

Biomass/Production



Outline

- Definition & uses of production
- Methods to measure production
- Advantages & disadvantages of production
- Considerations for production
- Calculating & analyzing production

Definitions of Production

- **Production** - amount of carbon fixed from CO_2 to organic material in an area (mass/area)
- **Biomass** - total weight of living organisms
- **Phytomass** - total weight of plant biomass
- **Standing crop** - biomass in an area at one point in time
- **Peak standing crop** - highest value for standing crop within a year (varies with species)

Definitions of Productivity

- **Primary productivity** - rate of C fixation (accumulated biomass) in an area per unit time (mass/area/time)
- **Gross primary productivity (GPP)** - total amount of energy (carbon) fixed by photosynthesis per unit time (*total production*)
- **Net primary productivity (NPP)** - GPP minus losses by respiration (*net production*)
 - Aboveground NPP
 - Belowground NPP
- **Annual net primary productivity (ANPP)** - NPP on a per year basis

More Terms Related to Production

- **Herbage** - production of herbaceous plants
- **Browse** - production of woody plants used by browsing animals
- **Forage** - production of herbaceous and woody plants used by foraging/grazing animals

Uses of Production

- **Scientific studies** -
 - Carbon storage
 - Energy budgets (carbon flux)
 - Indicator of ecological dominance
 - Indicator of plant vigor
- **Management** -
 - Grazing capacity/stocking rates
 - Range condition
 - Wildlife habitat

Methods for Production

- **Direct**

- Harvest
 - Clip to ground level
 - Clip species or functional groups?
 - Current season's growth vs. total growth?
 - Rooted vs. canopied plants?
 - Separate out live vs. dead?
- Dry @ 60-70°C for 24-48 hours
- Weigh
 - Biomass (above vs. below vs. total)
 - % dry matter = dry wt./fresh wt. * 100



Methods for Production

- **Indirect**

1. Double weight sampling

- Estimate biomass in several plots
- Clip representative plots and assign biomass estimates
- Re-estimate biomass of plots

Considerations

- Fast
- Accuracy depends on observer
- Not rigorous enough for research

Methods for Production

- **Indirect**

2. Weight unit estimate

- Define unit of vegetation
- Count the # of units
- Determine dry weight of one unit
- Multiply for whole plant biomass

Considerations

- Fast
- Accuracy depends on observer
- Not rigorous enough for research

Methods for Production

- **Indirect**

3. Comparative yield technique

- Select five plots that cover range of biomass
- **Rank** all plots relative to five reference plots
- Clip and weigh representative plots and assign biomass values

Considerations

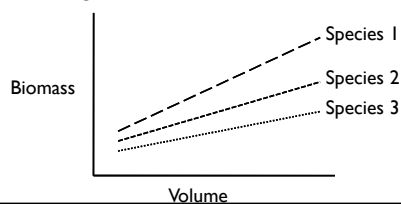
- Fast
- Accuracy depends on observer
- Not rigorous enough for research

Methods for Production

- **Indirect**

3. Plant dimensions

- Measure canopy widths and plant height to calculate volume
- Harvest representative size classes and establish a regression to estimate biomass



Dimensional Analysis

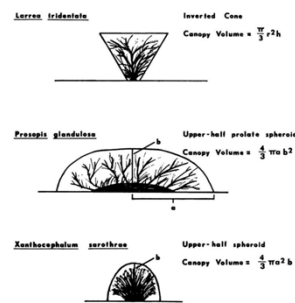


Fig. 1.—Canopy shapes and the geometric formulae used to fit these shapes for *Larrea tridentata*, *Prosopis glandulosa* and *Xanthocephalum sarothrae*

Ludwig et al. 1975

Indirectly Estimating Aboveground NPP

Shoot Growth



Indirectly Estimating Aboveground NPP

DBH in Trees



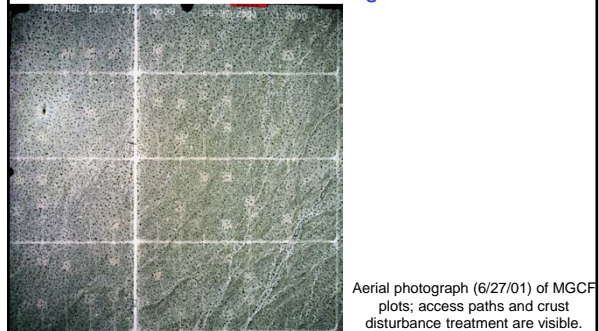
Indirectly Estimating Aboveground NPP

Digital Imagery



Indirectly Estimating Aboveground NPP

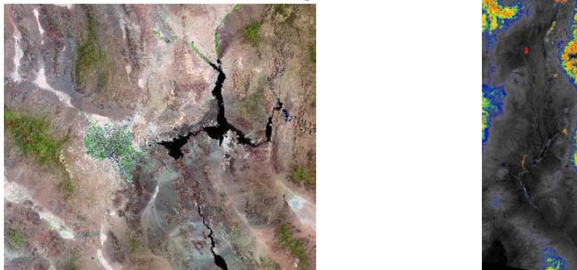
Remote Sensing



Aerial photograph (6/27/01) of MGCF plots; access paths and crust disturbance treatment are visible.

Indirectly Estimating Aboveground NPP

Remote Sensing

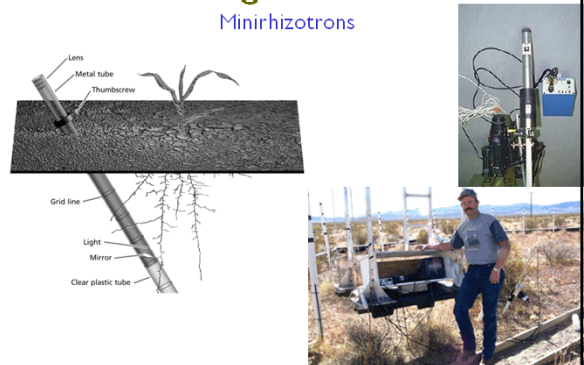


In this Landsat Image of Las Vegas and Lake Mead, vegetation appears as a green color

NDVI image of a basin in NV, colors highlight areas of higher vegetation density

Indirectly Estimating Belowground NPP

Minirhizotrons



Indirectly Estimating Belowground NPP

Minirhizotrons



Indirectly Estimating NPP

Eddy Covariance

Domes



Measure net ecosystem exchange
(NEE) – net CO₂ in and out of ecosystem

Advantages of Production

- Good indicator of ecological dominance
- Intuitive and easy to visualize
- Easy to measure

Disadvantages of Production

- Destructively sampled (mostly)
- Not practical to get belowground production
- Many species reach peak production at different times
- Time and labor intensive

Considerations for Production

- Define attribute measured
 - Time scale – per year or over many years
 - Aboveground vs. belowground vs. total
 - Standing crop vs. peak standing crop
- Moisture content varies
 - Always compare production on dry weight basis

Calculating of Production

Depends on Method!!!!

Analyzing Production

		Sampling Unit	
		Plots	Transects
Sample Independence	Independent	Independent sample t-test/ ANOVA	Independent sample t-test/ ANOVA
	Paired	Paired sample t-test/ repeated measures ANOVA	Paired sample t-test/ repeated measures ANOVA