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 CO₂ to organic material in an area (mass/area)
- **Biomass** - total weight of living organisms
- **Phyтомass** - 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 an annual 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
  - **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

**Indirect**
- **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**

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 MOCF plots; access paths and crust disturbance treatment are visible.

Indirectly Estimating Belowground NPP

Minirhizotrons

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 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

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