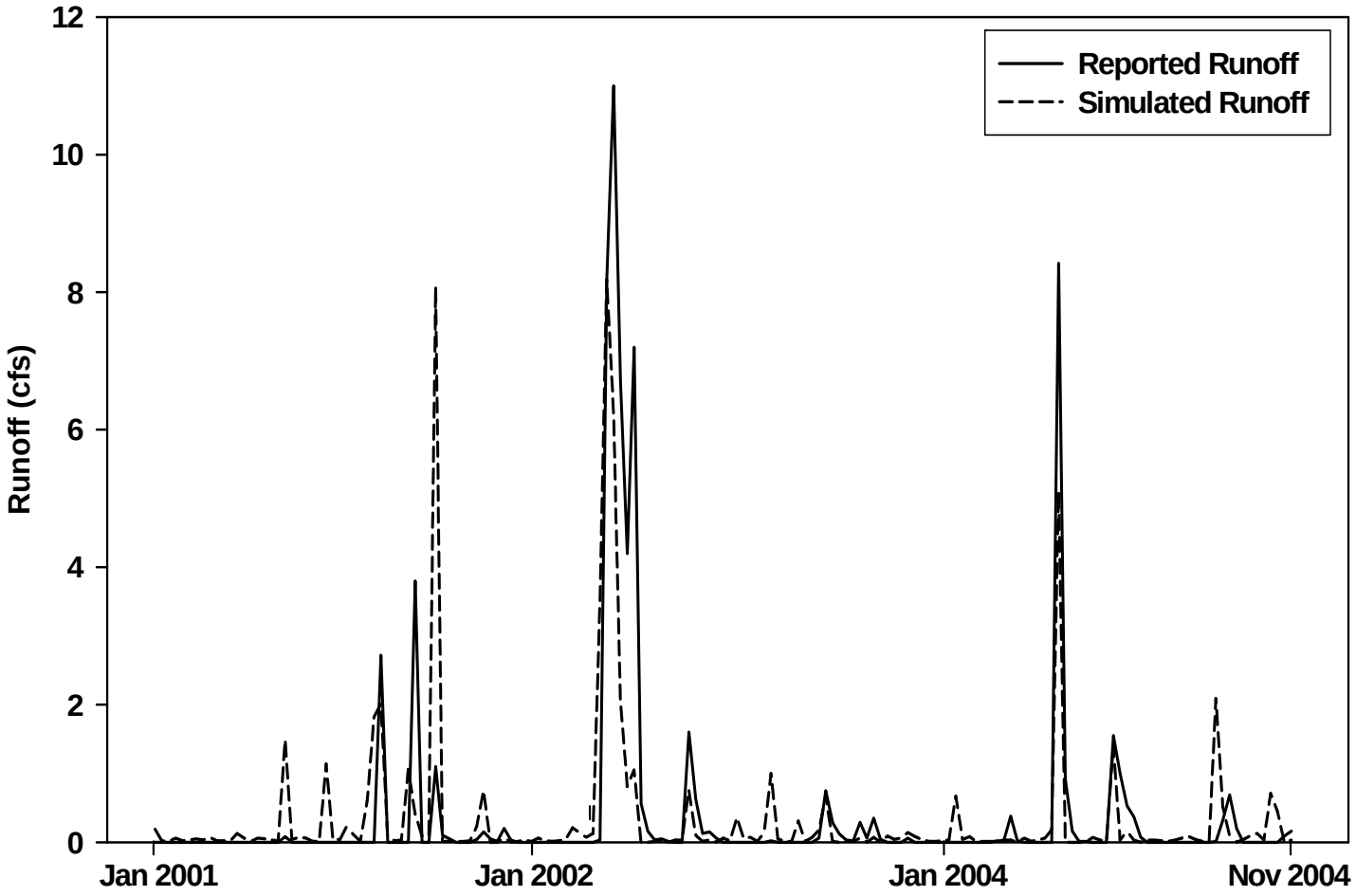
Owens Valley, California

Validation Results: Evapotranspiration



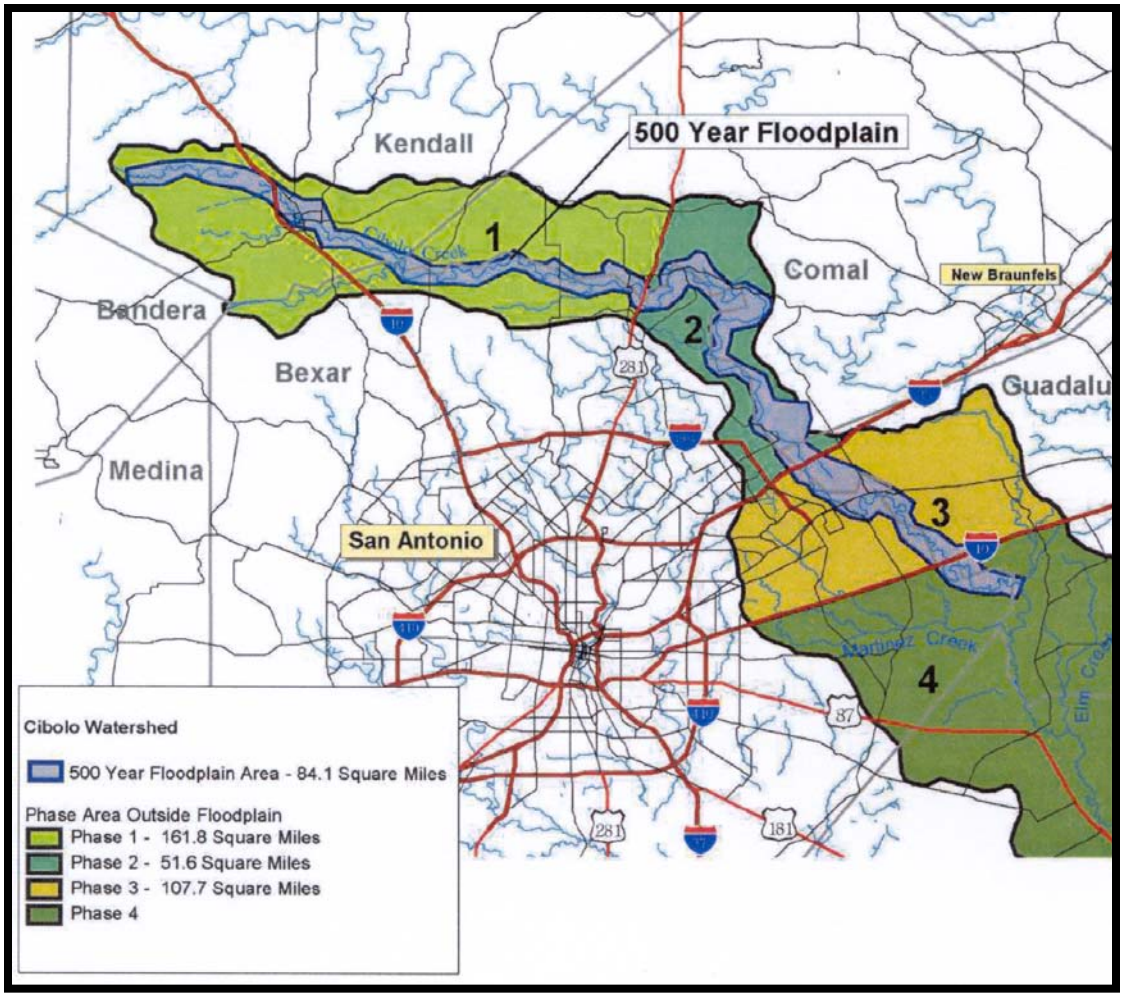
Honey Creek Watershed

Validation Results: Runoff



Honey Creek Watershed

Upper Cibolo Creek Watershed



Cibolo Creek Management Options

Livestock grazing	- Type, stocking rate, season of use
Brush management	- Dozing, mechanical-cut, hand-cut, fire
Cultivation	- Small grains, add or remove areas
Improved pasture	- Current pastures, add or remove areas
Fertilization	- Nitrogen, variable rates, any areas
Herbicides	- 2,4-D, picloram, dicamba
Reseeding	- Any included species, rate, and area
Hunting	- Species, season, harvest
Urbanization	- Buildings, roads, driveways, yards
Irrigation	- Yards, pastures, fields

Cibolo Creek Endpoint Variables

Water Quantity: recharge, runoff

Water Quality: sediment and nitrogen loadings

Ecological Restoration:

- **Change in vegetation types**
- **Change in juniper:oak in woodland types**
- **Change in tall- and mid-grasses in grasslands**
- **Change in grasses**
- **Change in perennial forbs + doveweed**

Cibolo Creek Watershed

Owens Valley, California

Owens Valley, California

- **Management tool for Owens Valley**
- **Linked with MODFLOW**
- **Issues:**
  - **Vegetative use of groundwater**
  - **Groundwater pumping**
  - **Grazing**
  - **Irrigation**

Townsville TA, Queensland

Environmental Management of Military Lands

Final Report

Andrew Ash and Lynn Walker
CSIRO Tropical Agriculture
Aitkenvale, Queensland

EDYS Queensland Application

“EDYS was capable of simulating basic ecosystem dynamics in these savanna ecosystems. When run for 50 years … the model realistically simulated the inter-annual variability in the tree, shrub and herbaceous layers. The model was able to simulate increases in exotic plants and increases in native shrubs in the absence of fire (Ash and Walker 1999).”

U. S. Air Force Academy

EDYS - U. S. Air Force Academy
End Point Variables

- **No increase in soil erosion: Jack's Valley, BCT Area, Monument Creek Area, Impact Area**
- **No decrease in successional status: Jack's Valley, BCT Area, Monument Creek, Impact Area**
- **No change in general vegetation structure: Jack's Valley, BCT Area, Monument Creek**
- **No bare ground except in roads, FERL, and BCT Area**
- **Reduce abundance of exotic species**
- **Shift Impact Area from smooth brome to native grasses**
- **Maintain prey bird populations for peregrine falcon**
- **Maintain spotted owl habitat**
- **Maintain deer, elk, and turkey populations**

EDYS

Site specific

- **Plants**
- **Soils**
- **Spatial**
- **Animals**

Application development requires extensive training

High degree of accuracy

Computer resource requirements are high

Objectives for EDYS-L

Screening-level ecological tool

Apply to virtually any area within the United States

Maintain the ecological processes in EDYS

Short run-times

Less computer resource requirements

Minimum training required

Linkage with other models (GSSHA…)

Differences between EDYS-L and EDYS

Enhanced user interfaces

Multiple regions

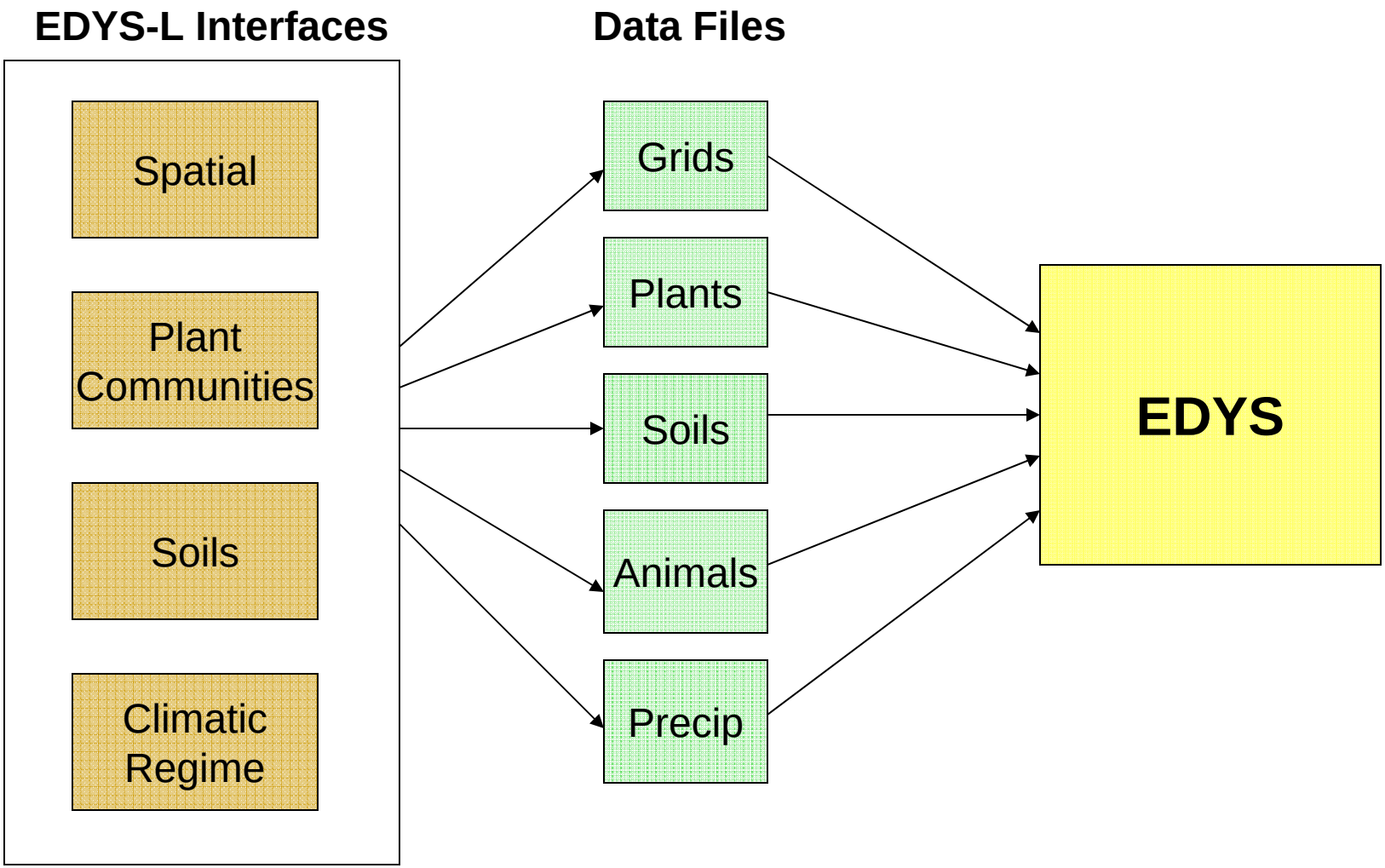
Range of communities within each region

Default suite of species

Default soils

Common management activities (BMPs)

EDYS-L Structure



EDYS-L Interfaces

Simplified spatial configuration

Select plant communities

- **Add/delete species**

Select soils

Select animals

Select climatic regime

EDYS-L Regions

WESTERN REGION	**Southwest** **Central Plains** **Great Basin**
EASTERN REGION	**Southeast** **Midwest** **Northeast**
PACIFIC COAST	
ALASKA	
CENTRAL PACIFIC	

EDYS-L Communities

Five communities within each region (Southwest, Central Plains, and Great Basin)

- **Montane**
- **Upland**
- **Lowland**
- **Riparian**
- **Wetland**

EDYS-L Plants

TREES (8)

Douglas fir
ponderosa pine
one-seeded juniper
aspen
Gambel oak
cottonwood
mesquite
live oak

SHRUBS (8)

bitterbrush
coyote willow
big sagebrush
greasewood
creosotebush
prickly pear
soapweed
sand sage

EDYS-L Plants

GRASSES (19)

hairgrass
Indiangrass
cheatgrass
blue grama
black grama
common reed
prairie cordgrass
little bluestem
smooth cordgrass
bermudagrass
bluebunch wheatgrass
saltgrass
crested wheatgrass
alkali sacaton
tobosa
needle-and-thread
big bluestem
buffalograss
seaoats

GRASS-LIKES (4)

Nebraska sedge
Baltic rush
cattail
saltmarsh bulrush

EDYS-L Plants

FORBS (12)

sweetclover
ragweed
tansymustard
mullein
Russian thistle
doveweed
lupine
globemallow
yarrow
alfalfa
sunflower
plantain

AQUATIC (3)

duckweed
arrowhead
widgeon-grass

MOSS/LICHENS (3)

tree moss
ground moss
lichen

EDYS-L Soils

Within each region

- **Montane – Shallow montane loam**
- **Upland – Shallow sandy loam**
- **Lowland – Medium sandy loam**
- **Riparian – Riparian sand/gravel**
- **Wetland – Organic clay loam**

EDYS-L Animals

Animals current supported

- **Insects**
- **Rabbits**
- **Deer (Mule and White-tailed)**
- **Cattle**

Simple herbivory for native species

Complex grazing regimes for livestock

EDYS-L Climatic Regime

Precipitation pattern from multiple locations

Ability to import data from a new location

Ability to modify the daily rainfall values (within EDYS)

Other climatic variables

- **Daily potential evaporation rate**
- **Snow months**
- **Snow melt rate**

EDYS-L Accuracy Compared to EDYS

	Single Community	Multiple Communities (14)
Aboveground Biomass	69%	93%
Tree Aboveground Biomass	68%	94%
ET	42%	49%
Runoff	21%	26%

Soils used in EDYS-L runs were the defaults and were twice as deep as soils used in EDYS, resulting in higher ET and lower Runoff

Honey Creek Watershed, Texas