M.L. 2015, Chp. 76, Sec. 2, Subd. 03n Project Abstract
For the Period Ending June 30, 2017

PROJECT TITLE: Digitization of Historic Gullion Ruffed Grouse Research
PROJECT MANAGER: Kent Montgomery
AFFILIATION: Central Lakes College
MAILING ADDRESS: 501 West College Drive
CITY/STATE/ZIP: Brainerd, MN 56401
PHONE: (218) 855-8155
E-MAIL: kmontgomery@clcmn.edu
WEBSITE: www.clcmn.edu
FUNDING SOURCE: Environment and Natural Resources Trust Fund
LEGAL CITATION: M.L. 2015, Chp. 76, Sec. 2, Subd. 03n

APPROPRIATION AMOUNT: $75,000

Overall Project Outcomes and Results

Dr. Gordon W. Gullion is recognized as one of the world's foremost authorities on ruffed grouse. Dr. Gullion began his study of ruffed grouse ecology and habitat management in 1958 at the Cloquet Forestry Center, the Mille Lacs Wildlife Management Area and a privately owned Crow Wing Study Area.

More than 69,000 individual data records from his work exist on hard copy data cards today. These data document ruffed grouse habitat use throughout the year, food habits, reproductive success and mortality factors that provided the very foundation of ruffed grouse (and many other species) habitat and population management throughout much of the Great Lakes region.

Unfortunately, with Dr. Gullion's sudden death in 1991, and the deterioration of the data cards, this information was at a point where it may have been lost forever – and with it an important chapter in the history of wildlife conservation in Minnesota - without conversion of the data to a more permanent medium. This project set out to transcribe 20,000 of these historic data cards into digital format and to develop of a data retrieval system that enables users to easily and efficiently navigate and retrieve data for specific analytical tasks from this electronic dataset. To assess this, a subset of Dr. Gullion's uncompleted manuscripts were to be completed using the data retrieval system to test its effectiveness.

Approximately 21,500 records were transcribed and archived in a digital database (MySQL). Data from MySQL files are easily exported into many analysis and spreadsheet programs, including MS Excel that increases accessibility to the data. Two of Dr. Gullion's manuscripts were reviewed using the archived data to determine the utility of the database. Additional funding provided by the Ruffed Grouse Society will allow digital transcription of the remaining 47,500 data cards. In addition, every data card will also be scanned front and back and a pdf version of each included in the database.

Project Results Use and Dissemination

Work will continue under Ruffed Grouse Society funding to continue to modify the digital database for ease of access as new card types and the remaining data cards are included. Upon the completion of transcription and scanning, the original data cards, files cabinets, maps, and any other materials from Dr. Gullion's collection currently housed at Central Lakes College will be returned to the Cloquet Forestry Center. The Center will also likely be the primary depository of the transcribed data and pdf images. Additional repository sites may include Central Lakes College, Minnesota Department of Natural Resources and the University of Minnesota. Archived materials in these collections will be available for electronic dissemination to anyone requesting the information.

Date of Report: 26 October 2017

Date of Next Status Update Report:

Date of Work Plan Approval: June 11, 2105

Project Completion Date: 30 June 2017

Does this submission include an amendment request? _no_

PROJECT TITLE: Digitization of Historic Gullion Ruffed Grouse Research

Project Manager: Kent Montomery

Organization: Central Lakes College

Mailing Address: 501 West College Drive

City/State/Zip Code: Brainerd, MN 56401

Telephone Number: (218) 855-8155

Email Address: kmontgomery@clcmn.edu

Web Address: www.clcmn.edu

Location: Carlton, Mille Lacs, and Crow Wing

Total ENRTF Project Budget:	**ENRTF Appropriation:**	**$75,000**
	Amount Spent:	**$37,456**
	Balance:	**$37,544**

Legal Citation: M.L. 2015, Chp. 76, Sec. 2, Subd. 03n

Appropriation Language:
$75,000 the first year is from the trust fund to the commissioner of natural resources for an agreement with Central Lakes College to preserve the Gordon Gullion ruffed grouse data sets as permanent digital data files to improve accessibility to the information and inform forest wildlife conservation policies and practices.

I. PROJECT TITLE: Digitization of Historic Gullion Ruffed Grouse Research

II. PROJECT STATEMENT: Prior to his untimely death in 1991, Dr. Gordon W. Gullion was universally recognized as the world's foremost authority on ruffed grouse. Dr. Gullion began his landmark study of ruffed grouse ecology and habitat management in 1958 under the auspices of the University of Minnesota at the Cloquet Forestry Center, the Minnesota Department of Natural Resources Mille Lacs Wildlife Management Area and the privately owned Crow Wing Study Area. Dr. Gullion's efforts followed those of Dr. Ralph King who initiated Ruffed Grouse research at Cloquet in the 1930's at the urging of Aldo Leopold. A gap in research occurred from the late 1930's until the mid-1950's at which time Dr. William H. Marshall re-opened the research efforts which included backtagging of ruffed grouse followed by pioneering research in the use of radio-telemetry to study ruffed grouse movements. The longevity and breadth of this research is unparalleled in the profession.

Over 69,000 individual data records were collected on hard copy edge punched field data forms. These irreplaceable data include records documenting ruffed grouse habitat use throughout the year, food habits, reproductive success and mortality factors that when used in concert, provide an assessment of ruffed grouse ecology that is the very foundation of ruffed grouse habitat and population management throughout much of the range of this important game bird, particularly the Great Lakes region. The forest management strategies designed to sustain habitats for ruffed grouse have been demonstrated equally beneficial to many species of nongame wildlife, including the seriously imperiled golden-winged warbler (petitioned for protection under the federal Endangered Species Act - February 2010).

Unfortunately, the hard copy data forms are slowly deteriorating to the point that if they are not soon converted to a more permanent medium, the information they contain will be lost forever – and with it an important chapter in the history of wildlife conservation in Minnesota. The loss of these data would seriously compromise efforts of today's resource management professionals to gain new insight into ruffed grouse ecology and management using recent statistical procedures unavailable to Gullion and his predecessors.

Also, Dr. Gullion, had at the time of his death, over 50 uncompleted technical papers and one book length manuscript describing his personal 30 years of research on Ruffed Grouse. Conversion of the data to current digital format standards is necessary to efficiently complete these manuscripts and eventually seek to have those published in memory of Dr. Gullion's 30-year research endeavor.

The overall goal of this project will be to preserve the Gullion ruffed grouse and other data sets in a series of two or three phases over the next four to six years to enable natural resource management professionals to take advantage of the wealth of information contained therein to further improve the understanding of ruffed grouse ecology and open possible new avenues of research. This project represents the first phase of the preservation of Gullion's data, targeting approximately one-third of the data cards. Student interns from Central Lakes College will provide data entry and analysis for this project. Approximately 20,000 data cards (one-third of all records) will be entered and analyzed over the course of two academic years. ENRTF funding will be used to leverage Federal Work Study funding for qualified students, providing additional support for data card entry.
A significant potential application for these data is the potential completion of over 50 unpublished manuscripts and Dr. Gullion's personal life's work manuscript pertaining to his research of ruffed grouse over a three decade period.

A second phase of the project would be to complete the entry of the remaining 49,000 data records. These records will also be digitally preserved using student interns at Central Lakes College supported by external funding (ENRTF and/or other sources) coupled with Federal Work Study funding. This data and phase one data would be disseminated through an online data repository at Central Lakes College, with digital copies provided to the University of Minnesota, the Minnesota Department of Natural Resources, and the Ruffed Grouse Society. The complete data set, representing over 69,000 cards, includes trapping records, observation records, drumming log

usage data, drumming log ecological data, individual bird records, band code data, feeding records, aspen bud production data, radio telemetry records and other miscellaneous data.

Permanent digital preservation of the data sets in an MS Access data format that can be efficiently analyzed using the latest analytical tools and statistical software to guide the development of forest wildlife conservation policies and practices. Following the entry of the first summer's data, a small number of the most completed manuscripts will be selected to finalize. Data retrieval and analysis methods will be tested using MS Access and MS Excel to test and evaluate the effectiveness of the data entry, compilation and analysis process. The completed manuscripts will be saved for possible future publication as "The Unpublished Ruffed Grouse Research Works of Dr. Gordon Gullion".

III. OVERALL PROJECT STATUS UPDATES:

Project Status as of 1 January 2016:
An additional $87,500 has been committed to the project by the Ruffed Grouse Society to cover additional costs associated with phase two of the project, preserving the remaining 49,000 records from Dr. Gullion's research. This funding will be used to fund additional students and/or fund students for an extended period of time to complete the data entry of these remaining records.

During fall of 2015 MySQL databases were created for the original data cards, including databases for observation records and individual bird records. Additional databases will be created for the other card.

Agreements for the loan and use of the original data cards were executed between the University of Minnesota and Central Lakes College. Frank Svoboda collected the original data records from the University of Minnesota Cloquet Forestry Center and delivered them to Central Lakes College. Two computer stations have been established and 100% of their use allocated to project personnel.

Four students were hired during Fall Semester at Central Lakes College. Initially one student tagged data cards with unique alpha-numeric codes and tested the databases. Once database performance was assured, the additional student began entering data cards into the database. Their work will continue through the Spring Semester with the option of continuing their work full time over the summer.   A fifth student is also working to enter data cards in the database with funding coming from Federal Work Study funds allocated to the Natural Resources Program at Central Lakes College.

Project Status as of 1 July 2016:
Approximately 10% (6,000) records have been transcribed to digital format. Three students worked part time over the spring semester and two students worked full-time over the summer to enter records. Four students will be transcribing additional records part-time (20 hours per week) during the fall semester. Additional students will be solicited for data entry to reach our goal of 20,000 records by the end of spring semester 2017 if not sooner.

Frank Svoboda, Project Leader, has maintained communication between the University of Minnesota Cloquet Forestry Center staff and Ruffed Grouse Society representatives. Mr. Svoboda has also coordinated database creation, management, and debugging with Jim Martinson.

Kent Montgomery, Project Manager, has overseen solicitation, hiring, and supervision of student workers throughout the year.

Project Status as of 1 January 2017:

To date, 9,800 record cards have been transcribed into digital format. This is approximately 50% of the target data entry for the LCCMR portion of the funding for this project. Five students are currently working part time (up to 20 hours per week as allowed by student employment). With eight weeks remaining in the spring semester, student workers will soon be screened and hired for full time work over the summer. Additional students (i.e. more than 2) will be employed during the 2017 summer due to the number of remaining cards to be transcribed. Supplemental funding from the Ruffed Grouse Society is available to cover their employment expenses should they exceed LCCMR funding allocations over the summer.

Data entry is lagging behind projections due in large part to the limited amount of hours students have been able to work over the academic year. All of the students have not been able to commit a full 20 hours per week to the project, an estimate that was used during project budgeting. To compensate, additional students were hired during spring semester to offset the reduced student hours worked.   The average number of minutes per record was also underestimated during project budgeting – actual data entry has been more time intensive due to a number of factors, including different data recorders on the cards, deciphering observer handwriting, and changing coding systems in use on the cards over the years. The number of minutes per card entry has dropped over the year as students have become more familiar with the card format and individual data recorder differences.

Franklin Svoboda, Project Leader, is working with Jim Martinson (Ridgewater College) to create additional card formats (e.g., drumming log records) since students are nearing the completion of entry of all the observation cards in the collection. The new formats will be in place once students finish archiving the observation record cards (the largest set in the collection) so as not to further delay the data entry efforts. Mr. Svoboda has projected that quality assurance checks on the data will be completed by the end of May 2017.

Project Status as of 1 July 2017:

Overall Project Outcomes and Results:
Approximately 21,500 records have been transcribed and archived in a MySQL database (the data is currently stored in a server housed on the Ridgewater College campus), surpassing the phase 1 goal of 20,000 records. All of the "Observation Record" data cards have been transcribed to digital format. This includes about 18,000 records, the next most numerous card type. The remaining 3,500 cards transcribed were "Individual Bird Record" data cards, the card type with the second-most entries. A portion of the "Individual Bird Record" cards and 16 other card types (totaling about 47,500 records) remain to be transcribed.

Transcription of the remaining data cards (phase 2) will continue with funding provided by the Ruffed Grouse Society ($87,500). Data transcription is expected to continue for another 2-4 years to complete the conversion of all records into digital format. This will also require the creation of many new data entry forms in MySQL by Mr. Martinson to accommodate the varied card types and the different versions of each used over the years. Compensation for Mr. Martinson to complete this work will be provided by the Ruffed Grouse Society funds as well.

In addition to the digital transcription of the information contained on each data card, every card will also be scanned front and back and a pdf version incorporated into the database.   This will allow researchers to access the original data in the event of any questions or discrepancies. Upon the completion of transcription and scanning, the original data cards, files cabinets, maps, and any other materials will be returned to the Cloquet Forestry Center in Cloquet. The Center will also likely be the primary depository of the transcribed data and pdf images (to be discussed at an upcoming project meeting next month at the Cloquet Forestry Center). Additional repository sites beyond the Cloquet Forestry Center and Central Lakes College (e.g., Minnesota Department of Natural Resources and the University of Minnesota St. Paul Campus) will be added upon request.

IV. PROJECT ACTIVITIES AND OUTCOMES:

ACTIVITY 1:
Description: Preserve Data by Converting to Electronic Format. Preserve 20,000 data records currently stored on deteriorating hard copy field forms by converting these data to an electronic Master Data File. Five student interns at Central Lakes College will be employed over two academic periods to enter the data into an MS Access format designed to mimic the data card format. These records will be searchable by word, phrase, date, and numeric content.

Summary Budget Information for Activity 1:	ENRTF Budget:	$ 40,601
	Amount Spent:	$ 28,456
	Balance:	$ 12,145

Outcome	Completion Date
1. Archival of Electronic MS Access Data Records; Phase 1	1 July 2017

Activity Status as of 1 January 2016:
During fall of 2015, Jim Martinson, an instructor in Computer Systems Technology at Ridgewater College, was retained to create databases for the original ruffed grouse data cards. Two initial databases have been created for data entry, including observation records of ruffed grouse and individual bird records. A free version of My SQL has been used to create the databases as this program is more adept at handling large sets of data than MS Access. Mr. Martinson will create the additional databases for the other card types/iterations on a billable basis with Ruffed Grouse Society funds to cover these expenditures (i.e. no LCCMR funds will be used for these expenses).

One student was initially hired during Fall Semester 2015 to begin individually tagging each of the 69,000 records with unique alpha-numeric codes and affixing these to the data cards. A small set of records were initially entered into the database to ensure data management and recovery. Five students are currently entering data into the databases and will continue their work through the current Spring Semester 2016, with one of these students supported through Federal Work Study funding (i.e. no LCCMR funds supporting his work).

Activity Status as of 1 July 2016:
Two students continued data entry over the summer (approximately 40 hours per week). Transcribed and archived data was initially reviewed for accuracy and database functionality. Approximately 6,000 records are currently transcribed and archived.

Activity Status as of 1 January 2017:
Five students have been continuing digital archive of the original data cards during the fall and spring academic semesters. Nearly 10,000 cards have been transcribed and five students will be continuing archival over the spring semester (2017). Additional students (i.e. more than two) will be hired for full time work over the summer beginning in mid-May following spring semester finals.

Activity Status as of 1 July 2017:

Final Report Summary:
Fifteen students have transcribed more than 21,500 data cards into digital format during the project period, surpassing the goal of 20,000. About 18,000 of these data cards were included in the "Observation Record" data card type. The remaining data cards were "Individual Bird Record" card types. Each card type required Mr. Martinson to create new data entry forms in MySQL.

MySQL was used in place of MS Access as it provided a simpler, user-friendly data entry interface and greater query options. Students will continue to archive the remaining 47,500 records in MySQL using funds provided by the Ruffed Grouse Society (Phase 2). The digital records are currently stored on a server housed at the Ridgewater College campus. Once completed, the archived data will be transferred to a permanent location (most likely the Cloquet Forest Center) and made available for archival or for use by interested parties, including the University of Minnesota and the Minnesota Department of Natural Resources.

This activity was completed under budget due in part to a couple of factors. First, preliminary estimates of data entry efficiency proved to be an underestimate. These estimates may have been close for students when they first began data entry, but as they became more familiar with MySQL, and proficient with data card formats, observers' handwriting, and other data card details, their data entry efficiency improved.

The second factor contributing to the underspending of this activity was the amount of time students were able to devote to the project. It was assumed that students would work twenty hours per week during the academic year and forty hours per week during the summer months when they were not enrolled in classes. Summer estimates proved to be accurate, with students routinely devoting forty hours per week to the project. During the academic year, however, students rarely met the estimate of twenty hours per week. Students quite often worked less than ten hours per week during this time. In addition, there was a great amount of turnover in student workers, with many only working a week or two before quitting (a problem not unique to this project), at which point new students were recruited for the program, resulting in work occurring at less than capacity.

ACTIVITY 2:
Description: Simplify Data Retrieval to Facilitate Use. Establish subsets of the Master Data File based on ecological, spatial and temporal attributes (e.g. cause of mortality, location, month-year, etc.). Establish companion subset keys to enable future users to easily and efficiently navigate and retrieve data relevant for the specific analytical task. A conversion key will need to be developed that automatically converts the grid data used to record observation and trapping records to latitude-longitude coordinates. A data conversion routine would be developed to accomplish this whereby specific grid coordinates would be automatically converted and recorded in lat-long data fields in the Access form. Previously mapped locations of drumming logs, trap sites and other fixed location sites have previously been mapped as part of another project and these data would be automatically entered when a fixed feature location was referenced. Two student interns will be selected to work on this task.

Summary Budget Information for Activity 2:	ENRTF Budget:	$ 19,806
	Amount Spent:	$ 7,500
	Balance:	$ 12,306

Outcome	Completion Date
1. Archival of Electronic MS Access Data Records; Phase 1	1 July 2017

Activity Status as of 1 January 2016:
No progress on this activity to date. Multiple databases must be populated with data prior to being able to test retrieval of data across these databases.

Activity Status as of 1 July 2016:
No progress on this activity to date.

Activity Status as of 1 January 2017:
No progress on this activity to date.

Activity Status as of 1 July 2017:

Final Report Summary:

Digital transcription of data cards was mediated through a MySQL image-based data entry forms. This form was a digital representation of the data card with fillable fields corresponding to the location of the information on the actual data card. Mr. Martinson created and modified these data entry interfaces as needed.

The task of creating and modifying data entry forms was complicated by the fact that there were different card formats used over the years. For example, for the more than 15,000 Observation Record data cards, seven different data card formats were used between 1956 and 1974. While the basic recorded data remained the same, more detail was added to some categories and others were dropped as research protocol changed over time. Consequently, fields had to be added to the MySQL databases for later data cards, while retaining those from previous years. Keeping all forms of the data recorded in one database lead to major challenges in database design. This design resulted in some more complicated programming and design layouts than anticipated, but the final product will allow for straightforward yet robust analysis.

Data from MySQL is easily exported as a .csv file that can be imported into many analysis programs, including MS Excel, which we used. Some problems appeared when exporting different file types. For example, extra columns were introduced and at times data from two different fields ended up in a single column. For this reason, exporting data to a .csv file was selected to minimize some of these problems. Additional programming corrections will likely be required when additional data card formats are developed for the continued transcription of data cards to digital format under phase 2 of the project supported by Ruffed Grouse Society funding.

Error analysis of transcribed data identified inconsistencies both in the transcription of the records and errors on the original data cards themselves. Batch correction processes, MySQL programming language and design, and reexamination and re-entry were all employed to correct these errors. Transcription errors arose in part from the interpretation of handwriting and changing data entry formats used over the years. Errors on the original data cards included data recorded in non-corresponding areas on the data cards and incomplete date or location information. These errors were magnified by the fading of the pencil writing over the years.

Currently, even with digital transcription, the original data cards remain the only written record of Dr. Gullion's work. During phase 2, all of the cards will be scanned (front and back), saved as a PDF file, and included with the digitally transcribed records in the archive. This will enable users to access individual data cards to clarify questionable data entries and decipher handwriting. Enhanced scanning techniques (e.g., contrast adjustments) will be used to provide better clarity of faded pencil entries.

The Cloquet Forestry Center was divided into 40-acre compartments. For the grouse project, each of these compartments was subdivided into 2-chain grids or a square 132 ft. by 132 ft. Thus, a standard forty-acre parcel would include 10 east-west and 10 north-south divisions. Any observation related to grouse activity or other location based observations would be referenced to the 40-acre compartments which were numbered beginning with 1. Off-forest 40-acre compartments were similarly designated but were either numbered or designated by letter prefixes. Thus, a typical observation might be designated as DL 40F6 meaning it was Compartment 40 on the CFC, in the 6th north-south 2-chain row and in the 6th 2-chain east-west column. This coding has been used to denote locations contained on the data cards.

Currently, about 13 different card formats have been developed to accommodate the two card types (Observer Records and Individual Bird Records) transcribed to date. Once completely transcribed, there could possibly be another 80 card types developed for transcription. This diversity of data entry formats required to transcribe the complete data set was not anticipated at the beginning of this project. Given this, the decision was made to

postpone developing a searchable index until data transcription was nearer completion when indexes could more accurately reflect the diversity of the transcribed files.

Additional details of data formats and data entry conventions can be found in the LCCMR Task Completion Report included as an addendum.

ACTIVITY 3:
Description: Examine the uncompleted manuscripts and select a small sample of those that could be completed to test the effectiveness of the data retrieval and analysis process and potential using MS Access and Excel as data management and analysis tools. Other compatible analytical packages may also be considered if shown to be more effective in the analysis process. Two student interns will be selected to work on this task.

Summary Budget Information for Activity 3:	ENRTF Budget:	$ 14,593
	Amount Spent:	$ 1,500
	Balance:	$ 13,093

Outcome	Completion Date
1. Archival of Electronic MS Access Data Records; Phase 1	30 June 2017

Activity Status as of 1 January 2016:
No progress on this activity. Databases must be completed and summarized before analysis can proceed.

Activity Status as of 1 July 2016:
No progress on this activity to date.

Activity Status as of 1 January 2017:
No progress on this activity to date.

Activity Status as of 1 July 2017:

Final Report Summary:

Gordon Gullion's unfinished manuscripts were reviewed and two of these were selected for use with the archived data set to assess the utility of the digital files for further data analysis required to complete these works and to use for new inquiries using this data. An outline of the application of the data to these two incomplete manuscripts (goshawk predation and drumming logs) follows. As additional data card types (e.g., drumming logs cards and predation cards) are digitally transcribed, this data will be accessed to complete/update Dr. Gullion's unfinished manuscripts and to verify its utility as a resource to inform ongoing research and management efforts.

Review of goshawk predation paper, Gullion Incomplete MS #4
Using the draft dataset of 13,801 records, the OBS data set was sorted for predator kills to determine the number of recorded PK's. There were 367 predator kill observations recorded between January 01, 1956 and December 31, 1974. While the Goshawk manuscript is in large part completed, a reference to a comment by Errington is at this time unable to be easily located.

The paper also references data pertaining to grouse abundance on the Cloquet Forestry Center up to 1981. The data card set only contains observation data records up to 1974. Further examination of the Gullion data is

required to determine if the 3 x 5 data card format for recording observations was replaced by an alternative record keeping system.

Completion of this manuscript will also require the use of GIS analysis to divide the forest cover types into 5 categories which are identified in this paper – 1) lowland-open bog-muskeg, 2) forested lowland, 3) upland aspen regeneration, 4, high security aspen regeneration and 5) low security conifer dominated forest.

Gullion comments in the MS that goshawks will significantly depress the population of male grouse within a 1-mail radius of the nest. They presumably also have a similar effect on females and young broods in the same area. Gullion's notes will need to be examined to determine the location of the resident goshawk nest(s) following their return to the CFC in 1978. The last known record of nesting goshawks on CFC was 1967.

Of the 367 PK records between 1956 and 1974, 74 related to goshawk predation.

Completion of this MS using GIS along with a more thorough search of the data records as well as Gullion's notes and other information in the files would provide insight into management strategies to enhance habitat security for ruffed grouse in areas occupied by goshawks and other raptors.

Review of Drumming Log Checks paper, Gullion Incomplete MS #10
Manuscript is complete other than for some minor editing changes that are needed. This appears to be an SOP that supplements SOP 15 – Procedure for determining activity at drumming logs. The focus of this MS is making sure that droppings at drumming logs are accurately counted and the droppings are characterized correctly as far as food content is concerned. This MS was not intended for publication but rather serves as an internal procedural paper to guide accurate collection of data around drumming logs.

Task – Guidance for working with Drumming Log Observation Records, Gullion Incomplete MS #49
These are handwritten notes prepared by Gullion's secretary pertaining to suggestions regarding the analysis of observation data collected at drumming logs.

Data from 01/01/1956 to 12/31/1974 was sorted for drumming log location and all records having a DL location prefix were extracted from the larger database. Total number of extracted records was 6,197 from a total record set of 13,801. Activities associated with drumming logs included one dead bird attributed to an unknown cause, 2,247 instances of drumming, 6 records of dusting activity, 106 feeding activities, 4 hunter kills, 691 recoveries of molted feathers, 2 display by hens suggesting the presence of a nearby brood of chicks, 38 "Other" observations. 17 predator kills, 30 roosting observations, 73 observations of tracks, and 2,973 records that did not have specific activities coded but many were indicated as drumming in the notes. These records can be edited to show drumming or other activities in the Activity field.

In sorting the data, many of the entries in the location field had additional notes which affected the sorting order. The Location field will need to be edited to include only locations where such editing is prudent. Other entries in the Location field may have to be discarded if the location is nonspecific. Where extra information appears in the Location field, that information can be moved to the "Notes" field.

Gullion suggests, in his notes, that perhaps the best way to check out the DL observation records is to sort them according to Observer and in chronological order. His notes did not elaborate on how this would validate or verify drumming log use.

Other comments in this note regarding analysis of drumming log data are not clear. It will likely take having complete data sets for the Observation, Individual Bird, Drumming Log and Drumming Log Habitat cards to better understand the intent of his comments and data analysis suggestions.

Summarizing, the SOP for dropping counts at drumming logs (MS #10) is complete other than minor editing requirements. MS #4, the paper pertaining to goshawk predation needs additional data searches based on the OBS, IBR, Drumming Log cards and GIS analysis including forest cover type layers from the 1960's to provide a better perspective of grouse mortality near the goshawk nest and farther away. The comments regarding the analysis of drumming log observations (MS #49) will need further data card inputs to provide more insight into the direction for analysis.

V. DISSEMINATION:

Description: Digitally preserved records (Master Data File) will be provided to the University of Minnesota, Minnesota Department of Natural Resources, and the Ruffed Grouse Society for archival and use upon completion of this phase. One copy of the Master Data File (original) will remain at the Natural Resource Program at the Central Lakes College and made available to the public. Each of these data sets will be updated as additional data is compiled (additional phases). Manuscripts completed or prepared from this data will be submitted to peer-review journals for publication. The digital archiving process will be documented and prepared as a technical paper for use by others seeking to preserve historic data sets.

Status as of 1 January 2016:
Communications between project personnel and staff at the Ruffed Grouse Society, the University of Minnesota, and the University of Minnesota Cloquet Forestry Center have taken place. These discussion have included access to and use of the original data, formats of final products, and coordination of research and publication activities. These conversations will continue throughout the term of the project (and beyond) to ensure that the final products are able to be disseminated and used as broadly as possible.

Status as of 1 July 2016:
Additional discussions between project personnel and staff at the University of Minnesota Cloquet Forestry Center have confirmed that the archived data resulting from this project will be made available to the University of Minnesota, the Minnesota Department of Natural Resources, and open data sources, and that upon completion of the project all original data (e.g., data cards) will be returned to the University of Minnesota Cloquet Forestry Center where they will be housed.

Status as of 1 January 2017:
No additional discussions have taken place between project staff, the University of Minnesota Cloquet Forestry Center, or the Minnesota Department of Natural Resources as all have agreed to the dissemination of the resulting archived data and data analysis products.

Status as of 1 July 2017:

Final Report Summary:

VI. PROJECT BUDGET SUMMARY:
A. ENRTF Budget Overview:

Budget Category	$ Amount	Overview Explanation
Personnel:	$ 59,120	Project Manager 5% FTE over 2 yrs. - $5,663 student workers 5 @ 71% FTE for 11 weeks each of two years +2 @ 25% FTE for 32 weeks + 2 @ 50% FTE for 16.5 weeks - $53,457
Professional/Technical/Service Contracts:	$ 12,500	Project Leader 10% FTE over 2 yrs. - $12,500
Travel Expenses in MN:	$ 3,380	Round trip travel to Brainerd (30 trips @ 200 mi) and Cloquet (2 trips @ 380 mi) from metro to gather data records and coordinate archival

TOTAL ENRTF BUDGET:	$ 75,000	

Explanation of Use of Classified Staff: Classified staff at Central Lakes College will be used for tracking and reporting budget expenses, managing Work Study students and funding, and processing of payment/purchase orders (listed under other expenses).

Explanation of Capital Expenditures Greater Than $5,000: NA

Number of Full-time Equivalents (FTE) Directly Funded with this ENRTF Appropriation: Approximately 1.4 FTE

Number of Full-time Equivalents (FTE) Estimated to Be Funded through Contracts with this ENRTF Appropriation: 0.1 FTE

B. Other Funds:

Source of Funds	$ Amount Proposed	$ Amount Spent	Use of Other Funds
Non-state			
Federal Work Study Funding for students (2 students @ 25% FTE for 36 weeks for each of two years)	$13,838	$0	Additional student hours for data entry, enter and analyze geographic data, and to assess unfinished manuscripts for completion.
Ruffed Grouse Society (pending)	$87,500	$70	Additional student hours to enter more data cards into digital storage.
TOTAL OTHER FUNDS:	$101,338	$70	

1. Updated from tentative numbers in original work plan – formal RGS funding committments

VII. PROJECT STRATEGY:

A. Project Partners: The University of Minnesota will provide access to the remaining records from Gordon Gullion's work for digital preservation. Central Lakes College will serve as an online repository for the digitally preserved data and the Mater Data Files. The University of Minnesota, Minesota Department of Natural Resources, and the Ruffed Grouse Society will be provided with digital copies of the Master Data Files for their use and further dissemination.

B. Project Impact and Long-term Strategy: The preservation of these perishable records will preserve the ruffed grouse and other data sets collected by Gordon Gullion in Cloquet and Mille Lacs Counties. This will enable natural resource management professionals to take advantage of the wealth of information contained therein to further improve the understanding of ruffed ecology and open possible new avenues of research. This project represents the first phase of the preservation of Gullion's data, targeting approximately 20,000 data cards. A significant potential application for these data is the potential completion of over 50 unpublished manuscripts and Dr. Gullion's personal life's work manuscript pertaining to his research of ruffed grouse over a three-decade period. A second phase of the project would be to complete the entry of the remaining 49,000 data records using additional student interns beginning in 2017 with funding provided from outside sources (e.g., ENRTF) and leveraged using Federal Work Study funding. All data will be disseminated using an online data repository managed by Central Lakes College with additional digital copies of the files provided to the University of Minnesota, the Minnesota Department of Natural Resources, and the Ruffed Grouse Society.

C. Funding History:

Funding Source and Use of Funds	Funding Timeframe	$ Amount

IX. VISUAL COMPONENT or MAP(S): See attached figure.

X. RESEARCH ADDENDUM: LCCMR Task Completion Report and Guidance for Data Entry

XI. REPORTING REQUIREMENTS:
Periodic work plan status update reports will be submitted no later than 1 January 2016, 1 July 2016, and 1 January 2017. A final report and associated products will be submitted between June 30 and August 15, 2017.

Task – Review of goshawk predation paper, Gullion Incomplete MS #4
Using the draft dataset of 13,801 records, the OBS data set was sorted for predator kills to determine the number of recorded PK's. There were 367 predator kill observations recorded between January 01, 1956 and December 31, 1974. While the Goshawk manuscript is in large part completed, a reference to a comment by Errington is at this time unable to be easily located.

The paper also references data pertaining to grouse abundance on the Cloquet Forestry Center up to 1981. The data card set only contains observation data records up to 1974. Further examination of the Gullion data is required to determine if the 3 x 5 data card format for recording observations was replaced by an alternative record keeping system.

Completion of this manuscript will also require the use of GIS analysis to divide the forest cover types into 5 categories which are identified in this paper – 1) lowland-open bog-muskeg, 2) forested lowland, 3) upland aspen regeneration, 4, high security aspen regeneration and 5) low security conifer dominated forest.

Gullion comments in the MS that goshawks will significantly depress the population of male grouse within a 1-mail radius of the nest. They presumably also have a similar effect on females and young broods in the same area. Gullion's notes will need to be examined to determine the location of the resident goshawk nest(s) following their return to the CFC in 1978. The last known record of nesting goshawks on CFC was 1967.

Of the 367 PK records between 1956 and 1974, 74 related to goshawk predation.

Completion of this MS using GIS along with a more thorough search of the data records as well as Gullion's notes and other information in the files would provide insight into management strategies to enhance habitat security for ruffed grouse in areas occupied by goshawks and other raptors.

Task – Review of Drumming Log Checks paper, Gullion Incomplete MS #10
Manuscript is complete other than for some minor editing changes that are needed. This appears to be an SOP that supplements SOP 15 – Procedure for determining activity at drumming logs. The focus of this MS is making sure that droppings at drumming logs are accurately counted and the droppings are characterized correctly as far as food content is concerned. This MS was not intended for publication but rather serves as an internal procedural paper to guide accurate collection of data around drumming logs.

Task – Guidance for working with Drumming Log Observation Records, Gullion Incomplete MS #49
These are handwritten notes prepared by Gullion's secretary pertaining to suggestions regarding the analysis of observation data collected at drumming logs.

Data from 01/01/1956 to 12/31/1974 was sorted for drumming log location and all records having a DL location prefix were extracted from the larger database. Total number of extracted records was 6,197 from a total record set of 13,801. Activities associated with drumming logs included one dead bird attributed to an unknown cause, 2,247 instances of drumming, 6 records of dusting activity, 106 feeding activities, 4 hunter kills, 691 recoveries of molted feathers, 2 display by hens suggesting the presence of a nearby brood of chicks, 38 "Other" observations. 17 predator kills, 30 roosting observations, 73 observations of tracks, and 2,973 records that did not have specific activities coded but many were indicated as drumming in the notes. These records can be edited to show drumming or other activities in the Activity field.

In sorting the data, many of the entries in the location field had additional notes which affected the sorting order. The Location field will need to be edited to include only locations where such editing is prudent. Other entries in the Location field may have to be discarded if the location is nonspecific. Where extra information appears in the Location field, that information can be moved to the "Notes" field.

Gullion suggests, in his notes, that perhaps the best way to check out the DL observation records is to sort them according to Observer and in chronological order. His notes did not elaborate on how this would validate or verify drumming log use.

Other comments in this note regarding analysis of drumming log data are not clear. It will likely take having complete data sets for the Observation, Individual Bird, Drumming Log and Drumming Log Habitat cards to better understand the intent of his comments and data analysis suggestions.

Summarizing, the SOP for dropping counts at drumming logs (MS #10) is complete other than minor editing requirements. MS #4, the paper pertaining to goshawk predation needs additional data searches based on the OBS, IBR, Drumming Log cards and GIS analysis including forest cover type layers from the 1960's to provide a better perspective of grouse mortality near the goshawk nest and farther away. The comments regarding the analysis of drumming log observations (MS #49) will need further data card inputs to provide more insight into the direction for analysis.

Observation Card Analysis (OBS)
Task - MySQL Data Card Formats
The task of designing a data card format for data entry was complicated by the fact that there were different card formats used over the years. There are over 15,000 OBS records recorded on 7 different data card formats between 1956 and 1974. While the basic recorded data remained the same, more detail was added to some categories and others were dropped as research protocol changed over time. Consequently, fields had to be added while retaining those from previous years. Analysis of the original data cards could be facilitated by manually rejecting certain sets of cards falling into certain categories or year groups. While digital analysis provides for far more analytical power, keeping all of the data intact in one database lead to major challenges in database design. These were overcome but resulted in some very complicated programming and design layouts. The final product, however, will provide for excellent analytical opportunities.

Task – MySQL Importing Data into Excel
Data from MySQL is readily exported as a .csv file which can be imported into any analysis program that accepts the .csv format. For this project, we chose to import the data into Microsoft Excel. Some problems with importing were noted. Some versions imported column header data readily allowing for effective data sorting and filtering. Other export versions had header information that was not recognized by Excel and it took some manipulation to create column headers that were recognizable.

 Also, in creating a combined dataset that recognized all of the various versions of the data cards, some programming bugs occurred and continue to be worked out. For example, extra columns were introduced and some data from two fields ended up in a single column. Exporting the .csv file for all of the combined data card formats needs further programming corrections to clean up the export process.

Over 300 OBS records had no date associated with them. A method is being developed to allow those records to be selected in the query process to allow them to be exported along with the dated records.

Task – Data Entry Error Checking
Data entry for the 15,000+ records has been completed. We are in the process of error checking the entries to be certain that the entered data correctly corresponds to the written record on the card. Data transfer is a process complicated by the pencil written copies having faded over the years, numerous hand writing styles

from dozens of different observers, entries belonging in one field in the database being written into non-corresponding areas on the data cards, variations in card formats over the years, diligence in resolving unclear entries on the part of the data entry staff, incomplete date or location entries on the original record that was not recognized as a valid entry by either MySQL or Excel, 24-hour time formatting, inconsistent data entry styles between data entry staff, inconsistent style formats on the data cards themselves, and other inconsistencies both in the cards formats and in the data entry process.

Now that all of the data have been entered, data inconsistencies both on the cards and in the data entry process can be recognized and corrected. Some of these can be accomplished as a batch correction process where comparative information exists. In other cases, where handwriting may have been hard to decipher, the original records will need to be consulted and corrections made. Other changes are being made to the MySQL programming language and design to remedy some of the layout problems and export/import inconsistencies.

Presently, only the original version of each data card exists. Plans to scan all of the cards in the next project phase will make calling up a specific card a simple exercise to clarify questionable data entries or to clarify difficult to decipher handwriting. Often a scanned copy can be enhanced to provide better clarity than the original record.

Task – Data Sorting
Numerous data sorts were completed on various data fields. The database has an index field that uniquely identifies each record. Each card was given a unique identifying sticker label that indentifies that record specifically.

Two date fields were created – one that combines the date format into mm/dd/yyyy and the other that maintains month day and year as separate and individual fields. Importing data into Excel results in a format change for the Date field. In MySQL, the date format is yyyy/mm/dd whereas in the .csv conversion and import into Excel the date format changes to mm/dd/yyyy. Attempting to use the format tool in Excel doesn't result in a changed format.

Project observations were related to 40-acre compartment 2-chain grids. The Cloquet Forestry Center is divided into 40-acre compartments. For the grouse project, each compartment was subdivided into 2-chain grids or a square 132' x 132'. A typical standard "forty" would have 10 east-west and 10 north-south divisions. Any observation related to grouse activity or other location based observations would be referenced to the 40-acre compartments which were numbered beginning with 1. Off-forest 40-acre compartments were similarly designated but were either numbered or designated by letter prefixes. Thus, a typical observation might be designated as DL 40F6 meaning it was Compartment 40 on the CFC, in the 6th north-south 2-chain row and in the 6th 2-chain east-west column.

In some of the data field exports, the Location designation was rendered as number, for example 1.00E+01 (10) or 1.47E+03 (1470). The original records will need to be consulted to see what the actual entry referred to.

The project time was always recorded in Central Standard Time using the 24-hour clock. The data format needs to be consistently 4 digits in 24-hour format. MySQL has the correct format but in the .csv export process, the leading zero is dropped for times between 0000 and 0959. The time data is locked and format changes to correct the error do not work.

Data entries sometimes used and "O" instead of "0" or "X" instead of "x". These are minor discrepancies that can be readily corrected.

In certain instances, dates were entered into a field for example when a snow event may have occurred where instead the snow fall depth should have been recorded.

In the Recorded By field, the original records may have had only observer initials, partial initials and last name or full name. Because of record clarity or for other reasons, often names were misspelled or mis-recorded.

In the Notes field, if the Note record was unclear, provision was made to enter ???. In the export process, the data in the formula bar would be truncated after the ? however it appeared in its entirety in the cell. Also, some of the entries in the Notes field, when viewed in Excel, were in the merge text format and occupied multiple lines creating large cell forms. This column had to be reformatted to reduce the Notes field to a single line.

When a field entry location was uncertain, the observer might enter Prob., Pr, pr or something similar before the DL prefix. This complicates the sorting process and those entries are being modified to put anything before the Location prefix after it.

Also, there was inconsistency in entering grid location information. Often, an entry would appear as DL 10 F 3 A which sorts differently that DL 10F3A which is the correct format. These are in the process of being corrected. Other data entry format variations also appeared which are being corrected.

Individual Bird Record (IBR)
Task - MySQL Data Card Formats
Six different card formats were used from 1956 until 1974. These varied less in the type of data recorded. Instead, the redesign was intended to provide better formats in which to record the data. With over 1300 records entered, there were no problems with the combined format layout.

Task – MySQL Importing Data into Excel
Importing data into Excel results in a format change for the Date field. In MySQL, the date format is yyyy/mm/dd whereas in the .csv conversion and import into Excel the date format changes to mm/dd/yyyy. Attempting to use the format tool in Excel doesn't result in a changed format.

The headers used in MySQL import correctly into Excel and allow for sorting and filtering with no further changes required.

Task – Data Entry Error Checking
The data entry discrepancies noted in the OBS records have in large part been remedied during the IBR data entry process. A few of the initials in the "By" field need correcting but this can be accomplished by a simple search and replace exercise.

The Date and By fields will have to be checked to verify that the data entered in the two fields corresponds to people in the field at the time.

The Bird# field will need to be corrected. Two numbers are entered the first of which is the Bird ID number. The second number in parentheses is the Julian date number which should be entered in a separate field after the yyyy/mm/dd field.

The Time field in MySQL is correctly recorded in the 4-digit 24-hour format but does export correctly into Excel with the leading zero being dropped for times between 0000 and 0959. Attempts to reformat in Excel are not successful.

Task – Data Sorting
The project time was always recorded in Central Standard Time using the 24-hour clock. The data format needs to be consistently 4 digits in 24-hour format. MySQL has the correct format but in the .csv export process, the

leading zero is dropped for times between 0000 and 0959. The time data is locked and format changes to correct the error do not work.

In the Notes field, if the Note record was unclear, provision was made to enter ???. In the export process, the data in the formula bar would be truncated after the ? however it appeared in its entirety in the cell. Also, some of the entries in the Notes field, when viewed in Excel, were in the merge text format and occupied multiple lines creating large cell forms. This column had to be reformatted to reduce the Notes field to a single line.

Following the review of nearly 14,000 data records that have been entered, there are some common data entry inconsistencies that need to be addressed. This guidance document addresses those inconsistencies and provides instructions on how data entry for various fields is to be handled.

Field Name – Loc: (Location)
This is the 40-acre grid compartment location recorded for observations and other features associated with the grouse project.

Correct data entry format *e.g.* is DL 40C10 or 9C4. There is one space after the prefix *e.g.* DL. There are no spaces between the compartment number (40) and the 2-chain compartment designation (C10). This applies to other abbreviations such as TS, NS, SS, etc. as well.

If there is text in front of the compartment location other than site specific designations such as DL, TS, etc (*e.g.* Prob, pr, pr.), that should be placed after the Location information. Data sorting is much easier using that form.

If directional information is included, that should also follow the compartment grid location. Directions should be recorded as SE or SSE. There should be no spaces or periods between the direction letters.

Some records have the drumming times or drumming direction entered in the Location field. All information pertaining to drumming activity should be recorded on the reverse side of the form either under Notes or where the heading is "Dr 1st heard from" on the reverse side of the card. A number of records have this information in the Location field. While that may be the way the card is filled out, following that form makes sorting difficult.

Band combo information also has appeared in the Dr 1st heard field. The correct location for this information is in the "Rec" fields. There are 3 of these. If more than 3 banded birds were observed and recorded then those added observations should be entered in the third records field. Band code information should not be entered in the "Dr 1st heard from" field.

Field Name – Time
Time should be recorded using the four digit 24-hour clock (*e.g.* 0600, 1218, etc) and entered as Central Standard Time.

Field Name – Record by
Initials of Observers should be capitalized and not separated by spaces or periods – *e.g.* GWG, AAA, FJS, BAB, etc. Where names appear, they should be recorded *e.g.* as B A Brown, B Brown or Bruce Brown.

Field Name – PCPT
Entries should be "0" not "O"

General – Check Boxes
Whenever an "x" is used to indicate a selection, it should always be lower case "x" not "X".

The first entry in a text field should always begin with a capital letter. Use *caps when starting a sentence or a phrase in Note fields or other narrative fields*. **The previous version of this**

guidance indicated all caps for the Notes field. The correct entry style is caps only for the first   word. If in doubt, ask.

INDIVIDUAL BIRD RECORDS

Field Name – Bird#
Any text before the Bird #, *e.g.* Prob. 376 – should follow the Bird # - 376 Prob – data sorting works better that way.

Environment and Natural Resources Trust Fund
M.L. 2015 Project Budget

Project Title: Enhancing Future Forest Conservation Using Gullion's Historic Research
Legal Citation: M.L. 2015, Chp. 76, Sec. 2, Subd. 03n
Project Manager: Kent Montgomery
Organization: Central Lakes College
M.L. 2015 ENRTF Appropriation: $ 75,000
Project Length and Completion Date: *2 Years, June 30, 2017*
Date of Report: Oct 2017

ENVIRONMENT AND NATURAL RESOURCES TRUST FUND BUDGET	Activity 1 Budget	Amount Spent	Activity 1 Balance	Activity 2 Budget	Amount Spent	Activity 2 Balance	Activity 3 Budget	Amount Spent	Activity 3 Balance	TOTAL BUDGET	TOTAL BALANCE
BUDGET ITEM	*Preserve Data by Converting to Electronic*			*Simplify Data Retrieval to Facilitate Use*			*Test the effectiveness of the data retrieval*				
Personnel (Wages and Benefits) Overall	$35,721	$24,668	$11,806	$11,806	$0	$11,806	$11,593	$0	$11,593	$59,120	$34,452
Kent Montgomery, (summer wages) Project Manager, $5,663 - 5% FTE (75% salary 25% benefits) over 2 years		$5,628									
9 Student Workers: $53,457 (90% salary, 10% benefits): Position 1 - 5 students at 71% FTE for 11 weeks for each of two years, Position 2 - 2 students at 25% FTE for 32 weeks, Position 3 - 2 students at 50% FTE for 16.5 weeks		$19,040									
Professional/Technical/Service Contracts											
Frank Svoboda, Project Leader, $12,500 - 10% FTE (100% salary) over 2 years	$2,500	$2,500	$0	$7,500	$7,500	$7,500	$2,500	$1,500	$2,500	$12,500	$8,500
Travel expenses in Minnesota											
Project Leader round trip travel to Brainerd (30 trips @ 200 mi) and Cloquet (2 trips @ 380 mi) to gather data records and coordinate archival. Mileage: $3,380	$2,380	$1,288	$1,092	$500	$0	$500	$500	$0	$500	$3,380	$2,092
COLUMN TOTAL	**$40,601**	**$28,456**	**$12,145**	**$19,806**	**$7,500**	**$12,306**	**$14,593**	**$1,500**	**$13,093**	$75,000	$37,544