GLOBAL CHANGES and

THE ROLE OF ORGANISMS AS

ECOSYSTEM ENGINEERS

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IN DRYLANDS:

WOODY VEGETATION CYANOBACTERIA

BIOMASS PATCH FORMATION SOIL CRUST FORMATION

BIOTIC INDUCED LANDSCAPE MOSAIC

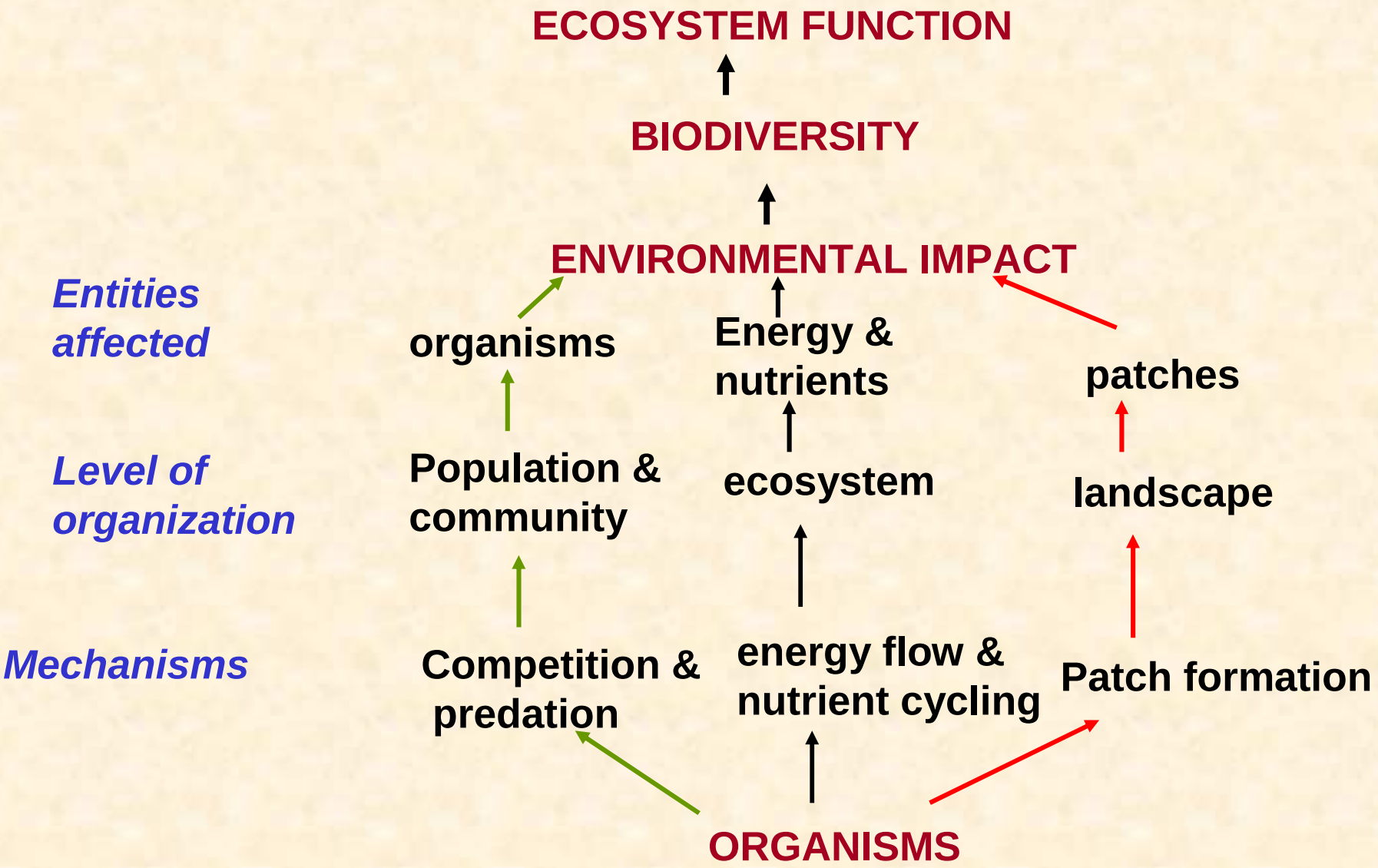
BIOTIC INDUCED LANDSCAPE MOSAIC

IS GENERATED BY
ORGANISMS AS ECOSYSTEM ENGINEERS(EE)
(Jones, Lawton and Shachak: Oikos 1994)

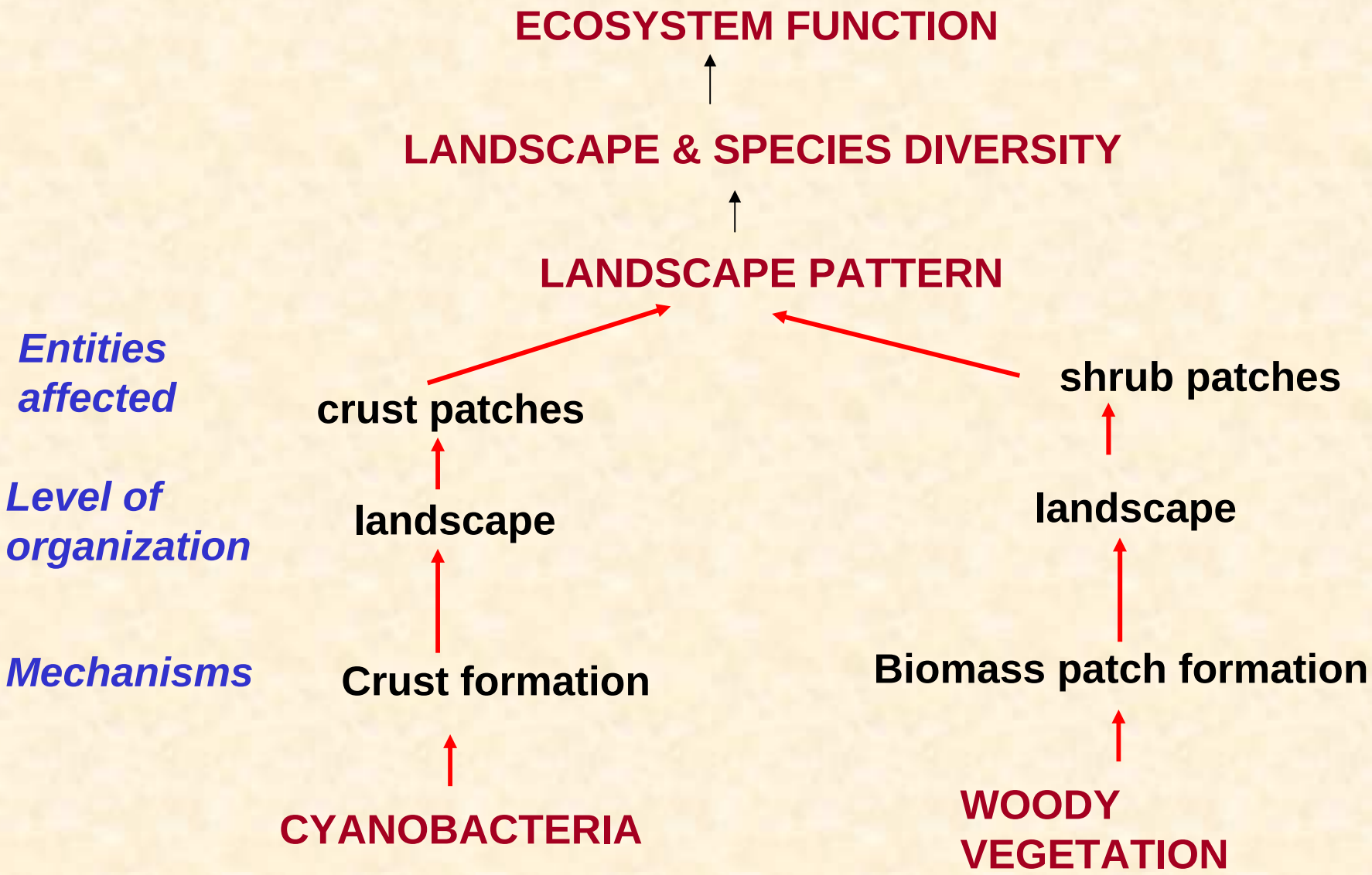
EE MODULATE THE LANDSCAPE STRUCTURE AND FUNCTION
AS A PART OF
THE GENERAL PROCESS OF

ENVIRONMENTAL IMPACT BY ORGANISNS

ENVIRONMENTAL IMPACT OF ORGANISMS



LANDSCAPE MODULATION IN DRYLANDS



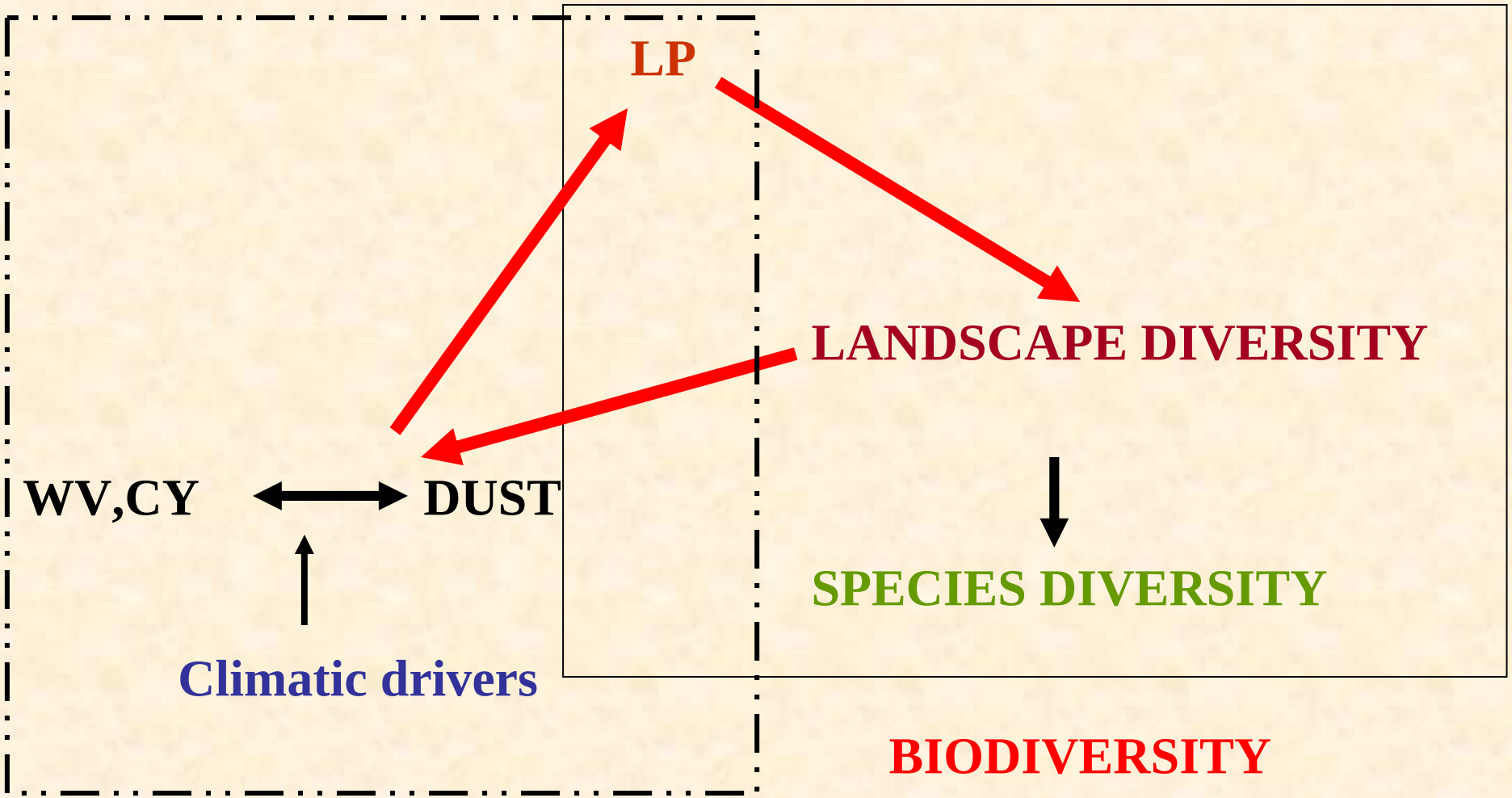
LANDSCAPE MODULATOR (LM)- DEFINITION:

AN ECOSYSTEM ENGINEER THAT CREATES

A LANDSCAPE MOSAIC

BY THE PROCESS OF PATCH FORMATION

LANDSCAPE PATTERN(LP) AND BIODIVERSITY

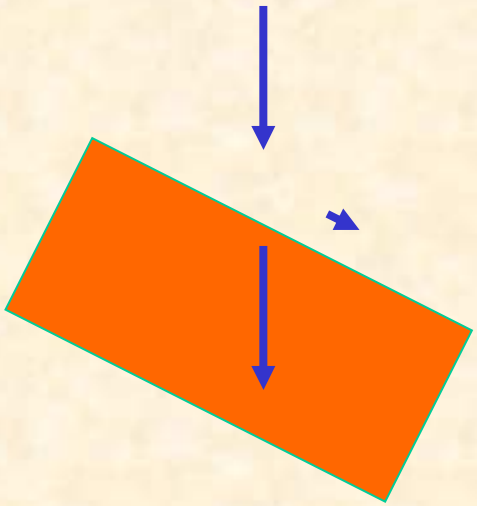


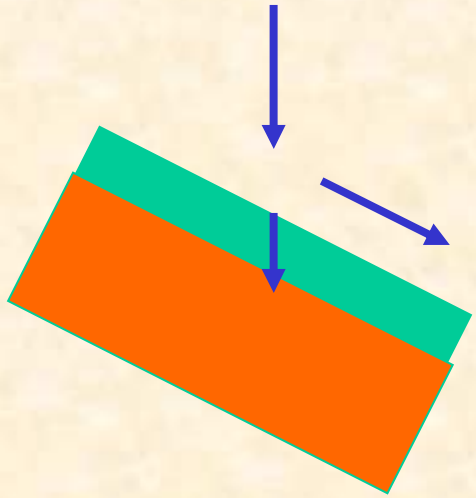
(Shachak et al 2005: Biodiversity in Drylands)

SHRUB-CRUST SYSTEM

200mm rainfall

CYANOBACTERIA
AS ECOSYSTEM ENGINEERS



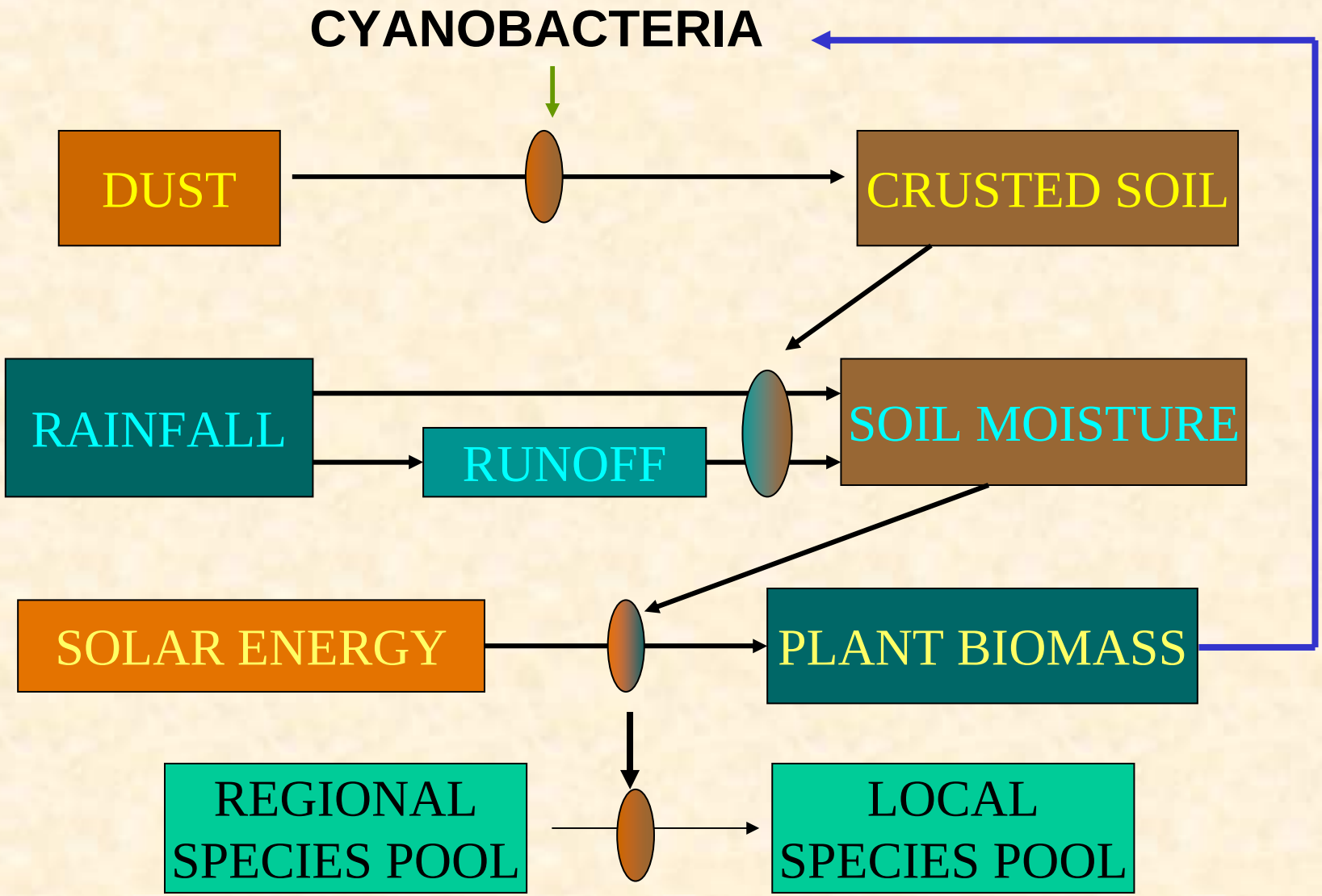


HIGH WATER LEAKAGE

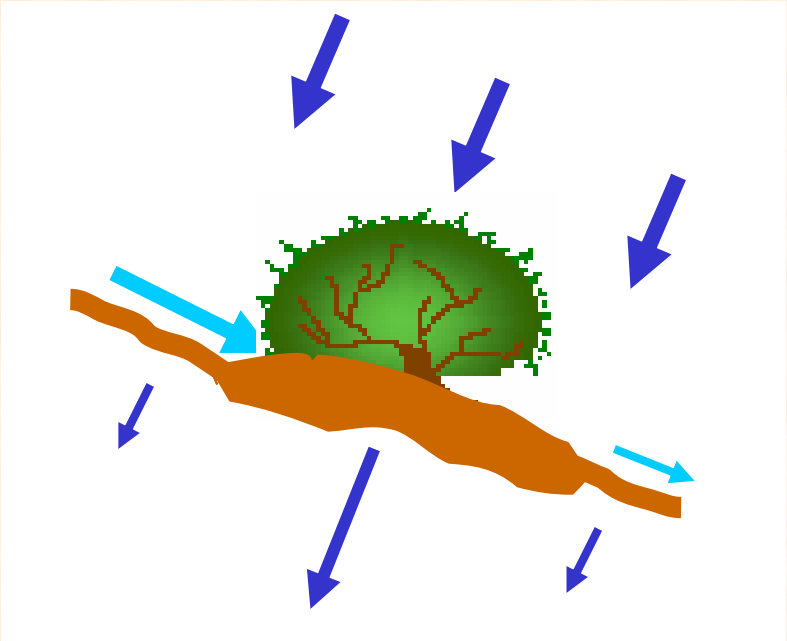
LOW PRODUCTIVITY

LOW BIODIVERSITY

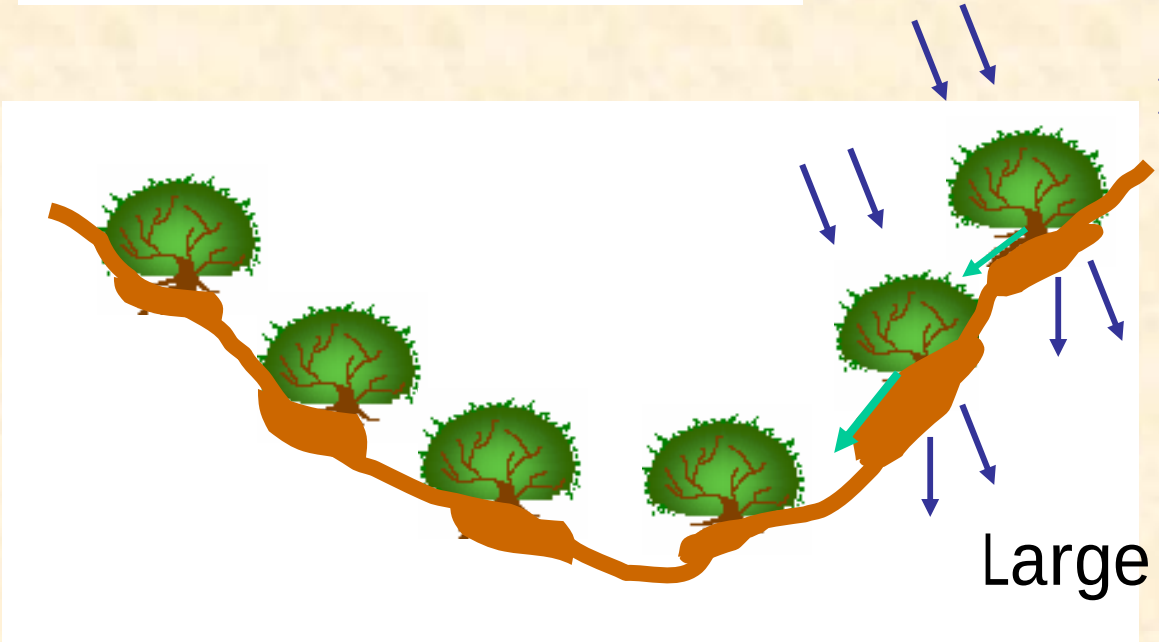
CYANOBACTERIA AS AN ECOSYSTEM ENGINEER



SHRUBS AS ECOSYSTEM ENGINEERS



Small scale



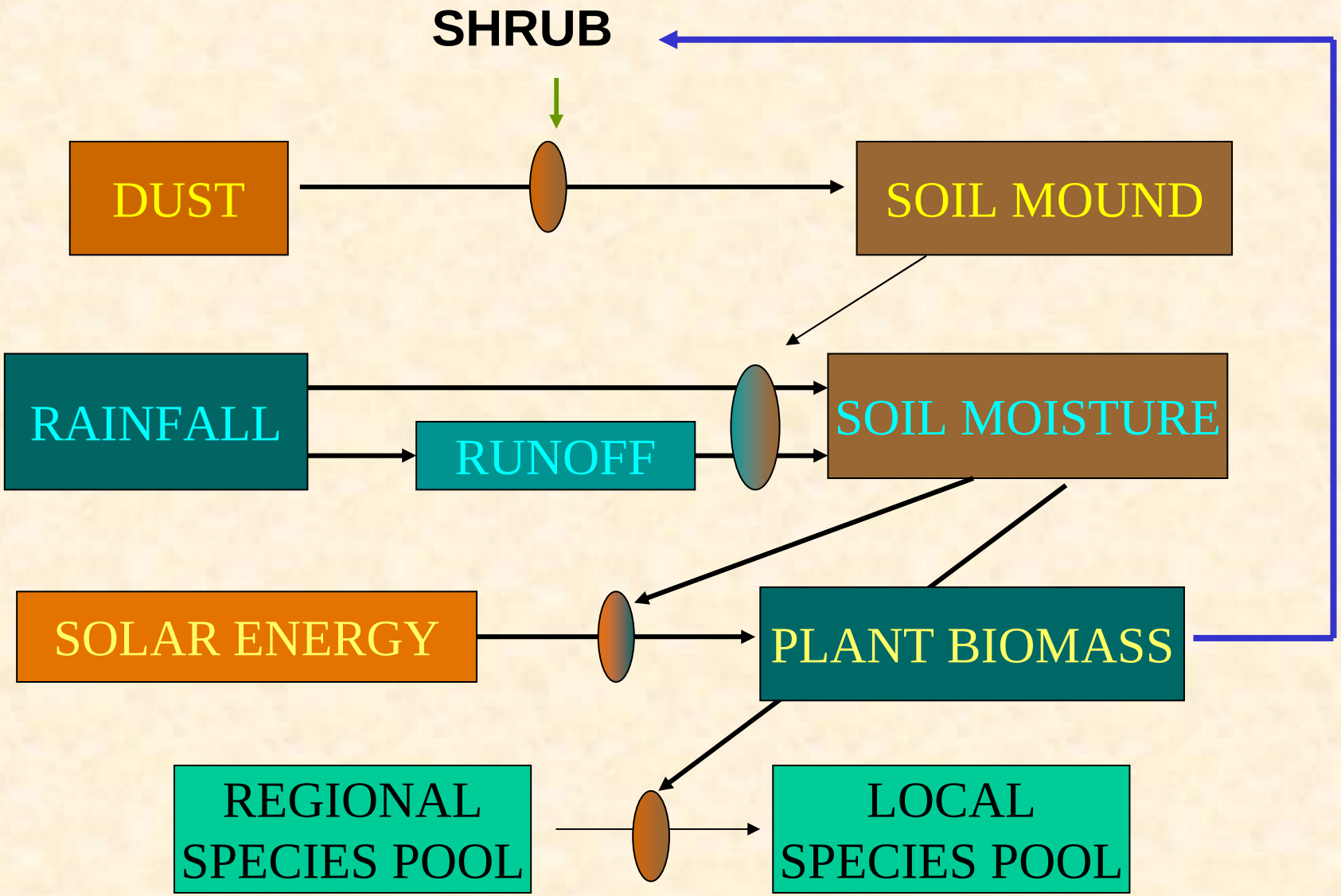
Large scale

LOW WATER LEAKAGE

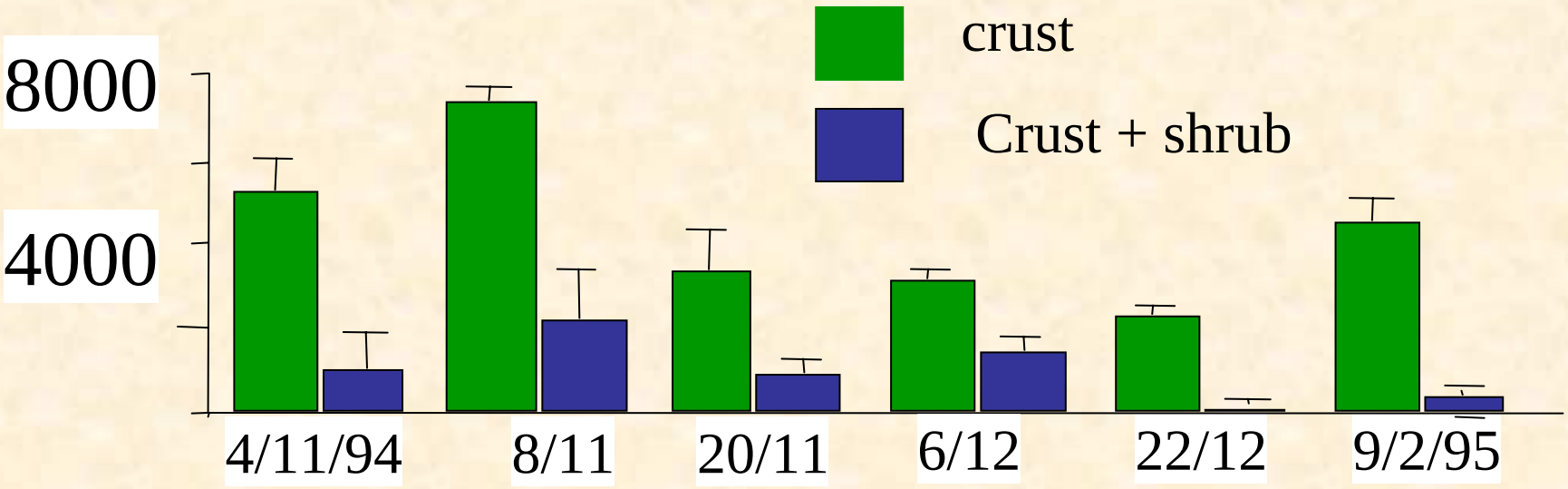
HIGH PRODUCTIVITY

HIGH BIODIVERSITY

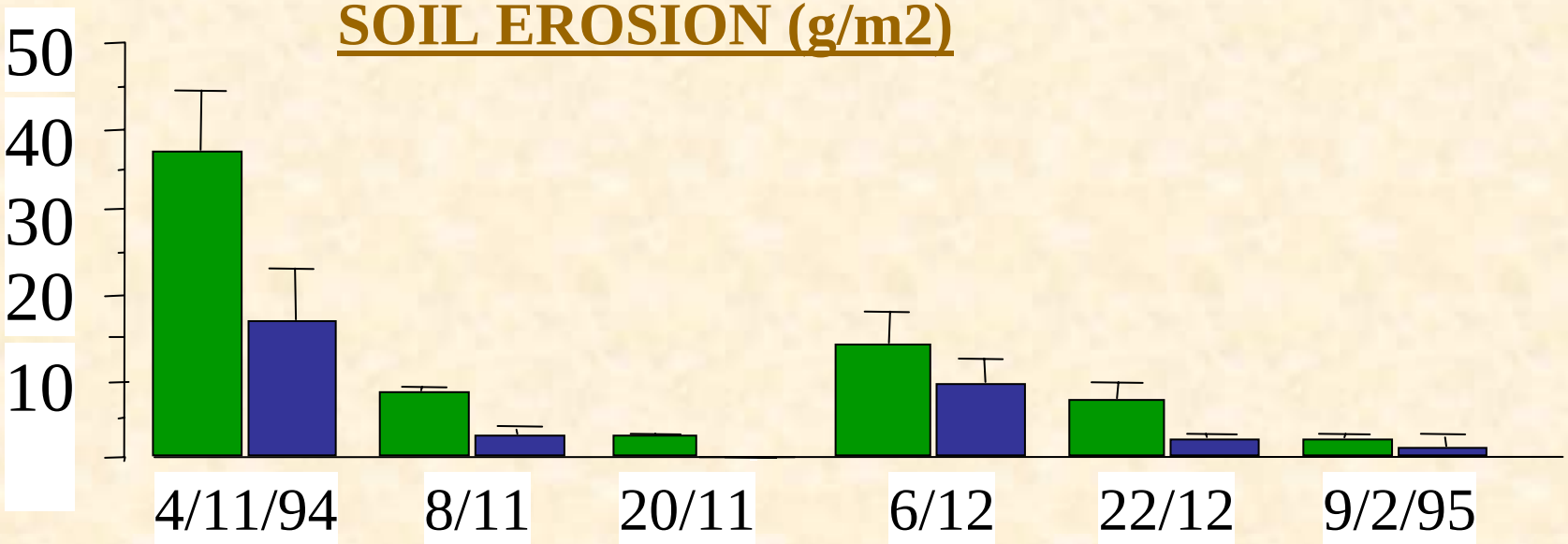
SHRUB AS AN ECOSYSTEM ENGINEER

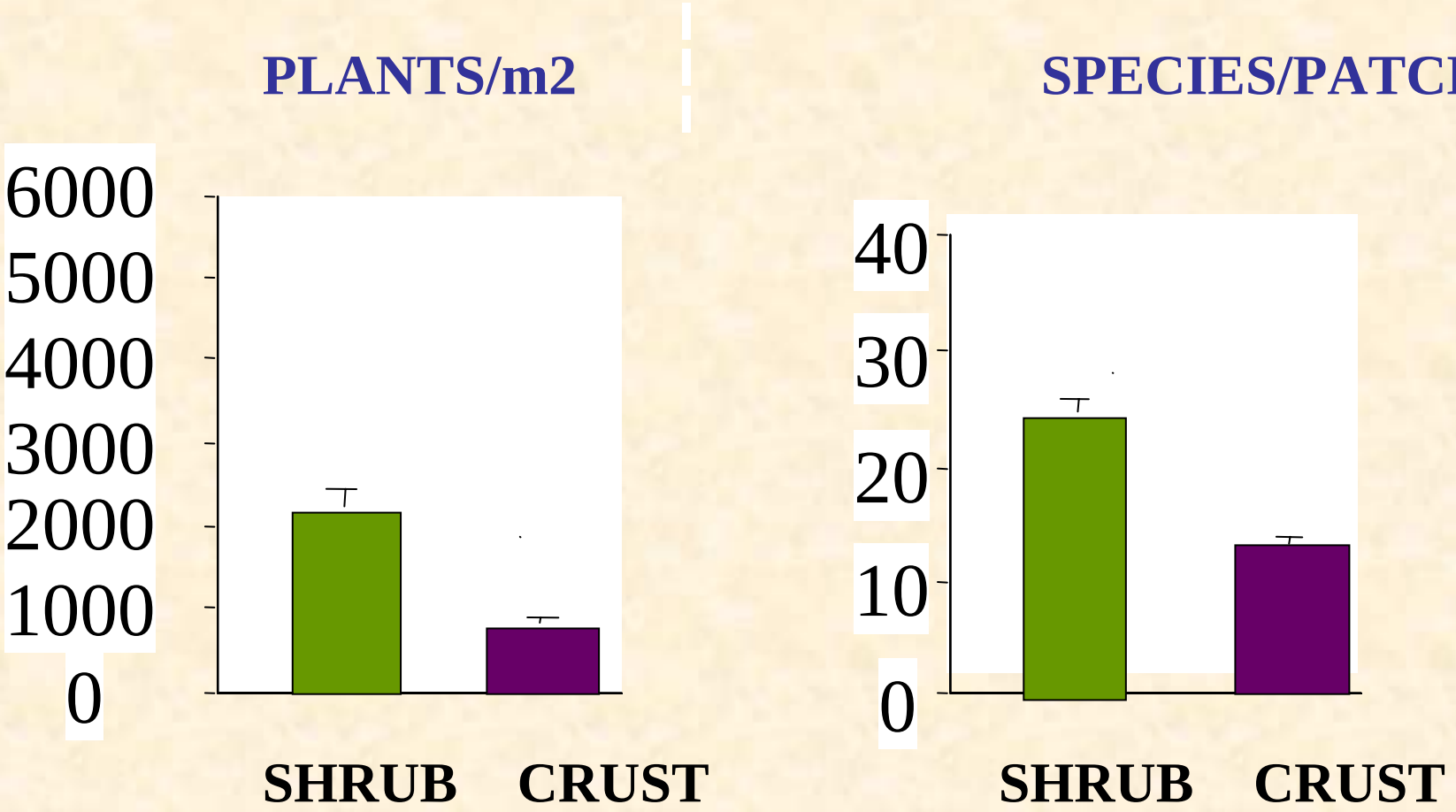


WATER LOSS (ml/m2)



SOIL EROSION (g/m2)

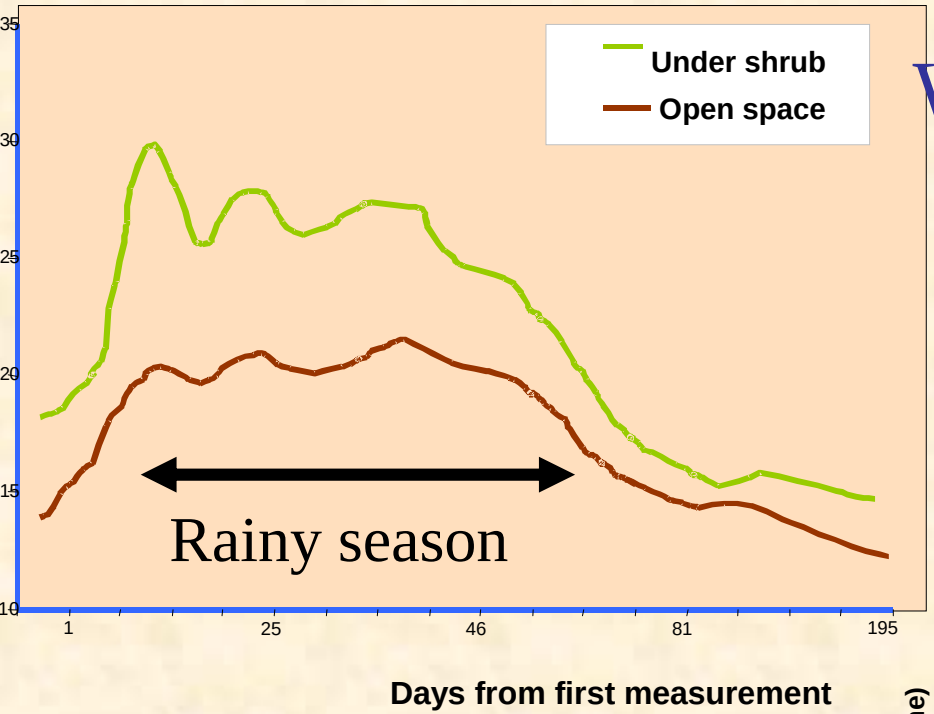




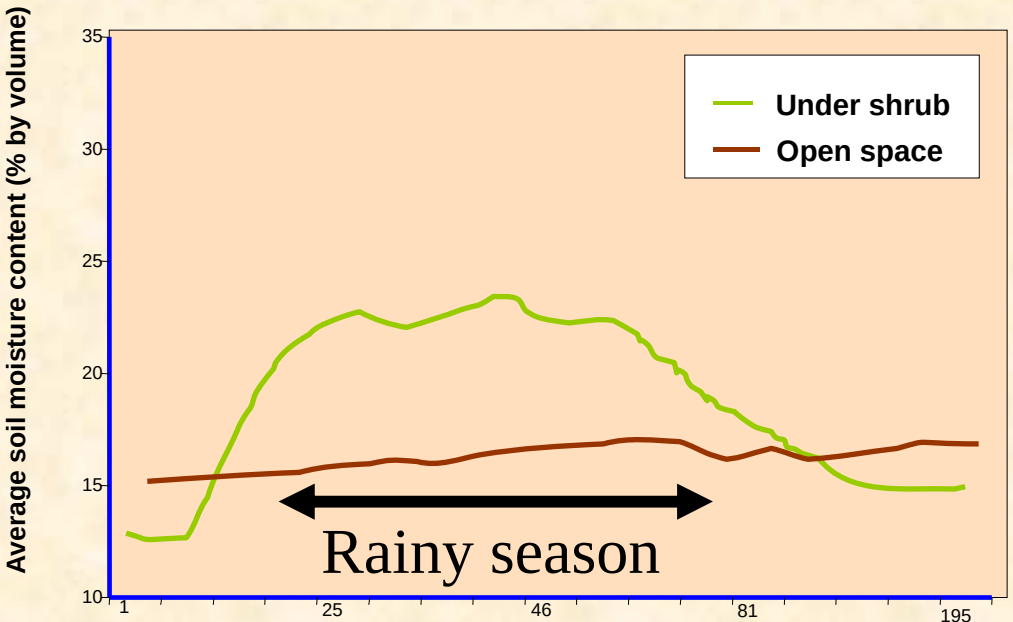
Boeken and Shachak 1994

WATER CONSERVATION BY SHRUB

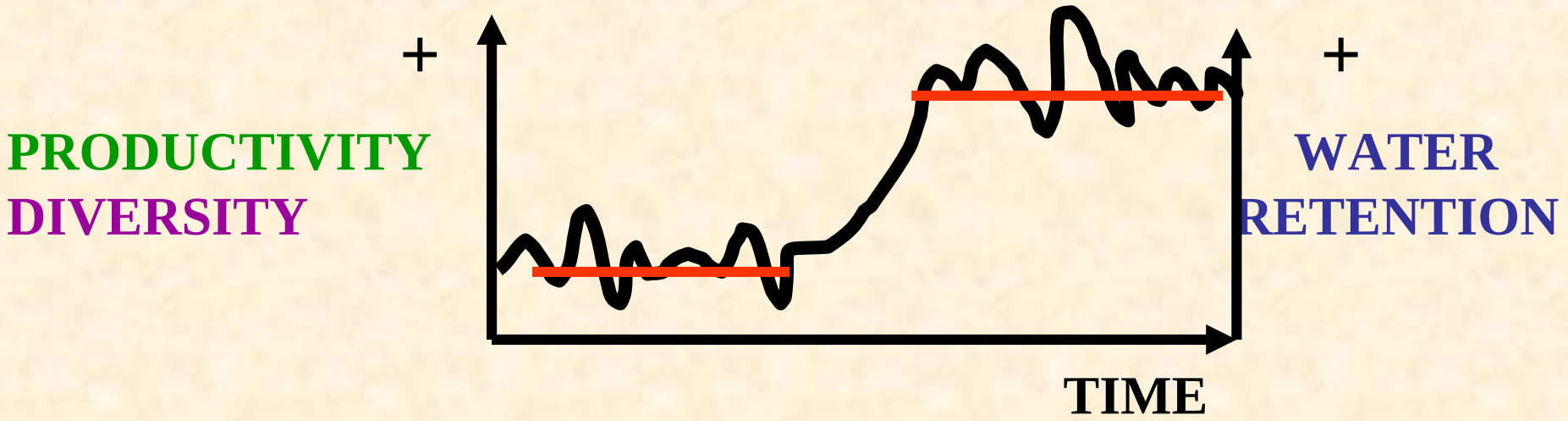
0-80 cm



80-160 cm



ECOSYSTEM ENGINEERS & ECOSYSTEM STATES



ODUM'S ECOSYSTEM DEVELOPMENT MODEL

COMMUNITY STRUCTURE:

Species diversity-*Increases*

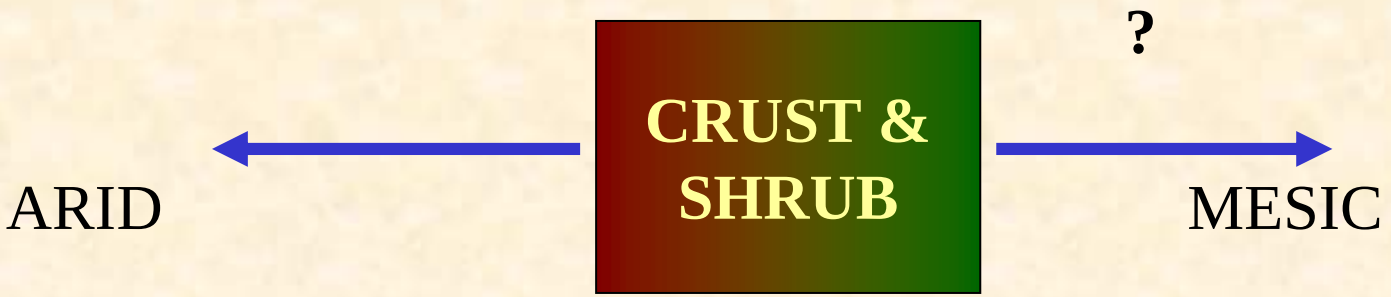
ENERGY FLOW:

Gross production-*Increases*

BIOGEOCHEMICAL CYCLES:

Storage of elements- *Increases*

CLIMATE CHANGE AND CRUST & SHRUB STATE



INSIGHT FROM MATHEMATICAL MODELLING

THE MODEL STRUCTURE

THREE DYNAMIC VARIABLES:

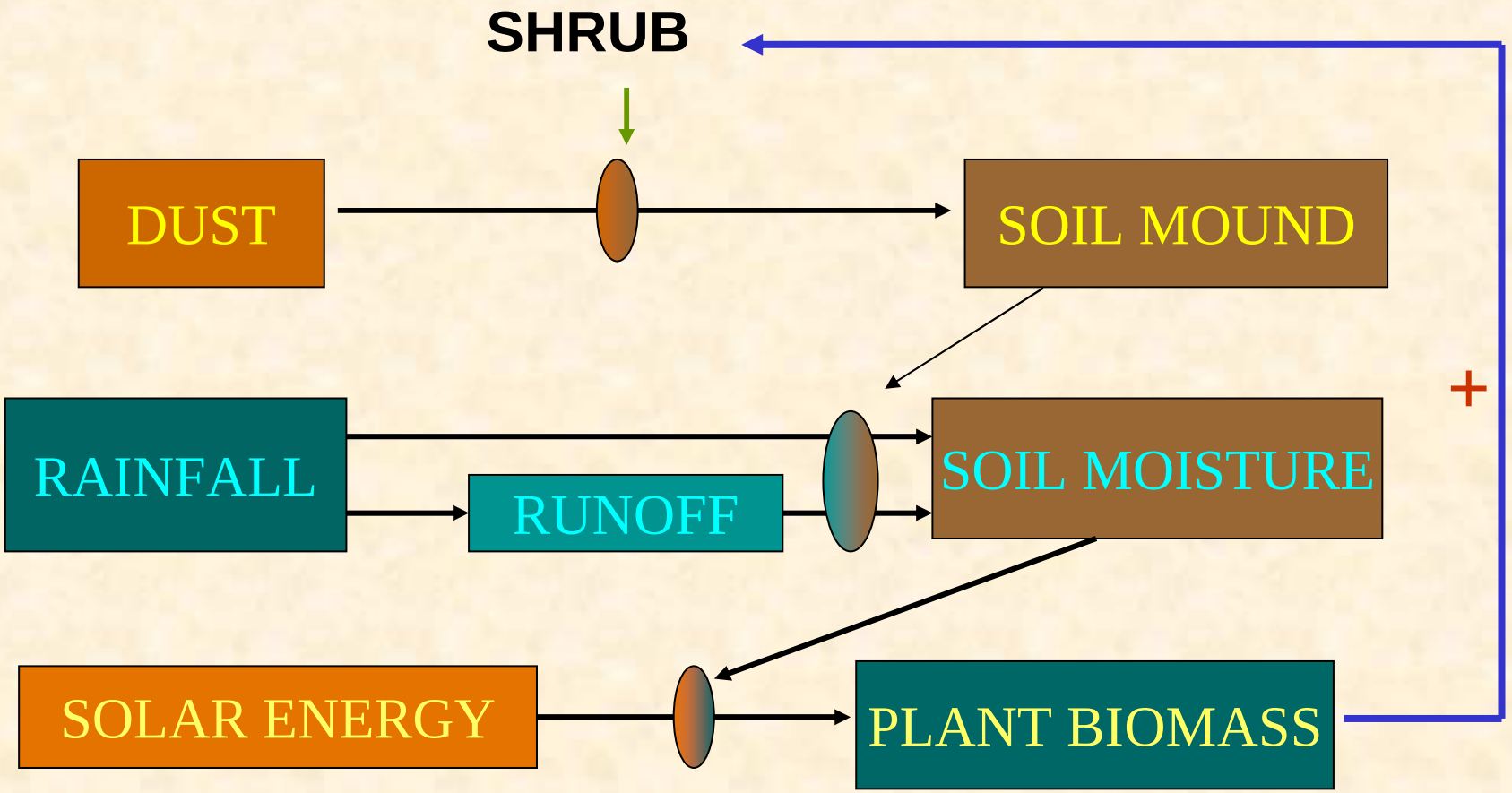
(A) PLANT BIOMASS

(B) SOIL WATER CONTENT,

(C) SURFACE RUNOFF WATER,

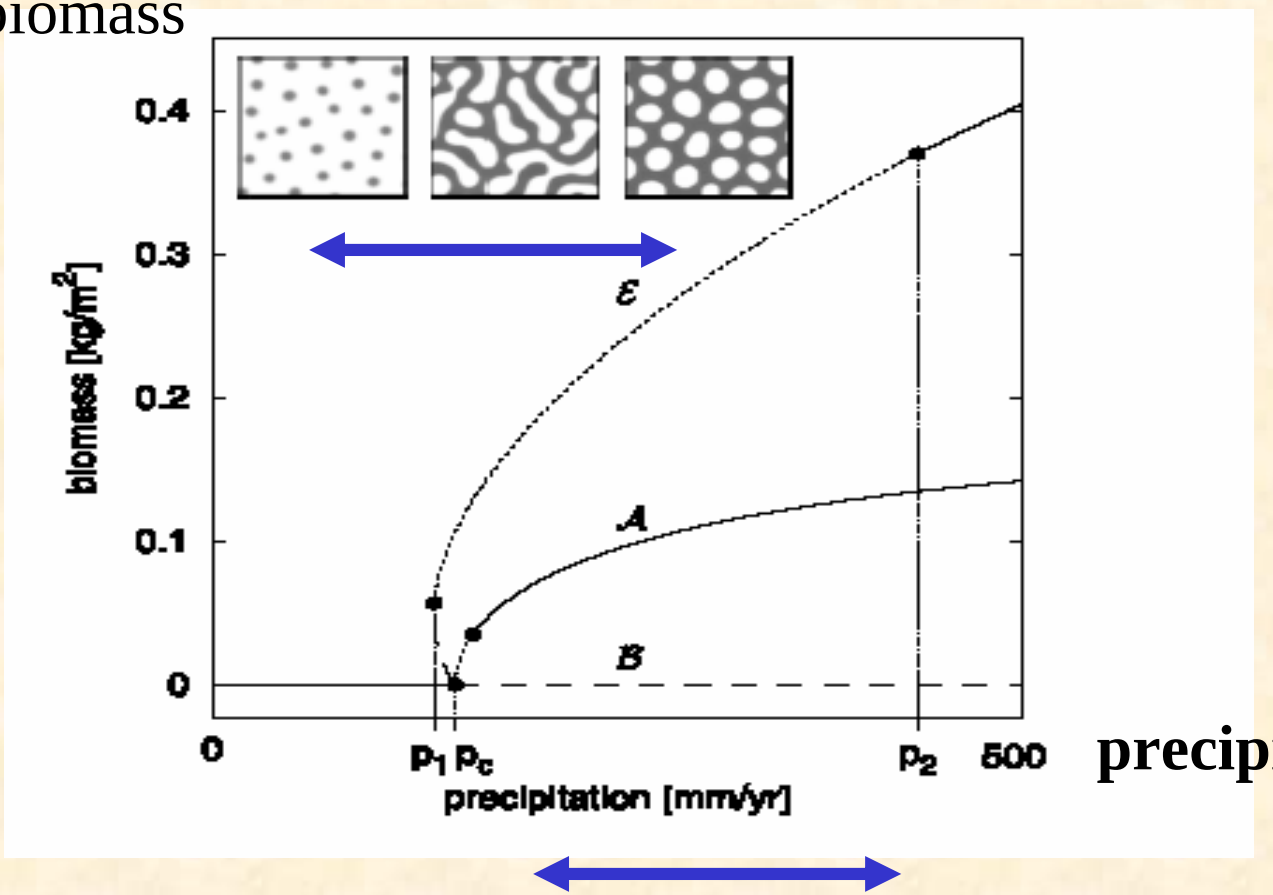
A POSITIVE FEEDBACK BETWEEN BIOMASS AND WATER.

Graphical representation of the model



CLIMATE CHANGE &
BIOTIC INDUCED LANDSCAPE MOSAIC

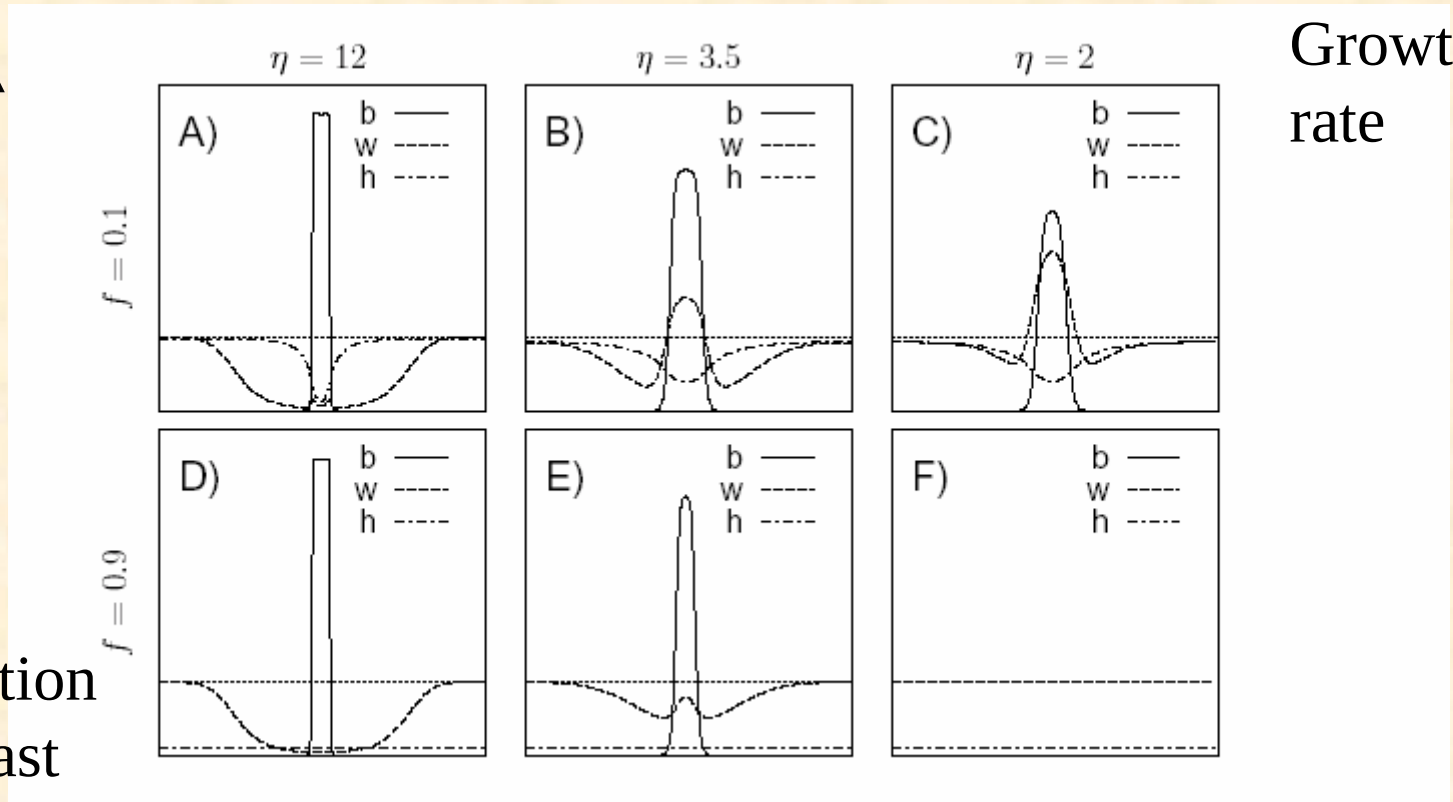
biomass



precipitation

Gilad et al 2004

CLIMATE CHANGE & HYDRO-ENGINEERING



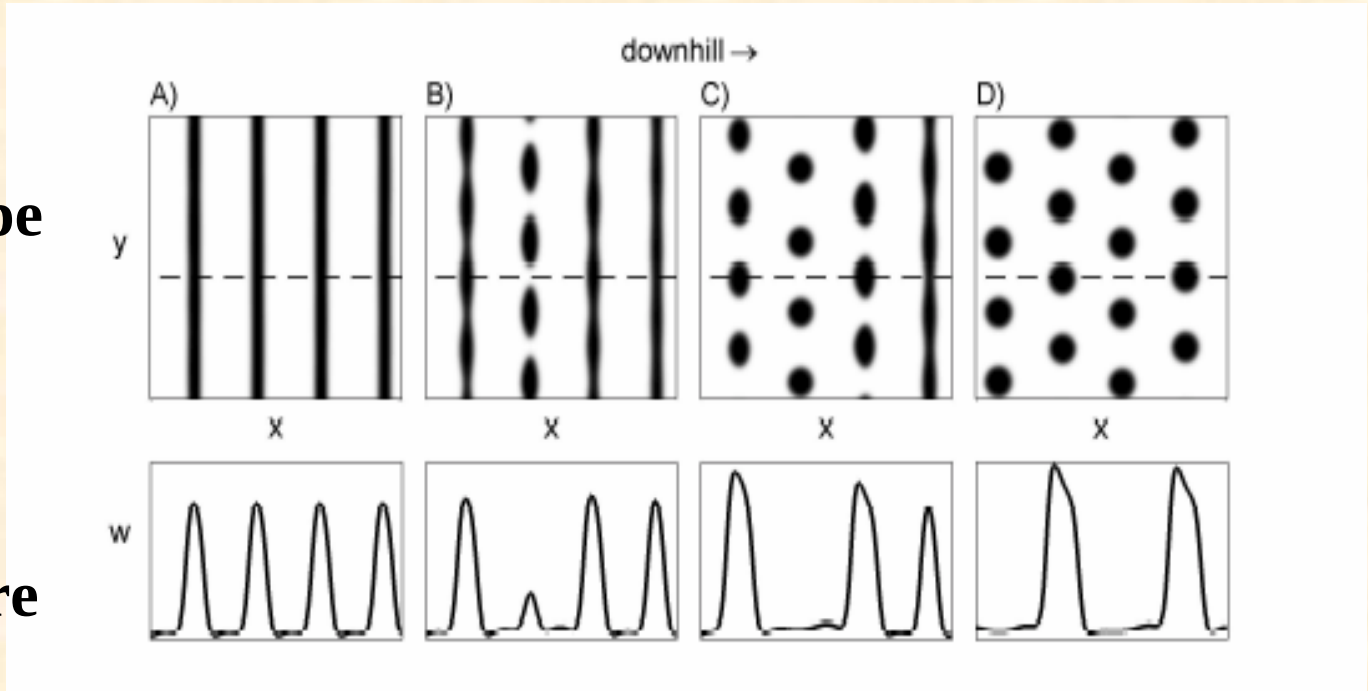
Gilad et al 2004

CLIMATE CHANGE
CRUST AND SHRUB STATES &
HYDRO-ENGINEERING

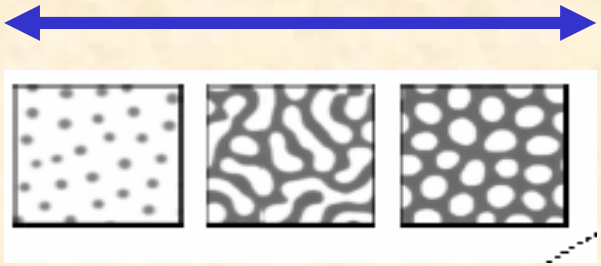
Aridification

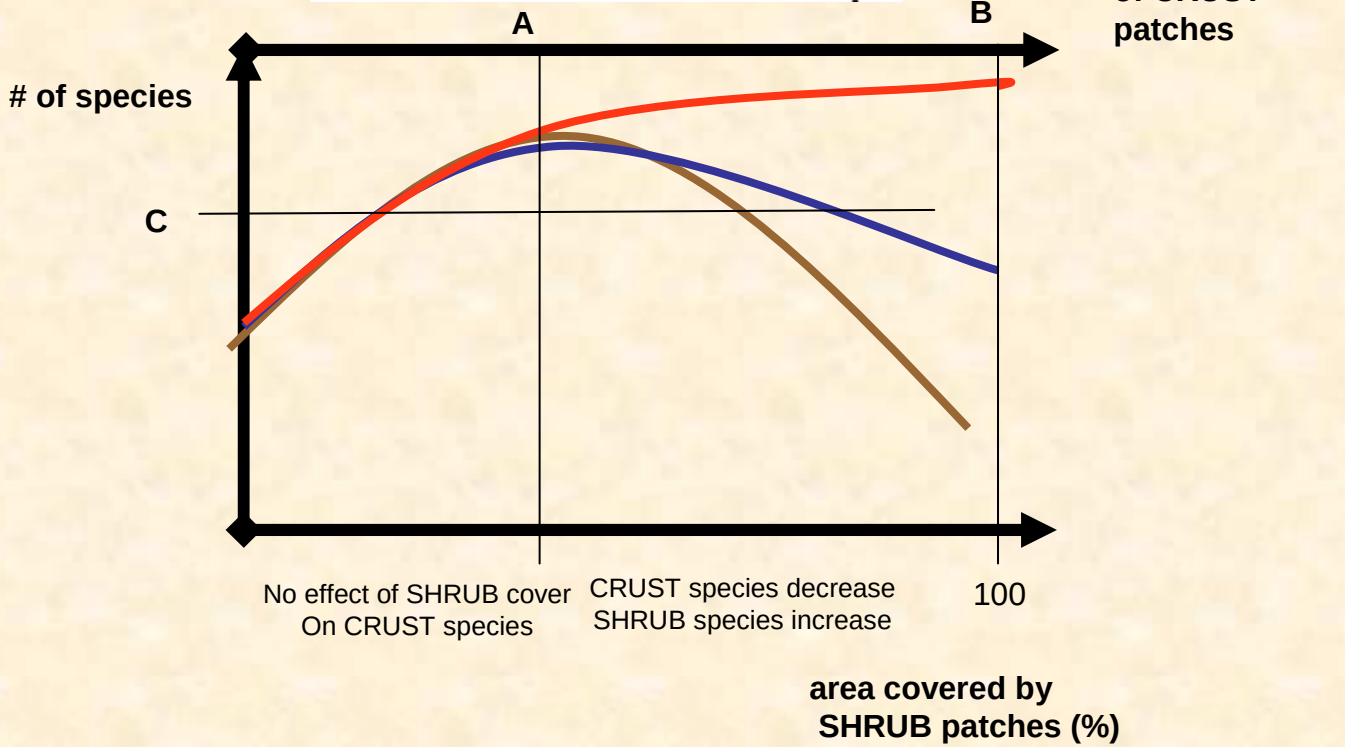
Landscape pattern

Soil moisture



CLIMATE CHANGE
CRUST AND SHRUB STATES & SPECIES RICHNESS





Summary:

- Drylands are biotic induced landscapes
- The biotic landscape is generated by ecosystem engineers
- The biotic patchiness controls water flow, soil processes biomass production and species filtering across spatial scales
- Climate change effects on ecosystem engineers may cause state transition due to changes in: landscape pattern, engineering properties and species richness and composition