PDF - THE IMPACT OF EXPERIMENTAL DESIGN ON THE APPLICATION OF GRAZING RESEARCH RESULTS: AN EXPOSITION. - researchcub.infoFunding Bmitationsoften restrict pasture replication in grazing research on rangeland.Consequently, subsample error has been used to estimate treatment effects orcharacterize populations. Assumptions associated with experimental designswhich utilize subsample error to make inferences are discussed and an exampleevaluated. The appropriate experImental unit for inferential grazing researchis the pasture. Animals or vegetation aampling within pastures must beconsidered as subsamples in inferential grazing research. Pasture replicationmust be used in intensive grazing trials to establish treatment dfferences orprovide adequate characterization. Following intensive trials, extensive,unreplicated trials implemented by private producers can be effective inestablishIng broad-based applicability. Unreplicated pasture trIaIs may also beused for screening several treatments. Shrinking research budgets, increasedcompetition for research dollars, and increased complexity of grazing researchhave contributed to efforts to enhance the efficiency of the research process.Additionally, range and pasture research competes with other research for landin organizations with finite land resources. Differentiating between efficiencyof experimental design and the ability to make the proper characterization orinference is particularly important in range science. Minimizing cost in theexperimental design process often is done at the expense of inference. Mostbooks on experimental design or statistics provide few examples representingexperimentation at the population, community, or ecosystem levels oforganization (Hurlbert 1984). The principles of design for grazing studies aremost often violated. It is the purpose of this discussion to explore someaspects of experimental design critical to evaluating efficiency and costversus interpretive credibility of grazing research. Hurlbert (1984) definedexperimental research as mensurative (sampling studies) or manipulative(external treatment). Mensurative experiments involve only the making ofmeasurements at one or more points in space or time; space or time is the onlyexperimental variable or “treatment”. Cochran (1977) provided an excellentreview of sampling techniques for sampling studies. Manipulative experimentsalways involve two or more treatments and have as goals making one or morecomparisons. Several references provide valuable information on the design ofmanipulative experiments (Federer 1955, Cochran and Cox 1957, Cox 1958).Measuring attributes of interest is important in both mensurative andmanipulative experiments. There are several references available on measurementtechniques (Brown 1954, U.S. Forest Service 1963, Greig-Smith 1964,Mueller-Dombois and Ellenberg 1974, ‘t Mennetge 1978, Stubbendieck and Schacht1984, Cook and Stubbendieck 1986). Experiments can be inferential, providinginformation about a population; or they can be descriptive, providinginformation about specific individuals within a population. Inferential GrazingTrials Population of Inference The focal point of inferential research is thecharacterization of or inference about some population. Steel and Torrie (1980)defined a population as all possible values of a variable. The Authors areresearch animal scientist, USDA, ARS, Rt. 2, Box 144A, Booneville, Ark. 72927;professor, Department of Agronomy, University of Nebraska-Lincoln, Lincoln685834915. Manuscript accepted 8 August 1985. JOURNAL OF RANGE

MANAGEMENT39(3), May 1996 selected population of interest becomes the population ofinference from which individuals are selected for experimentation. Thepopulation could be all native pastures in eastern Nebraska for a grazing studyor all silty range sites in Vegetative Zone IV of Nebraska for a vegetativesurvey. Explicit definition of the population of inference must be made priorto the selection of the experimental material. If the population is well defined;means, variances, covariances, probabilities and other statistics generatedfrom a research project can be properly interpreted. Once the population isdefined, sample units can be selected within the appropriate experimentalmaterial. Sample units could be termed observational units in descriptiveresearch and experimental units in experimental research. Experimental Unit Aproper experimental design can be destroyed by failing to recognize whatconstitutes the experimental unit (Nelson and Rawlings 1983). According to Cox(1958) the experimental unit corresponds to the smallest division ofexperimental material such that any two units may (independently) receivedifferent treatments in the actual experiment. Because responses are notconstant in biological research, sample units should be chosen at all levelswhich can affect characterizations or responses. For example, treatment,pasture, animal, year of measurement, year of treatment, the failure of maineffects to respond consistently within the grazing season, and appropriateinteractions are all potential sources of variability in a manipulative grazingtrial. Animals can be considered experimental units in mensurative andmanipulative research trials in which the forage resource has no differentialeffect on the measured response. Breed comparisons, reproductive physiology,insect or parasite studies are examples of such studies. Prior knowledge is thebasis for the assumption that pasture effects are negligible or of no interest.In identifying the animal as the experimental unit and not replicatingpastures, the researcher foregoes the opportunity to evaluate potential pastureX treatment interactions. Animals in manipulative grazing research on rangelandare generally used as a treatment (e.g., stocking rate study) or as measures oftreatment effect (e.g., gain/ head, gain/area). Freegrazing animals in rangesituations can seldom be considered as experimental units. Each animal mustreceive a treatment to be considered an experimental unit in manipulativeresearch. In addition, each animal must be independent of other animals for theresponse measured. If forage availability or selection are important factors inthe response variable, animals within a pasture cannot be consideredindependent. As an example, forage consumed by one animal cannot be consumed byanother, implying a dependency. Thus, animals are actually repeated measures onthe same experimental unit. The experimental unit of a production system in themeasurement of animal production from grasslands must consist of an area ofland and the animals grazing on it as well as auxiliary facilities for suchmanagement activities as supplemental feeding (Morley 1978). Pasture size andnumber is a critical consideration for research facilities with limited landresources. Pastures should be large enough to support adequate animal numbersto provide the precision in response measurements (Peterson and Lucas 1960).However, small pastures are more desirable than large, production-size pasturesfor intensive grazing trials since land is restricted.

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