U.S. Poultry Species Coordination Activities

Supported by Allotments of Regional Research Funds, Hatch Act

For the Period 1/1/11-12/31/11

FACILITIES AND PERSONNEL: Jerry Dodgson, Microbiology & Molecular Genetics, MSU, serves as Coordinator with Hans Cheng, ADOL, as Co-Coordinator.

OBJECTIVES 1. Create shared genomic tools and reagents and sequence information to enhance the understanding and discovery of genetic mechanisms affecting traits of interest. 2. Facilitate the development and sharing of animal populations and the collection and analysis of new, unique and interesting phenotypes. 3. Develop, integrate and implement bioinformatics resources to support the discovery of genetic mechanisms that underlie traits of interest.

Progress toward objective 1. Shared genomic tools and reagents and sequence information.

Reference linkage map. Linkage mapping is now primarily via high throughput SNP (single nucleotide polymorphism) assays. Coordination funds have been committed to SNP chip development and distribution. Very high density SNP mapping (ca. 600,000 SNP) panels have been developed and are being employed in genome-wide association studies and genome-wide marker-assisted selection (GMAS).

Physical and comparative maps. Physical mapping of the turkey genome is complete, involving construction of a detailed comparative chicken-turkey BAC contig comparative map.

Chicken genome sequence. A new build, Galgal4.0, of the chicken genome sequence which combines the original reads, next generation sequencing (NGS) reads (Roche and Illumina) and the near-finished quality of the Z sequence done by Bellott et al. (Nature 466:612-616, 2010) recently has been released (11/22/11). NGS technology appears not to have captured the roughly 5% of missing sequence (believed to be predominantly on the microchromosomes) in the current chicken assembly. Further efforts to do so were proposed in a whitepaper submitted for review by USDA NIFA and NIH, but funding is not yet available. A number of additional chicken genomes have been or are being sequenced with NGS technology. Coordination funds are supporting a project with DNA Landmarks to sequence 20 different chicken lines of interest to NRSP-8 members. NGS data for genomes from the DF1 and DT40 chicken cell lines have also been obtained and are currently being analyzed and compared to the new reference Galgal4.0 chicken genome assembly.

Turkey genome sequence. The Turkey Genome Sequencing Consortium generated a draft sequence of the turkey genome (Dalloul et al., PLoS Biology 8(9):e1000475, 2010) using a combination of NGS reads, along with the turkey BAC contig map noted above. Coordination funds were committed to aid in this effort which also enjoyed support from VaTech, BARC and U. of Minn., among others (the effort also garnered support to both VaTech and BARC from USDA-NIFA-AFRI). Efforts are on-going to improve the annotation of genes and fill gaps in the turkey sequence.

Chicken microarrays. In the past, coordination funds have been used to provide samples of the 44K element long oligonucleotide chicken array made by Agilent Corp. to several NRSP-8 participants, along with a new 244K whole genome long oligo array that can be used for comparative genome hybridization and whole genome transcriptional profiles. Alternatively, other participants chose to be provided GeneChip® Chicken Genome arrays from Affymetrix,

Inc. Some coordination support has also been committed to Illumina RNA-sequencing and Agilent chip-based transcriptional profiling, partly in hopes of filling in missing sequences.

Progress toward objective 2. Shared animal populations and phenotypes.

DNA from the East Lansing international reference population has been sent to many laboratories throughout the world.

Progress toward objective 3. Database resources.

Database activities are led by the NRSP-8 Bioinformatics Coordinator, Jim Reecy, and Susan Lamont, along with Shane Burgess, represent poultry interests on the advisory committee for this group. Poultry bioinformatics has also benefitted from support at several other locations. We maintain a homepage for the NRSP-8 U.S. Poultry Genome project (http://poultry.mph.msu.edu) that provides a variety of genome mapping resources, including our newsletter archive. The Poultry Genome Newsletter is published quarterly and is distributed through our Homepage and on the angenmap email discussion group.

Meetings: Over 2500 scientists attended the joint Plant and Animal Genome XIX meeting last January, held jointly with the annual NAGRP meeting. Coordination funds helped support attendance at PAG-XIX and will do so for the upcoming PAG-XX in Jan. 2012.

Impact: This project is generating tools through which the genome sequence can be used to locate inherited production trait alleles and apply the DNA sequence to ascertain the physiological basis for those traits. It has resulted, among other things, in the generation of the complete sequence of the chicken and now the turkey genome. Commercial breeders are using the sequence and SNP we generated to characterize and improve production lines using GMAS. In simpler terms, we are now moving closer to understanding the cause of phenotypic variation that is relevant to the agricultural use of poultry.

PLANS FOR THE FUTURE.

OBJECTIVE 1. Continued support for the use of SNP arrays and GMAS efforts. 600K or even larger SNP arrays should soon be available at reasonable cost, but there is also interest in low density SNP chips that provide reasonable coverage at low cost.

OBJECTIVE 2. Continue to promote the sharing of phenotypic and genotypic data, DNA sequences and genotyping panels.

OBJECTIVE 3: A variety of individual bioinformatic efforts for the chicken are underway as outlined above. We will explore ways to better support efforts to improve genome annotation and data sharing in general. Coordinators are also working with Titus Brown with NIFA-AFRI support to develop and distribute web-based tools for next generation sequence analysis. The Poultry Genome Newsletter and homepage information will be continue to be distributed and enhanced. We will continue to support travel to NRSP-8/PAG meetings.

(Prepared 12/02/11)