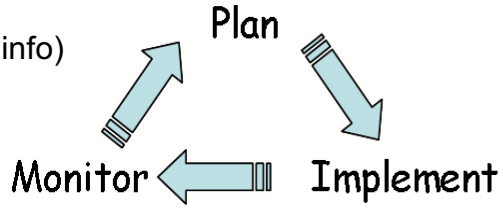
Introduction to Basic Concepts

- There are 5 basic steps to resource management:
  - 1st - Assess current situation (gather and analyze info)
  - 2nd - Develop a plan
  - 3rd- Implement the plan
  - 4th- Monitor results (effects) of plan
  - 5th- Replan



- This class will help you do the 1st and 4th steps in the process

- For any study of vegetation there are basically 8 steps:
  - 1st Set objectives - *What do you wan to know?*
    You can't study everything, you must have a goal

  - 2nd Choose variable you are going to measure
    Make sure you are meeting your objectives

  - 3rd Read published research & ask around
    Find out what is known about your topic and research area

  - 4th Choose a sampling method, number of samples, analysis technique, and statistical hypothesis

  - 5th Go collect data
    - *Details, details, details.... Pay attention to detail*
    - *Practice and train with selected methods before you start*
    - *Be able to adjust once you get to the field*

  - 6th Analyze the data
    - *Summarize data*
    - *Use a statistical comparison*

  - 7th Interpret the results
    - *What did you find? Why is it important?*
    - *What can your results tell you about the ecosystem?*
    - *Remember the limitations of your technique*

  - 8th Write the report
    - *Your results are worthless if they stay in your files*
    - *Clearly document your methods*
    - *Use tables and figures to explain your data*
    - *Be correct and concise*
    - *No matter how smart you are, you will sound stupid if you can't clearly communicate your results*

A good reference for several aspects of rangeland inventory and monitoring is:
http://rangelandswest.org/az/monitoringtechnical.html

- **Vegetation Attributes** (see page 23 - 29 in "Sampling Vegetation" available @ http://www.blm.gov/nstc/library/pdf/samplveg.pdf or on the CD distributed in class)
  - Frequency
  - Density
  - Cover
  - Biomass Production
  - Species Composition
  - Diversity
  - Plant Vigor
  - Structure

- **Terms and Concepts** - relative to habitat assessment
  - Inventory - Acquisition and documentation of information to describe, characterize or quantify resources on a management unit or area of interest.
    - Resources in an inventory can include vegetation (density, frequency, cover, biomass, composition), water quality (flow, sediment, temperature, nutrients, etc.), soil (infiltration, bare soil exposed, compaction, erosion), wildlife (species, age, condition, number), endangered species (location, habitat), or archeological resources (i.e., antiquities), and other resources of interest.
    - Inventories establish the current resources available.
    - Muir and McClaran describe inventory as - "*information collected to document and describe the existing resource status within a management unit. Features included depend on the purpose of the inventory, but in rangeland situations are likely to entail vegetation types, range sites, range condition, carrying capacity, soil types, utilization patterns, topography, streams, habitat assessments for wildlife, and improvements such as roads, watering points, and fences*." (1997 http://cals.arizona.edu/agnic/az/inventorymonitoring/)
  - Monitoring - A systematic and repeated measurement of habitat to detect change over time and assess effectiveness of current management or preservation strategies.
    - Muir and McClaran more fully note that "*monitoring is conducted to record changes in resource status, usually to assess the response to a management program at a site. Such changes can only be detected by a series of measurements spanning time. Data collected from a range inventory provides a valuable baseline against which to compare responses, but monitoring can rarely be conducted at the same level of detail as the information provided by an inventory. Instead, monitoring is usually based on observations of key areas and key vegetation attributes carefully selected to meet the objectives of the program. For example, species composition could be measured in a riparian area to determine the impact*

of a certain grazing system, changes in mesquite (Prosopis spp.) density could be used to assess the effectiveness of herbicide control, or ground cover could be chosen to monitor the impact of tourism at a popular site in a National Park." (1997 http://cals.arizona.edu/agnic/az/inventorymonitoring/)

- Monitoring is an important component of management because it is used to determine if current management approaches and strategies are meeting land management goals. Elinza and colleagues distinguish between measuring change and monitoring. "*Measuring change over time is a main characteristic of monitoring, but simply measuring change does not meet the definition of monitoring in this technical reference. Studies thatmeasure change can be implemented in the absence of an identified need for decision-making. In contrast, monitoring is characterized primarily by objectives and by being part of an adaptive management cycle. Monitoring uses change data to evaluate management and make decisions.*" (1998. http://www.blm.gov/nstc/library/pdf/MeasAndMon.pdf)

- Population - is a term that has two distinctly different meanings relative to sampling habitat.
  - Statistical Population (or target population) = a group about which one wishes to make statistical references. For example, if you want to know the density of yellow starthistle in the coyote creek watershed, you may examine the number of plants in 400 plots appropriately distributed in the watershed. Your statistical population, in this case, is yellow starthistle in coyote creek watershed because it is the area you would like to assess based on your 400 plots.
  - Biological Population = all of the individuals of a particular species in a particular place. For example, you may be interested the population of wintering elk in the Bridge Creek wildlife management. The biological population is defined by researcher or manager.
  - Sometimes a statistical population encompasses the whole biological population. At other times, it the statistical population may be a subset of a specified biological population.

- Sample - A set of units selected from a population used to estimate something about a target (statistical or biological) population. In the example above, if you examined the number of yellow starthistle plants in 400 plots in coyote creek watershed, the sample would be the 400 plots.
  - Statistics, such as a mean and standard error, are calculated on the sample to make inference to the statistical population which may be the same as the biological population or may be a subset of the biological population.
  - Sampling is the process of examining several to many sampling units to collect a sample with which you will make inferences about a plant community or habitat.
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- Sampling Unit - one of the set of objects in the sample that is drawn to make inferences about a population of the samples.
  - Common units:
    - quadrat = a plot of known area and a distinct boundary
    - transects = a line of known distance
    - point - a quadrat of smallest possible dimensions
  - must be distinct and not overlapping
  - summed together, the total sampling units may represent the whole population or area of interest (i.e., one could sample all the trees in a pasture)

- Selecting Units to Sample
  - Subjective - Selectively place a set of plots or plants (a sample) in specific areas that meet research interests or management objectives. Monitoring "key areas" or "critical areas" is a type of subjective sampling
    - Select sites that are considered representative of change or responsive to management
    - May or may not reflect the larger area - depends on judgement of person selecting sites.
    - Difficult or impossible to make statistical inferences about a whole pasture, park, watershed or management unit. However, use of subjective sampling may be very effective in determining if management strategies are working to meet management goals.
  - Systematic - Placing plots or selecting plants for research or monitoring by systematically and regularly spacing plots according to a predetermined grid.
    - Rapid and easy to use in the field.
    - Assures good distribution and uniform coverage of the target population.
    - Limitations in statistical analysis because units in the sample are not independent of one another. For example, if plots are placed every intersection in a ½ -mile grid, once the first sample is selected, the location of all other plots in the sample is known. In other words, the location of all plots is dependent on the location of the first plot of the placement of grid.
  - Random - Selection the location of plots or areas to be studies in a way that each sampling unit (i.e., plot or plant) is selected completely at random and any potential area or plot to be studied has an equal chance of being selected.
    - All observations in the sample are independent so normal (parametric) statistics can be applied with confidence
    - The best way to selecting a random sample is generally to apply a grid (with two coordinates) to the total area of interest.
      * A pair of random numbers can then be selected for the x- and y-coordinates on the grid.
      * One could also number all the intersections on the grid and select a random numbers from 1 to the total number of intersections.
      * Random numbers can be selected in several ways
        + roll dice
        + put all units or coordinates in hat and draw a number
        + use a random numbers table in a statistics book
        + create a list of random numbers in the "random" feature in a spreadsheet
    - One problem with random sampling is that it may result in poor distribution of sampling units as the units that are randomly selected may not be evenly distributed across the landscape or target population. Plant populations and habitats are rarely distributed evenly and randomly across the landscape, therefore a sample of random units may or may not represent the landscape.
  - Stratification - If there are aspects of the landscape that will clearly result in differences among the plots sampled it is often good to stratify the area and sample within these sub-units. For example, if a pasture has 3 major ecological sites that vary in biomass

productivity, the proportion (%) of samples examined in each ecological site could be based on the proportion of the total area occupied by each site.

- Stratification often overcomes the problem of poor sample distribution of random samples
- At least 2 sample units (preferably 3 or more) must be drawn from each sub-unit to determine the variation within each sub-unit
- Can yield info about variation among and within sub-units
- The samples within each sub-unit can be applied in a random fashion to create a "Stratified Random" sample, or systematically to create "Stratified Systematic" sample, or subjectively to create a "Stratified Subjective" sample.

- Several Other Sampling Approaches exist that could be considered such as paired sampling and cluster sampling. More information about statistical terms related to sampling can be found at: http://www.stats.gla.ac.uk/steps/glossary/sampling.html

- Accuracy vs Precision:
  - Accuracy = how close the sample estimate is to the true population attribute
  - Precision = how close do repeated samples of the population result in the same estimate
- Species = Organisms (animals or plants) that are capable of interbreeding and producing viable/fertile offspring
- Forage Class = A group of species with similar morphology which generally refers to grass, grass-likes, forb or browse.
- Individual Plant = Individuals that are genetically identical and share photo synthetic resources (i.e., water, nutrients, photosynthate). When counting or examining individual plants in a habitat assessment project it may difficult to distinguish among individual plants.
- Tiller = A group of connected phytomers
  - A single stem (or culm) in grasses
  - A stem of one years growth on a shrub

- Location of Study Sites
  - crucial to success of an inventory or monitoring program
  - selection process should be documented:
    - based on management objectives
    - criteria used for selecting site
      - soils
      - habitat type
      - seral state
      - topography
      - location of water, fences, & natural boundaries
      - areas of animal concentration
      - etc.
    - based on kinds of statistical comparisons or interpretations expected

- Critical Area -
  - Evaluated separately from mgmt. unit becuase they contain unique or special values such as:
    - fragile watersheds
    - sage grouse nesting grounds
    - riparian areas
    - habitats with rare plants

- Key Areas = “a portion of range which, because of its location, grazing or browsing value, and/or use, serve as an indicative, sample of range conditions, trend, or degree of seasonal use (SRM 1989).”

    - indicator areas that are able to reflect what is happening on a larger area as a result of on-th-ground management actions (interagency manual 1996)”.

    - requires appropriate stratification of management unit with key areas within each unit and statistical inferences made to the stratification unit only

    - key areas should be mapped accurately for a permanent record

- Key Species (or key plants)
    - “A forage species whose use serves as an indicator of the degree of use of associated species and, because of its importance, must be considered in any management program (SRM 1989)”

    - generally important components of a plant community that serve as indicators of change and may or may not be forage species (interagency manual 1996)

    - Selecting a Key Species:
        - more than one species may be selected for a stratum
        - may be problem plants
        - species used may change with season
        - should be tied to management objectives
        - depends on species currently present and potential natural community.
        - interdisciplinary team should select species