Chapter 2
The Benefits of the Soil Food Web

Lecture 11 - Weeds & Succession (Part 1)

Colorado State University – Soil Microbiology

An across ecosystem comparison of:

Irrigated wheat
Dryland wheat
Shortgrass prairie
Tallgrass prairie
Meadows
Lodgepole pine forest

Increasing F:B

Conclusions:

- The organisms in soil set the stage for different plants to grow
- Exclude weeds when biology shifts
- Most rapid rates of decomposition under a blanket of snow

SFI Data: Based on Ecosystem Studies

Arid/ Semiarid Grassland, Crop & Pasture

- Texas A&M, Colorado State, Wyoming, Nebraska, Kansas, Washington State, Mexico, Utah, New Mexico,

Alpine, Tundra, and Conifer Forests

- Rocky Mts, Maine, New Hampshire, Canada, Alaska

Deciduous Forests and Wetlands

- Oregon State, University of Georgia, North Carolina, Canada, Florida,

Tropical Fruits and Vegetables

- Hawaii, Mexico

ALL have data published about the Soil Food Web

Examples of Previous Projects

- **Tomato -** Territorial Seed, Sunbow Farms, Tanimura and Antle, Earthbound Farms, Dennison Farms, Hono Ho'Aka
- **Strawberry -** NCSU, Pac Ag, Soil Rx, East Coast Compost, T&A
- **Orchards, Vineyards -** Columbia Gorge Organics, Ono Farms, HI, Marders, Dennison Farms, Watts Brothers, AlphaWolf, Clos du Bois, Gallo, Macari, BethShin, R&R, Wren, NY, Highlands, Salinas, CA
- **Potato -** Rustic Ag, Soil Logic, Nu-Vision Ag in Idaho, OSU, Kimm in Montana, Circle B, Utah, Monte Vista, CO
- **Wheat, Soybean** – Grant, NB, Hroncek, CO, Bio-Ag, Australia
- **Dairy** – Tulare County, CA, Natural Aeration, Spokane, WA
- **Landscaping -** HSLD, WA, Treewise, NY, Bainbridge, HI, Harrington, Koch, Creative Gardens, Boston Tree Preservation, Highlands, CA.
- **Turf -** SFI, Bandon Dunes, Creative Gardens, 6 NY, Woodbury, NJ, Philadelphia, CA: Olympic, Presidio, El Niguel, Coyote Hills, Uplands, Mirage, Bellagio, Las Vegas
- **Palm trees, cycads -** Mirage Hotel, Bellagio Hotel

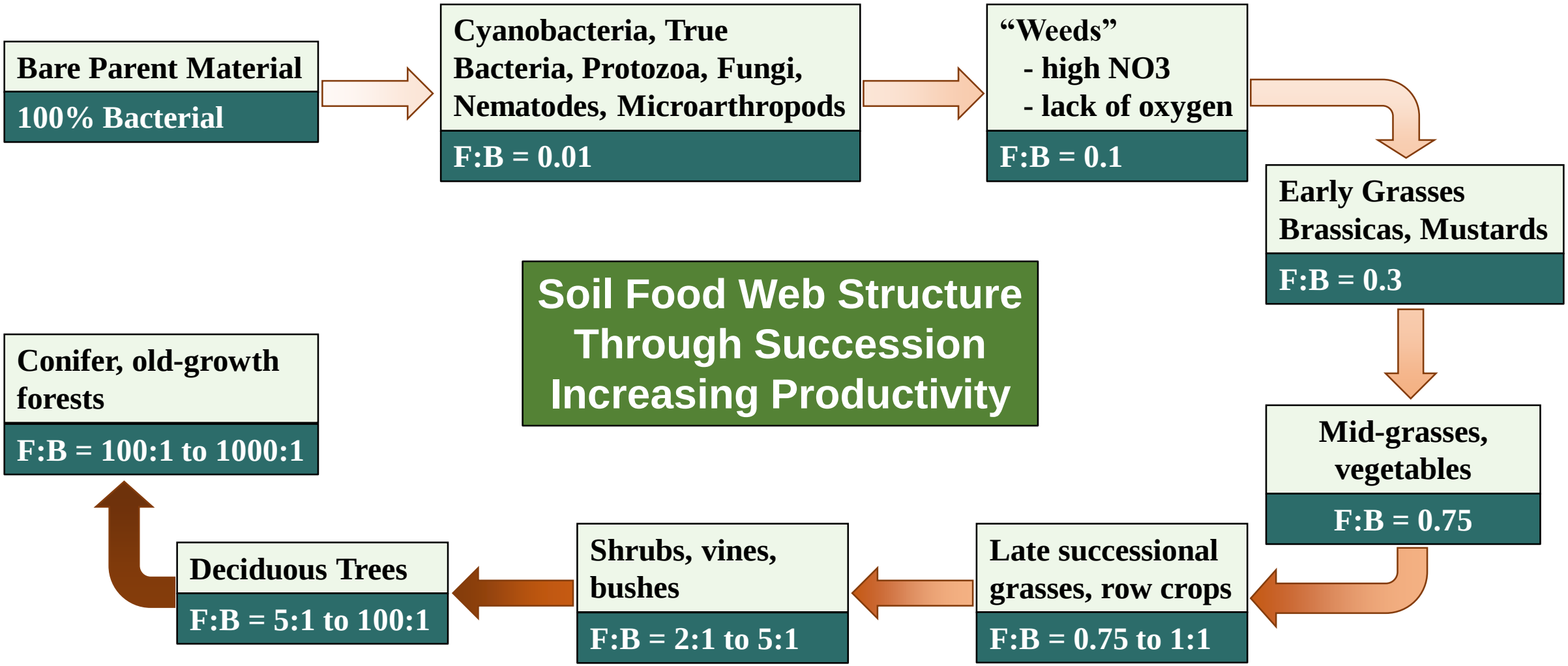
Plate Counts versus Direct Microscopy

System	Plate Index	B (µg/g)	F (µg/g)
Old Growth Forest	0	500	1200
Pasture			
2 lb weight gain	5	675	830
1 lb weight gain	6	230	50
Ag field			
180 bushels	7	450	400
100 bushels	12	210	75

Biological Counts

Production Gradient	AB	TB	AF	TF	Diam-eter	Protozoan Numbers /g			Nema-todes	INDEX
	(µg/g)				(µm)	F	A	C	(#/g)	
Weeds	56	147	11	64	2	6,400	6,400	51	7	1
Garden	78	144	3	19	2	51280	55400	1001	7.0	4
Chem Pas	44	127	13	55	2.5	5475	4242	33	2	5
Pasture	84	117	23	83	2.5	16178	6715	417	5	8
Clearcut	17	124	16	73	3	1819	5325	7	1	15
OgGarden	81	180	30	47	2.5	5787	5356	73	16	17
O Potato	94	229	10	237	2.5	7309	21998	5665	11	19
Strawberry	340	531	22	702	2.5	27070	27070	1123	1	22
YoungFir	165	245	29	1275	2.5	18	7489	0	18	23
Oldgrowth	194	458	79	2946	3	126	77716	0	24	25
Variation	17%						20%		8%	

What does your plant need?



Soil biological succession causes plant succession

All units are µg/g	Bacteria	A Few Fungi	Balanced	More Fungi	Fungi
Bacteria:	10	100	500	600	650	700
Fungi:	0	10	250	600	8,000	70,000

Forms of nutrients: Critical to understand

Limited Cycling NO_3 → Balanced NO_3 & NH_4 → NH_4

Protozoa → **Bf** → **Ff** → **Predatory Nematodes** → **Microarthropods**

Why isn’t everything an old growth forest?

DISTURBANCES

AIR POLLUTANTS

CLEARCUTTING, THINNING

COMPACTION

FERTILIZERS

PESTICIDES, HERBICIDES

TEMPERATURE (Freeze / Thaw)

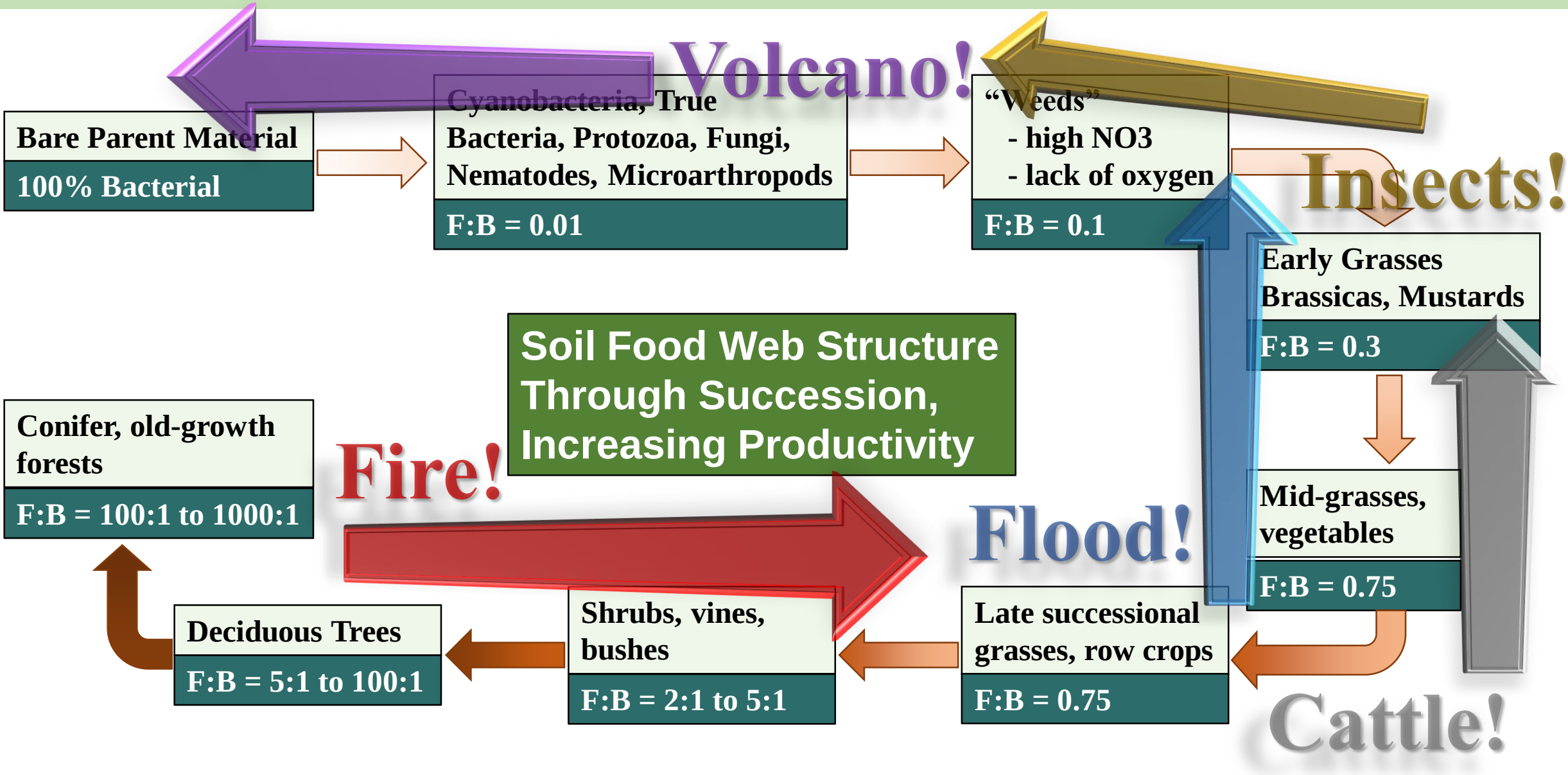
MOISTURE (Wet / Dry)

TILLAGE (Intensity, Repetition, Timing)

CROP (Monoculture, Intercropping)

ORGANIC MATTER (Timing, Type, Placement)

What does your plant need?



One of the biggest problems in agriculture….

- Weeds grow rapidly, makes lots of seeds
- The seeds disperse wide and far
- Pretty soon, there are more weeds than crop.
- Why do the weeds win?

Consider the natural world….. Why aren't weeds taking over old growth forest, or healthy pastures?

Why do weeds only win sometimes?