**NCERA-225 Renewal**

**Statement of Issue(s) and Justification:**

The beef industry in the United States is unique in that it is comprised of distinct, competing segments, each consisting of multiple profit centers. This diversity presents several challenges to a centralized system aimed at the genetic improvement of beef cattle. In addition to this diverse organization, improvement of individual cattle populations is at the hand of independent breeders and breed associations. As such, unlike the breeding companies in the swine and poultry industries, there are no generally acknowledged breeding goals, nor are there any such collaborative approaches for genetic improvement across its segments. Consequently, national genetic evaluation programs sponsored by beef cattle breed associations have become the foundation for genetic improvement in beef cattle and many of these breed associations have developed their own selection indices for their members to use.

National Cattle Evaluations (NCE) systems, historically, were developed through close-knit cooperative efforts between breed associations and specific land grant university personnel. These efforts resulted in the accumulation and analysis of large volumes of data, as well as the interpretation, and publication of genetic values for nearly every major beef breed (BIF, 2021). The success of NCE has been accomplished through breed associations paying a significant portion of the costs through contracts with land-grant universities. Their respective members also bear all the cost of data collection (NCERA-199, 2003). The formation of the National Beef Cattle Evaluation Consortium (NBCEC) in 2001, with a mission to "develop and implement improved methodologies and technologies for genetic evaluation of beef cattle for the purpose of maximizing the impact genetic programs have on the economic viability, international competitiveness, and sustainability of U.S. beef cattle producers and to provide consumers with affordable and healthy beef products" helped provide some reprieve to the financial burden of the breed association through new sources of federal funding to assist NCE efforts. In addition, several members of the NCERA 225 committee provided leadership, conducted research, and held regular outreach activities using the resources of the NBCEC (NBCEC, 2005). Unfortunately, sources of funds for the NBCEC were depleted in 2011, and monetary support for NCE was lost.

In the absence of the support of the NBCEC, the NCERA 225 committee fulfills a more critical role in the success of NCE through coordination of research activity, software development, and producer education. The value of the committee has become even more significant in the past ten years as the incorporation of genomic information into NCE has become the norm while strategies for doing so are still being developed and evaluated. In addition to the committee, support for advancements in NCE also comes from research conducted by a broad network of scientists at other universities and the USDA. These NCE results are disseminated, typically on a biannual basis, to the beef industry through individual breed associations. Even though universities are often no longer primarily responsible for facilitating NCE, research and software developed by universities and federal research institutions are still the major source of innovation driving higher accuracy NCE. Technology adoption by the industry is exceedingly quick, and the speed of this is due to outreach programs of NCERA 225 members, research and education personnel at the breed associations as well as extension specialists at universities (Garrick, 2011).

Adoption of NCE programs has been successful as evidenced by the broad use of the resultant genetic tools by both registered seedstock and commercial segments of the beef industry. This widespread adoption has resulted in favorable genetic trends over time within the performance programs of all breeds. Traditionally, large-scale genotyping for NCE programs has been conducted using inexpensive SNP chips. Advances in genotyping techniques are allowing sequence data to be generated at a lower cost; therefore, there is an interest to exploit these data (Georges et al., 2019). Imputing, selecting, and predicting effects for the millions of variants in the sequence data will require development of additional computational tools and techniques, which is currently being facilitated by NCERA 225 members.

Looking forward, in addition to genomics, emphasis is being placed on ‘phenomics’ in animal management and breeding. Phenomics, which is defined as ‘the acquisition of high-dimensional phenotypic data on an organism-wide scale’ (Houle et al., 2010), has blossomed thanks to the development electronic devices and computing technologies. Currently, sensors can inexpensively record images, videos, sounds, or a multitude of environmental parameters, making large-scale, continuous phenotyping possible. Phenomics data will allow integration of mechanistic biological models into genetic evaluation (Pérez-Enciso and Steibel, 2021). Redesigning animal breeding schemes to incorporate the high dimensional data associated with the phenomics revolution is an ongoing challenge that the members of NCERA 225 are uniquely qualified to address.

In spite of this demand for NCE programs by industry stakeholders, the continued funding of NCE by many breed associations has been difficult. To help ease these financial burdens, close coordination amongst both researchers and breed associations is critical to avoid duplication of efforts. NCERA 225 has been, and will continue to be, a primary resource for communicating the needs of NCE between breed associations and researchers, particularly in the absence of additional monetary resources provided for by the NBCEC. Cooperation amongst NCERA 225 members will help minimize costs incurred by breed associations by reducing unnecessary replication of endeavors.

During the project period spanning the years 2022 to 2026, the following represents research challenges to be addressed by this committee: 1) Development of genetic predictions for economically relevant traits, particularly those related to production efficiency, environmental adaptability, reduced environmental impact, animal welfare, animal health; 2) Increased collaboration in integrative projects that utilize bioinformatics (next generation sequencing, genotyping by sequencing, machine learning) and functional genomic advancements to exploit the genetic relationship of economically relevant traits for beef cattle production; 3) Improvements to current NCE methodology and computational strategies that facilitate the incorporation of vast quantities of both traditional and molecular data from different breeds and countries including phenotypic data from non-traditional sources such as commercial industry partners (feedlots, abattoirs, etc.); 4) Development, improvement and implementation of decision support systems that enable producers to evaluate use of limited economic resources in the context of genetic improvement balancing phenotyping, genotyping, and costs of those technologies. Research addressed in the project will be complimentary to other multi-state programs, including but not limited to National Animal Genome Research Program (NSRP8), Integrated Approach to Enhance Efficiency of Feed Utilization in Beef Production Systems (W3010), Precision Management of Animals for Improved Care, Health, and Welfare of Livestock and Poultry (NC1211), Nutrition Management of Feedlot Cattle to Optimize Performance, Carcass Value, and Environmental Compatibility (NCCC308), and Future Challenges in Animal Production Systems: Seeking Solutions through Focused Facilitation (S1074). The group already has some overlapping collaborations with these efforts and will examine other possible joint efforts during this term.

**Objectives**

1. Provide a venue for the discussion and exchange of information for the many disconnected and diverse research activities--biological, genomic, statistical, computational, and economical--that support National Cattle Evaluation (NCE).
2. Develop through this exchange new tools for delivery and use of beef cattle genetic research, including genomic information, to beef breed associations and beef cattle producers.
3. Update the beef cattle industry on current developments in beef breeding and genetics research including changes in genomic tools and analyses.
4. Collaborate with appropriate groups (eg. BIF, and USDA/NIFA funded Integrated Projects) on research and outreach.

**Procedures and Activities**

The NCERA 225 committee plans to implement the following procedures and activities to address each of the previously stated objectives for the committee.

Objective 1

A meeting will be held annually at a host university or beef cattle breed association, with the purpose of creating a collegial forum for information sharing amongst committee members. In addition, the committee will continue participation in annual activities hosted by the NBCEC at different symposiums and meetings. Specifically, members of the committee plan to participate as speakers each year for the NBCEC Brown Bagger Series (NBCEC, 2005). Also, committee members have been and will remain active in BIF, serving as committee chairmen and as invited speakers.

Objective 2

Annual beef cattle genetic evaluations conducted for the fulfillment of NCE and research that supports development of tools for said NCE will accomplish this objective. National cattle evaluations now take place at least biannually for many beef breed associations and weekly for several others. The research efforts of this committee will be implemented in genetic evaluations for the various beef breeds. Committee members will discuss results and ideas related to the success of NCE at the annual meeting. The dialogue between members provides critical feed back to those researching and developing new NCE selection tools. In previous years, speakers have used the collective knowledge of the committee to resolve technical issues with NCE analyses. In addition to the development of new selection tools, committee members will continue their research to integrate genomic information into genetic evaluation of beef cattle. These efforts will be coordinated with available funding and research projects conducted by members of this committee.

Objective 3

Committee members will be on programs aimed at informing the cattle industry of new developments in research. The BIF Annual Meeting and the Brown Bagger webinar series developed by the NBCEC provide forums for committee members to present research findings and discuss implications to the beef industry. Additionally, extension resources such as ebeef.org will be used to disseminate research findings to a broader, more diverse audience.

Objective 4

Committee members will continue to work to provide symposia, online seminars, and meetings. For example, the ongoing Brown Bagger series provides education and outreach to various professionals that serve the industry. Committee members will also be involved in coordinating and participating in research activities sponsored by NBCEC.

**Expected Outcomes and Impacts:**

1. Annual meetings with the agenda focused on NCE will allow shared ideas and techniques to be rapidly disseminated throughout the entire NCE system. Thus, NCE, as the primary tool for genetic improvement of beef cattle, will have the latest developments incorporated for institutions, such as Colorado State University, University of Georgia, Angus Genetics, Inc., International Genetic Solutions, and Livestock Genetic Services conducting genetic evaluations. These developments will include new traits, statistical methods, and computing techniques, as well as innovation in and standardization of how results are presented to the beef cattle industry.
2. Industry and extension representatives to the committee will convey to the research community NCE research priorities of the relevance to the beef cattle industry. Their participation will augment the outreach programs of breed associations as well as those of individual university members. Representatives will develop and present educational materials and programs to both seedstock breeders and commercial cattle producers on interpretation and use of NCE results.
3. Members of the committee will technically advise beef cattle breed associations on matters of breed improvement and serve as speakers at breed association functions.
4. Members of the committee are, and will continue to be, leaders and speakers at the annual meeting and research symposium of the Beef Improvement Federation (BIF) which is the primary forum for those interested in the genetic improvement of beef cattle.
5. The committee will co-sponsor a BIF genetic prediction workshop in the next five years. Any workshops or symposia will be evaluated to assess impacts.
6. Committee members will continue to participate in education programs for university extension faculty members and industry members using programs, such as the NBCEC Brown Bagger Series. Additional outcomes include the development of written resources on genetic improvement of beef cattle. The Brown Bagger Series is evaluated annually to assess impacts. An additional venue for dissemination of advancements will be made at sites such as ebeef.org. Strength of this committee is representation from extension and breed association personnel. These members will continue to provide the research community with industry priorities. Industry and extension members present educational programs dealing with national cattle evaluation, genomics, and other animal breeding topics to commercial and seedstock producers. Educational programs will be evaluated to assess impacts. Committee members will serve as advisors to breed associations on issues dealing with breeding and genetics. Committee members will continue to participate in BIF, both as speakers at the annual meeting as well as serve on the board. The committee will co-sponsor with the BIF a genetic prediction workshop, which will be evaluated by participants. Committee members will continue to participate in education and outreach activities, such as the NBCEC Brown Bagger series, which is evaluated annually by participants to assess its impact.

**Project Participation:**

Include a completed [Appendix E](http://nimss.umd.edu/homepages/outlineAppE.cfm?trackID=7836) form

**Educational Plan:**

Information developed by members of the committee will be of critical value to the beef cattle industry and to research scientists working in the area of genetic improvement of livestock. The committee will actively disseminate information in several ways. Members of the committee are active in other interested organizations such as the BIF and work closely with breed associations. Information from the committee will be reviewed and discussed by BIF committees and workshops. Committee members will then make presentations at meetings such as held by BIF and breed associations. The BIF annual meeting is attended by all segments of the beef industry including commercial cattlemen, seedstock breeders, personnel from breed associations and AI studs, extension specialists and researchers (university, USDA, etc.). The potential flow of information is as follows:

NCERA 225 Coordinating Committee
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NBCEC
BIF Genetic Prediction Committee
Genetic Prediction Workshops
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BIF Annual Meetings
Breed Associations
Extension Specialists
Continuing Education (i.e., NBCEC Brown Bagger)
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Seedstock Producers
Commercial Cattle Producers
Commercial Industry (e.g., Zoetis)

**Governance:**

Officers will consist of a chair and chair-elect. The term of office will be one year. The chair will be responsible for organizing the annual meeting and for coordinating meeting arrangements with the host location. The chair-elect will be responsible for writing and submitting minutes of the meeting to the administrative advisor and to the website coordinator.

Prospective members will be invited to attend regular meetings by the administrative advisor or a committee member. After attending a meeting, candidates are eligible for nomination to join the NCERA 225 committee. The approval will require a majority vote of the committee members present.

Committee members and participants need to regularly participate in the annual events associated with the NCERA 225 committee. If a member of the committee does not attend the annual meeting, their absence will be noted in the report with a copy sent to their agricultural experiment station director. Furthermore, the committee member must respond with an explanation for their absence and inform the committee of their expectations to participate in the future.

**Literature Cited:**

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Pérez-Enciso M, and Steibel, JP. 2021. Phenomes: the current frontier in animal breeding. *Genet Sel Evol* 53, 22.

**Attachments:**

**Internal Linkages:**

**External Linkages:**

**Signatures:**