University of Tennessee, Knoxville
TRACE: Tennessee Research and Creative Exchange

Masters Theses | Graduate School

5-2012

The Information Landscape of a Wicked Problem: An Evaluation of Web-Based Information on Colony Collapse Disorder for a Spectrum of Citizen Information Seekers

Reid Isaac Boehm
University of Tennessee - Knoxville, mboehm@utk.edu

Follow this and additional works at: https://trace.tennessee.edu/utk_gradthes

 Part of the Library and Information Science Commons, and the Social Influence and Political Communication Commons

Recommended Citation

Boehm, Reid Isaac, "The Information Landscape of a Wicked Problem: An Evaluation of Web-Based Information on Colony Collapse Disorder for a Spectrum of Citizen Information Seekers. " Master's Thesis, University of Tennessee, 2012.
https://trace.tennessee.edu/utk_gradthes/3241

This Thesis is brought to you for free and open access by the Graduate School at TRACE: Tennessee Research and Creative Exchange. It has been accepted for inclusion in Masters Theses by an authorized administrator of TRACE: Tennessee Research and Creative Exchange. For more information, please contact trace@utk.edu.

To the Graduate Council:

I am submitting herewith a thesis written by Reid Isaac Boehm entitled "The Information Landscape of a Wicked Problem: An Evaluation of Web-Based Information on Colony Collapse Disorder for a Spectrum of Citizen Information Seekers." I have examined the final electronic copy of this thesis for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Master of Science, with a major in Information Sciences.

Vandana Singh, Major Professor

We have read this thesis and recommend its acceptance:

Suzie Allard, Kimberly Douglass

Accepted for the Council:
Carolyn R. Hodges

Vice Provost and Dean of the Graduate School

(Original signatures are on file with official student records.)

The Information Landscape of a Wicked Problem: An Evaluation of Web-based Information on Colony Collapse Disorder for a Spectrum of Citizen Information Seekers

A Thesis Presented for the

Master of Science

Degree

The University of Tennessee, Knoxville

Reid Isaac Boehm

May 2012

ABSTRACT

The following research takes a mixed method approach to understanding the information landscape of a wicked problem. Wicked problems are defined as being uncertain in cause, having many stakeholders with conflicting interests, and inevitably have no foreseeable solution. Through the study a framework is implemented that assesses a portion of the landscape of colony collapse disorder information from the federal government via the web. Using a government information valuation framework that takes into account a spectrum of citizen user needs, the research was able to look at the information content within the context of the public sphere and to apply the lens of post- normal science theory to understand the essential nature of public participation to the provision of equitable information. This study contributed to the research in the field of information science and e-government studies by making several observations and strengthening perspectives on specific issues. The social network analysis component of the study shows how the USGSs' now cancelled NBII played a role as a bridge between the web 2.0 collaborative aspects of Wikipedia and the government entities that provide information. These entities include the EPA, the USDA, and the US FWS. The content analysis of these five entities shows that Wikipedia has the most comprehensive amount of information in comparison with the government entities, but the USDA has more consistent quality measures.

Overall the research shows that citizen user groups are in need of public engagement applications to facilitate a two-way flow of information. The research framework provides a starting point and a tool for use in future studies that examine the network of e-government information available about specific complex and wicked problems.

TABLE OF CONTENTS

Abstract II

Table of Contents III

Tables VI

Figures VIII

CHAPTER I Introduction and Statement of the Problem 1

General Objective 1

Statement of the Problem 3

CCD Information Background 4

CHAPTER II Literature Review 8

Post Normal Science Theory 10

Information Quality Literature 12

CHAPTER III Research Design 17

Research Objective 17

Data collection 18

Data Process 19

Data Analysis 29

Chapter IV Comparative Summary of Results 30

1. Social Network Analysis 30

1.1. SNA Process 30

1.2. SNA Results 35

2. Overall Entity Results 40

2.1. Information Topics 40

2.2. Information Types 41

2.3. Information Formats 43

2.4. Information Quality 45

2.5. The GIV citizen framework 55

CHAPTER V Comprehensive Entity Results 56

3. Results for the EPA 56

3.1. EPA Information Topics 56

3.2. EPA Information Types 57
3.3. EPA Information Formats 58
3.4. EPA Information Quality 59
3.5. EPA and the GIV Citizen Framework 62
3.6. EPA First Impressions 63
3.7. EPA Discussion of Results 65
4. Results for the NBII 65
4.1. NBII Information Topics 65
4.2. NBII Information Types 66
4.3. NBII Information Formats 67
4.4. NBII Information Quality 68
4.5. NBII and the GIV Citizen Framework 71
4.6. NBII First Impressions 72
4.7. NBII Discussion of Results 74
5. Results for the USDA 74
5.1. USDA Information Topics 74
5.2. USDA Information Types 76
5.3. USDA Information Formats 77
5.4. USDA Information Quality 78
5.5. USDA and the GIV Citizen Framework 81
5.6. USDA First Impressions 82
5.7. USDA Discussion of Results 83
6. Results for the US FWS 84
6.1. US FWS Information Topics 84
6.2. US FWS Information Types 85
6.3. US FWS Information Formats 86
6.4. US FWS Information Quality 87
6.5. US FWS and the GIV Citizen Framework 89
6.6. US FWS First Impressions 90
6.7. US FWS Discussion of Results 92
7. Results for Wikipedia 92
7.1. Wikipedia Information Topics 92
7.2. Wikipedia Information Types 93

7.3. Wikipedia Information Formats 94
7.4. Wikipedia Information Quality 95
7.5. Wikipedia and the GIV Citizen Framework 98
7.6. Wikipedia First Impressions 99
7.7. Wikipedia Discussion of Results 100

CHAPTER 6 DIscussion and Implications 101

Discussion and Implications of results 102

Research Limitations 110

Conclusion 111

LIST OF REFERENCES 112

APPENDIX 117

Vita 132

TABLES

Table 1 A Recommended Content for the GIV Citizen User Groups.* 27
Table 1 B Corresponding CCD Topics and Citizen Types. *..... 27
Table 2.4 A Checklist for Design and Usability for all Entities. 53
Table 2.4 B Checklist for Interactivity and Public Engagement for all Entities. 54
Table 2.5 A Entities Ranked by GIV Citizen User Group Content. 55
Table 3.4 A EPA Information Accuracy. 59
Table 3.4 B EPA Source Authority. 60
Table 3.4 C EPA Information Currency. 60
Table 3.4 D EPA Checklist for Design and Usability. 61
Table 3.4 E EPA Checklist for Interactivity and Public Engagement. 62
Table 3.5 A EPA and the GIV Citizen User Groups. 62
Table 4.4 A NBII Information Accuracy. 68
Table 4.4 B NBII Source Authority. 69
Table 4.4 C NBII Information Currency. 69
Table 4.4 D NBII Checklist for Design and Usability. 69
Table 4.4 E NBII Checklist for Interactivity and Public Engagement. 70
Table 4.5 A The NBII and the GIV Citizen User Groups. 71
Table 5.4 A USDA Information Accuracy. 78
Table 5.4 B USDA Source Authority. 79
Table 5.4 C USDA Information Currency. 79
Table 5.4 D USDA Checklist for Design and Usability. 80
Table 5.4 E USDA Checklist for Interactivity and Public Engagement. 80
Table 5.5 A USDA Citizen Users and the GIV Citizen Framework. 81
Table 6.4 A US FWS Information Accuracy. 87
Table 6.4 B US FWS Source Authority. 87
Table 6.4 C US FWS Information Currency. 88
Table 6.4 D US FWS Checklist for Design and Usability. 88
Table 6.4 E US FWS Checklist for Interactivity and Public Engagement. 89
Table 6.5 A US FWS Citizen Users and the GIV Framework. 89
Table 7.4 A Wikipedia Information Accuracy. 95
Table 7.4 B Wikipedia Source Authority. 96
Table 7.4 C Wikipedia Information Currency. 96
Table 7.4 D Wikipedia Checklist for Design and Usability. 97
Table 7.4 E Wikipedia Checklist for Interactivity and Public Engagement. 97
Table 7.5 A Wikipedia Citizen Users and GIV Citizen User Groups. 98
Table 8 A Overall highest and lowest scoring measures in each category. 104

Table 8 B Highest and Lowest Ranked Entities for each Category. 108
Table 8 C EPA Highs and Lows..... 108
Table 8 D NBII Highs and Lows..... 108
Table 8 E USDA Highs and Lows..... 109
Table 8 F US FWS Highs and Lows..... 109
Table 8 G Wikipedia Highs and Lows..... 110

FIGURES

Figure 1.1 A Initial Mapping of the Network using Force Atlas Layout 31
Figure 1.1 B Force Atlas Map with Wikipedia Removed. 32
Figure 1.1 C Labeled Map of Network 46
Figure 1.1 D Labeled Force Atlas Map without Wikipedia. 34
Figure 1.2 A Directed Relationships from Entities to USDA Nodes. 35
Figure 1.2 B Major External Connection Nodes. 36
Figure 1.2 C Connections Between Wikipedia and the NBII. 37
Figure 1.2 D Connection Node MAAREC with Wikipedia Removed. 38
Figure 1.2 E Connections to USA.gov. 39
Figure 1.2 F Centrality of the USDA CCD Page. 39
Figure 2.1 A Information Topics for all 5 Entities. 40
Figure 2.1 B Information Topic Coverage for all 5 Entities. 41
Figure 2.2 A Information Types for all 5 Entities. 42
Figure 2.2 B Information Type Coverage for all 5 Entities. 43
Figure 2.3 A Information Formats for all 5 Entities. 44
Figure 2.3 B Information Format Coverage for all 5 Entities. 45
Figure 2.4 A Cumulative Average of 5 IQ Measures for all Entities. 45
Figure 2.4 B Information Accuracy Percentages. 46
Figure 2.4 C Layout of Information Accuracy Measures 47
Figure 2.4 D Source Authority Percentages. 48
Figure 2.4 E Layout of Source Authority Measures. 49
Figure 2.4 F Information Currency Percentages for all Entities. 50
Figure 2.4 G Layout of Information Currency Measures. 51
Figure 2.4 H Usability and Design Percentiles for all Entities. 52
Figure 2.4 I Information Interactivity Percentiles for all Entities. 54
Figure 3.1 A EPA Information Topics. 57
Figure 3.2 A EPA Information Types. 58
Figure 3.3 A EPA Information Formats 59
Figure 3.5 A The EPA and the GIV citizen category applicable content percentages. 63
Figure 4.1 A NBII Information Topics. 66
Figure 4.2 A NBII Information Types. 67
Figure 4.3 A NBII Information Formats. 68
Figure 4.5 A The NBII and the GIV citizen category applicable content percentages. 72
Figure 5.1 A USDA Information Topics 76
Figure 5.2 A USDA Information Types. 77

Figure 5.3 A USDA Information Formats. 78
Figure 5.5 A USDA and GIV Citizen User Content Percentages. 82
Figure 6.1 A US FWS Information Topics. 85
Figure 6.2 A US FWS Information Types. 86
Figure 6.3 A US FWS Information Formats. 87
Figure 6.5 A US FWS and GIV Citizen User Content Percentages 90
Figure 7.1 A Wikipedia Information Types. 93
Figure 7.2 A Wikipedia Information Types. 94
Figure 7.3 A Wikipedia Information Formats. 95
Figure 7.5 A Wikipedia and GIV Citizen User Content Percentages. 99

CHAPTER I
INTRODUCTION AND STATEMENT OF THE PROBLEM

General Objective

The following research seeks to identify entities that provide information about Colony Collapse Disorder (CCD), to discover what information is available from the web pages of these entities, and to evaluate the quality of the information provided as it pertains to a defined spectrum of citizen information seekers.

The research is organized into six chapters. The first chapter addresses the general problem of information dissemination of complex environmental problems to the public sphere using the web. The phenomenon of CCD is defined and the issues surrounding the debate are introduced. The introduction looks at the potential contribution of the study to the field of e-science and e-government studies. It also establishes the need for the current analysis, as it applies to a large number of complex environmental issues that need to engage the public sphere in the dialogue surrounding environmental studies. This future need for public deliberation about solutions to complex problems is supported through the lens of post-normal science theory.

Chapter two addresses the literature in the field and the nature of the current research. The literature review looks to the post-normal science theory to explain the importance of quality information dissemination practices that relate to a spectrum of citizen user groups. The chapter also identifies studies that address information quality and that explore content analysis of online information about complex environmental issues. Chapter three establishes the design of the research. The research questions are defined, terminology is operationalized and the process of data collection and analysis are discussed. In chapter four the results from the social network analysis and a comparative summary of the content analysis components are reported. In chapter five the results of the study and all of its components are discussed individually. Chapter six discusses the findings, looking at issues related to the findings in connection with ideas from the literature, and highlighting interesting discoveries. In particular, the recently canceled USGSs' National Biological Information Infrastructure (NBII) was shown during the time of the analysis to have been an integral connecting component between information providing entities. The chapter goes on to discuss the implications of this study to the field and the potential for future research, as well as the limitations that were inherent in the study. Finally, the discussion highlights the major findings of the study, the components of the mixed method framework, and the benefit of using such an approach for future study. An appendix includes tables and screen shots from the study for further data review and understanding of the research components.

The research addresses three specific problems that relate to the general research objective, which seeks to define the web-based information landscape of a complex environmental problem such as CCD,

to identify the information available from the major agencies, and to evaluate the quality of the information as it applies to a range of citizen user groups.

The research questions are as follows:

RQ1: Who are the providers of federal government information about Colony Collapse Disorder in the online environment and what are the relationships between these entities?

- What entities/ agencies provide information about CCD?
- What are the relationships between these entities?

RQ2: What information about Colony Collapse Disorder is available online from the USDA, the US FWS, the EPA, the USGS's NBII, and Wikipedia?

- What are the Colony Collapse Disorder information topics available online from these five entities?
- What are the available types? Types provide context to the delivery of the information (i.e., frequently asked questions).
- What are the available media formats?

RQ3: What is the quality of the available information on these sites and what are the measures of information quality (IQ)?

- How accurate is the information?
- Does the information have source authority?
- How current is the information?
- What is the level of usability and design of the information?
- What amount of interactivity and public engagement is available with the information?

Statement of the Problem

The World Wide Web has become the major vehicle to provide the greatest amount of information to the greatest number of people in the shortest amount of time. As Jobe (2006) notes, "Technology, in the form of the Internet, has enabled federal agencies and others to deliver detailed data, bibliographic databases, and publications in a cost effective manner" (p. 257). Another advantage of the web is the ability the user has to explore material aided by the immediacy of hyperlinks and instant personal access to downloadable documents. "World Wide Web sites offer several advantages for disseminating information on a fast-changing technical topic, including their global accessibility; and their ability to update information frequently, incorporate multimedia formats, and link to networks of other sites" (Byrne et al., 2002. p. 293).

Limited research exists that applies information quality (IQ) criteria to the communication of complex environmental information about problems such as CCD on the web, yet the sources of the information are abundant and vary in content and context (Byrne et al., 2002; Eschenfelder & Miller, 2006; 2007). In order to include the public in the discussion surrounding environmental problem solving and in public policy making information is needed in the online environment that allows citizens from different backgrounds with different information needs to learn and engage. "There is no one-size-fits-all message, as the so-called general public does not exist, and so effective outreach to diverse audiences will require multiple communication strategies and messages" (Schweitzer, et al., 2009. p.269). Certain information types, topics, and formats will be applicable to a specific group of users. In the case of environmental problems and the dissemination of information about the uncertain and often highly debated findings from scientific studies, specific care is needed in order to create quality information that is comprehensive to the situation and to the population. "Even recommendations that appear most solidly grounded in scientific evidence may be modified as a result of continued scientific inquiry, technological innovations and re-evaluation of past observations" (Goldberg & Sliwa, 2011. p. 27). Thus, in an age of digital information abundance an entity disseminating important information regarding scientific endeavors faces multi-faceted challenges to creating comprehensive content for more than one type of user.

While the webpage can lead the user to numerous articles, multimedia applications, and data sets, it is difficult to define whether the environmental organization provides an equitable picture of a complex problem to all types of information seekers. The equitability of the information is essential to information dissemination because of the complexity of the issue and the impact that it has on stakeholders and citizens.

Discussing the theory of Collins and Pinch, Gregory and Miller (1998) state, "for citizens who want to take part in the democratic process of technological society, all the science that they need to know about is controversial; so it is the mess, the disagreements, and the uncertainties of science that matter most to the public sphere" (p.61). The practices of government information dissemination of the past and the adoption of the website as the medium of choice for maximum potential citizen engagement suggest the need for studies that evaluate the characteristics of these web pages by creating a mixed method framework for evaluation. "Numerous government website evaluation toolkits include assessments of information content but typically no scale is provided to define the adequacy of the provided information" (Eschenfelder & Miller, 2007. p.3). This study takes this gap in information dissemination of environmental science to the spectrum of citizen information seekers into account by creating a framework for analysis that combines content analysis according to predefined user needs with social network analysis in order to map the information landscape for Colony Collapse Disorder information on the web. While the research looks at information related to the specific phenomenon of CCD, the framework is one that can be applied to other environmental e-science, e-government information dissemination inquiries in the future. By creating this framework the research contributes a multi-faceted framework for use in future studies that evaluate environmental agency dissemination of a specific type of complex environmental information.

What are the expectations and contributions of the project?

Evaluating a website's delivery of CCD information by the types of information, topics, and media formats that are offered for a spectrum of users is an asset to further analysis of IQ in the context of complex environmental web-based information dissemination. In conjunction with a secondary content analysis of material available from five major websites, social network analysis can provide a bigger picture of the current landscape of available information about CCD. The analysis defines the major stakeholders and how they function within the network of stakeholders. This analysis helps one to grasp network strengths and weaknesses as well as define the relationships of the key information agencies to gain a clearer picture of the status of available CCD information overall.

CCD Information Background

What is the problem?

In the fall of 2006, the National Research Council submitted a report covering the emergence of a phenomenon called Colony Collapse Disorder or CCD. This term refers to the nationwide deaths of honeybee colonies in the last decade. The adult bees often disappear from the hive and die leaving the colony weak and vulnerable to disease. Since 2004, farmers and apiculturists across the nation have experienced massive declines in their managed European honeybee populations. The North American

Pollinator Protection Campaign estimates the loss in the last decade to be between fifty and ninety percent of managed colonies (NAPPC, 2007). This loss has deep implications for the nation and the sustainability of our environment. Honeybees are major pollinators of crops such as almonds, fruit trees, and alfalfa. Almost a third of our nation's food supply is dependant on the proliferation of honeybee pollination activity. Thus, the problem of CCD is one of major environmental, agricultural, economic, and political concern. It affects a broad spectrum of citizens both directly and indirectly. CCD information seekers need quality information to understand and interpret research discussions and make sense of the conflicting opinions among the stakeholders and media reports. As Goldberg and Sliwa (2011) note in their discussion of communication of scientific information from many perspectives, "A problem can occur when individuals who may or may not have recognized credentials position themselves as authorities and speak to the public with information and advice that is not evidence-based and may even be inaccurate" (p. 28). For engaged citizens and stakeholders, quality information about the health, research and management of honeybees, beekeeping, and crop growth is in high demand.

The cause or causes of CCD are uncertain.

Within the environmental science and agricultural fields many different perspectives have emerged. Kim Flottum (2010) discusses seven possible contributing factors that scientists are exploring. The discrepancy in the cause contributing to the phenomenon creates questions about equitable dissemination of CCD information to a variety of public information seekers. Wardekker et al., (2008) characterizes the difficulty that arises in communicating uncertainty to the public. "Uncertainties cannot be easily quantified or expressed probabilistically and are hard to communicate using traditional methods, such as probability terms, uncertainty ranges, and error bars. Among these uncertainties are qualitative issues, such as problem framing, choice of methods, general level of knowledge and value-ladenness" (p. 634).

Possible Causes

The Congressional Research Service (CRS) in a 2010 summary lists three major possible causes of CCD as established by the United States Department of Agriculture and the CCD Working Group. The CCD Working Group is a task force that was established in 1997. Based mainly in the mid-Atlantic region of the United States, they are considered the main CCD research consortium in the country. The three major possibilities discussed in their reports include: pesticides such as Clothianidin mentioned below, an unknown parasite or pathogen, or a combination of stress factors. These stresses range from infection by mites, to poor nutrition, and migration stress (Johnson, 2010). Another proposed factor that has subsequently been refuted is that the signals from cell phones and cell phone towers were affecting the bees' keen sense of direction. This proposal still receives attention in the media even though it is not a

current hypothesis (Kaplan, 2011; Sylvers, 2007). Research is difficult because worker bees die during their absence from the hive and often these workers cannot be found for examination.

Current issue in December 2010

The winter of 2010 saw the return of CCD into the media spotlight. This particular problem is a good example of the complex controversy that has been surrounding CCD since the phenomenon was first named in 2006 (Philpott, 2011; Pilatic, & Feldman, 2010). Since 2003 the Environmental Protection Agency (EPA) has been assessing the effects of a Bayer chemical pesticide product called Clothianidin. This pesticide was under "conditional registration" pending confirmation from Bayer field experiments that the widely used insecticide is not a threat to the honeybee colonies. A leaked EPA memo revealed to beekeepers and apiculturists in the United States that Bayer's experiments had several major errors. Honeybee researchers, beekeepers, and apicultural organizations requested the EPA discontinue use before the registration was extended (EPA, 2010; Pilatic, & Feldman, 2010).

Issues surrounding the debate

The issues surrounding the debate of CCD are numerous and reveal the complexity inherent in some environmental problems. Funtowicz et al., (1999) characterize this type of problem as they discuss tools for environmental policy making, "the systems are not merely complicated, but by their nature involve deep uncertainties and a plurality of legitimate perspectives" (p.5). Discussing the stakeholder perspectives can show this plurality. Honeybees are the most economically valuable pollinators worldwide. In the United States, one hundred percent of the almond crop relies solely on the honeybees' pollination services. Other crops that rely almost completely on the honeybee include alfalfa, hay and seed (food for livestock), and apples to name only a few (Johnson, 2010). The following list highlights some of the major issues.

- The farmers and agricultural industry have deep concern for crop production and the need for honeybee services. Migratory beekeeping is required to fulfill this need, and farms pay to have bee colonies shipped across the country to their croplands. However, colony migration is a stress factor and spreads illnesses.

- Chemical companies earn a considerable profit from the sale of pesticides, but current and past problems leave beekeepers and scientists questioning the research behind the safety of these chemicals (Flottum, 2010; Philpott, 2011; Pilatic & Feldman 2010).

- Another rift occurs between researchers. Scientists who work for industries may naturally have a different perspective than those who participate in government funded or environmental agency research.

- Finally, the genetically modified food (GMO) controversy adds another layer to the debate. Organic farmers claim to experience fewer problems with CCD (Philpott, 2011), but supporters of genetically modified crops disagree that GMOs are to blame. Suspicion arises concerning the use of high fructose corn syrup (from genetically modified corn) to sustain honeybees when they do not have access to the nutrients they need. As Kim Flottum (2010) of Bee Culture notes, "Imagine living for a month on only Twinkies" (p.1).

All of these issues combine with the knowledge that beekeepers are losing their livelihoods, and the availability of the foods we love and rely on is diminishing. Citizens are stakeholders. We become confused trying to distinguish between fact and fiction in the glut of available information. Kules and Schneiderman (2004) note, "Every day, information seekers attempt to find, organize, understand, and ultimately learn from information on the web...These users struggle with information overload, coping with an overabundance of information that lacks a comprehensible organization" (p. 1). The user conducting a web search for CCD information often receives results with headlines that contain misleading statements. According to Funtowicz et al., (1999) in complex systems such as CCD information dissemination, "quality becomes crucial and refers more to process than product" (p. 9). Thus, users seeking CCD information require information quality on several levels.

Why is this problem important?

Not only is CCD topical within the agricultural and biodiversity research fields, CCD research information dissemination practices also provide an example of the trans-disciplinary complexity surrounding environmental issues. Schweizer et al., (2009) discuss the problem as it relates to government agencies stating: "many of these agencies were not designed or organizationally structured to address interdisciplinary issues that transcend agency boundaries, nor have they been fully equipped to communicate the nuances of such complex topics with the public. Effectively dealing with the challenge of climate change (a complex problem like CCD) will require thoughtful and coordinated responses across multiple agencies, communities, and landscapes" (p. 269). Studies exist regarding state level wildlife agency websites for other problems (Eschenfelder & Miller, 2007), and there is research surrounding the media coverage of issues such as CCD and climate change (Cho, 2009). There is a need for the discussion of the dissemination of CCD information using an analysis of environmental web resources.

The first chapter of the research has introduced the objective of the research and outlined the specific questions that are addressed to meet this objective. Using Colony Collapse Disorder information dissemination on the web as the unit of analysis, the following thesis uses a mixed method analysis to look at complex e-science, e-government communication through the point of view of participatory science communication theory. The study seeks to understand the information availability and quality as it applies to a large spectrum of information seekers on the web. In the next chapter the research introduces related literature within the information science and science communication fields. The examined research sets the stage and provides context for the role this study plays in the information sciences domain.

CHAPTER II
LITERATURE REVIEW

The second chapter contains the review of the related literature. The chapter is divided into two parts. The first introduces the theory of post-normal science and looks at related studies that address e-government information, wicked problems, and CCD information in the media. Post-normal science and citizen interaction in environmental policy-making provide a background that serves to explain the

necessity of studies that seek to measure the equitable dissemination of complex environmental problems. The second part of the literature review clarifies the methods for analysis. By examining studies of information quality (IQ) and the definitions of web quality attributes as proposed by information science studies, the chapter provides a base for development of definitions that drive the study. Following the literature review in chapter two, chapter three introduces the research design, structuring the mixed method framework and operationalizing the terminology.

A number of studies explore the communication of complex environmental issues. These studies involve issues of risk assessment and the communication of scientific data that involves policy making, stakeholders, and the public sphere. Several studies suggest a shift in scientific thought that includes the citizen as an equal contributor to problem solving activities and policy making process (Eschenfelder & Miller, 2007; Fischer, 2000; Funtowicz et.al. 1999; Maxim & van der Sluijs, 2007). The notion of public understanding and engagement in complex problem solving drives this particular study. In order for the public sphere to participate fully in the solving of complex problems, as the following literature suggests, the public needs to have the tools in order to participate and contribute on an equal ground with the scientific experts and policy makers. This need becomes even harder to address as issues become increasingly complex and uncertain. For example, in Fischer's *Citizens, Experts and the Environment* (2000) he uses the term "wicked" to describe the nature of environmental problems such as CCD. Similar to climate change controversies (Cho, 2009) and the "Not in my Backyard" or NIMBY phenomenon, wicked problems are "those in which we do not know the solution but are not even sure what the problem is" (Fischer, 2000. p. 136). In the context of Fischer's definition, and in the following discussion of post-normal science theory the literature review highlights the importance of equitable information dissemination to ensure public understanding of current research due to the "wickedness" of the situation.

One study devoted to CCD communication, "Silence of the Bees" is a survey of media articles and scholarly representations of CCD (Cho, 2009). Cho discusses the differences between the press' portrayal of the issue and scholarly journal discussions through the eyes of the scientist. By engaging in a content analysis of science journal articles that discuss CCD in contrast to "US prestige press" articles, Cho demonstrates the differences in the number of publications, discussion types, and word choice that she found over the two year period from 2007-2009. "Silence of the Bees" highlights differences between three specific groups of communicators: scientists, the media, and the public sphere. Cho gives details about two types of science communication and the ways media distortion causes problems with public awareness over time. The study addresses two forms of written media but the analysis leaves out the impact of web-based outlets. These outlets have continued to expand since the article was written and may account for discrepancy in some of her findings regarding the decline of urgency in the newspaper articles.

Another example of a study addressing a similar issue can be seen in Eschenfelder and Miller's (2007) case study on state website information dissemination about Chronic Wasting Disease (CWD). Eschenfelder and Miller explore how information transmission fosters relationships among the government and different communities of citizens. The study is significant to the exploration of CCD information because of the similarities between CWD and CCD. Both phenomena involve highly contested views of what is causing the problem and to the basic definitions of the problem. Both phenomena influence the rules and regulations regarding the public and the regulation of resources such as hunting, livestock, and agriculture within a specific region. Additionally, both problems are addressed by myriad resources that offer information in different formats with differing perspectives. The authors expand on Bimber's 2003 proposal that "increased governmental use of technology will lead in part to a period of 'information abundance' facilitating citizen and civil society involvement in governance" (Eschenfelder & Miller, 2007, p. 2).

Their study assesses the variations in scope of text information available on four state websites and asserts that the current level of agency analysis is insufficient because it does not take into account the specific content of the documents in relation to the intended audience (Eschenfelder & Miller, 2007). To fill the observed gap, their study assesses the variations in scope of text information available on the websites. Their framework is called the Government Information Valuation framework (GIV) and the approach breaks the information seeking public down into specific categories. The citizens are characterized based on their role in and their use of information about CWD. This study utilizes their framework as it seeks to define the "public" by organizing user groups by citizen role and information need. The similarity between the issues makes the framework easily adaptable to the needs of the CCD information seekers on the web.

Post Normal Science Theory

Why is the equitable dissemination of CCD information important?

In post-normal science theory, a concept developed by Funtowicz and Ravetz (1999; 2003), research "focuses on aspects of problem solving that tend to be neglected in traditional accounts of scientific practice: uncertainty, value loading, and a plurality of legitimate perspectives" (Funtowicz & Ravetz, 2003. p.1). In the case of the current research the study focuses on the uncertainty of the causes of CCD, the needs of the information-seeking spectrum of citizens, and the federal e-government websites' role as intermediaries in a network of information providers. The research questions address the need to go beyond the reporting of scientific data to examine the comprehensiveness of the vehicle to transmit information for further deliberation outside the scientific community. Sheila Jasanoff (2003) like Funtowicz and Ravetz (2003) also discusses the current need for a different kind of objective communication about scientific

research. By making room for other subjective points of view within the data-driven studies, this kind of communication creates space for a two-way dialogue between science and the public. Her 2003 article "Technologies of Humility" discusses the incongruencies between our ever-increasing access to new technology in juxtaposition with the old habits of scholarly hierarchy and exclusion that persist in the science and government realms. Her proposal, "offers a framework to bring the human elements of morality and subjectivity back into the discussion of science and technology as opposed to the "Technologies of Hubris" disconnecting science from such human qualities" (p. 240). Her four key elements for these technologies of humility are framing, vulnerability, distribution and learning (Jasanoff, 2003). Her proposal serves as a guide to the exploration of CCD information. The philosophy applies to wicked problems in all arenas of scientific inquiry and influences the formulation of additional research topics such as CCD information dissemination practices.

Another study looking at science communication through the lens of post-normal science is from Bradshaw and Borchers (2000). Their article "Uncertainty as Information" studies the differences between scientific and government mind sets. The study uses the phrase "science-policy gap" to describe the "dysfunctional aspects of the science-policy interface" (Bradshaw & Borchers, 2000, p. 2). The authors examine Intergovernmental Panel on Climate Change (IPCC) reports and apply theories of cognitive dissonance and volition to explain why uncertainty creates doubt and mistrust among groups. Using a scale of increasing complexity and uncertainty, Bradshaw and Borchers chart the types of environmental controversies and where each rank on the scale. The scale offers a framework to understand information needs of a spectrum of stakeholders. However the definitions do not cover the public sphere as a whole. In the light of the complexity of wicked problems such as CCD, this study recognizes the need for a more diverse spectrum of citizen involvement, thus the Government Information Valuation framework creates a better tool to begin defining the users' needs (Eschenfelder & Miller, 2006; 2007).

To understand how information quality studies are applied to environmental problems such as CCD, a case study that relates to the current research is Maxim and van der Sluijs' (2007) study of information for policy making discourse in the French government. The study focuses on deliberation and regulation on the topic of honeybee risk from insecticide. The paper discusses a role for the researchers' proposed information framework, Knowledge Quality Assessment or KQA. The study tests the KQA framework by applying it to a situation where policy makers are involved in communicating about uncertainty and are invested in fostering cooperation among French stakeholders (Maxim & van der Sluijs, 2007). The framework to assess the quality of the knowledge is important to the process because the individuals engaged in the deliberation seek clear and meaningful content to back up their arguments and assess the statements of the proponents of other views. Maxim and van der Sluijs address one area of CCD and one very specific information user group. While their knowledge framework discusses the information

environment of the French legislature and field experts, the study does not address the needs of the information seeking public beyond these specific users.

In looking at these studies that apply post-normal science, complex problem solving, and involve the public understanding of scientific information, there is a definite space for more research to determine what information is available for multiple user groups and to define a framework that can first, evaluate the quality of the information and second, measures availability according to a spectrum of information seekers. In deciding how to measure the quality of the CCD information from the point of view of post-normal science theory, this study examines past research on information quality.

Information Quality Literature

How does one measure CCD information dissemination?

Information quality (IQ) may foster informed decision-making and empower citizens to initiate problem-solving and conservation practices. However, measuring information quality requires firm definitions of the dimensions of information quality as defined by past IQ research. These concepts of quality can then be associated with the needs of a spectrum of citizen information seekers as is addressed in the Government Information Valuation framework. Web-based IQ assessment differs from other types of IQ because of the dearth of material that is both in constant flux and is free from the standards of quality that publishers require for text material. Eysenbach and Diepgen (1998) point out that, "the anarchic nature is desirable for fostering open debate without censorship" (p.1496). Conversely, the immediacy and influential nature of the web brings with it a temptation to trust the material. Rubin (2004) reminds the information scientist that, "all databases have their limitations, biases, and deficiencies and we know that the web is filled with unreliable information" (p.336).

A majority of IQ studies frame quality in terms of several dimensions or categories including but not limited to concepts of authority or reliability, currency, accessibility or usability, and accuracy (Alexander & Tate, 1999; Eysenbach & Diepgen, 1998; Kahn et. al., 2002; Katerattanakul et. al., 1999; Knight & Burn. 2005; Wang & Strong, 1996; Zeist & Hendriks, 1996). Other studies focus on the visual dynamics and design related to IQ (Holmes & Robins, 2008; Lingaard et al., 2006; Michailidou & Bechhofer, 2008). In addition, the quality dimensions listed above are in many cases defined by category. Intrinsic IQ, accessibility IQ, contextual IQ, and representational IQ are four main categories that delineate an element's specific contribution to the information entity as a whole (Katerattanakul et al., 1999; Wang & Strong, 1996). Another practice involves mapping IQ dimensions according to service quality and product quality criteria (Kahn et al., 2002). The current research focuses on defining commonly discussed IQ dimensions including: source authority, accuracy, usability and design, currency, and interactivity and

public engagement features. These dimensions as they relate to the current study are defined in chapter three in the section Data process.

Source Authority

Authority of source is difficult to verify on the web, in some cases the source may not even exist as a single entity. As Fritch and Cromwell (2001) state, "On the Internet, we are sometimes forced to ascribe authority at least partially through institutional or organizational affiliation because we lack other bona fide authority cues and indicators" (p. 499). One way authority is ascribed is through reputation. Reputation can be defined by the high status and/or knowledge level (socio-culturally defined) of the affiliated agency, institution, author, or content (Alexander & Tate, 1999; Kahn et al., 2002; Knight & Burn, 2005; Stvilia et al., 2007). Disclosure of the author allows for further assessment of authority. Knowledge of a webpage's author and the apparent transparency of his or her affiliation can be a clear message to the user that the creator is interested in the quality of the content (Bonati et al., 1998). The National Science Foundation (NSF, 2002) defines transparency of source as a dimension of quality as it "allows the user to understand how the information was designed or produced" (p. 15). Warnick (2004) describes the ambiguity of the web environment stating, "segments of the Web seem to function as an authorless environment where the author's identity is of little or no importance. Instead, it is the quality of the performance that counts" (p. 264).

Accuracy

In the context of IQ accuracy is commonly defined as an information object's ability to provide a correct and reliable representation of another process, event, phenomenon, or object (Alexander & Tate, 1999; Kahn et al., 2002; Knight & Burn, 2005; Stvilia et al., 2007). The United States Office of Management and Budget (OMB, 2002) defines accuracy under the umbrella of objectivity, which the office describes as involving "a focus on ensuring accurate, reliable and unbiased information" (p. 8459).

Currency

The constantly changing environment of the World Wide Web requires IQ analysis definitions to include the dimension of currency. Currency is commonly defined within IQ studies as timeliness or the extent to which the provided information is up to date (Alexander & Tate, 1999; Kahn et al., 2002; Knight & Burn, 2005; Wang & Strong, 1996). The OMB (2002) includes the term "influential" in defining currency and IQ. Influential information is novel to the user and has a "clear substantial impact" (p. 8460).

Usability and Design

The OMB is responsible for defining information quality for government agency dissemination of information. These information agencies include those that offer public environmental information on complex issues such as CCD. One problem arising during dissemination of information regarding these issues is related to the design and construction of the user interface. The systems are often constructed and seen in a similar light to that of professional documents (Hackley, 2003). The nuances of the public sphere and the online environment are not always conducive to this treatment. Instead, IQ studies addressing the design of the page stress visual clarity and concentrate on a website's "ease- of- use" (Alexander & Tate, 1999; Holmes & Robins, 2008; Katerattanakul et al., 1998; Kahn et al., 2002; Knight & Burn, 2005; Klobas, 1995; Michailidou et al., 2008; Wang & Strong, 1996). Another factor in visual design IQ is aesthetic perception of quality. Lindegaard et al., (2006) state that a user's first visual impression is determined within the first fifty milliseconds of viewing. The aesthetic quality and degree of professional design components influence the perceived credibility of the material. Holmes & Robins (2008) find that, "viscerally-based credibility judgments occur without conscious analytical cognitive processes…they relate to factors such as dynamism and trustworthiness" (p. 390). While understanding the perception of quality from the user perspective is beyond the scope of this study, a checklist for usability criteria allows for developing an idea of usability levels. On his Alert-box web resource Jakob Nielson (2011) provides a list of ten current usability issues common to website design. These ten issues are based on his ten usability principles and include characteristics of search, pdf files, scan-ability, hyperlink resources, font-size, advertisements, headings, design conventions and purpose (Nielson, 2011). The comprehensiveness of this list makes it applicable to the definitions of IQ for this research. The research design employs Nielson's checklist to define usability standards for each entities' web page.

Interactivity and Public Engagement

One area of IQ that is important to the scope of this study and is rarely addressed in the literature of information sciences appears quite frequently in the literature surrounding environmental science communication studies. Public engagement within the context of complex environmental issues becomes an integral dimension to defining the quality of available information (Eschenfelder & Miller, 2006; 2007; Fischer, 2000; Funtowicz & Ravetz, 1999; 2003; Maxim and van der Sluijs, 2007). To define why engagement is so important Funtowicz & Ravetz (2003) state:

> Each of those (scientific research) has its means for quality assurance of the products of the work, be they peer review, professional associations, or the market. For these new

> problems, quality depends on open dialogue between all those affected. This we call an extended peer community, consisting not merely of persons with some form or other of institutional accreditation, but rather of all those with a desire to participate in the resolution of the issue (p. 7).

To include an "extended peer community" involves trust. Bonati et al., (1998) discuss this concept; "interaction and feedback are high markers of quality web sites: allowing a user to submit comments demonstrates serious intention by the authors to both improve the information supplied by them and to become respectable sources" (p.317). Thus, quality information and user engagement create a synergy with which both information provider and information seeker find a greater understanding of the issue.

Connecting Literature and Methodology

Information quality (IQ) studies frequently acknowledge the subjective nature of the terms used to describe and assess information on the web by stressing the need for contextual understanding of the concept (Alexander & Tate, 1999; Kahn et al., 2002; Knight & Burn, 2005; Stvilia, et al., 2007; Wang & Strong, 1996). Stvilia, et al., (2007) describe two types of context: culture and socio-technical structures. "An information entity can be of good quality in its original context but can become of lower quality once it is moved to a different context" (p. 1722). This context dependency is exemplified in the aforementioned Government Information Valuation framework (GIV) introduced by Eschenfelder and Miller (2007). While this framework looks solely at citizen/government relationships, it can be useful in the current research because the majority of research on CCD is done through funding from the federal government and designated federal government agencies are responsible for dissemination of CCD information to citizens and stakeholders through their web resources (CCD Steering Committee Working Group, 2007). Thus the assessment of the information is defined in the context of the dialogue between the government entities and the public. This context builds the foundation for constructing the research methods.

This study uses mixed methods of data analysis. In related literature, content analysis is a frequently used and successful method for assessing information dissemination practices (Byrne, et al., 2002; Cho, 2009; Eschenfelder & Miller, 2007). This study conducts content analysis that looks at the available types of topics and formats of the available information. The study applies the GIV framework to assess IQ within the context of specifically defined user communities. Additionally, social network analysis will take this assessment further by looking at the full landscape of CCD information (Barabasia et al., 2002; Hanneman & Riddle, 2005; Marin & Wellman, 2009). In a health informatics study, Meric, et al., (2002) found that type of content rather than quality of content correlates to a website's measure of popularity. Mapping the nuances of the available CCD information on the network provides a holistic assessment of the

relationships among information providers and identifies strengths and weaknesses in CCD information dissemination. By using a mixed method approach to study the complexity of the information environment, the results of this study are richer, more robust, and provide a more contextual understanding of the available information.

Chapter two provided an introduction to several studies that help frame the current analysis and serve as guides to establish an understanding of why such research is necessary. The literature review looked at post-normal theory and wicked problems to explain the importance of quality information dissemination for the purpose of citizen engagement in future problem solving. Information quality (IQ) research established criteria for quality information dissemination on the web. Eschenfelder & Miller's (2007) Government Information Valuation framework was introduced as part of the framework for the mixed method analysis. Social network analysis and the importance of including this method were discussed. In the following chapter, chapter three, the research methods are introduced, the study subjects are defined, and terms used within the framework are operationalized. Finally, the chapter includes the procedure for data collection and analysis.

CHAPTER III
RESEARCH DESIGN

Chapter two reviewed the literature related to wicked problems, science communication and information quality as well as current studies about CCD information. The studies addressed in the literature review present a perspective of the current research environment related to CCD information resources available to a spectrum of citizen users on the web. The chapter also introduced the Government Information Valuation framework as Eschenfelder and Miller defined it in 2007 for their study on Chronic Wasting Disease information resources at the state government level. In the following chapter the research design is discussed. Chapter three outlines the major objectives of the research and states the three research questions and their specific units of inquiry. The sources for data collection are defined, as is the mixed method evaluation framework with which the collection and analysis occurred. Finally, the process is discussed and terms for analysis are operationalized. The analysis framework is proposed as a standard by which to analyze web page content of complex environmental problems.

Research Objective

To identify entities that provide information about CCD, to identify the characteristics of the information they provide, and to evaluate the quality of this information.

General Research Question: "What is the scope of information about Colony Collapse Disorder that is available on the World Wide Web?"
Scope of information in this context includes:

RQ1: Who are the providers of federal government information about Colony Collapse Disorder in the online environment and what are the relationships between these entities?

- What entities/ agencies provide information about CCD?
- What are the relationships between these entities?

RQ2: What information about Colony Collapse Disorder is available online from the USDA, the US FWS, the EPA, the USGS's NBII, and Wikipedia?

- What are the Colony Collapse Disorder information topics available online from these five entities?
- What are the available types? Types provide context to the delivery of the information (i.e., frequently asked questions).
- What are the available media formats?

RQ3: What is the quality of the available information on these sites and what are the measures of information quality (IQ)?

- How accurate is the information?
- Does the information have source authority?
- How current is the information?
- What is the level of usability and design of the information?
- What amount of interactivity and public engagement is available with the information?

Data collection

The collection of data for the research used the following collection protocol:

- Searching for resources within *Science.gov* identified four federal agencies with CCD information pages.
- Wikipedia's CCD page was added to the analysis.
- Terms were operationalized to define the scope of the analysis
- A template for collection was constructed in Microsoft Excel. This template has tables to record the data from the comprehensive inventory. Please see the appendix for the definition of the terms and a sample table that shows the measures used in the data collection template.
- A comprehensive inventory of the five subjects was taken. Content from the CCD page, external links from the CCD page, and external links from the entity's home page were organized. All types, topics, and formats of CCD information were included in the analysis.

Based on a pilot study during the spring of 2011, it was determined that the following steps were an effective means of collecting data for analysis.

Sources for data collection

The first four sources for data collection were chosen based on a search through the federal government information web portal *Science.gov* in January of 2011. Four federal government agencies

maintained a web page devoted to Colony Collapse Disorder. It is important to note that at the beginning of the research USGS's NBII was fully operational. There was no knowledge, until the summer of 2011, that the site and the program would be cancelled. The USDA devoted several pages to aspects of information related to CCD. At the time of the entity search this web page consistently reoccurred as the main information page that supplied public information about the general phenomenon of CCD. It was also most often the USDA link given by the other entities. After the results of the pilot study validated the feasibility of the framework, it was determined that the research needed a comparable and well-known non-government resource that also provided CCD information. Wikipedia was chosen because of its ubiquitous reputation as a source for information created by the public for the public (Stvilia, et al., 2007). As the research applies the theoretical component of post-normal science to the definition of information dissemination quality, the interactive and wiki engagement characteristics of Wikipedia provided alternative perspectives by which to understand the information landscape in the context of a larger network of resource types.

The entities analyzed in the study include:

- USDA (U.S. Department of Agriculture)
  http://www.ars.usda.gov/News/docs.htm?docid=15572
- EPA (Environmental Protection Agency)
  http://www.epa.gov/opp00001/about/intheworks/honeybee.htm
- USGS's NBII (U.S. Geological Survey's National Biological Information Infrastructure)
  http://www.nbii.gov/portal/server.pt/community/threats_to_native_species/850/colony_collapse_disorder_%28ccd%29/3656
- US FWS (U.S. Fish and Wildlife Service)
  http://www.fws.gov/contaminants/Info/CCD.html
- Wikipedia
  http://en.wikipedia.org/wiki/Colony_collapse_disorder

Data Process

First, a data collection template was established and a codebook was created that operationalized the terms, standardizing the measures that were applied to all five entities. The following section contains the definitions from the codebook that were applied to the data collection process. The definitions are also listed in table format on page 126 of the appendix for quick reference.

Defining Information Topics

- Definition of CCD
- Potential Causes
- Proposed Solutions
- Consequences of CCD
- Importance of Honeybees
- Future Research
- Current Research
- Myths
- Uncertainties
- Controversy
- Institutional Focus
- Public Engagement

In the codebook, there were twelve information topics based on the contextual components of the five CCD entities. Additional definitions were based upon related literature on CCD (Calderone, 2012; CCD Steering Committee Working Group, 2007; NAPPC, 2007). Each topic was defined by several subtopics.

A basic definition of CCD was determined by at least three of the five subtopics: who, what, when, where, and why. Entities addressing potential causes discuss one or more of the following: pesticides, diseases, parasites, and stress from migration, stress from malnutrition, stress from pollution, habitat modification, or improper breeding of queens. It was important to the definition that the author includes the uncertain status of these causes. Proposed solutions were defined as the theories of action that have been suggested in the light of uncertainty. These include improving overall health, adoption of organic farming, increased regulation of beekeeping practices, increased research, finding alternatives to honey bees, and breeding strength through genome knowledge.

Consequences of CCD were discussed by an entity when they mentioned one or more of the following subtopics: economic loss, diminished food supply, threatened livelihoods, species decline, or future large-scale environmental decline. Attention to the importance of honeybees required that the discussion address elements of food production and supply, plant pollination, economic value, medicinal value, or research endeavors. The topic of future research referred to genetic research, future involvement from institutions, new monitoring practices, new plans for funding and other ideas not yet in action. Accompanying this definition was a discussion of what researchers are currently working on including:

genetic screening, pesticide testing, recreating diseases and stressors, monitoring hives, natural miticides, and antibiotics.

Myths were defined as common misconceptions about CCD. This topic required that the entity provide an explanation about why this is a myth. Myths included: cell phone towers and signal issues, bees as pests, past occurrences of CCD, and disbelief in the actual existence of CCD. Uncertainties were subtopics that addressed the areas of difficulty in determining specific theory regarding CCD. These areas include regional differences, absence of dead bees near the hive, multifaceted phenomenon, and research discrepancies. The entity mentioned that this subtopic was a contributing factor to uncertain, unclear, or undetermined issues. Also, the topic of controversy was defined as a discussion of the main debates. The entity needed to explain more than one perspective on an issue of contention. Controversies included one or more of the following: genetically modified organisms, organic farming, pesticide testing methods, nutrient supplements, and the influences of corporate agendas.

Institutional involvement was defined as an instance where the entity spoke directly about the mission and role of the institution in the current and future endeavors surrounding CCD. This instance was required to include one or more of the following: policy formulation and regulation, research management and funding, public outreach, provision of services, or another related focus. The final topic, public participation, was defined as involvement of the information seeker in the information process by discussion of one or more of the following: how to help, requesting information from citizens, asking for comments and questions, or profiling national, regional, and local programs for involvement.

Defining Information Types

- Basic Information
- Frequently Asked Questions
- Latest News
- Feature Stories
- Government and Official Documents
- Scholarly Research Articles
- Data Visualization
- Administrative Information
- Resource Lists

Information types were defined as information functions un-related to format or topic. For this study information types were defined by their function and ranked according to their usefulness per GIV citizen user group. Usefulness was defined by the ability of the type to align with the GIV recommended types of information for each citizen group. There were nine information types defined. These types were

established based on the contents of the entities with acknowledgement of other known information types used on the Web to convey information.

Basic information was defined as broad and essential. It did not require any prior knowledge of the issue and if a technical term was used, the definition was readily available in the immediate text or through a hyper link. Frequently asked questions were types presented in a question and direct answer format and simulated a dialogue. This text must have been labeled as FAQs and had technical terms defined immediately or with hypertext links to a definition. Latest news was established as the most recent available information on programs, events, projects, research findings, or problems, with recent is being within two years of the current date August 2011. Feature stories were distinguished from latest news as highlighting a specific story of programs, events, projects, research findings, or problems. Unlike latest news, they were either current or from the past and they must have been separate from the basic information. Government and other official documents are files that serve as guidelines, reports, or resources to a governing body. The documents were either in the form of a PDF or HTML from an external link. Scholarly research articles were defined as supporting information in the form of papers, composed by scholars and submitted to peer reviewed journals for publication. These articles were also in the form of a PDF file or an external link.

Another information type, data visualization was defined as a visual interpretation of recorded data in the form of a graph, a map, a table, a chart, or other pictorial figure. The image needed to be visible on the page, or if contained in a link, it was labeled as a visual representation of data in a link summary. Information about the people and institutes that work on issues related to CCD was categorized as administrative information. This type included such content as an organization's history, members, mission, funding, or partnerships. Resource lists were defined as lists of places to go for more information. The lists contained links to internal and external web resources with a brief annotation about the resource.

Defining Information Formats

- Embedded Text
- Image
- Audio
- Multimedia
- Data
- Internal Links
- External Links

Information formats were defined in the research template as the forms in which the information topic exists. The template had nine information format classifications. Textual information that was part of the web page defined the format called embedded text. Embedded text was limited to the page and not located on a separate file from the source code. Image file formats were defined as two-dimensional images; the file material was in the form of a jpg, png, giff, or tiff file. Audio format was defined as a sound file. Multimedia formats were defined as video, animation, or podcast files. The requirements were that the materials contain more than one type of sensory information transmission.

Data as an information format was defined as a file that contains the results of a research activity during a specific period of time. Specifically, the data was processed in a graph or chart or unprocessed as raw results of a scholarly study. Internal links were defined as clickable hypertext with pictures, tabs, text, or URL that automatically transferred the user to another page within the website. External links were defined similarly except that they automatically transferred the user to another site's page outside the original website.

Defining Information Quality

- Currency
- Source Authority
- Accuracy
- Usability and Design
- Interactivity and Public Engagement

Each topic was analyzed according to measures of information quality based on previous IQ studies in web-based material. In the analysis IQ measures were defined as elements that define quality information according to the needs of the users. These users were grouped according to their roles as citizen information seekers. These user groups are defined later in the article.

Measures of IQ were defined using five areas of analysis. These areas included currency, source authority, accuracy, usability and design, interactivity and public engagement, and readability. Currency was defined using three criteria: the page had no broken links, the page was updated within the past two years (from 6/20/2011) and the page was free from information about canceled programs or projects.

Source Authority was also defined using three criteria. For topics with quality source authority, authorship was disclosed, contact information was readily available, and institutional affiliation was cited. Definition of information accuracy also consisted of three criteria. Accurate topics had content that was free of known errors, free of misinformation and was integral in providing the information the entity promised.

Usability and design was defined using a checklist of ten criteria as defined by Jakob Nielsen (2011) these criteria included:

- A simple search field existed on the page,
- Any PDFs were reserved for manuals and large documents.
- The page's visited links changed color.
- The text was written for online reading and supported scan- ability.
- The font size was not fixed or too small
- The page titles were descriptive and short.
- There was no animation, no advertisements nor pop-ups.
- The design was consistent with other web pages and sites.
- The links worked as simple hypertext reference; new windows did not open.
- The answers and main ideas were visible as such.

Additional supporting criteria in the usability and design information quality measure included navigability, and look and feel. Navigability was defined as ease of access and movement to information. A page that was easy to navigate must have had no broken links, no areas that are slow to load, no broken tabs and no redundant resources. Quality look and feel to the information was defined as a design and layout that reflected and supported the content. The content was consistent among the pages and the colors were harmonious with graphics that were appropriate to the content.

Interactivity and other public participation features were also defined using a checklist of criteria. These criteria were defined as the basic features that commonly appear on websites that have interactive applications. Experience derived interactive application criteria include:

- User support/ help functions
- Advanced or user customized search options
- Open comment fields
- Interactive media or applications for wireless devices
- Folksonomy and tagging applications
- Web 2.0 component/ or endorsement of a citizen science program
- Specific requests for citizen input on topics

Defining the scope of the Citizen Categories

- Private Citizen
- Deliberative Citizen
- Attentive Citizen
- Citizen Publisher/Practitioner
- Corporate Citizen

User categories and needs were established according to a spectrum of citizen types that reflect the definitions of citizen users established by Eschenfelder and Miller's GIV framework (Eschenfelder & Miller, 2007). These user categories include private citizen, attentive citizen, deliberative citizen, and citizen practitioner or publisher. In order to reflect the specific needs of the CCD phenomenon an additional category was added to the spectrum. The title of this additional category was corporate citizen.

Private citizens were defined as users who need information as individual citizens to make private decisions or to take private actions. While every person was considered a private citizen, many fall into other categories as well. Examples of private citizens were students, teachers, parents and guardians, consumers, gardeners, hobbyist farmers, and small business owners. An attentive citizen was defined as a user who requires a two-way flow of information for the assessment of agency policy and performance. Attentive citizens were those who were integral in providing citizen opinion and feedback to the government and other entities, and supplemented expert opinion. Attentive citizen information needs to be comprehensive to facilitate this two- way flow. Examples of attentive citizens were defined as hobbyist beekeepers, small-scale farmers, consumer advocates, and land use and planning experts.

A deliberative citizen user was defined as an individual or group who needs information to formulate, articulate and defend in the public forum. They need a range of facts and interpretations for informed debate including information about the stakeholders and excluding messages that are persuasive to a particular agenda. Examples of deliberative citizen users include environmental analysts, economic analysts, grassroots organizations, community level leaders such as a mayor or a commissioner, and editorial journalists. Citizen practitioner or publisher was defined as a user who requires a horizontal and multi-dimensional flow of information. Civil society and government information was not the user's main focus, but the information supported and reflected their active role in creation of new information material. Examples of the citizen practitioner and publisher were university affiliated researchers, non-governmental organization administration, policy analysts, agricultural engineers, apiculturists, scientists from related fields (e.g., chemists), journalists and media specialists, and information specialists. Corporate citizens were

defined as having interests that cater to a specific company or agenda. These citizens had vested interests in the economic impact of specific decisions related to the dissemination of the information to the public sphere. Especially relevant to this group were current updates about regulations and policies with continued avenues of communication and documents that focused on backing up the information presented. Examples were lawyers, chemical company affiliates, food production affiliates, scientists employed by these corporations and political leaders.

The GIV established information topics and their connection to the different user types. The needs of the users were comprehensive across the spectrum from simple to complex. These concepts provided a background for aligning previously defined user needs with specific CCD information components (types, topics, and formats) in this analysis.

Defining user needs for each citizen category

Core information was defined as content recommended for all members of the public. Core information was considered general information about the CCD phenomenon created with speed and ease of understanding in mind. The material supplemented other materials. User community-specific information acknowledged that it was produced for a specific group of users. The parameters may have been regional, cultural, job related, and etc. Reports were defined as official documents created by an organized agency that provided a current assessment of the issue and/or reported on observed changes over a period of time. These reports had to be labeled and the author must have been acknowledged. Action plans and strategies were also defined as documents. These were documents drawn up by an organized agency to identify the mission of the group and to delegate responsibilities and funding appropriately to facilitate the best possible outcome. These reports had to be labeled and the author must have been acknowledged.

Materials for debate were described as information that was useful to individuals who desired to strengthen their argument on an issue of contention. Multiple perspectives of the argument must have been addressed. Gap disclosure was defined as information where areas of uncertainty were clearly identified. Gap disclosure materials must have clearly addressed that there was no known answer at the time of the page's creation. Citizen participation tools were defined as applications and materials that allowed any individual to get involved, make comments, or provide additional information. Information dissemination assistance was defined as instructions for use of the citizen participation tools or contact information that offered services and information. This category also included materials that were provided for community education practices such as posters, fact sheets and workshop guidelines.

Other citizen user needs, links to databases and forums, were defined as applications that directed the user to an avenue for searching, sharing, debate or discussion. These databases and forums were required to be related specifically to the issue of colony collapse disorder and pollinator health.

Agreements and statements were defined as statements and documents that acknowledged the relationship between two or more organizations. These agreements must have provided an explanation of the partnership parameters as well as a hyperlink to the external entity's website. The final category of GIV user needs was labeled as updates. These were updates to events, regulations or policies, plans, and new research developments. These updates were required to be current (within one year of the analysis) and authorship had to be provided with the update explanation. To illustrate how these information needs related to the citizen user categories and the research template's twelve information topics (both previously defined) two tables (Table 1 A and Table 1 B) were created that defined these relationships.

Table 1 A Recommended Content for the GIV Citizen User Groups.*

Citizen type	Private	Attentive	Deliberative	Practitioner/Publisher	Corporate
Recommended Content	Core information	Reports: Progress/ Working Groups	Clear picture of debate-listing responsible parties and stakeholders	Information dissemination assistance	Current updates about regulations and policies
	Customized information for specific user communities	Action Plans/Strategies	Gap Disclosure	Links to databases and forums	Avenues of communication
			No persuasive messages	Memorandums of understanding and partnership info	Documents which focus on backing up the information
			Citizen participation tools		

Table 1 B Corresponding CCD Topics and Citizen Types. *

Citizen type	Private	Attentive	Deliberative	Practitioner/Publisher	Corporate
Corresponding CCD Topics	Definition of CCD	Potential Causes	Uncertainties	Current Research	Institutional Focus
	Importance of honey bees	Proposed Solutions	Controversy	Future Research	
	Myths	Consequences of CCD	Public Participation		

*Note that the cells are cumulative from left to right

The previously defined data collection template categories of observation aligned with the three previously established research questions. The template had seven tables per entity. These tables were as follows:

1. A profile of the entity
2. A list of the physical areas and the information formats that correspond with each web page area
3. A checklist of design and usability features
4. A checklist of interactivity and public engagement features
5. A large list of the information topics and subtopics with corresponding information formats, information types, and measures of information accuracy, currency and source authority
6. A comprehensive list of external links for the homepage and the CCD page. This data would drive the social network analysis portion of the research.
7. A list of total values for information types, information topics and information formats

At this time a PDF file of the home page and the CCD web page was created for each entity and the date was recorded. The contents of the PDF file were the basis for the content of the collection and analysis. The next step was to fill in the fields of the template starting with the profile and the physical areas. Presence of the attribute was noted using a "1" and an absence of the attribute was noted using a "0." When encountering multiple existences of the attribute, the number of existences encountered was recorded. After these tables were complete, the links from the home page and the CCD page were recorded noting any broken or disabled links. Then the checklists for design and for interactivity were analyzed and graded accordingly. These lists were comprehensive for each entity's page. Analysis of these tables first allowed for a comprehensive overview of the page before the individual topic inventory.

The topic table data collection process started with the first topic and subtopic listed and moved from left to right for each topic row. Each row included several subtopics with an overall total, a number of information formats that related to that topic, number of information types that related to the topic, plus three identifiers of information quality under the three information quality categories for each topic. Thus, each of the twelve information topics was examined in depth to analyze the characteristics of the entities' treatment of each topic. As each topic was completed, observations and other notes were recorded in specified columns. At this time, the comprehensive list (summary table) of total values was gradually added in to the table that recorded the amount for each topic. At the completion of the information topics table, this summary table was also complete. To conclude the process, a narrative was written that included the steps taken and the following observations from the collection and analysis process.

Data Analysis

RQ1: Who are the providers of federal government information about Colony Collapse Disorder in the online environment and what are the relationships between these entities?

Proposed method: Social Network Analysis of websites with CCD information pages

Tools: Gephi: Social Network Analysis Visualization Software (Bastien & Jacomy, 2009)

RQ2: What information about Colony Collapse Disorder is available online from the USDA, the US FWS, the EPA, the USGS's NBII, and Wikipedia?

Proposed method: Content Analysis of the topics addressed on the five web pages and connecting the topics with their types and media formats

Tools: Charts for analysis using *Microsoft Excel*

RQ3: What is the quality of the available information on these sites and what are the measures of information quality (IQ)?

Proposed method: Content Analysis of the types and topics of information available on the five pages and connecting each with the measures of quality for the spectrum citizen users

Tools:

- Charts for content analysis using *Microsoft Excel*
- Government Information Valuation continuum of citizen needs (Eschenfelder and Miller, 2007)

In this chapter the research design for the data collection and analysis was presented. The three research questions were addressed and the methods used to assess and answer the questions were defined. The five CCD information entities were defined and the framework for analysis was constructed. The analysis contains several components that determine the complete framework for each entity. These components include a content analysis to determine the information topics, types, and formats available from each entity, an information quality analysis using standard measures set forth by previous IQ studies in the field of information science, and a network analysis component to determine the landscape of the information network of CCD web information available using these five entities as the nodes with which the network was constructed. The citizen user categories were additional tools employed in the analysis framework that added information to the understanding of the nature of the available information on each entity's CCD page. In the next chapter the results of the research process are reported, comparing among the five entities. The results of the network analysis are shown initially and set the stage for further discussion of the entity results in the context of CCD information resources available on the web.

CHAPTER IV
COMPARATIVE SUMMARY OF RESULTS

Chapter four of the research reports the comparative results of all five entities. In the following results sections the entities are viewed together. First, the chapter reports the results of the social network analysis. Then the content analysis results are compared across the five entities. Charts are included for all information characteristics. These include information topics, information types, and information formats. Each of these sections had one chart to show the actual amount and one to show the percentages. Measures of information quality were individually depicted. In chapter five the results are depicted comprehensively for each entity. By reporting the measures individually, the analysis was able to construct an in-depth picture of the content per entity and the characteristics therein. The results of chapter five, in combination with chapter four, creates the context for chapter six. This final chapter discusses the major implications of the research and applies the current understanding gained to the literature from past studies. Chapter six makes suggestions about future research directions; it addresses the limitations of the research and concludes with specific recommendations for CCD information seekers.

1. Social Network Analysis

1.1. SNA Process

To answer the first research question the study included a survey of the network of CCD information available on the web in relation to the five major entities defined in the initial research. Using the open source software package Gephi, relationships were identified among the entities that link resources about CCD.

In the first step, the URLs of all external links were collected for each of the five entities in the study. These external links are links that appear on either the entity's home page and/or the pre-defined entity CCD page. Links were organized by entity. Entities did not contain duplicate URLs. However URLs were repeated when used by multiple entities. A table was constructed in Excel that listed the name of the site page and the URL of the page. This table was used to describe the nodes in the Gephi data file. Each row defined a node. Upon uploading the spreadsheet into the program, each node was given a unique number identifier. One number identifier named duplicate nodes and if repeated in the table, the initial number was repeated. In Gephi, edges were defined from the nodes by connecting the number of the source node with the number of the target node. For example, if the Wikipedia CCD node was number 360 and

the URL link 365 was the North American Pollinator Protection Campaign, an edge defined between the two nodes would be defined as source 360 to target 365 and labeled as belonging to the source using the designation WIKI. Each edge was classified as directed. Undirected edges would indicate a reciprocal relationship. However, the relationship analysis is directed outward as an external link from the initial entity pages in the study.

After the nodes and edges were defined for all five entities the relationships were mapped as a graph. The organization of the graph depicted different parameters, depending on the choice of layout from a menu of choices. Nodes and edges were color coded to reflect their respective entities. Figure 1.1 A demonstrates the initial placement of nodes and edges using the Force Atlas layout.

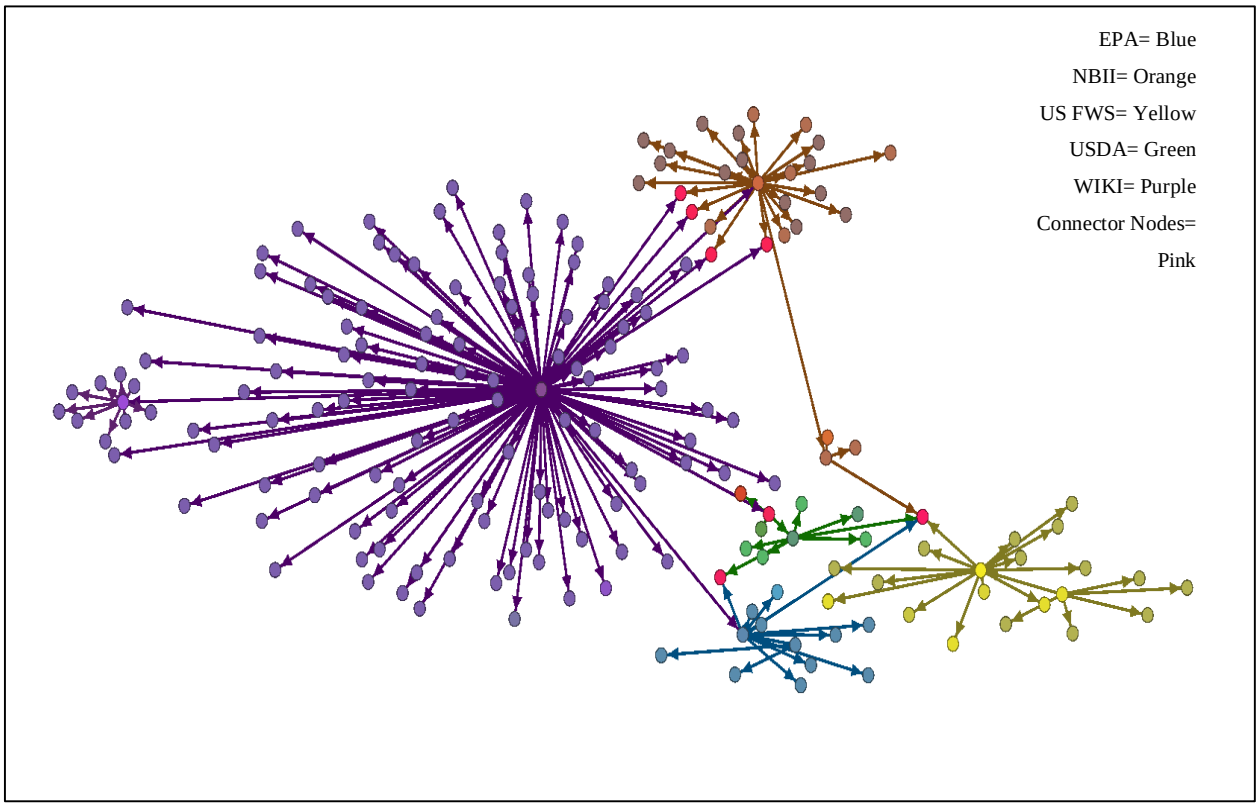


Figure 1.1 A Initial mapping of the network using Force Atlas layout

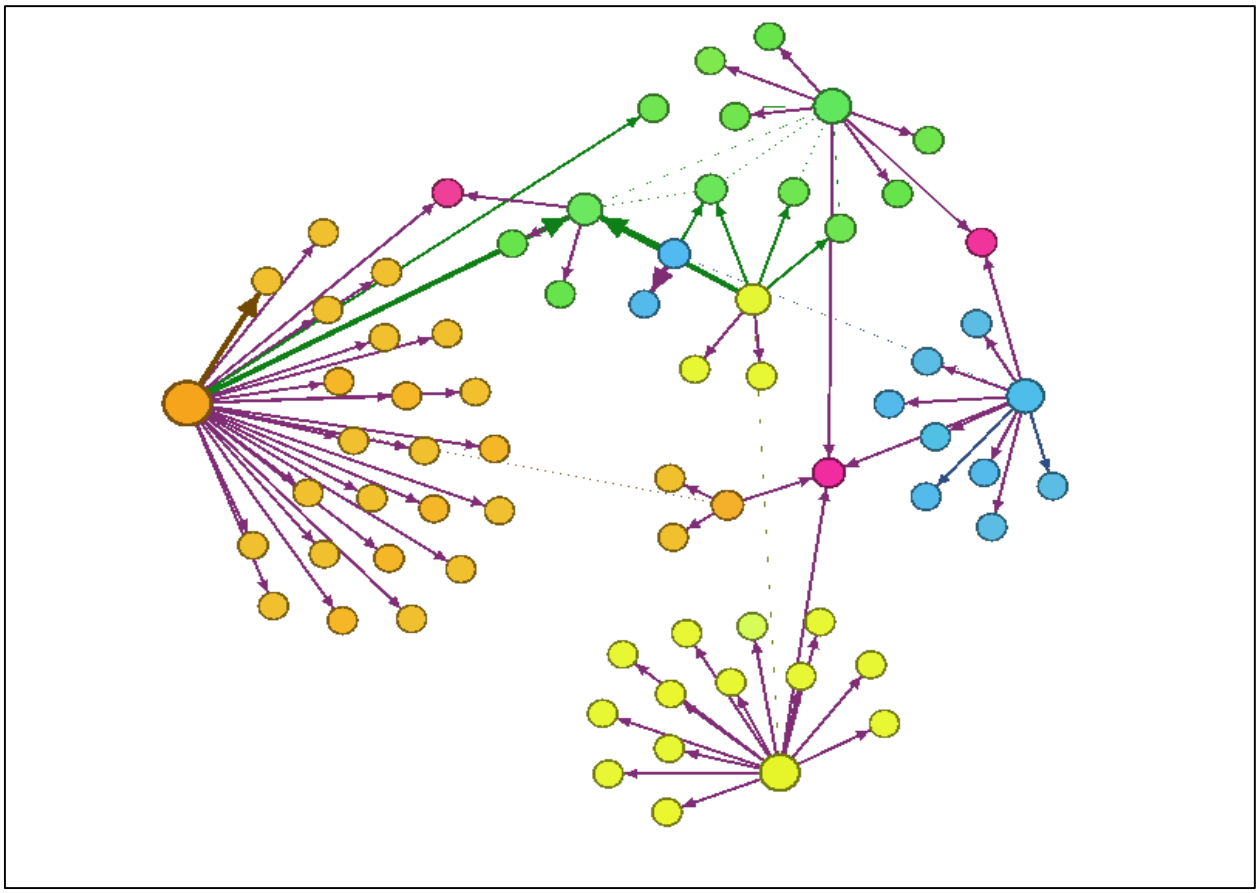


Figure 1.1 B Force Atlas map with Wikipedia removed.

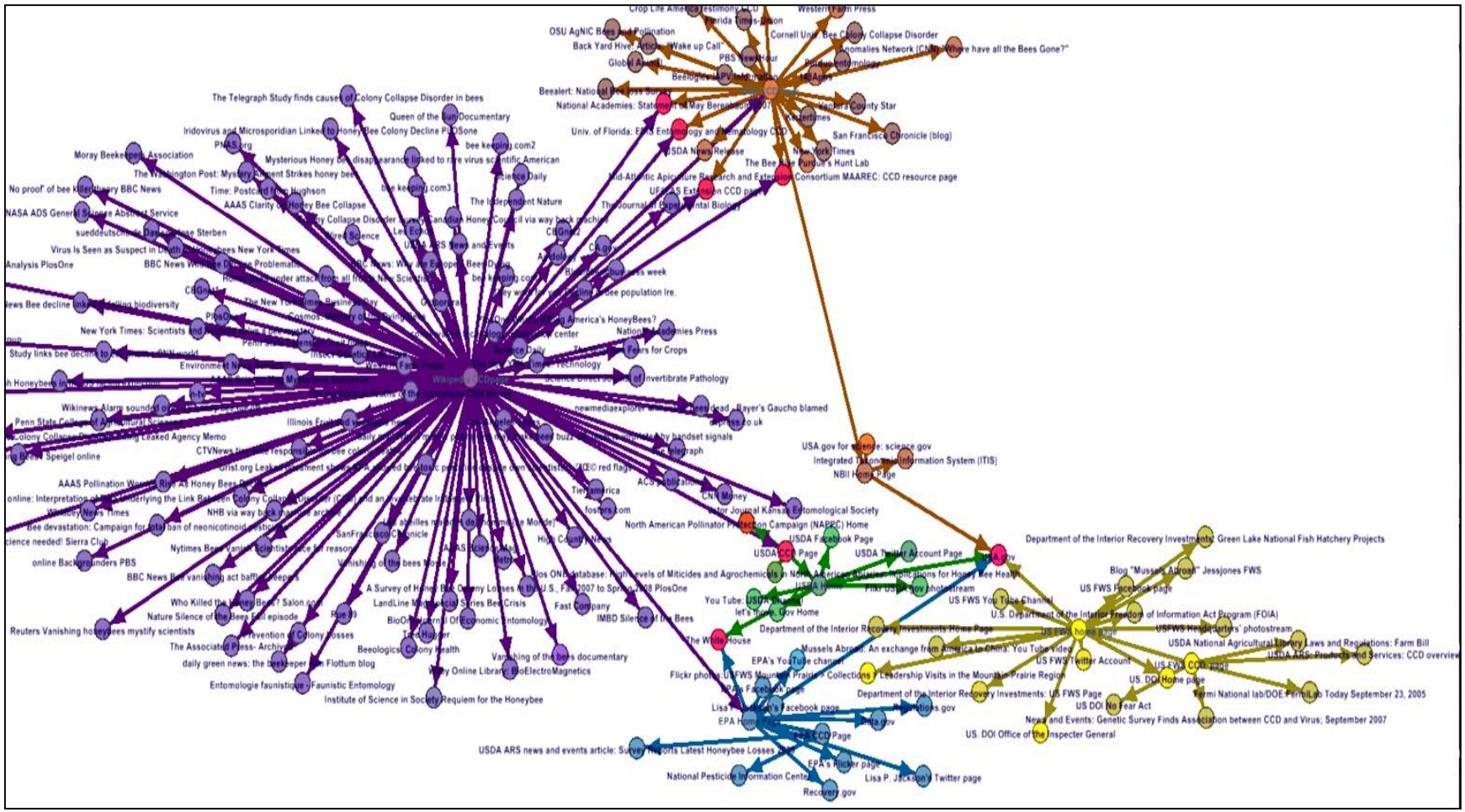


Figure 1.1 C Labeled map of network

The Force Atlas layout is a network analysis algorithm that is unique to Gephi. According to the developers Force Atlas is a "degree-dependant repulsion force that creates minimal visual cluttering" (Bastian et al. 2011, p. 2). Several different layouts and labeling techniques were applied to the node-edge relationship to understand the landscape of the study entities and their immediate neighbors.

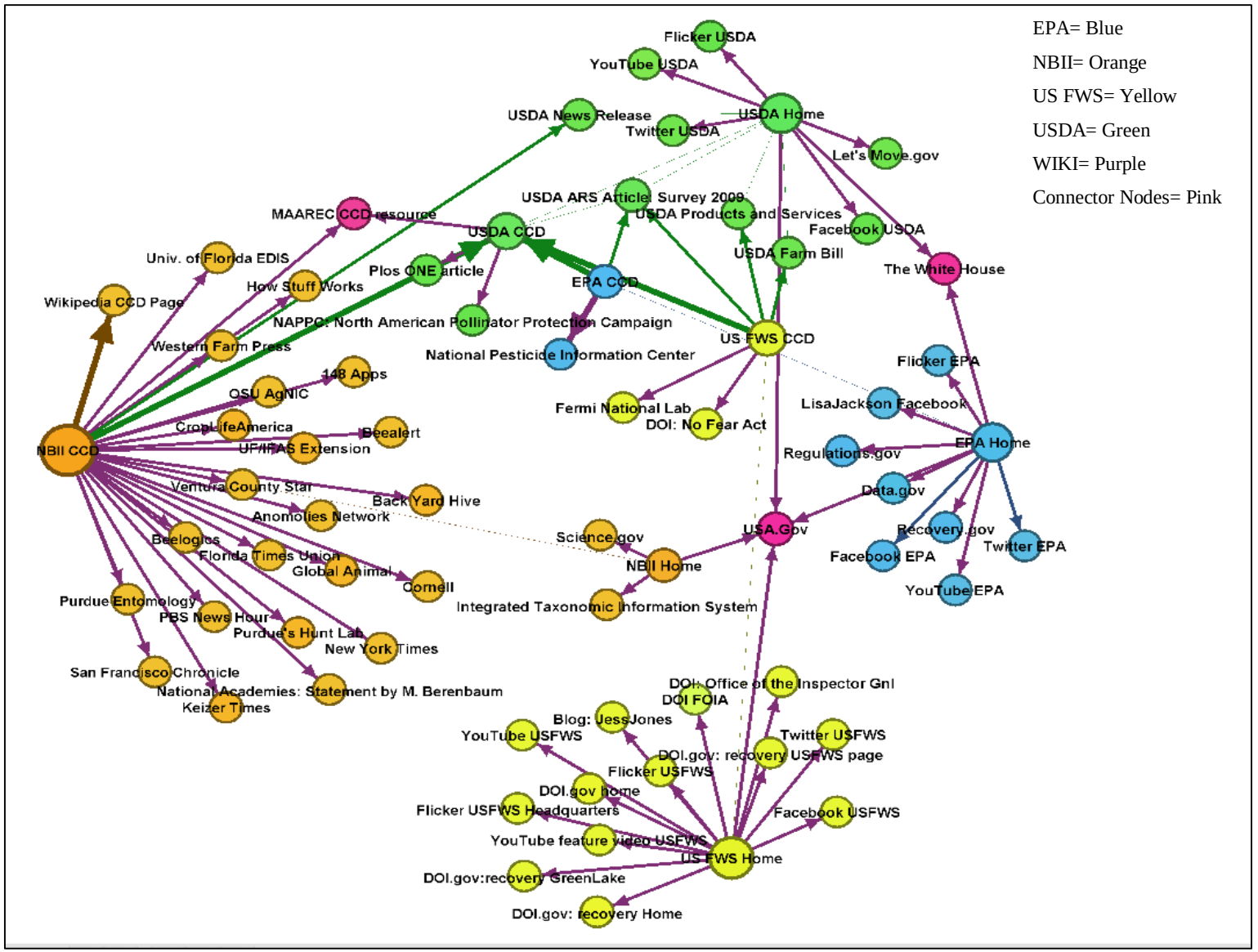
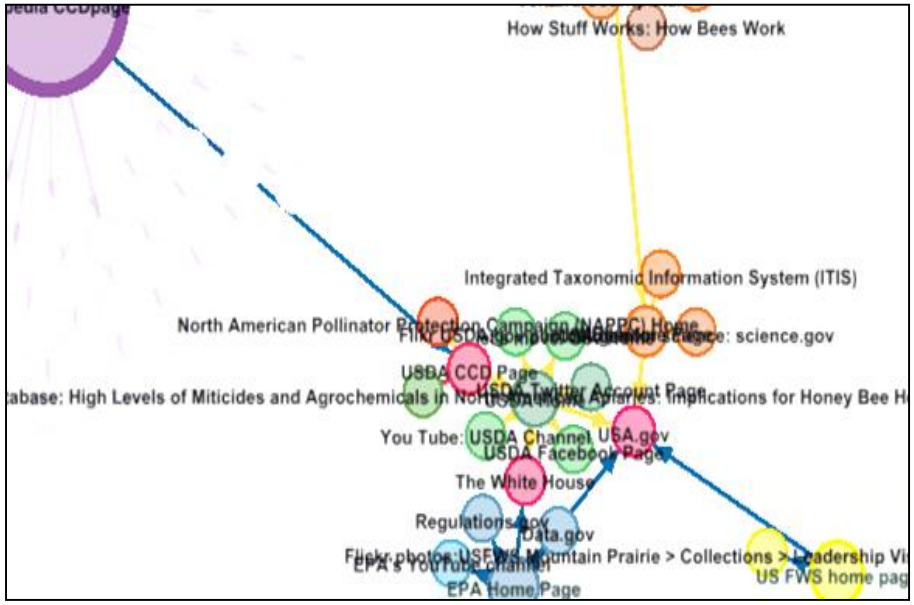


Figure 1.1 D Labeled Force Atlas map without Wikipedia.

The layouts used in the visualization include: Force Atlas, Force Atlas 2, Fruchterman Rheingold, Yifan Hu Proportional, Yifan Hu Multi-Level, and a dual circle layout. In addition to the full layout views, the program allows for selection of specific relationships. Views were created that isolate relationships. Results from the analysis are reported below.

1.2. SNA Results

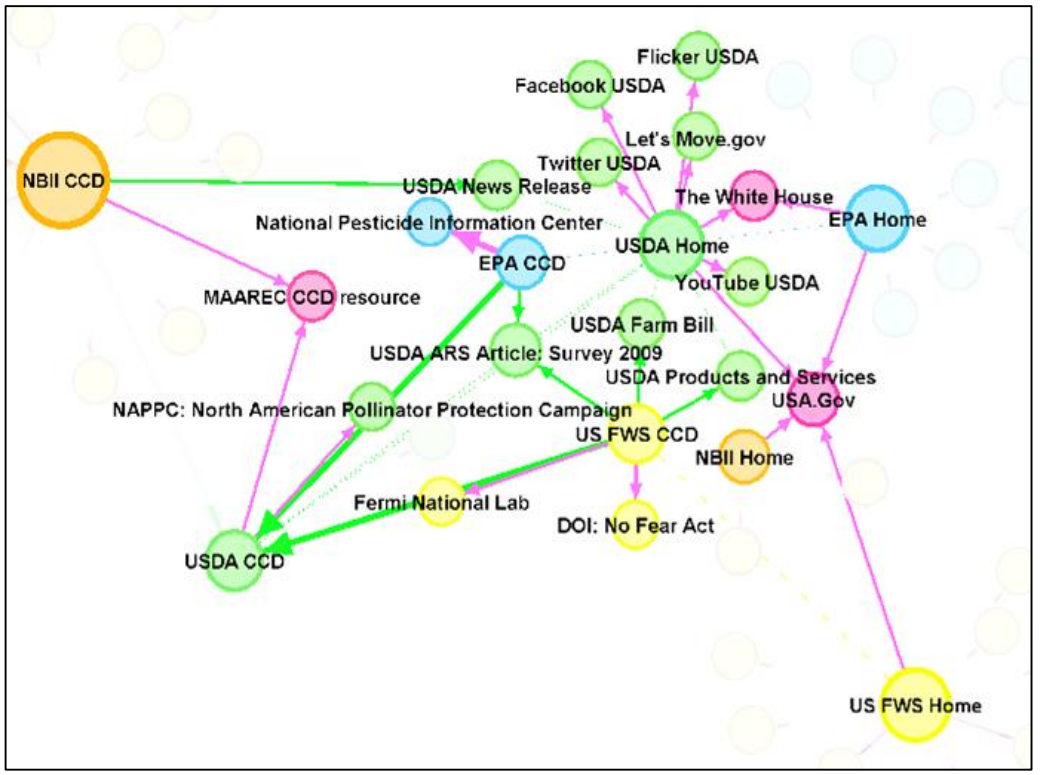
Wikipedia's CCD page and the NBII's CCD page have the greatest number of edges. Wikipedia has a total of one hundred and twelve edges and NBII has a total of twenty-five. This was a significant indicator that the resource lists and information hub design of these two entities created greater resource sharing among entities, and even outside of the federal government information network. *The USDA has the least number of edges.* This is indicative of their lack of external connections and their tendency to link to internal resources. The majority of the USDA nodes are shared. This means that they are the entity to which other entities frequently link. Figure 1.2 A illustrates the directed relationships to USDA's nodes.



EPA= Blue
NBII= Orange
US FWS= Yellow
USDA= Green
WIKI= Purple
Connector Nodes= Pink

Figure 1.2 A Directed relationships from entities to USDA nodes.

In this example the USDA CCD page is highlighted in pink to differentiate from the USDA home.



EPA= Blue
NBII= Orange
US FWS= Yellow
USDA= Green
WIKI= Purple
Connector Nodes= Pink

Figure 1.2 B Major external connection nodes.

The pink color of the node in figure 1.2 B signifies a shared entity that is independent of the main entities in the analysis. All three pink nodes are links from the USDA and another entity. The external connections shown in figure 7.2 B are the MAAREC CCD page, *USA.gov*, and the White House website. This shows that the information from the entities may be shared indirectly by both referencing a resource external to the entity.

Other major external connection nodes exist between the Wikipedia CCD page and the NBII CCD page. Figure 1.2 C highlights the four entities that are linked from the two main entities.

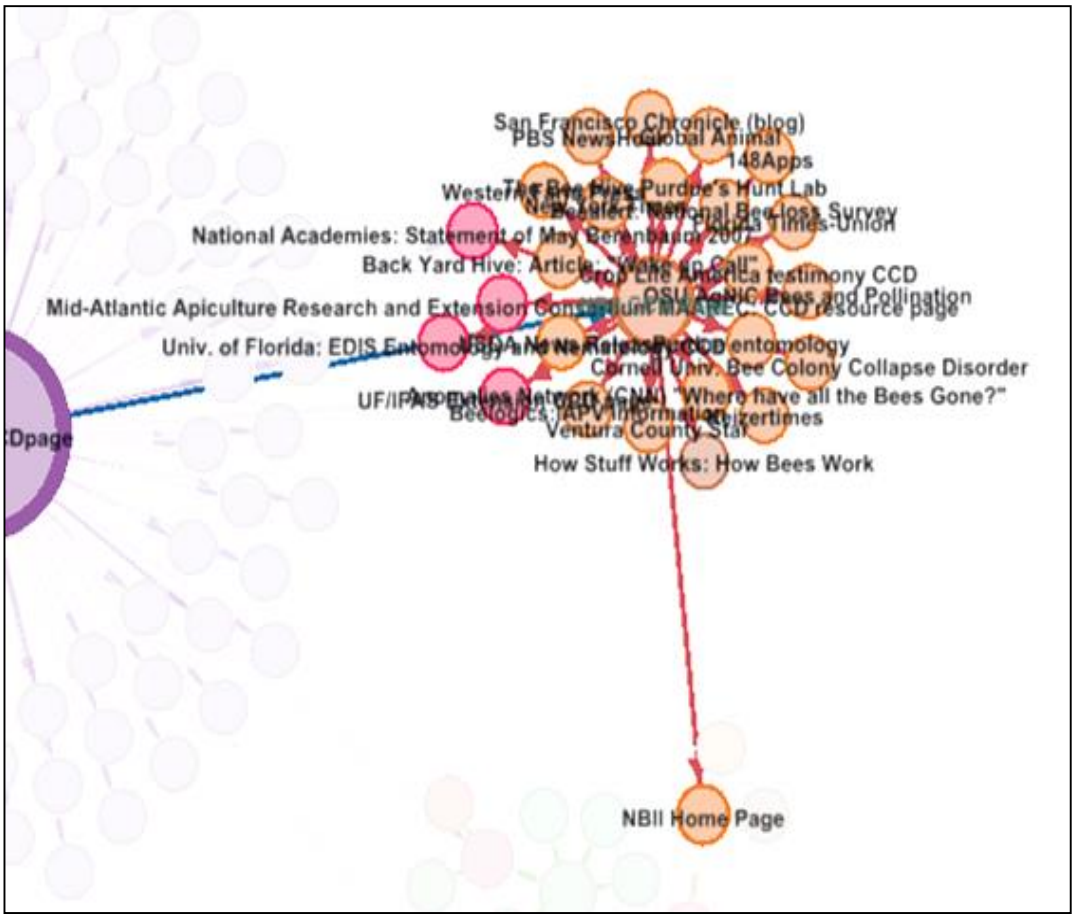


Figure 1.2 C Connections between Wikipedia and the NBII.

The four pink nodes in figure 1.2 C represent the following entities: The National Academies; Statement of Mary Berenbaum to Congress from 2007, the Mid-Atlantic Apicultural Research and Extension Consortium (MAAREC) home page, the University of Florida EDIS Entomology and Nemotology CCD page, and the University of Florida/IFAS Extension CCD page. These pages are external links from Wikipedia's CCD page and the NBII's CCD page. MAAREC also shares a connection through the NBII and the USDA. This shows the importance of other external resources in the network of information. Figure 1.2 D shows MAAREC's relationship between the NBII and the USDA.

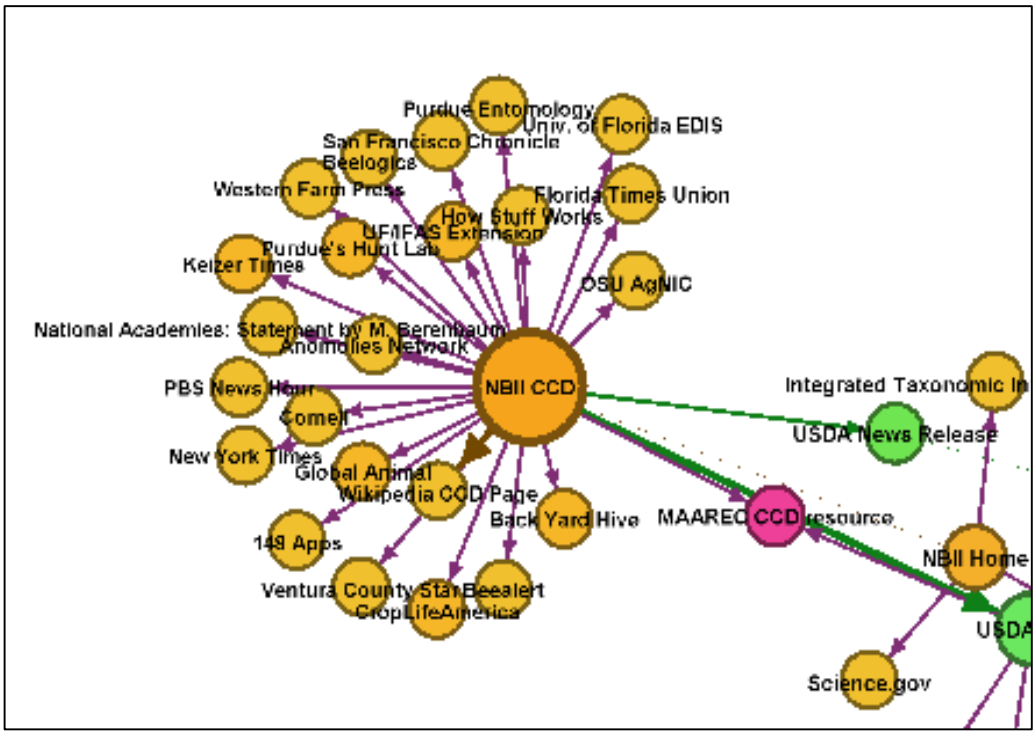


Figure 1.2 D Connection node MAAREC with Wikipedia removed.

It should be noted that the US FWS does not share any edges with Wikipedia. This means that *information seekers who access the US FWS would not be exposed to the myriad resources available through Wikipedia*. All other entities have at least one link in common with the Wikipedia CCD page. The Wikipedia home page was naturally not connected directly to any other entities. *Wikipedia's CCD page has the most directed nodes with no link relationship to the federal government entities*. The directed nature of the nodes and the scope of the study limit the analysis to the main entity nodes and one external link. Deeper network node connections were not explored. Four of the five entities link to *USA.gov*. Wikipedia does not have a direct link. This is natural considering the unaffiliated nature of Wikipedia. None of the CCD pages have a direct link. Figure 1.2 E shows this relationship between the government entity homepages and the *USA.gov* Web site.

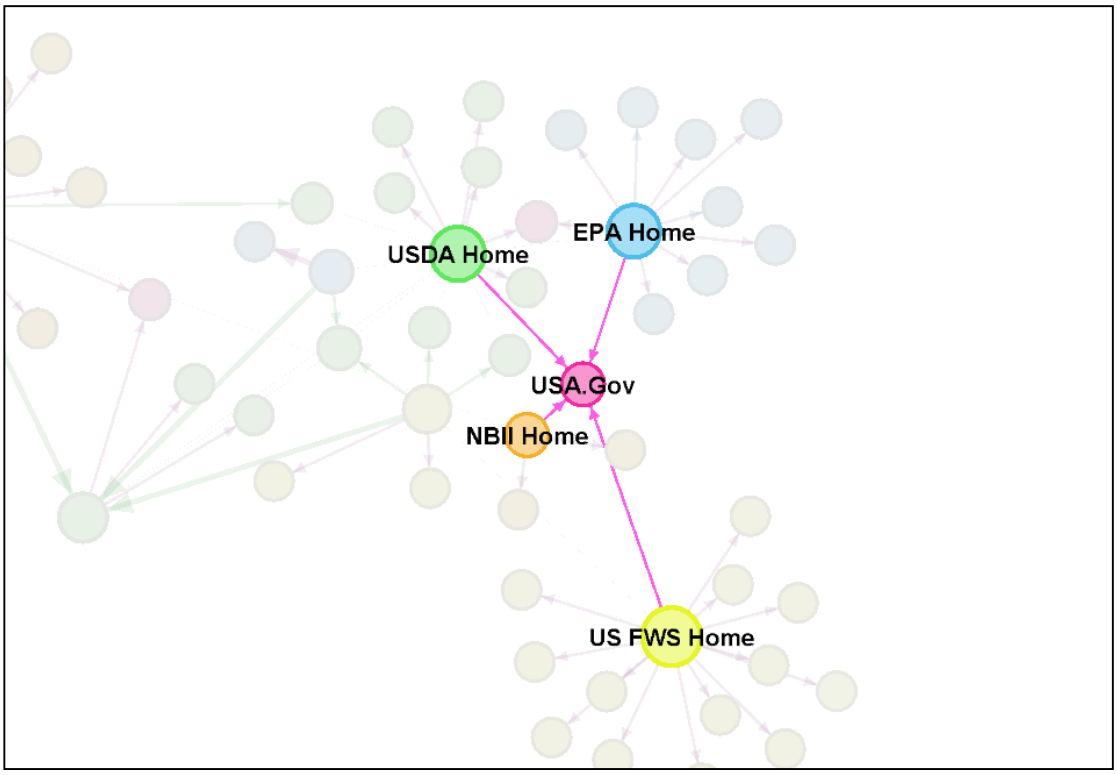


Figure 1.2 E Connections to *USA.gov*.

In figure 1.2 F all other non-government entity nodes relationships were left out in order to visualize the four government entities by degree. *The USDA's CCD page becomes the central node among the entities.* From yellow to green to pink, the figure below illustrates the connectivity of each node. From this visualization it is apparent that the USDA CCD has the greatest degree of linking nodes and links to only one, the USDA home page.

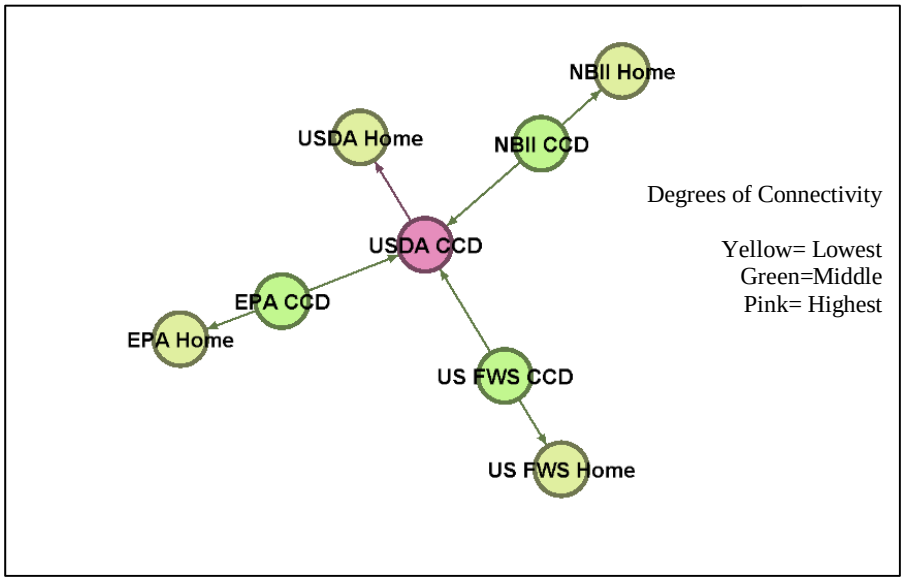


Figure 1.2 F Centrality of the USDA CCD page.

2. Overall Entity Results

2.1. Information Topics

There were a total of twelve information topics established and defined for data collection. The topics included: definition of CCD, potential causes, proposed solutions, consequences of CCD, importance of honeybees, future research, current research, myths, uncertainties, controversy, institutional focus, and public participation. Each of the twelve topics had between four and eight possible subtopics that defined each topic. There were a possible total of sixty-two subtopics that could be addressed by an entity. A score of sixty-two would denote comprehensive coverage for this analysis. Figure 2.1 A shows the amount of subtopics per topic for each entity.

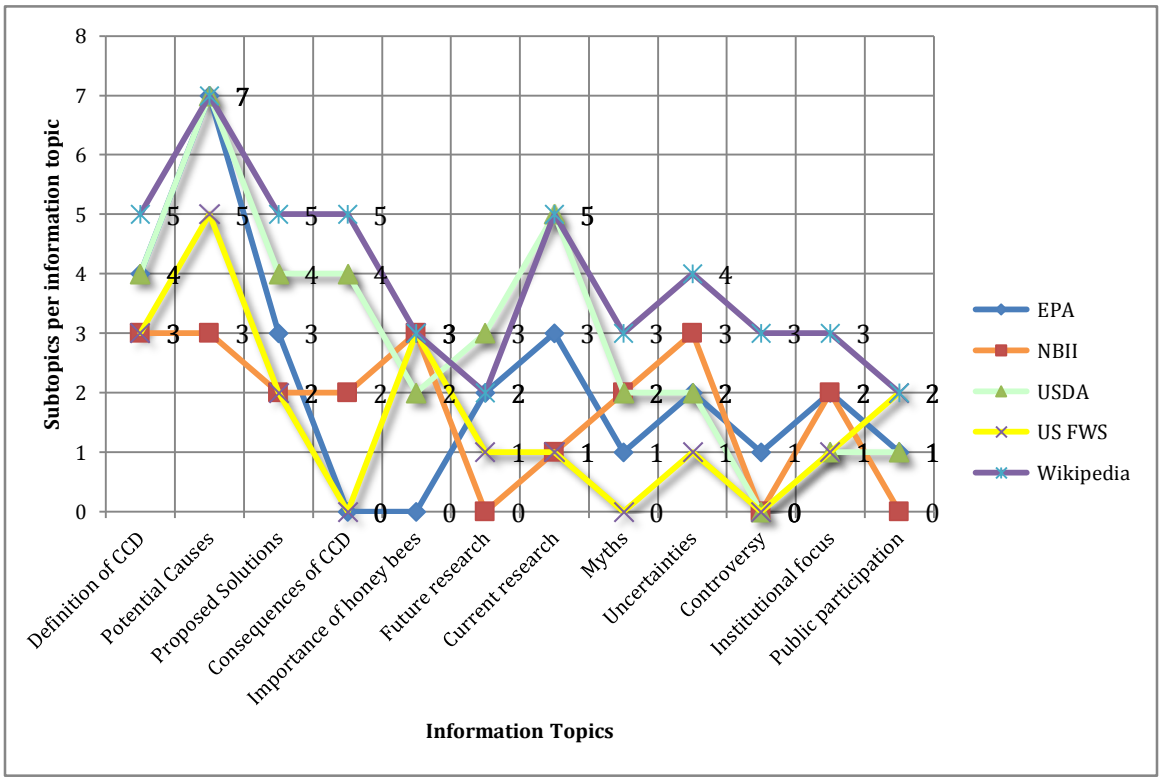


Figure 2.1 A Information Topics for all 5 entities.

No entity reached the full capacity of topic coverage. *Potential causes had the most subtopics addressed of all topics while public participation had the least amount of subtopics addressed*. The EPA, the USDA and Wikipedia all addressed seven potential cause subtopics. Public participation subtopics were addressed by four of the five entities. The NBII did not address any of participatory subtopics. The US FWS and Wikipedia both addressed two and the EPA and the USDA both addressed one. A second topic with little coverage was controversy. Three of the five entities did not address any subtopics relating to controversy, however Wikipedia covered three and boosted the overall topical coverage amount slightly

greater for controversy. The EPA was the only other entity that addressed a controversy subtopic. Wikipedia was the most comprehensive in topic coverage overall. No other entity covered all the topics. Figure 2.1 B shows the topic coverage percentile for all the five entities.

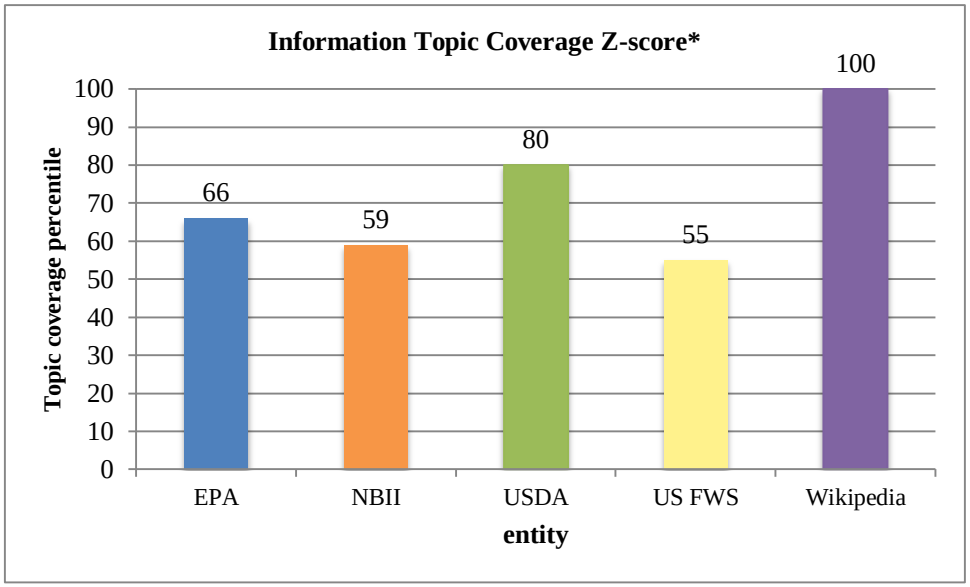


Figure 2.1 B Information topic coverage for all 5 entities.

*****Note that since no entity scored at full topic coverage potential Wikipedia, the highest scoring entity, was set as the standard to show the percentiles within context of the network of available information.

All entities scored above the fiftieth percentile. Instances of topical weaknesses and strengths occurred among the entities. US FWS covered the least amount of subtopics. The EPA was the lowest in discussion of the importance of honeybees and the consequences of CCD, but it was one of the highest in addressing the possible causes of CCD. The EPA scored at sixty-six percent. The USDA had the most content about current and future research but the entity was one of the lowest in aspects of controversy and institutional focus. The USDA scored eighty percent overall. The NBII and the US FWS had the least amount of information in all topics except for the importance of honeybees with fifty-nine and fifty-five percent respectively. Wikipedia was consistently high or one of the highest in all topics except future research. This shows the similarities in content amount for the EPA, the NBII and the US FWS. From the standpoint of the federal agency entities, the USDA had the most content, but the results show the major difference in quantity that a resource such as Wikipedia can have.

2.2. Information Types

There were a total of nine information types established and defined for the data collection. Information types included: basic information, frequently asked questions, latest news, feature stories,

government and official documents, scholarly research articles, data visualization, administrative information, and resource lists. Each type scored a point when the types were used to address an information topic. Figure 2.2 A shows the frequency an information type was used by each entity.

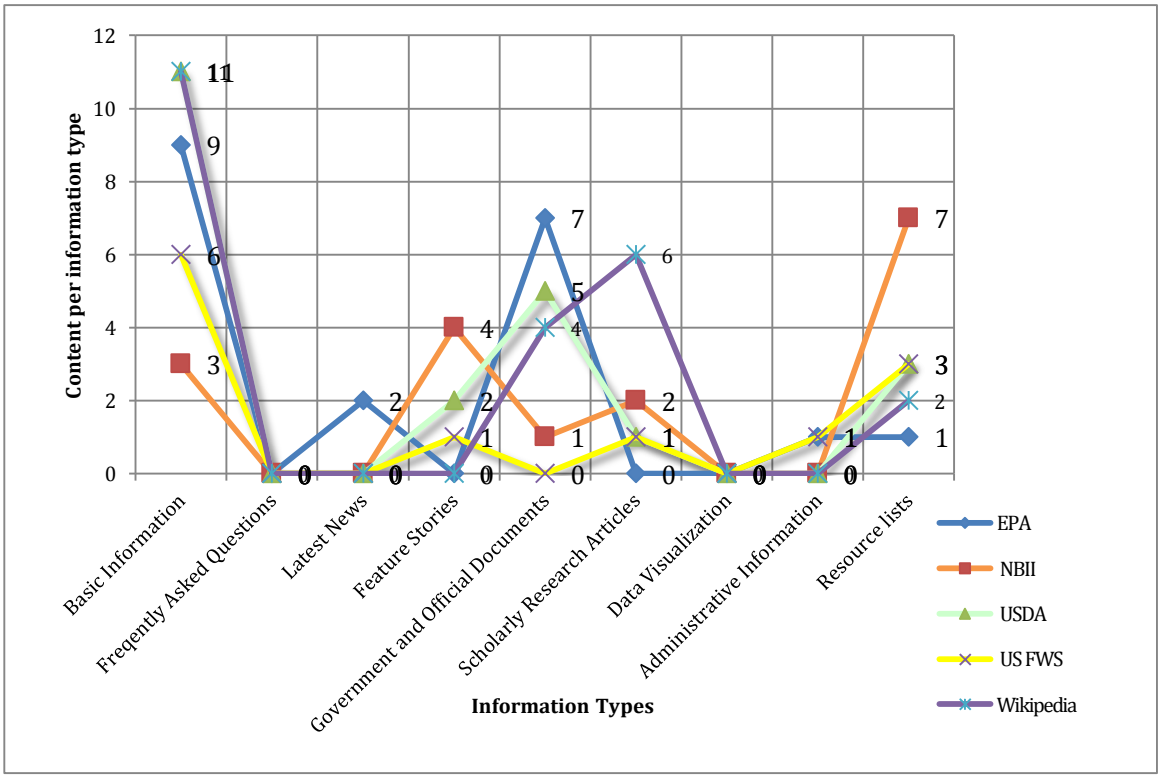


Figure 2.2 A Information types for all 5 entities.

The type of information most commonly used was basic information. There were two types of information types that were not used in any instance. These types were frequently asked questions and data visualization. This indicates there were no graphs or charts for the pages and there was little to no instances of users asking questions of the entities. Resource lists were the only other information type that was used by all entities. Other commonly used types included government and official documents and scholarly research articles. *The five entities were more equally matched in the amount of information types used than by the topics that they covered.* Wikipedia used the most overall because it had the most content, however the entity that had the most diverse amount of types used was the USDA. Figure 2.2 B shows the overall percentage of topics used.

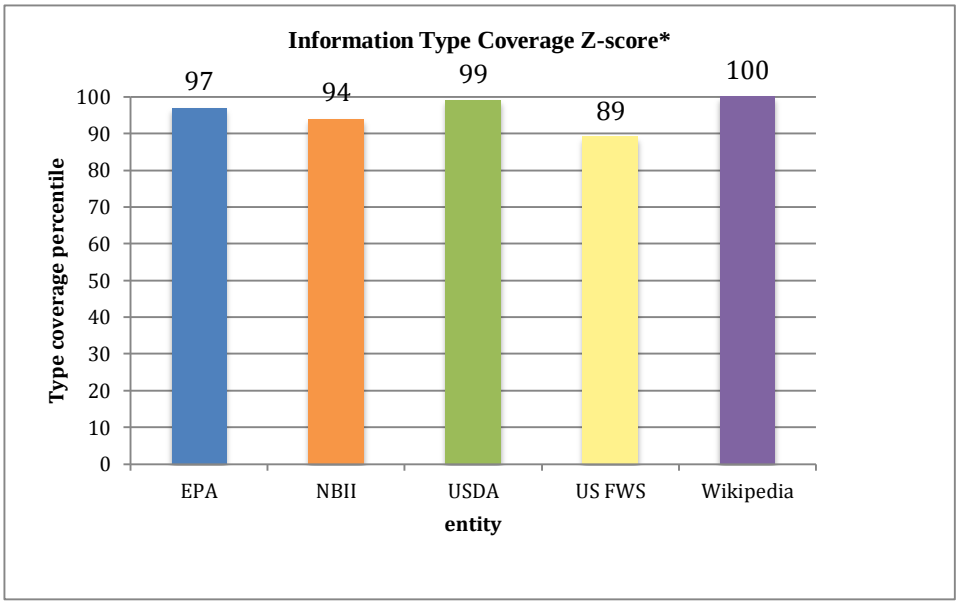


Figure 2.2 B Information type coverage for all 5 entities.

***Note that since no entity scored at full topic coverage Wikipedia, the highest scoring entity, was set as the standard to show the percentiles within context of the network of available information.

Instances of specific type strengths and weaknesses existed among the entities. The EPA had the most amounts of latest news and government document types with the least amount in scholarly articles and resource lists. The EPA scored ninety-seven percent overall. The NBII had the greatest amount of resource lists as well as feature stories, but the lowest amount of basic information. The NBII scored ninety-four percent. The US FWS had no government document information types while all other entities provided at least one. The US FWS scored eighty-nine percent. Wikipedia had the greatest amount of scholarly articles and was only slightly greater in the overall amount of information types used. Since no entity scored at full topic coverage Wikipedia, the highest scoring entity, was set as the standard one hundred percent to show the percentiles within the context of the network of available information.

2.3. Information Formats

There were a total of nine information formats established and defined for data collection. Each of the nine formats scored a point when the format was used to address an information topic. The formats included: embedded text, images, audio, multimedia, data files, internal links, external links, PDF files, and interactive applications. Figure 2.3 A shows the frequency with which each format was used by the five entities.

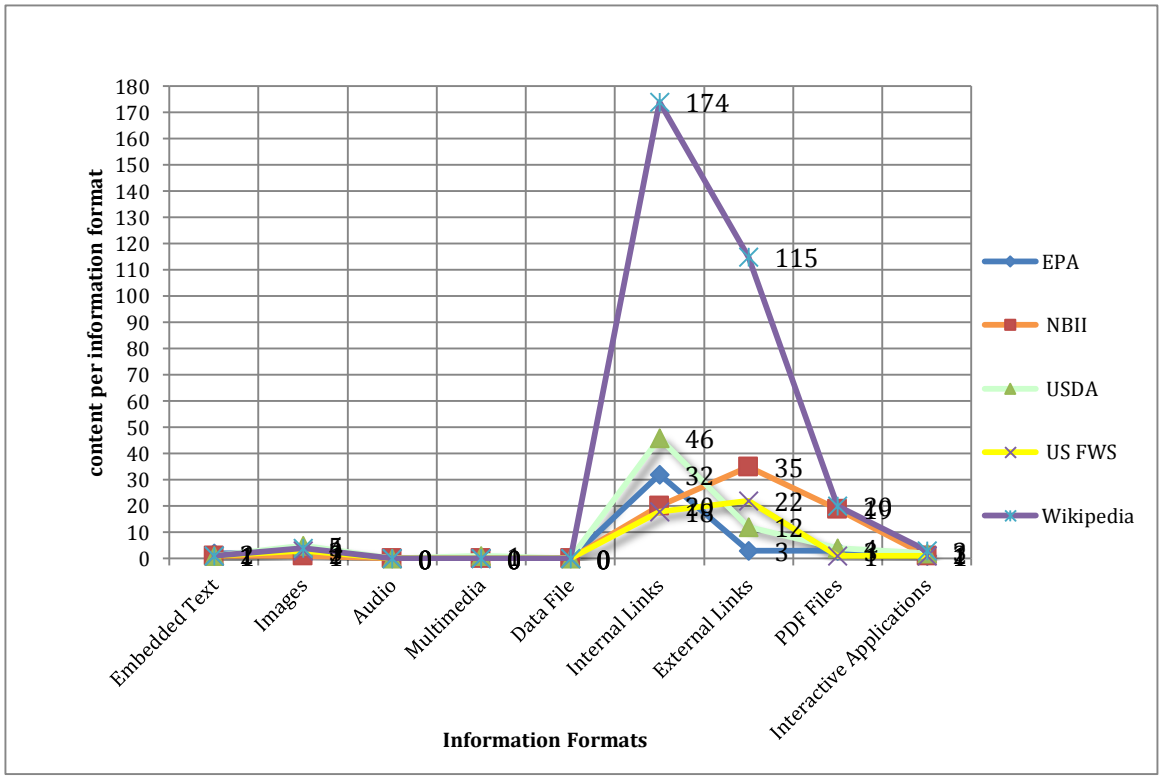


Figure 2.3 A Information formats for all 5 entities.

The information format most commonly used was the internal link. The least used information formats included audio, multimedia, data files, and interactive applications. No entity used these formats. Two other frequently used formats were external links and pdf files. Wikipedia had the most format usage instances with a total of three hundred seventeen because the entity had the most content and a very high number of both internal and external links. The other entities, the federal government non-wiki entities, were more equally matched in the amount of format usage. The EPA was the entity with the least amount of formats used with an amount of forty-three. The variety of formats employed was also almost equal. Wikipedia and the USDA both had slightly higher variety in formats used. Figure 2.3 B shows the amount of formats used overall per entity.

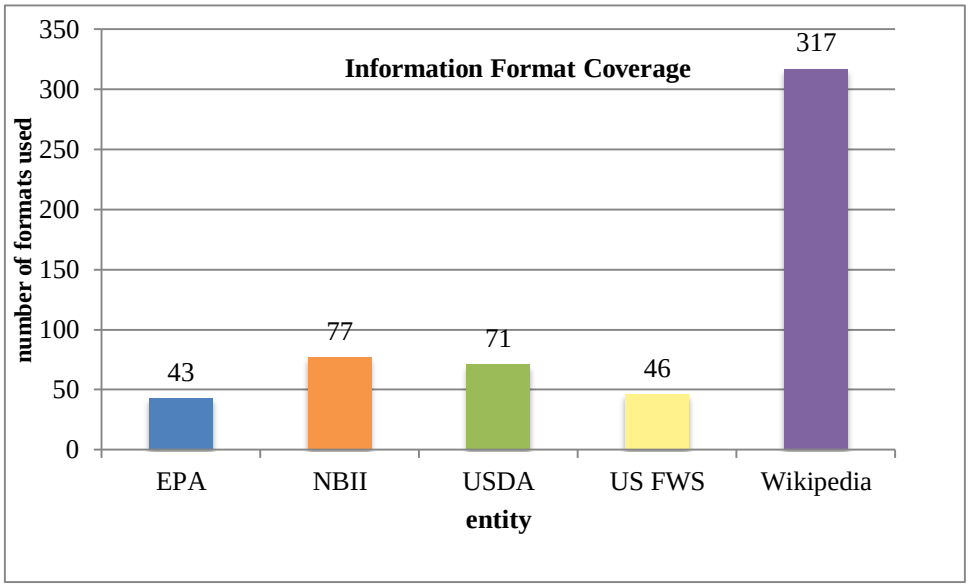


Figure 2.3 B Information format coverage for all 5 entities.

* Note that the numbers display amount total and not percentile. The large disparity between Wikipedia and the other four entities made a percentile visual impossible.

2.4. Information Quality

The following figure, 2.4 A, shows the average percentages of IQ for each entity based on the five IQ components: information accuracy, source authority, information currency, usability and design and interactivity and public engagement.

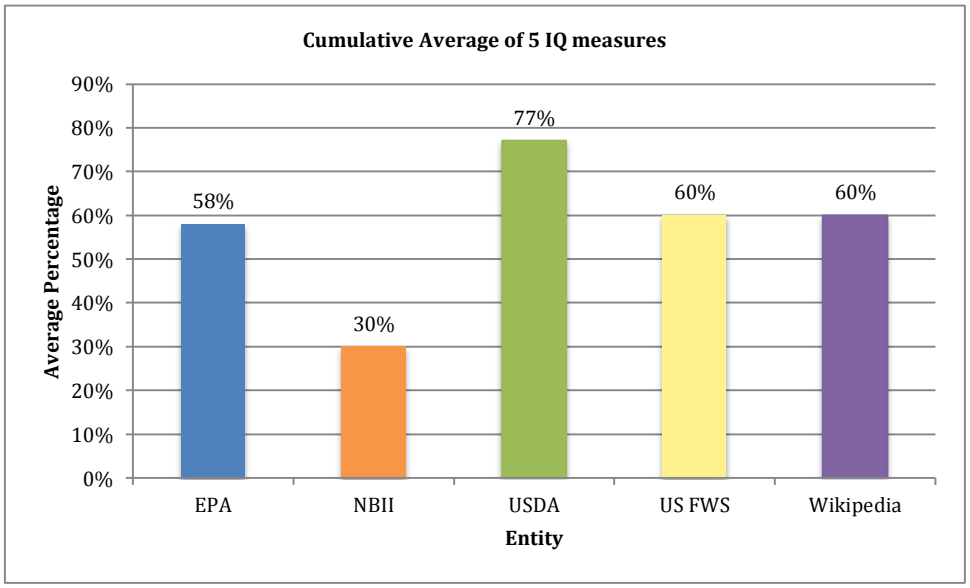


Figure 2.4 A Cumulative average of 5 IQ measures for all 5 entities.

The USDA had the most consistently high IQ scores for the five measures with seventy-seven percent. NBII had the least amount of consistent IQ scores overall with thirty-percent. The other three

entities had averages above fifty percent. The EPA had fifty-eight and the US FWS and Wikipedia both had sixty percent. Thus, the middle three were almost equal in score. In proportion with the disparity in the amount of available content it is easy to see the difference in the measures of information quality versus topic quantity when comparing Wikipedia with the federal government entities.

2.4.1.Information Accuracy

There were a total of three information accuracy measures established and defined for the data collection. These measures included: the content had no known errors, the content had no misinformation, and the page delivered what it promised. Each entity scored an information accuracy point when the information topic addressed delivered the defined accuracy measure. Each entity had the potential to earn a total of thirty-six information accuracy points. Figure 2.4 B shows the percentages each entity scored for information accuracy measures.

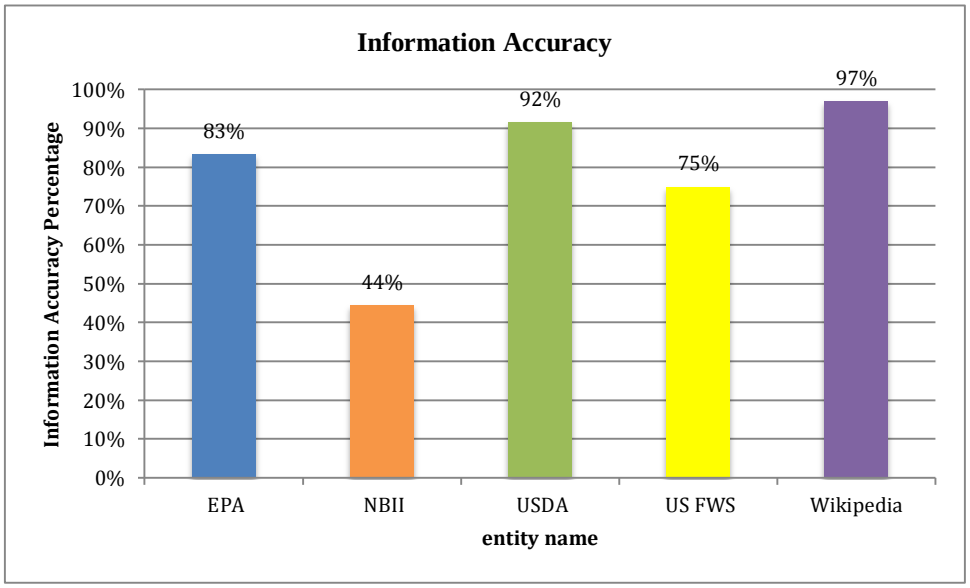


Figure 2.4 B Information accuracy percentages.

All entities scored above fifty percent except for the NBII, which had forty-four percent. This score was indicative of content errors on the page. Wikipedia scored the highest with ninety-seven percent. The USDA was also in the ninetieth percentile, scoring ninety-two percent. The EPA scored eighty-three and the US FWS scored seventy-five percent. Instances of specific information accuracy strengths and weaknesses existed among the entities. Figure 2.4 C shows the three specific information accuracy measures for each entity.

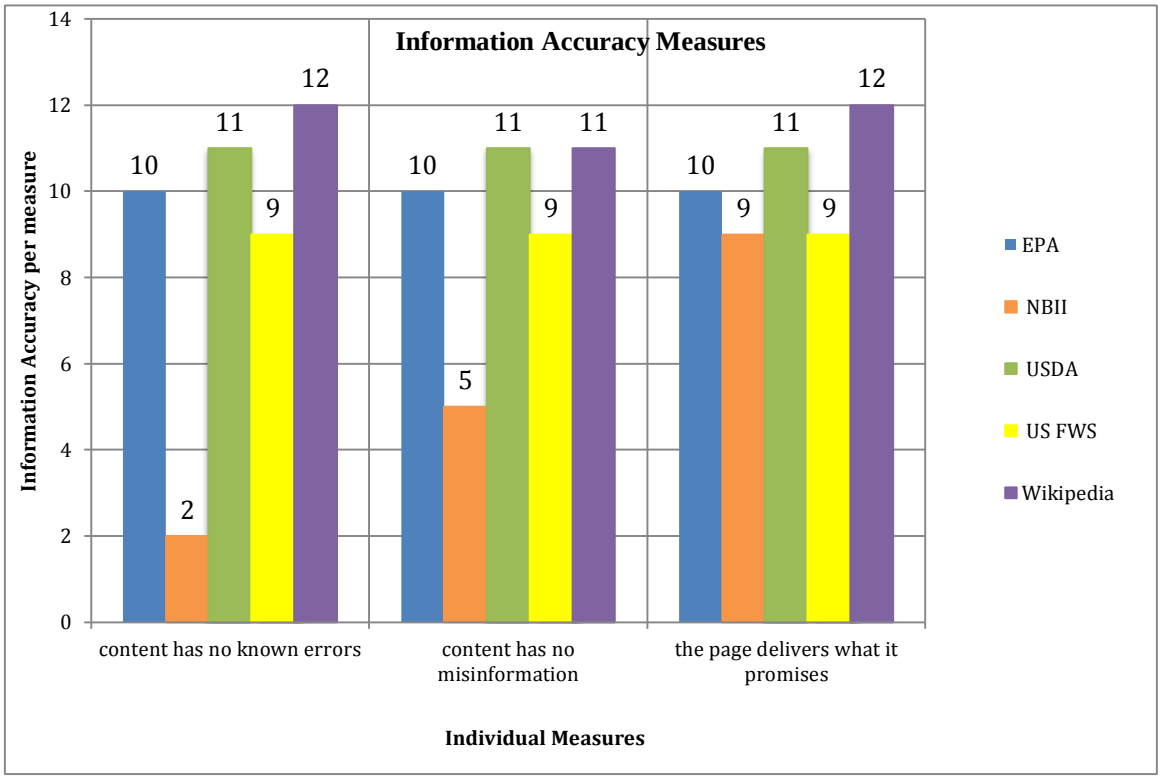


Figure 2.4 C Layout of information accuracy measures.

The NBII scored the lowest in content has no known errors. The USDA, the EPA and the US FWS were consistent across all three measures. Wikipedia had an instance of misinformation that lowered the entity's accuracy score by one point.

2.4.2.Source Authority

There were a total of three source authority measures established and defined for the data collection. Source authority measured included: the authorship was disclosed, the contact information was provided and the institutional affiliation was cited. Each entity scored an information accuracy point when the information topic addressed delivered the defined source authority measure. Each entity had the potential to earn a total of thirty-six source authority points. Figure 2.4 D shows the percentages each entity scored for source authority measures.

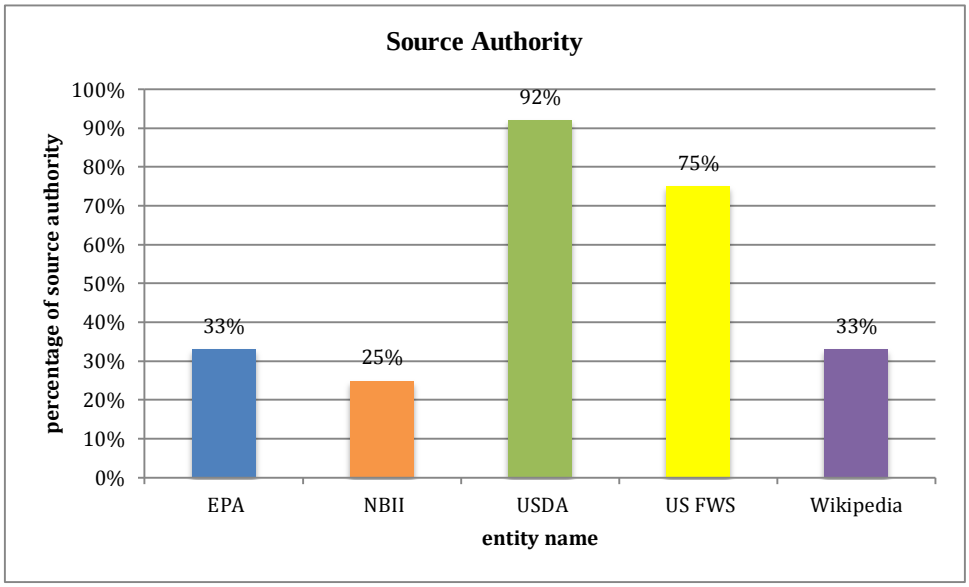


Figure 2.4 D Source authority percentages.

The USDA and the US FWS scored above fifty percent in source authority with ninety-two and seventy-five percent respectively. The lowest scoring entity was the NBII with twenty-five percent. Wikipedia and the EPA both had thirty-three percent. This shows Wikipedia's lack of source authority given that the amount of content for Wikipedia is much greater than it is for EPA. Instances of specific source authority strengths and weaknesses existed among the entities. Figure 2.4 E shows the three specific source authority measures for each entity.

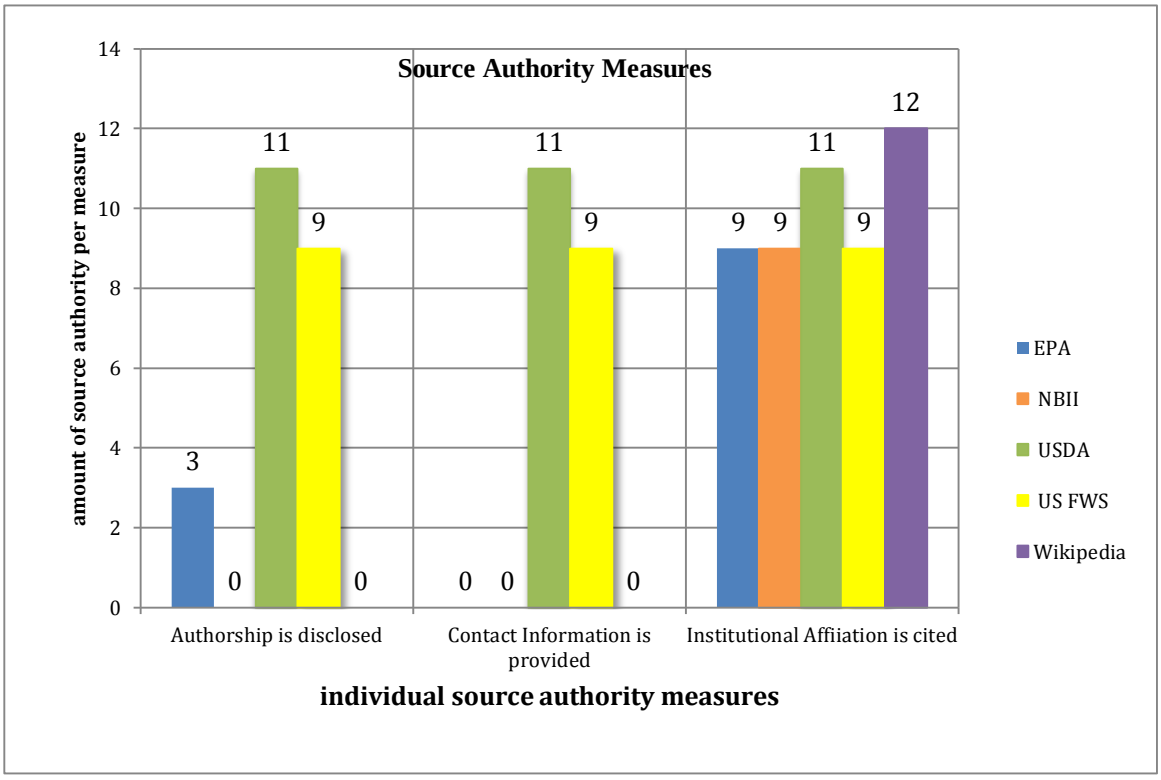


Figure 2.4 E Layout of source authority measures.

The USDA and the US FWS are consistent through out all three specific measures. The NBII and Wikipedia did not score points for authorship disclosure or provision of contact information. The EPA also scored low in these two measures of source authority. Only the USDA and the US FWS provided contact information. This suggests that the perceived source authority measure of greatest importance is that of institutional affiliation.

2.4.3.Information Currency

There were a total of three information currency measures established and defined for the data collection. Information currency measures included: the page had no broken links, the page had been updated in the past two years since August of 2011, and the page had no information about cancelled programs. Each entity scored an information currency point when the information topic addressed delivered the defined currency measure. Each entity had the potential to earn a total of thirty-six information currency points. Figure 2.4 F shows the percentages each entity scored for information currency measures.

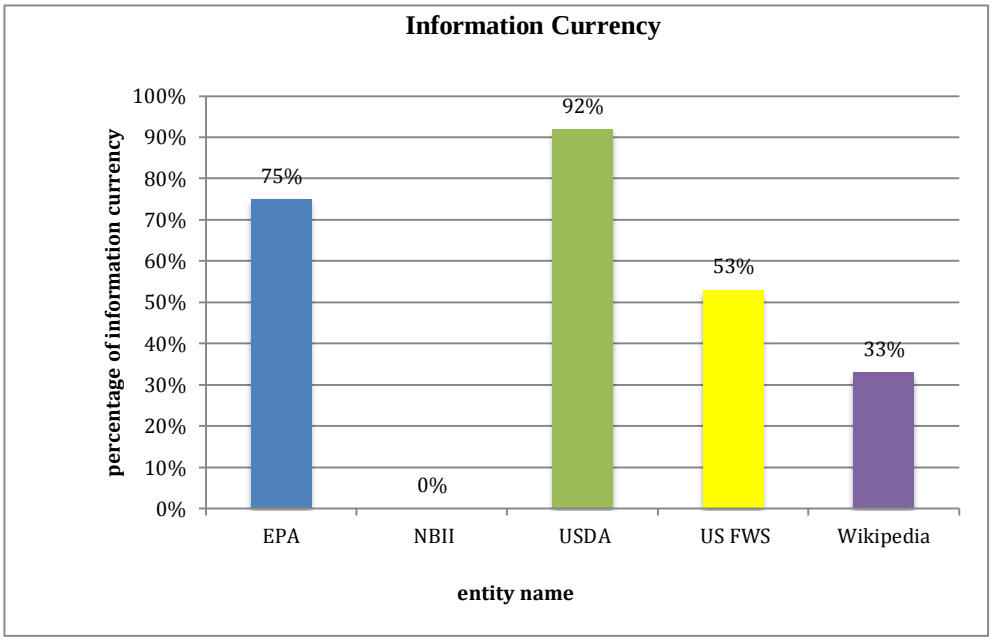


Figure 2.4 F Information currency percentages for all 5 entities.

The USDA scored the highest in currency with ninety-two percent. The NBII did not score any points for information currency. Three of the five entities scored above fifty percent. The EPA scored seventy-five percent. The US FWS scored fifty-three percent and Wikipedia scored low with thirty-three percent. This shows the difference in information currency between the pages that have information in the form of resource lists and those who provide basic information as text on the page. The two with the information lists, NBII and Wikipedia, had lower information currency scores. Instances of specific currency strengths and weaknesses existed among the entities. Figure 2.4 G below shows the three specific information currency measures for each entity.

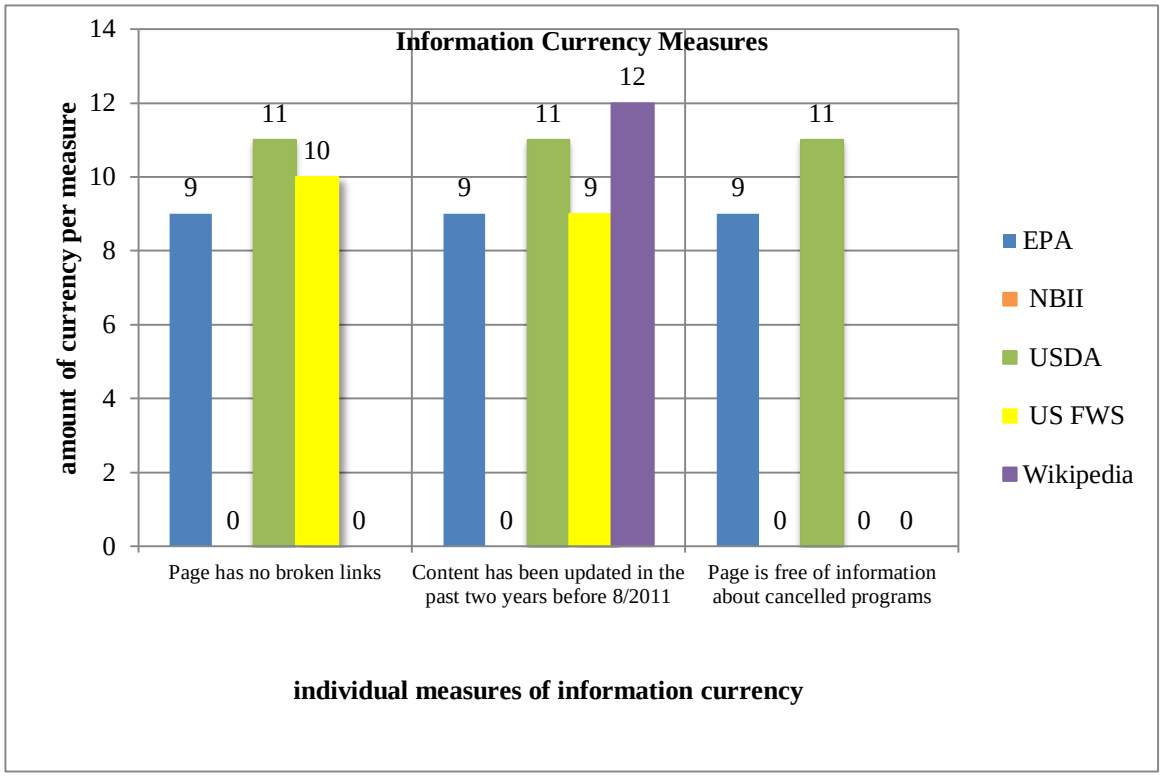


Figure 2.4 G Layout of information currency measures.

The EPA and the USDA are consistent in their fulfillment of the established currency measures with a score of nine and eleven respectively. US FWS did not score in page has no information about cancelled programs. Wikipedia scored highest in the measure of content has been updated with a score of twelve, however the entity did not score in the other two measures. This shows that while Wikipedia is constantly being updated there is not a way to ensure that the updated content is accurately current or to determine without constant monitoring which topic is or is not being updated.

2.4.4.Usability and Design

There were twelve components established and defined to evaluate the design and usability measures for the purposes of data collection. These components included: A simple search engine was included, PDFs were reserved for manuals and big documents, the visited links changed color, the text was written for online reading and supported scan ability, the font size was not fixed or too small, the page titles were descriptive and short, there were no animations advertisements or pop-ups, the design was consistent with the other web pages and sites, links worked as simple hyper-text reference, answers and main ideas were visible as such, the page supported navigation and the look and feel were pleasing. Each entity scored a point for the measure if the overall content on the page fulfilled the specific component as defined by the study. Figure 2.4 H shows the usability and design percentiles for all five entities.

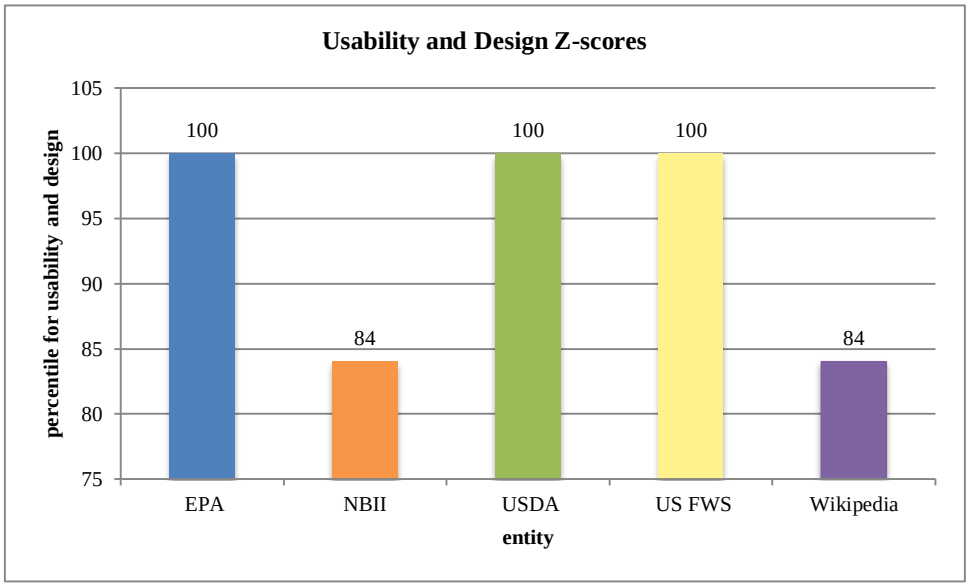


Figure 2.4 H Usability and design percentiles for all 5 entities.*

*Note that since no entity scored at full topic coverage Wikipedia, the highest scoring entity, was set as the standard to show the percentiles within context of the network of available information.

The EPA, the USDA, and the US FWS all scored in ten out of the twelve categories. All entities scored in the top fiftieth percentile in usability and design measures. The NBII and Wikipedia scored equally with eighty-four percent when the other three top scoring entities were set as the standard one hundred percent. This usability and design weakness is indicative of the similarity between the NBII and Wikipedia. The NBII was designed as a resource repository for biological research from agencies and their partnerships around the country (Sepic & Kase, 2002). Like Wikipedia, the collection of resources from external sources creates a variance in information quality measurements. Instances of specific design and usability strengths and weaknesses existed among the entities. Table 2.4 A shows the specific usability and design measures for each entity.

Table 2.4 A Checklist for design and usability for all 5 entities.

Checklist for Design and Usability Definition	EPA	NBII	USDA	US FWS	Wiki
1. Simple search engine	1	1	1	1	1
2. PDFs are reserved for manuals and big documents	1	1	1	0	1
3. Visited links change color	1	1	1	1	0
4. Text is written for online reading and supports scan ability	1	1	0	1	0
5. Font size is not fixed nor too small	1	1	1	1	1
6. Page titles are descriptive and short	0	0	1	1	1
7. No animation, advertisements nor pop-ups	1	1	1	1	1
8. Design is consistent with other web pages and sites	1	1	1	1	1
9. Links work as simple hypertext reference, new windows do not open	1	0	1	1	1
10. Answers and main ideas are visible as such.	0	1	1	0	1
11.Navigation	1	0	0	1	0
12. Look and Feel	1	0	1	1	0

All entities provide a simple search engine, have a font size that is not fixed, are free from ads pop-ups and animation and the designs are consistent with the other pages and corresponding sites. Navigation has the lowest amount of entity scores. The NBII is the only entity with links that were not simple hypertext reference because the activated links opened up a new browser window. Wikipedia's visited links did not visibly change color. The US FWS was the only entity that did not reserve PDFs for large documents.

2.4.5.Information Interactivity

There were seven components established and defined to evaluate the information interactivity measures for the purposes of data collection. These components included: there was an available user support or help function, there was an advanced or user customized search option, there were open comment fields, there were interactive media or applications for wireless devices, there were applications for folksonomy or tagging, the page offered a web 2.0 component or endorsed a citizen science program and there were specific requests for citizen input on topics. Each entity scored a point for the measure if the overall content on the page fulfilled the specific component as defined by the study. Figure 2.4 I shows the interactivity percentiles for all five entities.

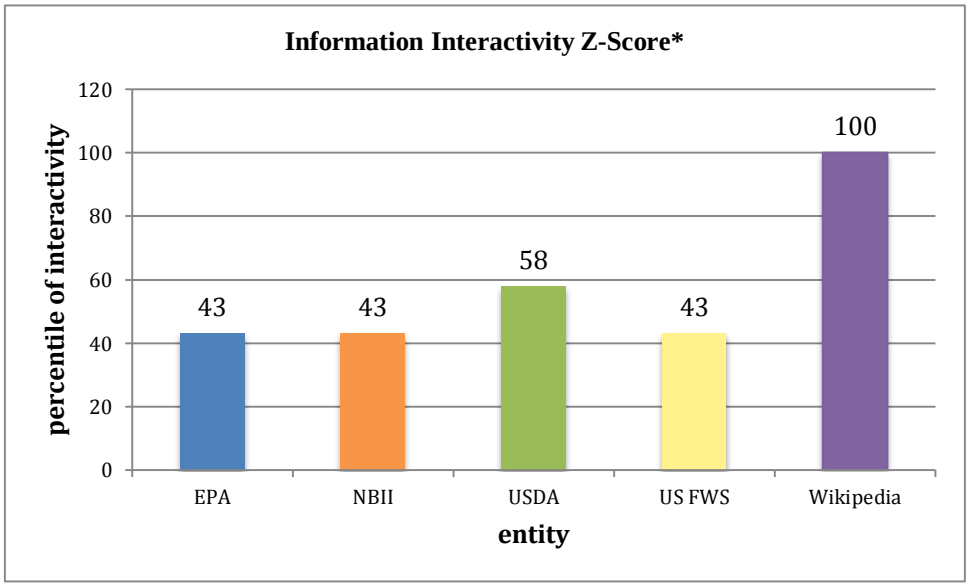


Figure 2.4 I Information interactivity percentiles for all 5 entities.

*Note that since no entity scored at full topic coverage Wikipedia, the highest scoring entity, was set as the standard to show the percentiles within context of the network of available information.

Wikipedia had the most measures of interactivity. Because none of the entities scored for all components of interactivity and public engagement, Wikipedia was set as the top percent. The USDA was the only other entity to score above the fiftieth percentile with fifty-eight. This shows the slightly more interactive nature of the USDA compared with the other government entities that all scored equally at forty-three percent. Instances of specific interactivity strengths and weaknesses existed among the entities. Table 2.4 B shows the specific checklist of information interactivity for each entity.

Table 2.4 B Checklist for interactivity and public engagement for all 5 entities.

Checklist for Interactivity and Public Engagement	EPA	NBII	USDA	US FWS	Wiki
1. User support/ help functions	0	1	1	1	1
2. Advanced or user customized search options	1	0	1	0	1
3. Open comment fields	0	0	0	0	0
4. Interactive media or applications for wireless devices	0	0	0	0	0
5. Folksonomy and tagging applications	0	0	0	0	1
6. Offers a web 2.0 component/ or endorses citizen science program	0	0	0	0	1
7. Specific requests for citizen input on topics	0	0	0	0	1

None of the entities scored in the categories of open comment fields and interactive media or applications for wireless devices. The EPA was the only entity that did not have user support or help functions. Wikipedia was the only entity that scored for having folksonomy or tagging applications, offering web 2.0 components, and specifically requesting citizen input on the topics.

2.5. The GIV citizen framework

Each entity in the study provided information to all citizen user groups as defined by the Government Information Valuation Framework. Table 1 A and 1 B in Chapter 3 pg. 36 discussed the definitions for the citizen user groups in the scope of the analysis. The user information needs were established for each citizen user category. The analysis of the types, topics and formats that were available from each entity allowed percentages to be calculated showing the percentage of information available for each user group. From those percentages the following table, table 2.5 A, was constructed to display the ranking of each entity's content for each user group and for the amount of applicable information catering to the each group overall.

Table 2.5 A Entities ranked by GIV citizen user group content.

Private Citizen	Attentive Citizen	Deliberative Citizen	Citizen Practitioner/Publisher	Corporate Citizen	Rank
WIKI	WIKI	WIKI	USDA	WIKI	5
USDA	USDA	EPA	WIKI	EPA	4
NBII	EPA	USDA	EPA	NBII	3
US FWS	NBII	NBII	US FWS	USDA	2
EPA	US FWS	US FWS	NBII	US FWS	1

Wikipedia was the top ranked provider. The entity had the highest percentage in four out of the five user groups. The USDA had more information for the citizen practitioner/ publisher. *The US FWS had the lowest rank overall* however the NBII had the least amount of information for the citizen practitioner/ publisher and the EPA had the least information for the private citizen.

Chapter four reported the results from the social network analysis and took a comparative view of the results of the content analysis measures of all five entities. These results showed the similarities and differences among entities. The network analysis results showed the connections between the entities and brought to light the major players within the network of information about CCD on the web. In chapter five the content analysis results are reported individually for each entity. In chapter six the results are discussed and implications of the findings are synthesized. The discussion considered past research and theory while proposing future research directions for the framework developed in the study. Chapter 6 also addresses the research limitations and offers specific recommendations and contraindications for users seeking information about CCD on the Web.

CHAPTER V
COMPREHENSIVE RESULTS FOR RESEARCH ENTITIES

In chapter five the individual analysis results for all five entities will be discussed. The entities in the analysis were: the Environmental Protection Agency (EPA) represented by the color blue, the United States Geological Survey's former National Biological Information Infrastructure (NBII) represented by the color orange, the United States Department of Agriculture (USDA) represented by the color green, the United States Fish and Wildlife Service (US FWS) represented by the color yellow, and Wikipedia represented by the color purple. Each entity results section includes charts that show the results for information topics, information types, information formats, measures of information quality, and the entity's applicability to the GIV citizen user framework. The charts are designed to look at the differences in the information elements individually and thus, the scale of the y-axis is not identical across all measures. Please note any discrepancies when comparing across entities. For a comparative summary, please see chapter four, section 2. In the next chapter, chapter six, the implications of the findings are discussed, as are research limitations and avenues for future research endeavors.

3. Results for the EPA

3.1. EPA Information Topics

The presented topics included a definition of CCD that discussed who, what, when, and why. There was no discussion of where. All potential causes (subtopics) were addressed except for stress due to pollution. These causes included: pesticides, diseases, parasites, stress from migration, stress from malnutrition, modification of the honeybees' habitat and improper breeding. Proposed solutions that were addressed included improving overall health, regulating bee keeping practices and increased research. The EPA did not mention organic farming, finding alternatives to the honeybee or breeding strength through genome knowledge as proposed solutions.

The EPA mentioned no information about the consequences of CCD or the importance of honeybees. Areas of future research discussed were future institutional involvement and new monitoring practices. The EPA did not address genetic research, new plans for funding, and other ideas not yet in action or any new sources for funding. Current research subtopics addressed by the EPA were pesticide testing, monitoring hives and testing natural miticides and antibiotics. Recreating diseases and stressors and genetic screening were not discussed.

The EPA discussed the myth of past occurrences of CCD. The other subtopics, cell phone signals, perceptions of bees as pests, and the possibility that CCD is a made up phenomenon, were not addressed. The EPA addressed two subtopics of uncertainty: the multifaceted nature of CCD and research

discrepancies. The authors did not discuss regional differences or the absence of bees around the hive. The EPA discussed one area of controversy. This area was pesticide testing methods. Other subtopics including nutritional supplements, influence of corporate agendas, GMOs and organic farming were not mentioned.

Two areas of institutional focus were addressed. These included policy formulation and regulation, and research management and funding. Provision of services and public outreach were not addressed. In the final topic of public participation the EPA discussed other action-oriented information. The text mentioned things the private citizen could do at home. The authors did not address how to help, request information from citizens, ask for comments or questions, or profile national regional or local programs for involvement. The EPA addressed a total of twenty-six of the sixty-two subtopics. Figure 3.1 A illustrates the topic coverage by EPA.

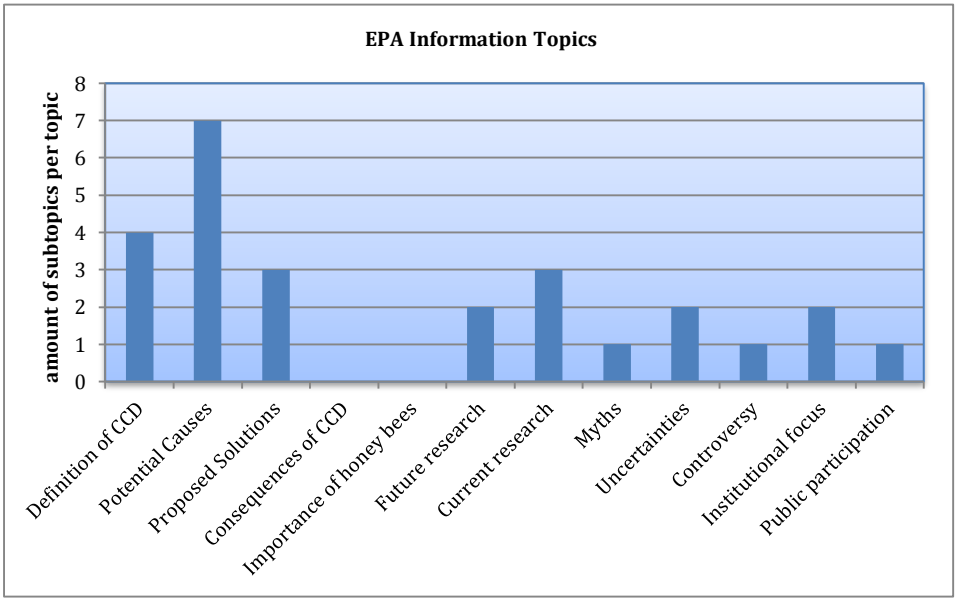


Figure 3.1 A EPA information topics.

The horizontal axis lists the information topics measured. Each topic had several subtopics and the number of these subtopics per topic is shown on the vertical axis.

3.2. EPA Information Types

The research template included nine information types. These information types included: basic information, frequently asked questions, latest news, feature stories, government and official documents, scholarly research articles, data visualization, administrative information and resource links. The EPA used five of the nine available information types defined in the template. Basic Information is used to address nine of the information topics. The type latest news was used twice to address topics. Government and official documents supported information topics seven times. There was one topical instance of a resource list and one topical instance of administrative information. Frequently asked questions, feature stories,

scholarly research articles, and data visualization information types were not used to cover the information topics. Figure 3.2 A illustrates the information types and the amount the EPA used.

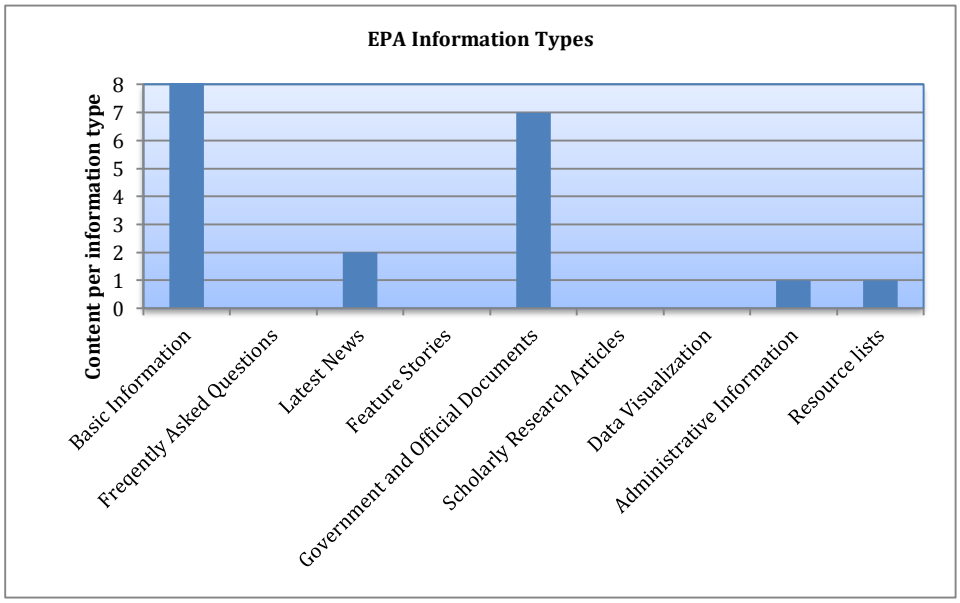


Figure 3.2 A EPA information types.

The horizontal axis lists the information types measured. The vertical axis gives the total number of times the information type was used on the entity's CCD page.

3.3. EPA Information Formats

The research template included nine information formats. These formats included: embedded text, images, audio, multimedia, data files, internal links, external links, pdf files and interactive applications. The EPA used six of the nine available information formats defined in the template. Embedded text was used to address nine of the information topics. The one available image addressed one information topic. Six topics were addressed by internal links. There were a total of thirty-two internal links on the CCD page. There were seven information topics addressed using external links. The CCD page had three external links available. There were three pdf files available from the page. The pdf information format addressed information topics in seven instances. The CCD page had one interactive application format available. This format did not address a specific information topic. The unavailable information formats were audio, multimedia, and data files. Figure 3.3 A illustrates the information formats employed by the EPA.

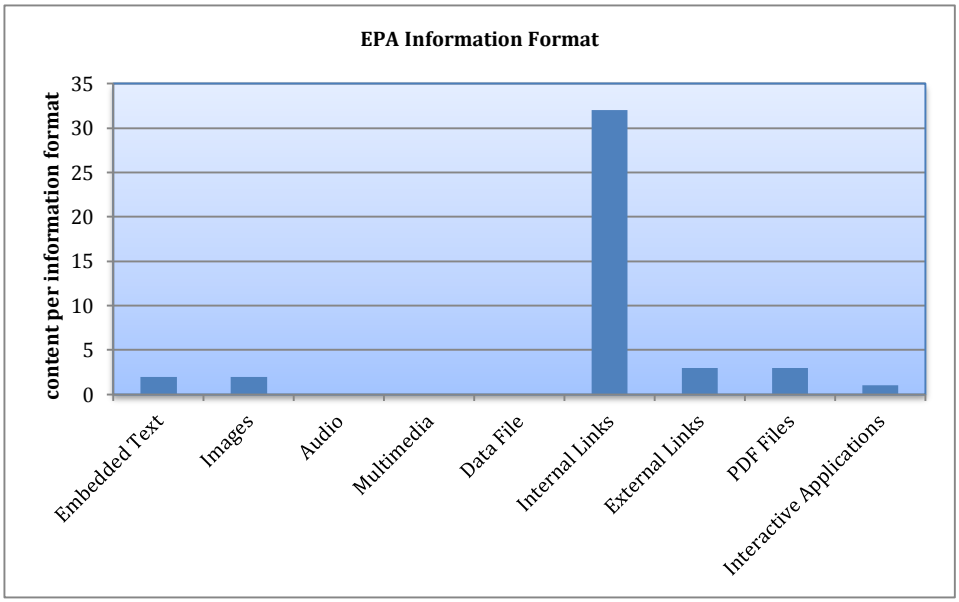


Figure 3.3 A EPA information formats.

The horizontal axis lists the information formats that were measured. The vertical axis gives the total amount of times that format was used on the CCD page.

3.4. EPA Information Quality

3.4.1.EPA Information Accuracy

For the topics and subtopics that the EPA addressed, the content fulfilled the three components of information accuracy measures. The content was free of known errors, free of misinformation, and it delivered the information that it promised. Table 3.4 A shows the information accuracy scores for the EPA.

Table 3.4 A EPA information accuracy.

EPA Information Accuracy	Scores
Content has no known errors	10
Content has no misinformation	10
The page delivers what it promises	10
Total	30

3.4.2.EPA Source Authority

Three measures were included in source authority. The measures were: authorship is disclosed, contact information is provided and institutional affiliation is cited. The EPA page content fulfilled two of the three components of source authority measures for the topics of proposed solutions, future research, current research and institutional focus. Six topics fulfilled one of the three components. This component was "institutional affiliation is cited." The six topics were definitions, causes, myths, uncertainty,

controversy, and public participation. No contact information was available for any topic. Table 3.4 B shows the source authority scores for the EPA.

Table 3.4 B EPA source authority.

EPA Source Authority	Scores
Authorship is disclosed	3
Contact Information is provided	0
Institutional Affiliation is cited	9
Total	12

3.4.3.EPA Information Currency

For the topics and subtopics that the EPA addressed, the content fulfilled the three components of currency of information measures for all but one topic. This topic was causes. The measure was "topic has been updated within the last 2 years from 6/20/2011." Table 3.4 C shows the information currency scores for the EPA.

Table 3.4 C EPA information currency.

EPA Information Currency	Scores
Page has no broken links	9
Content has been updated in the past two years before 8/2011	9
Page is free of information about cancelled programs	9
Total	27

3.4.4.EPA Usability and Design

There were twelve components used to evaluate the design and usability measure in the research template. The EPA had ten of the twelve components. The components the page did not have were "page titles are descriptive and short" and "answers and main ideas are visible as such." Table 3.4 D shows the components that the EPA had. These components included: a simple search engine, PDFs that were reserved specifically for manuals and large documents, the visited links changed color, text was written for online reading, the font size was flexible, there was no animation, pop-ups or ads, the design was consistent with the other pages and titles, new windows did not open when hyperlinks were activated, the page was easy to navigate, and the look and feel was pleasing.

Table 3.4 D EPA checklist for design and usability.

EPA Checklist for Design and Usability	Score
1.simple search engine	1
2. PDFs are reserved for manuals and big documents	1
3. Visited links change color	1
4. Text is written for online reading and supports scan ability	1
5. Font size is not fixed or too small	1
6. Page titles are descriptive and short	0
7. No animation, advertisements nor pop-ups	1
8. Design is consistent with other web pages and sites	1
9. Links work as simple hypertext reference, new windows do not open	1
10. Answers and main ideas are visible as such.	0
11.Navigation	1
12. Look and Feel	1
Total	10

3.4.5.EPA Information Interactivity

The checklist for interactivity and public engagement had seven components in the research template. The EPA had one of the seven components. The page had advanced or user customized search options. All other list items were not found. These missing items included: user support or help functions, open comment fields, interactive media and applications for wireless devices, folksonomy or tagging applications, a web 2.0 component or endorsement of a citizen science program, and requests for citizen input on topics. Table 3.4 E shows the checklist for interactivity and public engagement for the EPA.

Table 3.4 E EPA checklist for interactivity and public engagement.

EPA Checklist for Interactivity and Public Engagement	Scores
1. User support/ help functions	0
2. Advanced or user customized search options	1
3. Open comment fields	0
4. Interactive media or applications for wireless devices	0
5. Folksonomy and tagging applications	0
6. Offers a web 2.0 component/ or endorses citizen science program	0
7. Specific requests for citizen input on topics	0
Total	1

3.5. EPA and the GIV Citizen Framework

The EPA had specified user groups on the home page that reflected the audience for whom the entity had information. By matching the user group with the citizen definition the following relationships between the user spectrum and the citizen categories of the GIV framework were made. Private citizens were connected with students and members of a tribe, Attentive citizens with concerned citizens and educators, deliberative citizens with local officials and researchers, citizen practitioner or publisher with reporters, health officials and scientists, and corporate citizens with businesses. Table 3.5 A shows the layout of the citizen users for the EPA.

Table 3.5 A EPA and the GIV citizen user groups.

GIV Citizen Group	EPA Citizen Users as listed by the entity's Web Site		
Private Citizen	Student	Member of a tribe	
Attentive Citizen	Concerned citizen	Educator	
Deliberative Citizen	Local official	Researcher	
Citizen Practitioner/Publisher	Reporter	Public health official	Scientist
Corporate Citizen	Business		

Table 1 A and 1 B, from chapter three (p. 36) discuss the definitions for the scope of the analysis and defines the information needs that pertain to each citizen user category. The analysis of the types, topics and formats that were available from the EPA allowed the following percentages to be calculated showing the percentage of information available for each user group. The EPA had the most information types, topics, and formats that were most beneficial and applicable to the attentive citizen with a total of twenty-six percent. The private citizen and the deliberative citizen had the least amount of information needs fulfilled. Both user categories had fourteen percent. The citizen publisher and practitioner group

was in the middle with twenty-two percent, and the corporate citizen group had a slightly greater amount with twenty-four percent of the information. Figure 3.5 A illustrates the distribution of content as defined by the needs of the GIV framework of citizen users.

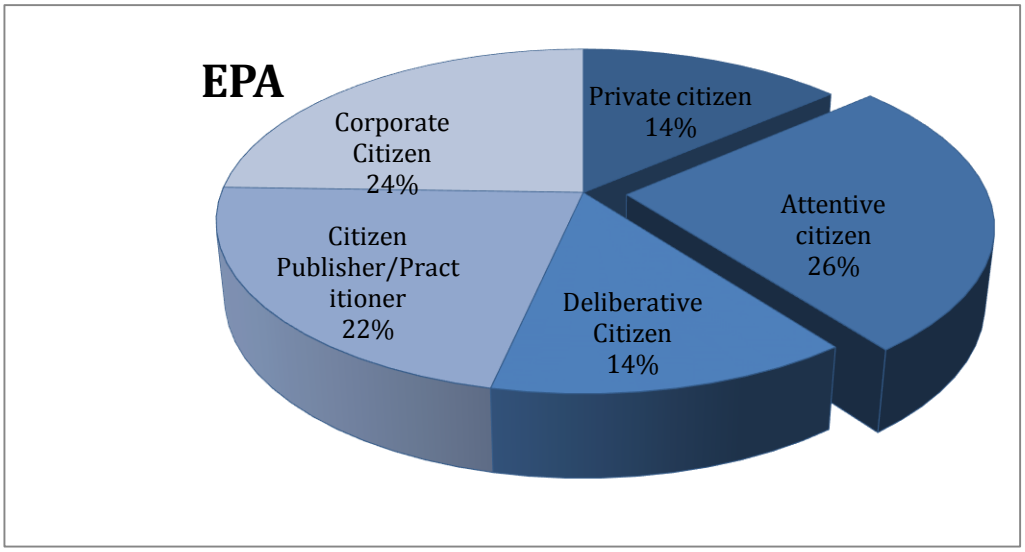


Figure 3.5 A The EPA and the GIV citizen category applicable content percentages.

3.6. EPA First Impressions

The CCD page's appearance was similar, but an older style design than the homepage. The homepage had been recently updated using Drupal. The date the CCD page was last updated was clearly displayed below the header, but the first link in the second introductory paragraph offered "the most recent data from beekeepers for 2009." This contradicted the most recent update posted. There would have been the potential for more recent data and reports from beekeepers. The poster image to the right of the page no longer linked the user to the poster. The 2011 posters have been *coming soon* since February of 2011. There was no new reporting going forward in regards to CCD research and discussion at this time.

Navigation, Design and Interactivity

The physical design of the information was clean and simple. There was a lot of text, but clear divisions to the central text existed that made the information easy to skim or find a particular element of information. Looking at the checklist for design and usability, the page lacked two of the twelve elements. The page titles were not short and descriptive. The titles were cryptic, for example, "Dead bees don't necessarily mean CCD" or "Why it's happening." The page did not have any interactivity or public engagement elements except for the search field and the options available in the header menu.

Information Topics

The EPA addressed the first two topics. CCD was defined and potential causes were explained with the respective subtopics, in a comprehensive manner. In both cases there was content in all subtopic fields except for one. The page did not distinguish any particular location for CCD afflicted colonies. In the topic

of potential causes, the author did not mention pollution as a stress factor. Types of pollution such as air quality and water quality were not addressed. The EPA used general terms throughout the introductory paragraphs. For example, "some beekeepers began to report unusually high losses of 30-90%," was a general explanation. Thirty to ninety percent was an unclear value. There was no basis of colony amount and population to gauge what this percentage actually meant in context.

The EPA delivered the majority of subtopics in the first three topics of the table and discussed current research endeavors. One unique existing feature was a numbered list that summarized the attached PDF of the Steering Committee's action plan. The list was an extension for reference. Certain topics were not addressed at all. There was no discussion about the consequences of CCD or the importance of the honeybees to the national and global population.

The EPA spent little time talking about myths of CCD causes, elements of uncertainty, or controversy among stakeholders. Subtopics under the topic of controversy were avoided, such as the proposed idea that organic farming is a possible solution to CCD. There was no discussion of stakeholder perspectives.

The page heading read: "Pesticide Issues in the works: Honeybee Colony Collapse Disorder." The page did provide other information regarding the pesticide controversy in the form of PDF letters and internally linked reports on a specific pesticide issue that occurred in the winter of 2010. The title of the documents did not provide context to those unfamiliar with Clothianidin.

Information Types and Information Formats

The EPA page did not provide information types that supported the users between the very simple, broad information and the complex, specific information. The EPA linked to the USDA and cited the entity had more explicit information about future CCD research. The EPA was focused on the types of information and format that relayed the information about protection of pollinators as a whole. Many of the internal links redirected the user to the same EPA Pollinator Protection page. The CCD page used five of nine established information types and six of eight established information formats with the most information transmitted through embedded text.

Information Quality

The EPA had no broken links external or internal. One IQ measure where the agency fell short was source authority. There was no author information and no agency contact information on the page. While there was a "contact us" link, the creator and his or her source remained anonymous. The author did acknowledge and link to a few information sources such as the USDA and the National Pesticide Information Center. The information had no known errors, but vague statements left out specific details. The focus of the page appeared to be less about providing information about the problem and more about communicating the EPA's current relationship to the problem.

3.7. EPA Discussion of Results

The EPA's CCD page fell under the specific category of pesticide issues. According to the Steering Committee's action plan, the EPA's role in the future understanding and prevention of CCD is to regulate and explore pesticide use and their effects on the health of the honeybee. The mission statement of the EPA is to "protect human health and the environment" (EPA, 2012). The emphasis on potential causes and basic information in the presented information topics could reflect this mission. The EPA's Strategic Plan "identifies the measurable environmental and human health outcomes the public can expect from EPA and describes how the entity intends to achieve those results" (EPA, 2012). *The anonymity of the source and the generality of the information addressed as shown in the results for the EPA CCD page reflected the attention to specific components of CCD, in this case, the role of pesticides as causes*. The mission also aligns with the high score of information currency for the page. The pesticide debate is a current and reoccurring issue with a spectrum of stakeholders. The EPA's links to the USDA for more information as seen in the results of the network analysis and the amount of external links support the idea that the EPA is not a central authority, but instead provides specialized services as indicated in the specific references connected by internal links and pdf documents that were available from the page.

According to the results of the analysis, *the EPA is a recommended resource for accessing information about possible causes*. It would not be a source for information about the consequences of CCD or to learn about the importance of the honeybee to the population. The results also indicate that *the EPA is a recommended resource for users who needed information types that included government documents and latest news.* Users looking to read embedded text formatting could be advised to go to the EPA for information in this format. Finally, the EPA could be considered a resource that provides specific types of information quality. In this instance, *the entity shows a high level of usability and accuracy* as these concepts are defined within the scope of the study. This result would make them a good resource when information seekers needed current information that was easily accessible. While the user groups are all addressed by the content available, the citizen group that would find the resource most applicable would be the attentive citizen group. In the groups defined by the EPA home page, these citizens would include concerned citizens and educators.

4. Results for the NBII

4.1. NBII Information Topics

The NBII had twenty-one of the sixty-two information subtopics and nine of the twelve information topics. The topics with the most available sub-topics were definitions of CCD, potential causes and uncertainties. Two of the subtopics were addressed within potential solutions, consequences of CCD,

myths, and institutional focus. There was one subtopic covered under the subject of current research. Future research, controversy and public participation were not discussed. Figure 4.1 A illustrates the topic coverage by NBII.

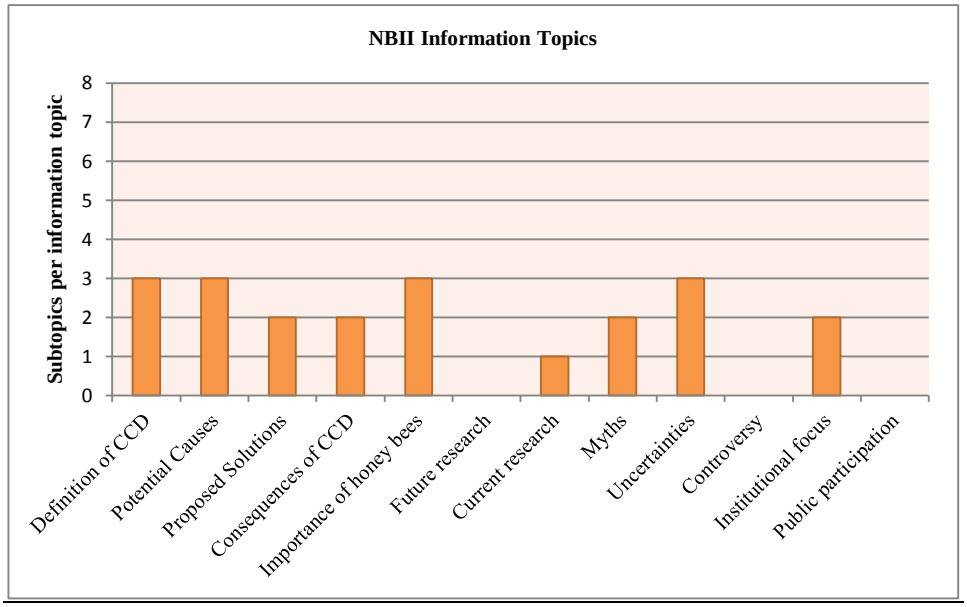


Figure 4.1 A NBII information topics.

The horizontal axis lists the information topics measured. Each topic had several subtopics and the number of these subtopics per topic is shown on the vertical axis.

4.2. NBII Information Types

The NBII had five of the nine information types. Resource lists presented the majority of NBII's CCD information and addressed seven out of the twelve available topics. There was one official document available and two scholarly research articles. Three of the topics were covered using the basic information type and four by feature stories. There was no administrative information, frequently asked questions, latest news, or data visualization found on the page. Figure 4.2 A illustrates the information types and the amount the NBII used.

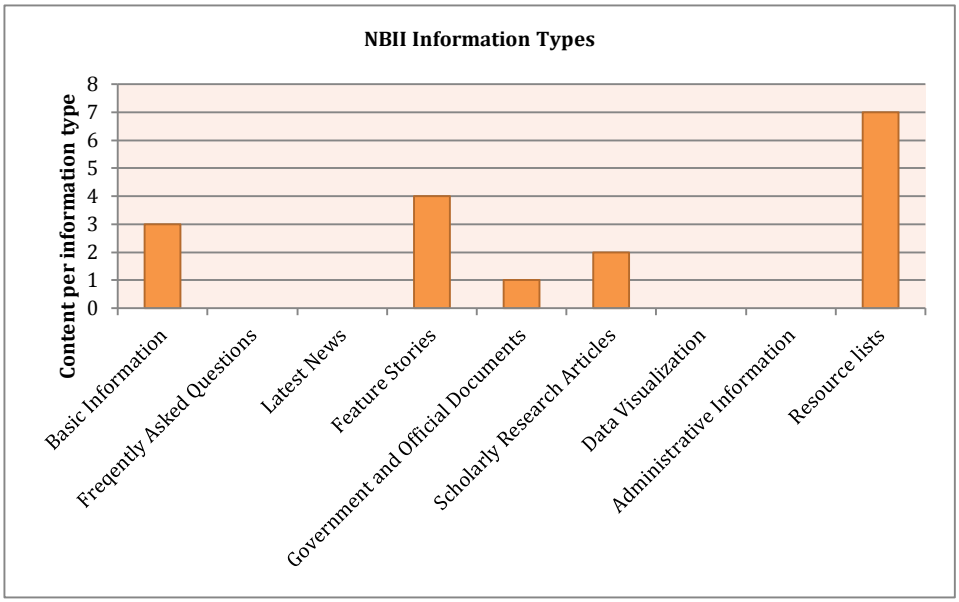


Figure 4.2 A NBII information types.

The horizontal axis lists the information types measured. The vertical axis gives the total number of times the information type was used on the entity's CCD page.

4.3. NBII Information Formats

The NBII had six out of nine information formats. There was one area of embedded text and announcement of a book that contained one image of the book's cover. The NBII had the most external links of all the information formats with a total of thirty-five. There were twenty internal links and nineteen PDF files available. There was one interactive application. This was the search function. There were no audio, multi-media, or data files available on the page. Figure 4.3 A illustrates the information formats employed by the NBII.

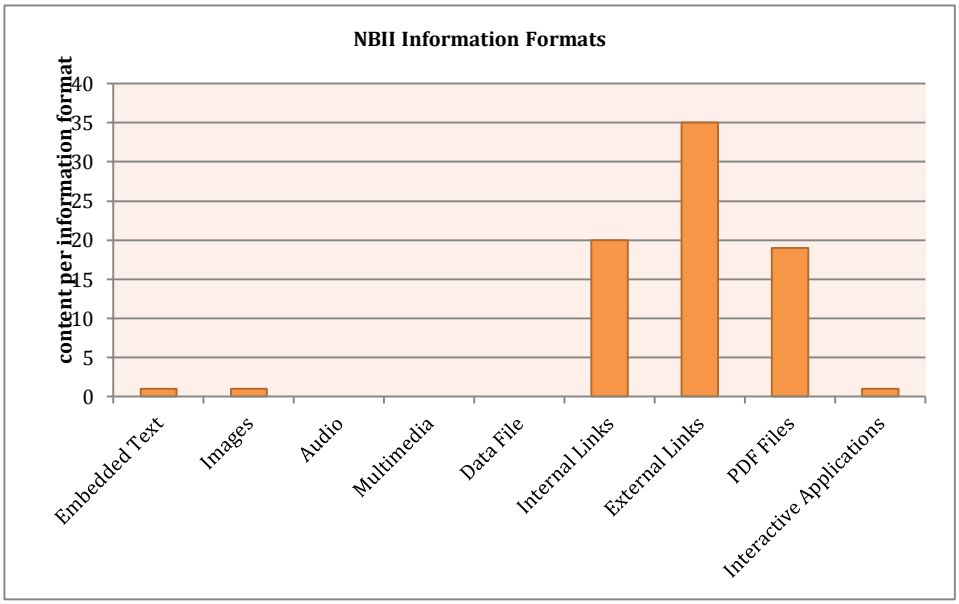


Figure 4.3 A NBII information formats.

The horizontal axis lists the information formats that were measured. The vertical axis gives the total amount of times that format was used on the CCD page.

4.4. NBII Information Quality

4.4.1.NBII Information Accuracy

The NBII had sixteen out of a potential score of thirty-six points for information accuracy. In two of the twelve topics the page content had no known errors. In five out of twelve topics the content had no misinformation. In nine out of twelve topics the page delivered what it promised. Table 4.4 A illustrates the information accuracy scores for the NBII.

Table 4.4 A NBII information accuracy.

NBII Information Accuracy	Scores
Content has no known errors	2
Content has no misinformation	5
The page delivers what it promises	9
Total	16

4.4.2.NBII Source Authority

The NBII had nine out of the thirty-six potential points for source authority. Authorship was not disclosed in any topic and contact information was not provided. In nine out of twelve topics the institutional affiliation was cited. Table 4.4 B shows the NBII's scores for source authority.

Table 4.4 B NBII source authority.

NBII Source Authority	Scores
Authorship is disclosed	0
Contact Information is provided	0
Institutional Affiliation is cited	9
Total	9

4.4.3.NBII Information Currency

The NBII did not have any measure of information currency. The page contained broken links, the date last updated was not posted, and there was information about cancelled programs or materials. The potential maximum score was thirty-six. Table 4.4 C shows the NBII's scores for information currency.

Table 4.4 C NBII information currency.

NBII Information Currency	Scores
Page has no broken links	0
Content has been updated in the past two years before 8/2011	0
Page is free of information about cancelled programs	0
Total	0

4.4.4. NBII Usability and Design

The NBII had eight out of twelve items in the checklist of measures for usability and design. The page had all items except navigation, look and feel, page titles that were descriptive and short, and links that worked as simple hypertext reference (In all cases, new windows opened). Usability and design elements for the NBII included: a simple search engine, PDFs reserved for manuals and big documents, visited links changed color, text supported online reading, the font size was flexible, there was no animation, ads, or pop-ups, the design was consistent with other pages, and the main ideas and answers were visible as such. Table 4.4 D shows the checklist elements for the NBII.

Table 4.4 D NBII checklist for design and usability.

NBII Checklist for Design and Usability	Scores

1.simple search engine	1
2. PDFs are reserved for manuals and big documents	1
3. Visited links change color	1
4. Text is written for online reading and supports scan ability	1
5. Font size is not fixed or too small	1
6. Page titles are descriptive and short	0
7. No animation, advertisements nor pop-ups	1
8. Design is consistent with other web pages and sites	1
9. Links work as simple hypertext reference, new windows do not open	0
10. Answers and main ideas are visible as such.	1
11.Navigation	0
12. Look and Feel	0
Total	8

4.4.5.NBII Information Interactivity

The NBII had one of the seven list items for interactivity and public engagement. This item was the user support/help function in the form of a simple search field. The other six items were not found. These items include: advanced or user customized search options, open comment fields, interactive media or applications for wireless devices, folksonomy or tagging applications, web 2.0 components or citizen science program endorsements, and specific requests for citizen input. Table 4.4 E illustrates the interactivity checklist scores for the NBII.

Table 4.4 E NBII checklist for interactivity and public engagement.

NBII Checklist for Interactivity and Public Engagement	Scores
1. User support/ help functions	1
2. Advanced or user customized search options	0
3. Open comment fields	0
4. Interactive media or applications for wireless devices	0
5. Folksonomy and tagging applications	0
6. Offers a web 2.0 component/ or endorses citizen science program	0
7. Specific requests for citizen input on topics	0
Total	1

4.5. NBII and the GIV Citizen Framework

The NBII had specified user groups on the home page that reflected the audience for whom the entity had information. By matching the user group with the citizen definition the following relationships between the user spectrum and the citizen categories of the GIV framework were made. Private citizen users were defined as the general public, Attentive citizens were educators and the general public, deliberative citizens were also connected generally with the public, citizen practitioners and publishers were scientists and the general public and the corporate citizen corresponded to resource managers and the general public. Table 4.5 A lists the connections between the GIV framework and the NBII Web site.

Table 4.5 A The NBII and the GIV citizen user groups.

GIV Citizen User Group	NBII Citizen Users as listed by the entity's Web Site	
Private Citizen	General public	
Attentive Citizen	Educators	General public
Deliberative Citizen	General public	
Citizen Practitioner/Publisher	Scientists	General public
Corporate Citizen	Resource managers	General public

Table 1 A and 1 B, from chapter three (p. 36) discuss the definitions for the scope of the analysis and defines the information needs that pertain to each citizen user category. The analysis of the types, topics and formats that were available from the NBII allowed the following percentages to be calculated showing the percentage of information available for each user group. The NBII had the most information types, topics and formats that were most beneficial and applicable to the private citizen with thirty-three percent. The citizen publisher/practitioner had the least amount of information needs fulfilled with five percent. Middle groups were the deliberative citizen with twelve percent, the attentive citizen with twenty-one

percent, and the corporate citizen with twenty-nine percent. Figure 4.5 A shows the percentages of citizen user group materials for the NBII.

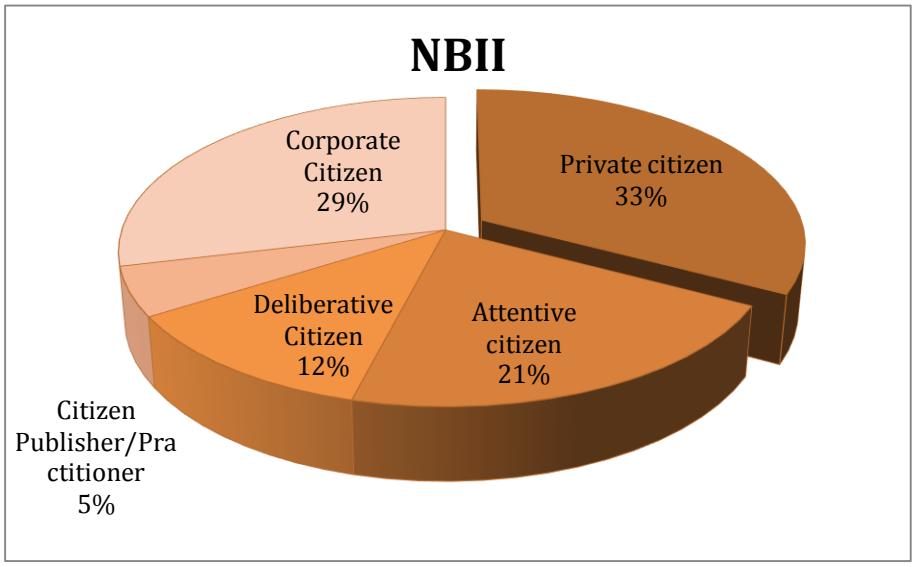


Figure 4.5 A The NBII and the GIV citizen category applicable content percentages.

4.6. NBII First Impressions

NBII's CCD page had myriad resources. The bottom half of the page contained two separate lists that provided two different functions. The page was visually pleasing yet the large amount of material that was accessible was overwhelming. One major piece of misinformation existed on the page. The heading for the category with which the CCD page was organized was "Threats to our native species." Honeybees are not native. They were brought from Europe to America in the 1800s.

There was one image besides the banner. It was an advertisement for a book on CCD called *A Spring Without Bees*. The link was previously active, but at the date the data was collected and in the weeks following, the link was broken. The image contained a summary underneath the picture that mentioned subtopics that were not available in the embedded text. A search for a date of page creation and the last update was done, but none were found. There was also no author or contact information with the exception of links to the home page.

Navigability, Design and Interactivity

The physical design appeared to be high quality, but there were many technical problems. In the left-hand column there was a widget showing a Google search for CCD. The search was specifically designed to retrieve articles from newspapers around the nation. The widget provided a regional and current view. It changed everyday, however the widget did not show more than one link summary when the page was opened. The expand button was small and slow to respond. The same applied to the resource list that was the main feature of the page. The page displayed fifteen links upon opening and the list expanded to

thirty hyperlinked citations. The expansion action only worked from one of the two icons available. The top worked, but the bottom was not functioning. There were summaries included, similar to an annotated bibliography, but they also had to be expanded using a tiny icon. Within these links, there were issues with redundancy of resources and broken links. Internally and externally, there were links to expired sites and link repetitions. The problem occurred most often when linking the user to the MAAREC site resources. All list items for MAAREC lead the user to the home page of the entity. The actual resource pages cited by NBII were not accessible without further investigation from MAAREC's home page.

Information Topics

The NBII addressed several of the major topics and their subtopics. The majority of the discussion in the introductory paragraph dealt with the symptoms of CCD. The author did not discuss whom, but covered what and where thoroughly. The resource lists that were visible upon the initial opening of the page alluded to further exploration of the causes. NBII stated that the causes are uncertain, however they did not connect causes of past problems with the possibility of the current phenomenon. While they linked to the USDA and Wikipedia they did not specify possible areas of focus to define a cause. The topics that were missing from NBII's page were the future research, controversy, and public participation topics. The most information was available for the first two topics: definitions and potential causes, and also for the importance of honeybees. Link summaries or link titles that were not immediately accessible from the first view without any expansion were not evaluated. In the brief text box captions for the additional resources, there were other pieces of information about terminology. The bottom of the left column had a "Word Helper" box. The box listed other terms that were commonly used. NBII cited Wikipedia's CCD page as their source for this feature.

Information Types and Information Formats

The majority of the topics were addressed using links to external sites. Text dominated the page. The one image was the book announcement. There was a lot of information advertised within the book and the accompanying author website, however the link was broken. The featured material drew attention to specific documents and sites. These documents were frequently repeated in the other resource lists and in some cases they were also broken or linked to unidentified URLs.

Information Quality

There were several missing pieces of discussion and issues with the quality, but the authors recognized other sources of information and the entity/organization who produced the information. The sources included a spectrum of resources such as CNN's *Anomalies Network* and other for-profit resources as well as university entomology department websites. The NBII did provide a function as an information hub. The information assumed a level of environmental knowledge. There was nothing specifically focused on outreach or interactivity with the site's users.

4.7. NBII Discussion of Results

The NBII was described in the mission statement as "a broad, collaborative program to provide increased access to data and information on the nation's biological resources." The main purpose as described by the web's home page is that the entity "links diverse, high-quality biological databases, information products, and analytical tools maintained by NBII partners and other contributors in government agencies, academic institutions, non-government organizations, and private industry" (NBII, 2011). The mission of the entity as a broad collaborative could explain the amount of resources and the broad spectrum of the kinds of information providers referenced. This mission and the attention to linking resources could be an explanation for the small amount of information that is delivered in the embedded text as opposed to being referenced in the resource list annotations. *The purpose as defined by the entity does not connect with the major instance of misinformation in the page's classification.* The site had a minimal score of information quality, which did not reflect the functional motive of the entity as an information hub to quality tools and sources. The amount of resources that were available from different types of resources could explain the apparent absence of information currency. The upkeep could have been a distributed effort without a central authority to provide quality control.

According to the results of the analysis, *the NBII could have been a resource for accessing information about the importance of honeybees.* It would not have been a source for information about the topic of future research. The results also indicate that *the NBII could have been a recommended resource for users who needed information types that included resource lists and feature stories*. Users looking to find links to resources and pdf files could have been advised to go to the NBII for information in this format. Finally, the NBII could have been considered a resource that provided information quality in the form of usability and intended design. In this instance, *the entity showed a high level of usability standards* as the concept is defined within the scope of the study. The analysis found that the lowest level of information was available for the citizen publisher and practitioner user group. This finding does not match with the other results that suggest the user would require a working knowledge of the issue. While the user groups were all addressed by the content available, *the citizen group that would find the resource most applicable would be the private citizen group*. In the groups defined by the NBII home page, these citizens would be considered the general public.

5. Results for the USDA

5.1. USDA Information Topics

The research template contained twelve major topics related to CCD with several subtopics for each topic. For the first topic, the definition of CCD, USDA answered all but one of the subtopics. The

entity addressed who, what, when, and why but did not address where. Seven out of eight potential causes were addressed on the page including: pesticides, disease, parasites, habitat modification, and stress from migration, malnutrition and other pollution factors. The USDA did not address improper breeding practices.

The USDA discusses four proposed solutions, improving overall health, regulating beekeeping practices, increased research and breeding increased strength through genome knowledge. The site did not mention organic farming or finding pollinator alternatives to honey bees. Four out of the five subtopics of the topic consequences of CCD were discussed on the page. These subtopics were economic loss, diminished food supply, threatened farmer and/ or beekeeper livelihood, and species decline. The authors did not discuss CCD as an indicator of other large-scale environmental problems.

The entity discussed three subtopics under the topic, importance of honeybees. The USDA mentioned the contribution to food production, their role in plant pollination, and their economic value. The authors did not mention medicinal values or any other additional value. Three subtopics under the topic of future research were discussed. Genetic research, future institutional involvement, and new monitoring practices were identified. New plans for funding, ideas not yet in action and new funding sources were not mentioned.

The USDA mentioned all five of the subtopics of current research. These included genetic screening, pesticide testing, recreating diseases and stressors in the laboratory, monitoring hives, and testing natural miticides and antibiotics. Two myth subtopics were addressed. These were cell phone signals and past occurrences of CCD. There was no discussion about CCD as a made up phenomenon and no discussion of the perception of bees as pests. The USDA discussed two of four uncertainties. The two subtopics were the absence of dead bees around the hive and the multifaceted aspect of the phenomenon. Regional differences and research discrepancies were not mentioned.

The USDA did not mention any information about the topic of controversy. Under the topic of institutional focus the page mentioned one subtopic. The information addressed research management and funding. The authors did not discuss policy formulation and regulation, public outreach, provision of services, or another related focus. The final topic in the table was public participation. The USDA discussed how to help. Information requests from citizens, calls for comments and questions, program profiles, and/or other action-oriented information were not available on the page. Figure 5.1 A illustrates the topic coverage by USDA.

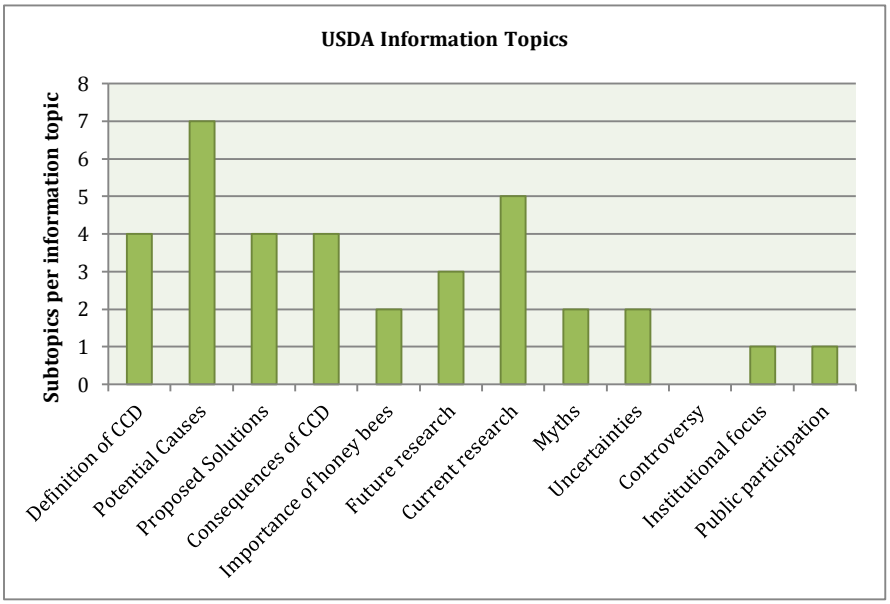


Figure 5.1 A USDA information topics.

The horizontal axis lists the information topics measured. Each topic had several subtopics and the number of these subtopics per topic is shown on the vertical axis.

5.2. USDA Information Types

The research template included nine information types. The USDA used five of the nine information types defined in the template to address the twelve information topics. Basic information was used to address eleven topics. Feature stories were used twice. There were five instances when topics were covered using government or official documents and a scholarly research article provided information on one topic. Three topics were addressed through the use of the page's resource list. Frequently asked questions, latest news, data visualization and administrative information were not found on the USDA's CCD page. Figure 5.2 A illustrates the information types and the amount for the USDA.

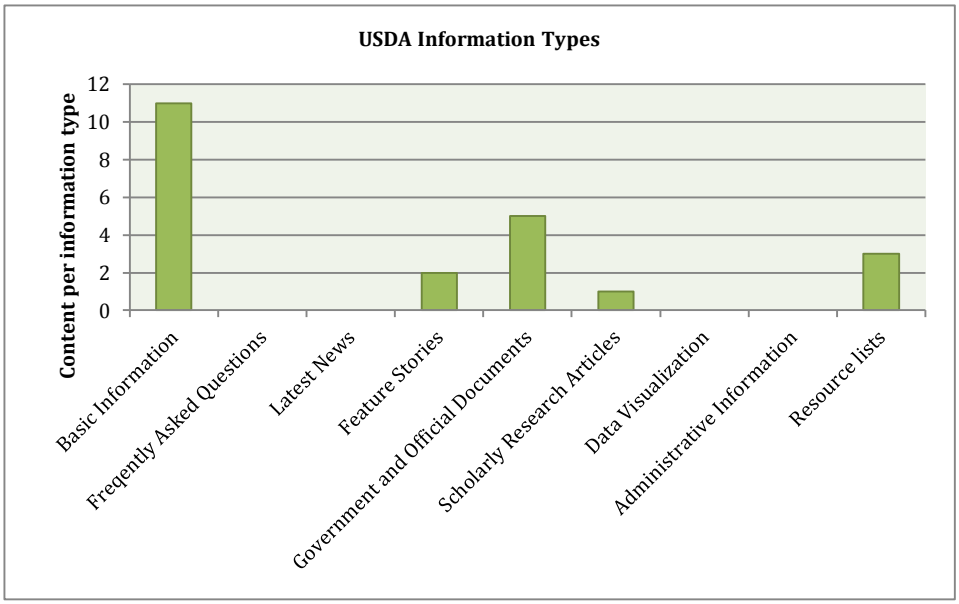


Figure 5.2 A USDA information types.

The horizontal axis lists the information types measured. The vertical axis gives the total number of times the information type was used on the entity's CCD page.

5.3. USDA Information Formats

The research template included nine information formats. The USDA uses five of the nine available information formats defined in the template. Embedded text was the most often used format, covering eleven of the twelve topics. The page had one instance of a multimedia file. This was an internal link to a video. Of forty-six internal links on the page, they addressed nine of the information topics. External links and pdf files both addressed five topics. The page had five image files that did not address topical information. The page did not include audio or data visualization information formats. Two interactive applications existed on the page. This format did not specifically address the information topics as defined by the research template. Figure 5.3 A illustrates the information formats employed by the USDA.

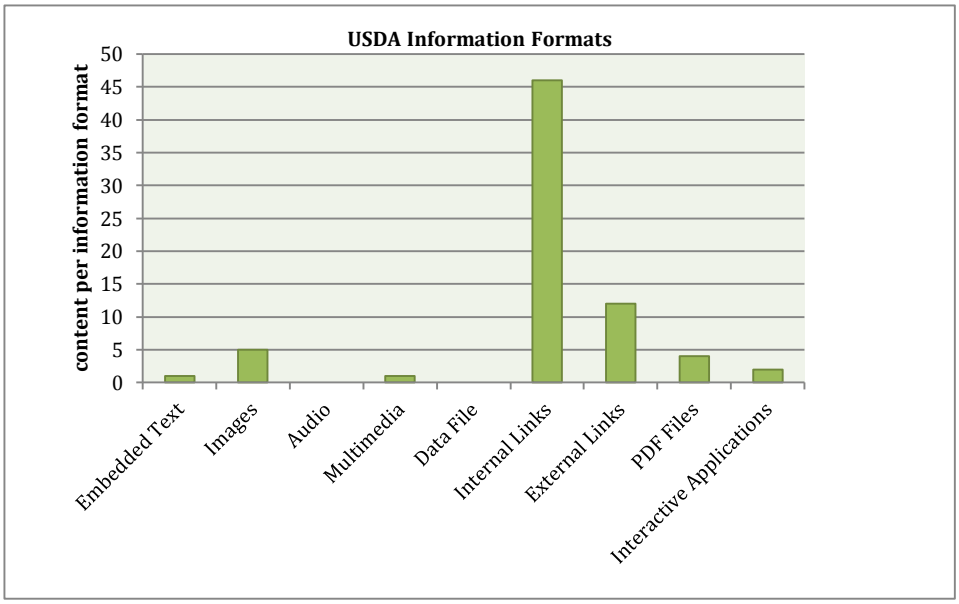


Figure 5.3 A USDA information formats.

The horizontal axis lists the information formats that were measured. The vertical axis gives the total amount of times that format was used on the CCD page.

5.4. USDA Information Quality

5.4.1. USDA Information Accuracy

For the topics and subtopics that the USDA addresses, the content fulfilled the three components of information accuracy measures. The content is free of known errors, free of misinformation, and it delivers the information the information that it promises. Table 5.4 A shows the USDA scores for information accuracy.

Table 5.4 A USDA information accuracy.

USDA Information Accuracy	Scores
Content has no known errors	11
Content has no misinformation	11
The page delivers what it promises	11
Total	33

5.4.2. USDA Source Authority

The USDA page content fulfilled three out of three components of source authority measures for the eleven information topics for which there is information. Authorship was disclosed, contact information

was available on the page, and institutional affiliation was cited. Table 5.4 B shows the scores for source authority for the USDA.

Table 5.4 B USDA source authority.

USDA Source Authority	Scores
Authorship is disclosed	11
Contact Information is provided	11
Institutional Affiliation is cited	11
Total	33

5.4.3. USDA Information Currency

For the eleven topics and subtopics that the USDA addresses, the content fulfilled the three components of currency of information measures for all information topics. The content was free of known errors, free of misinformation and delivered the information that was promised. Table 5.4 C shows the USDA's scores for information currency.

Table 5.4 C USDA information currency.

USDA Information Currency	Scores
Page has no broken links	11
Content has been updated in the past two years before 8/2011	11
Page is free of information about cancelled programs	11
Total	33

5.4.4. USDA Usability and Design

There were twelve components used to evaluate the design and usability measure in the research template. The USDA had ten of the twelve components. The text was not written for online reading and scan ability and the content did not score in the category of navigation due to resource redundancy and broken links. The usability and design components available were: a simple search engine, PDFs were reserved for manuals and big documents, visited links changed color, font size was flexible, page titles were descriptive and short, there were no animations ads or pop-ups, the design was consistent with other Web pages, the links functioned as simple hypertext references, the answers and main ideas were visible as such and the look and feel were pleasing to the eye and experience. Table 5.4 D shows the checklist for design and usability for the USDA.

Table 5.4 D USDA checklist for design and usability.

USDA Checklist for Design and Usability	Scores
1.simple search engine	1
2. PDFs are reserved for manuals and big documents	1
3. Visited links change color	1
4. Text is written for online reading and supports scan ability	0
5. Font size is not fixed or too small	1
6. Page titles are descriptive and short	1
7. No animation, advertisements nor pop-ups	1
8. Design is consistent with other web pages and sites	1
9. Links work as simple hypertext reference, new windows do not open	1
10. Answers and main ideas are visible as such.	1
11.Navigation	0
12. Look and Feel	1
Total	10

5.4.5. USDA Information Interactivity

The checklist for public interactivity and seven engagement had components in the research template. The USDA had two of the seven components. The page has user support or help functions and advanced or user customized search options. All other interactivity components were not found. The missing components included: open comment fields, interactive media or applications for wireless devices, folksonomy and tagging applications, a web 2.0 component or endorsement of a citizen science program, and specific requests for citizen input on topics. Table 5.4 E shows the checklist for public engagement and interactivity for the USDA.

Table 5.4 E USDA checklist for interactivity and public engagement.

USDA Checklist for Interactivity and Public Engagement	Scores
1. User support/ help functions	1
2. Advanced or user customized search options	1
3. Open comment fields	0
4. Interactive media or applications for wireless devices	0
5. Folksonomy and tagging applications	0
6. Offers a web 2.0 component/ or endorses citizen science program	0
7. Specific requests for citizen input on topics	0
Total	2

5.5. USDA and the GIV Citizen Framework

The USDA had specified user groups on the home page that reflect the audience for whom the entity has information. By matching the user group with the citizen definition the following relationships between the user spectrum and the citizen categories of the GIV framework were made. These relationships included: Private citizens were landowners and parents or caregivers, attentive citizens were educators and students, deliberative citizens were cooperatives and rural communities, citizen practitioner and publishers were the media, and the corporate citizen category corresponded with producers and USDA employees. Table 5.5 A shows the relationships for the USDA.

Table 5.5 A USDA citizen users and the GIV citizen framework.

GIV Citizen User Group	USDA Citizen Users as listed by the entity's Web Site	
Private Citizen	Landowners	Parents and Caregivers
Attentive Citizen	Educators and Students	
Deliberative Citizen	Cooperatives	Rural communities
Citizen Practitioner/Publisher	Media	
Corporate Citizen	Producers	USDA Employee

Table 1 A and 1 B, from chapter three (p. 36) discuss the definitions for the scope of the analysis and define the information needs that pertain to each citizen user category. The analysis of the types, topics and formats that were available from the USDA allowed the following percentages to be calculated showing the percentage of information available for each user group. The USDA had the most information types, topics and formats that were most beneficial and applicable to the attentive citizen with thirty percent. The deliberative citizen had the least amount of information needs fulfilled with eight percent. In the middle were the corporate citizen with ten percent, the private citizen with twenty-four percent and the citizen publisher/practitioner with twenty-eight percent. Figure 5.5 A shows the percentages per citizen user category for the USDA.

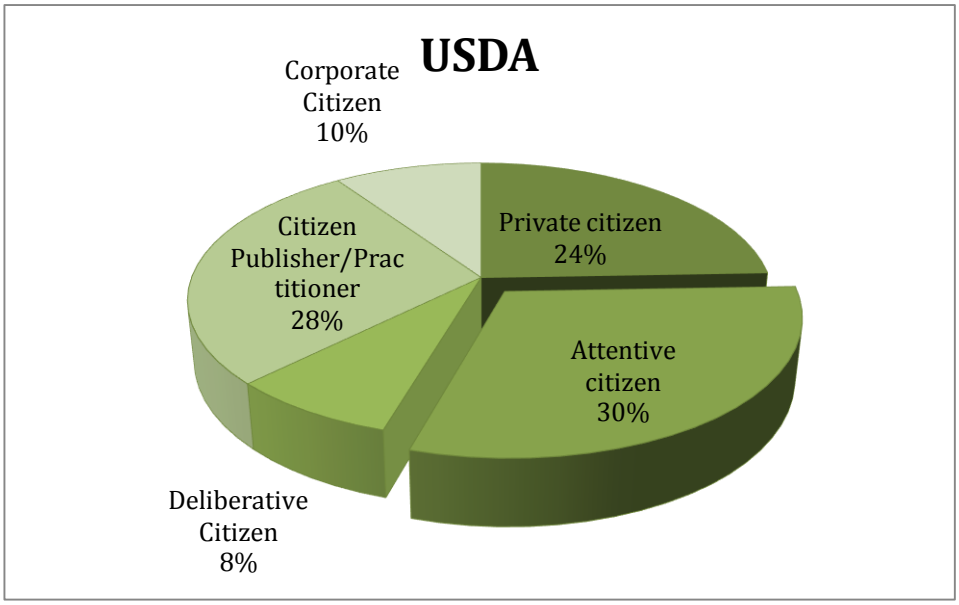


Figure 5.5 A USDA and GIV citizen user content percentages.

5.6. USDA First Impressions

The main page for the USDA was difficult to determine. The page was under the heading of news and events. There were other pages that had content related to honeybees and information related to farming and apiculture, but this page was the most comprehensive page and appeared first when searching within the USDA and on the web. The page was titled "Questions and Answers." What the page contained was an overview of the problem. There were explanations and avenues for more information.

Navigability, Design, and Interactivity

The page was very dense with text, however it had several images. The text was broken up by the pictures and allowed for on-line reading. The design had identical colors to the home page, but the homepage has been updated recently using a program such as Drupal. The difference in the ages of the two designs was apparent. There were active links to outdated and incomplete material and sometimes the pages

were not clear links to reach the promised content. The majority of the links were internal. There was no discussion to clarify the framework within the organization or to explain how the entity managed CCD information as a whole.

Information Topics

The USDA covered the majority of the CCD definition subtopics. There were no specific names of the original researchers or beekeepers. The subtopic of pesticides was specifically an external link in comparison with the other information links, which were mainly internal. The USDA stressed genetic research and honeybee genome knowledge as important steps to finding solutions. The page addressed many topics thoroughly and directly addressed the economic issues. The section heading "why should the public care about Colony Collapse Disorder" spoke to the consequences of the problem. There was also a detailed discussion about IAPV research. The USDA made a clear statement that CCD did not happen at anytime in the past. Discussion of uncertainty was general. There was mention of nutritional supplements, a controversial topic, but the reference was not in context with the matters of controversy. The USDA also had a brief section entitled "what the public an do."

Information Types and Information Formats

The USDA also had a link to a multimedia file. The video was not functioning properly at the time of the research. The site scored high in both number of topics and number of formats. There was a major difference between the number of internal links (forty-six) and the number of external links (twelve). The USDA had many other resources within the agency and did not often reference external sources of information.

Information Quality

The entity fulfilled accuracy, currency, and source authority in all the topics in which material was available. The page gave the name and contact information for the author. There were time-sensitive information topics where the information was from several years in the past, yet it was labeled as the current status.

5.7. USDA Discussion of Results

The USDA mission statement describes the focus of the USDA as a group that "provides leadership on food, agriculture, natural resources, and related issues based on sound public policy, the best available science, and efficient management" (USDA, 2012). The mission's mention of leadership could indicate the entity's position within the network of available CCD information. The size and scope of the USDA are large. This notion of scale could explain the majority of internal links and the ability to fulfill many topic areas while remaining general in the explanation. The attention to public policy and research could also be a factor in the entities' ability to provide several different formats and types of information within the

website itself. Attention to the public and to current information could be a result of the size and amount of the population with which they cater to on a regular basis. The site was not entirely current in information and links. This result does not align with the mission's focus on efficient management.

According to the results of the analysis, *the USDA could be a resource for accessing information about current and future research and understanding possible causes*. It would not be a source for information about the topic of controversy or institutional focus. The results also indicate that *the USDA could be a recommended resource for users who needed information types that included basic information*. *Users looking to find images and multimedia content could be advised to go to the USDA for information in this format.* Finally, *the USDA could be considered a resource that provides information quality in the form of accuracy, currency, and source authority*. In this instance, the entity shows a high level of all three IQ standards as the concepts are defined within the scope of the study. The analysis found that the lowest level of information was available for the deliberative citizen user group. While the user groups are all addressed by the content available, *the user group with the most available information material was the attentive citizen user group*.

6. Results for the US FWS

6.1. US FWS Information Topics

The US FWS presented the greatest amount of information on the topic potential causes. The page had the least amount of information topics and subtopics of all entities in the analysis with a total of nineteen out of a potential score of sixty-two. The page contained three subtopics on the definition of CCD and the importance of honeybees. Two subtopics were presented under potential causes and public participation. One subtopic was addressed for current research, future research, uncertainties, and institutional focus. The remaining three topics were not covered on the page. Figure 6.1 A displays the recorded results for the twelve topics and the amount of defined subtopics for the US FWS.

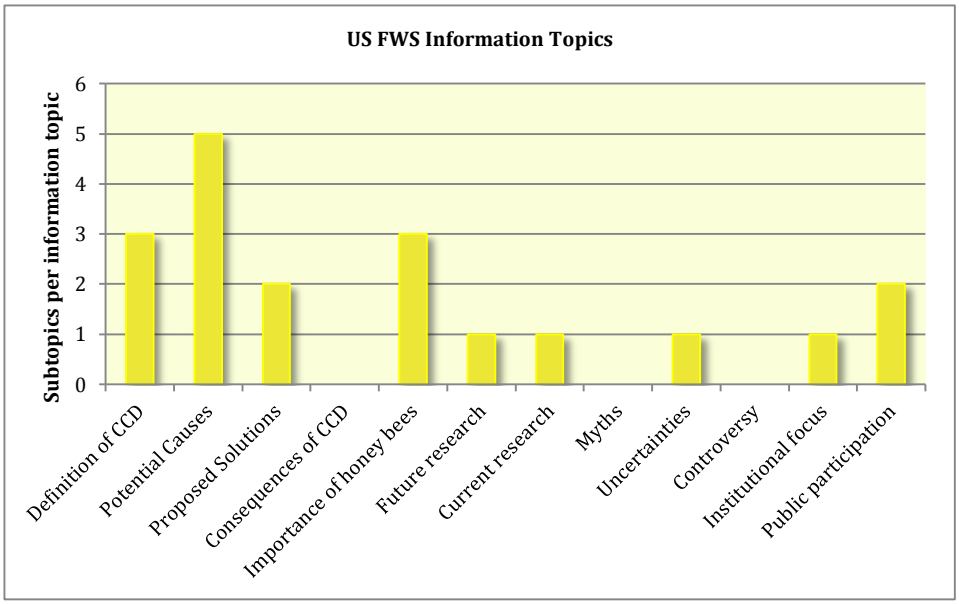


Figure 6.1 A US FWS information topics.

The horizontal axis lists the information topics measured. Each topic had several subtopics and the number of these subtopics per topic is shown on the vertical axis.

6.2. US FWS Information Types

The US FWS used the three information types. There were twelve total instances of type use and five out of the nine information types were available. The page had six instances of basic information. This type was used most often. Feature stories, scholarly research articles and administrative information were each utilized once. The resource list information type addressed three information topics. All other information types were not applicable to the presented topics on the page. Figure 6.2 A reflects the distribution of information types.

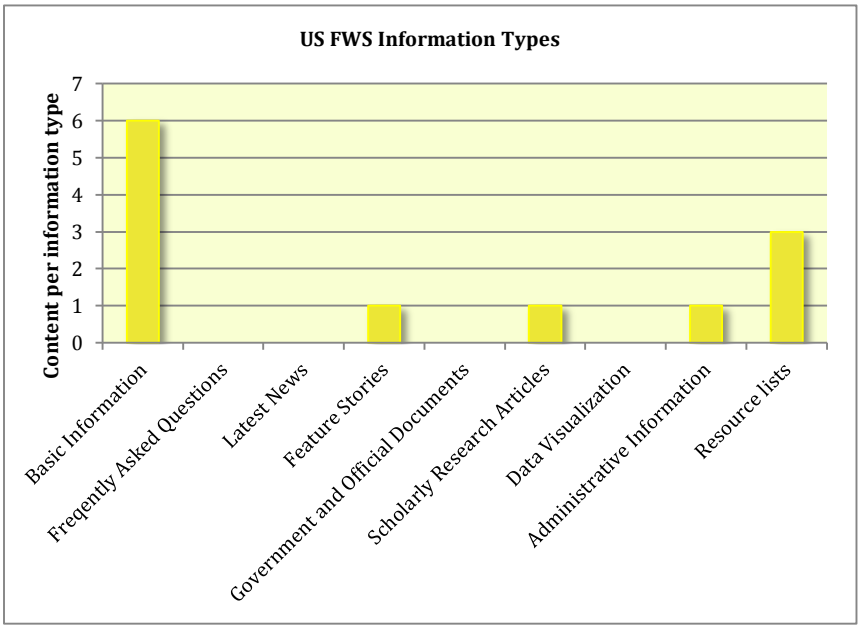


Figure 6.2 A US FWS information types.

The horizontal axis lists the information types measured. The vertical axis gives the total number of times the information type was used on the entity's CCD page.

6.3. US FWS Information Formats

The US FWS used forty-six instances of information formats. Six of the nine types were available. The majority of the formats available were links. The page had twenty-two external and eighteen internal links. There were three images, one pdf file and one instance of an interactive application. The US FWS did not have audio, multimedia or data files available on the page. Figure 6.3 A reflects the distribution of information formats.

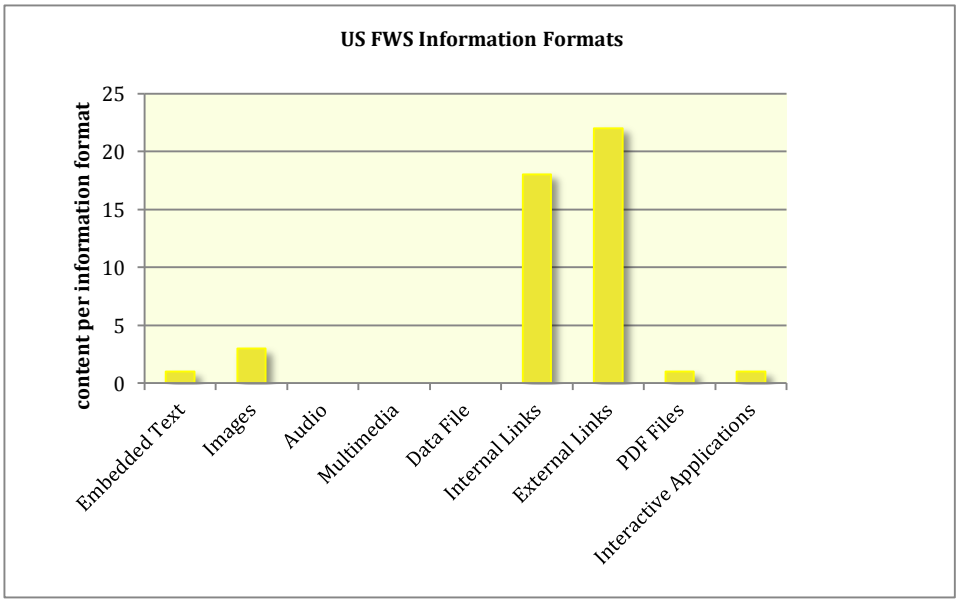


Figure 6.3 A US FWS information formats.

The horizontal axis lists the information formats that were measured. The vertical axis gives the total amount of times that format was used on the CCD page.

6.4. US FWS Information Quality

6.4.1. US FWS Information Accuracy

The USFWS had twenty-seven out of a potential score of thirty-six points for information accuracy. In nine of the twelve topics the page content had no known errors, had no misinformation and the page delivered what it promised. Table 6.4 A shows the information accuracy measures for the US FWS.

Table 6.4 A US FWS information accuracy.

US FWS Information Accuracy	Scores
1. Content has no known errors	9
2. Content has no misinformation	9
3. The page delivers what it promises	9
Total	27

6.4.2. US FWS Source Authority

The US FWS had twenty-seven out of the thirty-six potential points for source authority. Authorship was disclosed in nine topics and contact information was provided for nine topics. In nine out of the twelve topics the institutional affiliation was also cited. Table 6.4 B shows the source authority measures for the US FWS.

Table 6.4 B US FWS source authority.

US FWS Source Authority	Scores
Authorship is disclosed	9
Contact Information is provided	9
Institutional Affiliation is cited	9
Total	27

6.4.3.US FWS Information Currency

The US FWS had nineteen measures of information currency. The potential maximum score was thirty-six. The page had information about cancelled programs and events. In nine of the twelve topics the content had been updated. In ten topics there were no instances of broken links. Table 6.4 C shows the information currency measures for the US FWS.

Table 6.4 C US FWS information currency.

US FWS Information Currency	Scores
Page has no broken links	10
Content has been updated in the past two years before 8/2011	9
Page is free of information about cancelled programs	0
Total	19

6.4.4.US FWS Usability and Design

The US FWS had ten out of twelve items in the checklist of measures for usability and design. The page had all items except PDFs were not reserved for manuals and large documents, and answers and main ideas were not visible as such. The measures that were available included: a simple search engine, the visited links changed color, the text was written for online reading, the font size was flexible, the page titles were descriptive and short, there were no animations, ads or pop-ups, the design was consistent with other web pages, and the links worked as simple hypertext references. Table 6.4 D shows the usability and design measures for the US FWS.

Table 6.4 D US FWS checklist for design and usability.

US FWS Checklist for Design and Usability	Scores
1. Simple search engine	1
2. PDFs are reserved for manuals and big documents	0
3. Visited links change color	1
4. Text is written for online reading and supports scan ability	1
5. Font size is not fixed or too small	1
6. Page titles are descriptive and short	1
7. No animation, advertisements nor pop-ups	1
8. Design is consistent with other web pages and sites	1
9. Links work as simple hypertext reference, new windows do not open	1
10. Answers and main ideas are visible as such.	0
11.Navigation	1
12. Look and Feel	1
Total	10

6.4.5. US FWS Information Interactivity

The US FWS had one of the seven list items for interactivity and public engagement. This item was the user support/help function in the form of a simple search field. The other six items were not found. The missing items included: advanced or user customized search options, open comment fields, interactive media or applications for wireless devices, folksonomy or tagging applications, a web 2.0 component or an endorsement of a citizen science program, and specific requests for citizen input on topics. Table 6.4 E shows the checklist for interactivity and public engagement for the US FWS.

Table 6.4 E US FWS checklist for interactivity and public engagement.

US FWS Checklist for Interactivity and Public Engagement	Scores
1. User support/ help functions	1
2. Advanced or user customized search options	0
3. Open comment fields	0
4. Interactive media or applications for wireless devices	0
5. Folksonomy and tagging applications	0
6. Offers a web 2.0 component/ or endorses citizen science program	0
7. Specific requests for citizen input on topics	0
Total	1

6.5. US FWS and the GIV Citizen Framework

The US FWS had no specified user groups on the home page to reflect a specific audience for whom the entity had information. The entity mentioned that the information was for the general public. The entity focuses on all citizen categories of the GIV framework and no specific connections were made. Table 6.5 A reflects this lack of specialization.

Table 6.5 A US FWS citizen users and the GIV framework.

GIV Citizen User Group	US FWS Citizen Users as listed by the entity's Web Site
Private Citizen	General Public
Attentive Citizen	General Public
Deliberative Citizen	General Public
Citizen Practitioner/Publisher	General Public
Corporate Citizen	General Public

Table 1 A and 1 B, from chapter three (p. 36) discuss the definitions for the scope of the analysis and define the information needs that pertain to each citizen user category. The analysis of the types, topics and formats that were available from the US FWS allowed the following percentages to be calculated showing the percentage of information available for each user group. The US FWS had information types, topics, and formats that were most beneficial and applicable to the private citizen with thirty percent. The citizen publisher/practitioner had the least amount of information needs fulfilled with twelve percent just under the deliberative and corporate citizen with fifteen and seventeen percent respectively. The attentive citizen was in the middle with twenty- six percent applicable content. Figure 6.5 A shows the percentages of citizen user content for the US FWS.

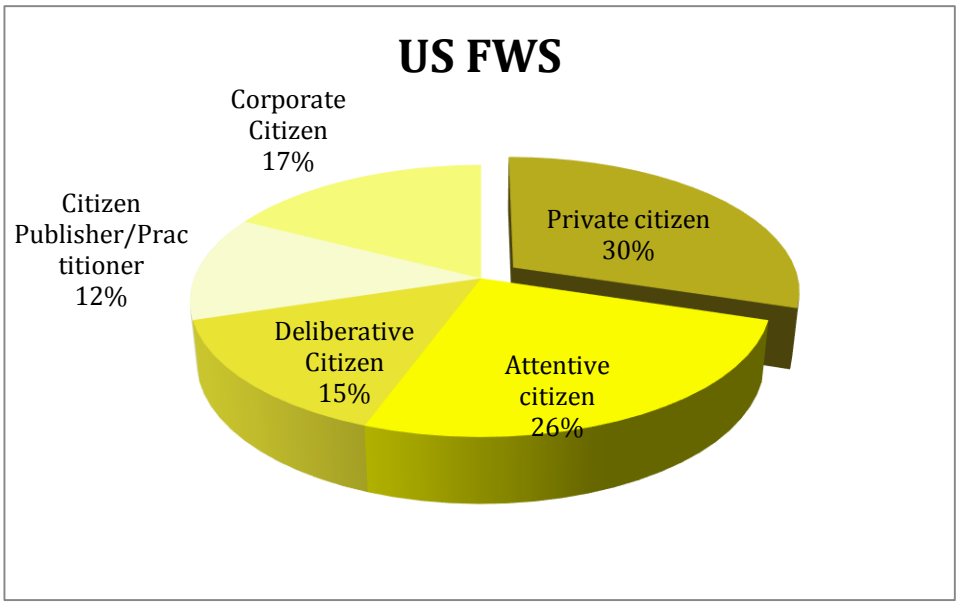


Figure 6.5 A US FWS and GIV Citizen User Content Percentages.

6.6. US FWS First Impressions

The US FWS had very little content. The layout was clear and readable. There was nothing found on the page that demonstrated any current content updates. Most of the content was from 2007. There was bibliographic citation for the information sources. This feature appeared at the bottom of the page in the embedded text. The image on the page also linked to the source of the image at Fermi National Laboratory.

At a first glance on the page there was not much information and it was approximately four years out of date.

Navigability, Design and Interactivity

The US FWS had the majority of the navigation and design quality measures. The page gave the user the ability to choose a different language including Spanish, French or Chinese. It was not clear why specifically these languages were chosen. The PDFs were not reserved for large documents. Clicking on a link to more information for an event procured a poster file for a workshop from 2007. There were no main ideas specified. The textual content was in one main paragraph with the broad heading Colony Collapse Disorder. External links provided an exit disclaimer.

Information Topics

The US FWS page remained general in scope. The majority of the subtopics addressed were from the definitions and causes topic categories. The entity discussed solutions indirectly. The page did not propose any measures toward solutions, but endorsed the proposals of external research by entities such as the USDA. The menu in the left column, which referred to pollinators as a group, demonstrated the focus of the page. The text centered more on value of honeybees and other pollinators and less on the consequences of CCD. The general nature of the text extended to the topic of uncertainty. The page mentioned that there are "a variety of uncertainties" but entertained no specific examples.

Information Types and Information Formats

There was very little content on the CCD page compared to the other entities and the majority of the content was basic information in the embedded text format. The menu on the left of the page alluded to more resources of other formats such as educational materials and podcasts. These internal links were about pollinators as a group and not associated directly with honeybees and colony collapse disorder specifically. These resources were not counted due to the difference in topic. The links on the page were equal in the ratio of internal to external.

Information Quality

There was a lack of current information on the US FWS CCD page. All information was dated approximately four years in the past. An announcement gave information about an event that happened in the fall of 2007. The PDF file was still available to download. The page also stated that it was last updated in the fall of 2009, which fell in the deadline set for a currently updated page as defined in the analysis. The dates of the actual material did not reflect the 2009 update.

6.7. US FWS Discussion of Results

The US FWS mission statement says, "the U.S. Fish and Wildlife Service is working with others to conserve, protect, and enhance fish, wildlife, plants, and their habitats for the continuing benefit of the American people. We will continue to be a leader and trusted partner in fish and wildlife conservation, known for our scientific excellence, stewardship of lands and natural resources, dedicated professionals, and commitment to public service" (US FWS, 2012). This statement mentions the entity's focus on partnerships and could provide insight into the small amount of material available from the page, as well as the citation of sources and links to the USDA. *The focus on wildlife conservation and natural resources is congruent with the finding that the information centered mainly on pollinators as a group and less on the problem of CCD and honeybees specifically*. The lack of currency could also be associated with the entity's more major topical discussion of pollinator protection and the focus on promoting resources with which the entity maintains partnerships. The resources were old, but the links provided avenues to the other available resources. For example, one could search online for the North American Pollinator Protection Campaign or NAPPC.

According to the results of the analysis, *the US FWS could be a resource for accessing information about the importance of honeybees and information about past events for participation*. It would not be a source for information about the topic of current research or understanding myths and uncertainties. The results also indicate that *the US FWS could be a recommended resource for users who needed information types that included general administrative information*. Users looking for information in a specific format would not be advised to go to the US FWS CCD page. Finally, *the US FWS could be considered a resource that provides information quality in the form of usability*. In this instance, the entity shows a high level of usability as the concept is defined within the scope of the study. The analysis found that the lowest level of information was available for the citizen publisher/ practitioner user group. While the user groups are all addressed by the content available, *the user group with the most available information material was the private citizen user group*. This result is congruent with the general nature of the material and the attention shown to linking the user to specific resource partners.

7. Results for Wikipedia

7.1. Wikipedia Information Topics

Wikipedia had information on at least two subtopics for each of the twelve topics. Of the possible score of sixty-two subtopics covered, Wikipedia had forty-seven. The most covered information topics were potential causes, definition of CCD, proposed solutions, consequences of CCD and current research. The two least discussed topics were future research and public participation. Institutional focus, controversy,

myths, uncertainties and importance of honeybees all had a medium amount with three or four subtopics addressed. Figure 7.1 A illustrates the topic coverage by Wikipedia.

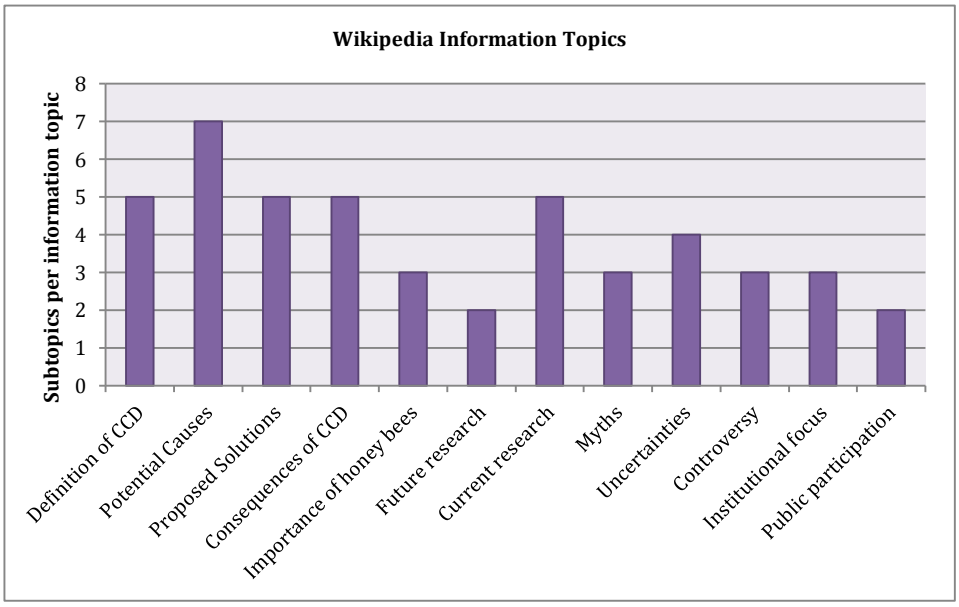


Figure 7.1 A Wikipedia information types.

The horizontal axis lists the information topics measured. Each topic had several subtopics and the number of these subtopics per topic is shown on the vertical axis.

7.2. Wikipedia Information Types

The majority of Wikipedia's information types were basic information, scholarly research articles, and government or official documents. Wikipedia did not offer frequently asked questions, latest news, feature stories, data visualization and administrative information. Figure 7.2 A illustrates the information types and the amount Wikipedia used.

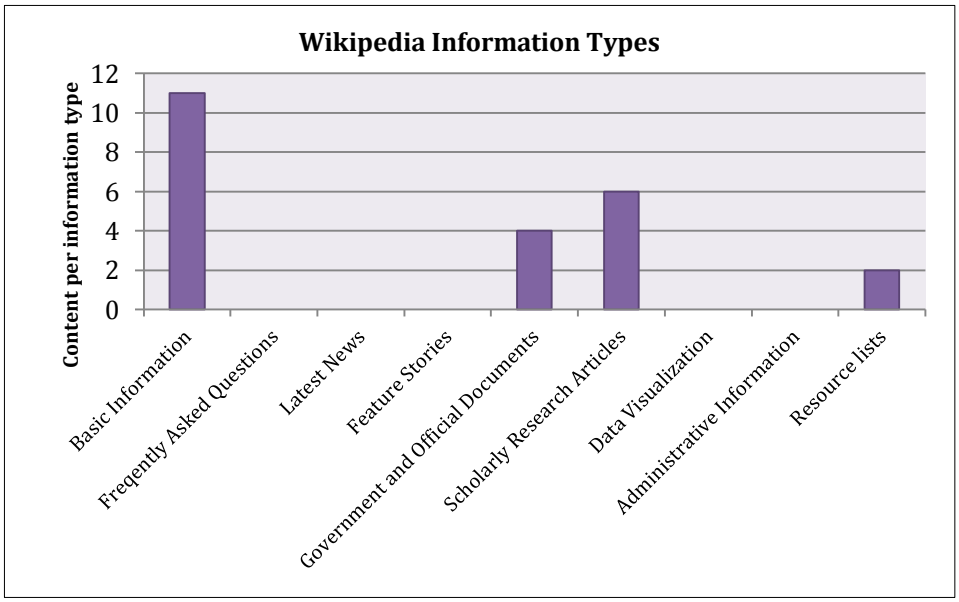


Figure 7.2 A Wikipedia information types.

The horizontal axis lists the information types measured. The vertical axis gives the total number of times the information type was used on the entity's CCD page.

7.3. Wikipedia Information Formats

The majority of the topics Wikipedia addressed existed in the form of internal and external links. The majority of the links were internal. Wikipedia did not use audio, multimedia or data file formats to discuss the twelve topics. There were several images along with a small amount of embedded text, twenty PDF files, and a small amount of interactive applications. Figure 7.3 A illustrates the information formats employed by Wikipedia.

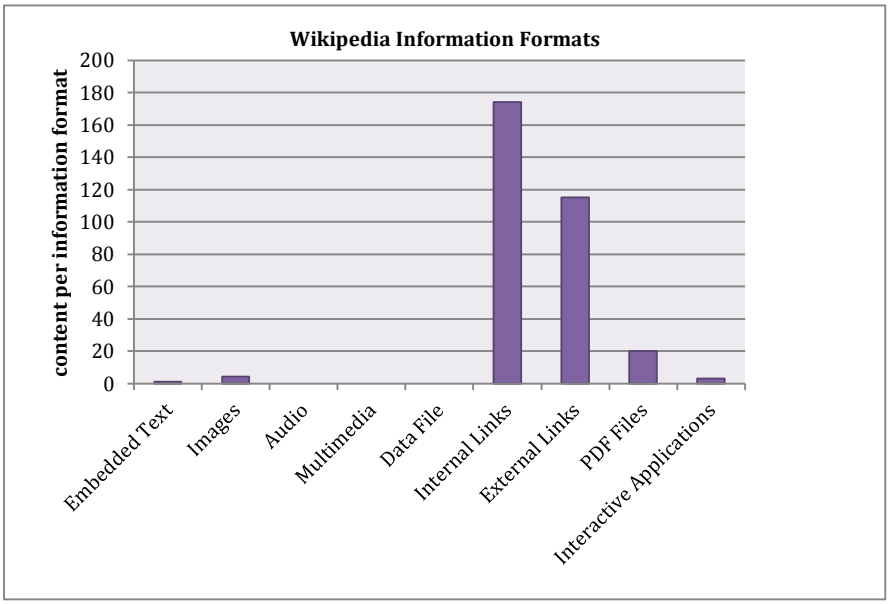


Figure 7.3 A Wikipedia Information Formats.

The horizontal axis lists the information formats that were measured. The vertical axis gives the total amount of times that format was used on the CCD page.

7.4. Wikipedia Information Quality

7.4.1. Wikipedia Information Accuracy

For the topics and subtopics that Wikipedia addresses, the content fulfilled two of the three components of information accuracy measures. The content was free of known errors, and it delivered the information that it promised. There was only one instance where misinformation occurred. Table 5.4 A shows the information accuracy measures for Wikipedia.

Table 7.4 A Wikipedia information accuracy.

Wikipedia Information Accuracy	Scores
1. Content has no known errors	12
2. Content has no misinformation	11
3. The page delivers what it promises	12
4. Total	35

7.4.2. Wikipedia Source Authority

Wikipedia's page content fulfilled one out of three components of source authority measures for the twelve information topics for which there was information. Authorship was not disclosed, contact information was not available on the page, but institutional affiliation was cited for all twelve topics. Table 7.4 B shows the source authority measures for Wikipedia.

Table 7.4 B Wikipedia source authority.

Wikipedia Source Authority	Scores
1. Authorship is disclosed	0
2. Contact Information is provided	0
3. Institutional Affiliation is cited	12
4. Total	12

7.4.3. Wikipedia Information Currency

For the twelve topics and subtopics that Wikipedia addresses, the content fulfilled one of the three components of information currency. The page had broken links and information about cancelled programs. The page stated that the content had been recently updated. Table 7.4 C shows the information currency measures for Wikipedia.

Table 7.4 C Wikipedia information currency.

Wikipedia Information Currency	Scores
Page has no broken links	0
Content has been updated in the past two years before 8/2011	12
Page is free of information about cancelled programs	0
Total	12

7.4.4. Wikipedia Usability and Design

There were twelve components used to evaluate the design and usability measure in the research template. Wikipedia had eight of the twelve components. The text was not written for online reading or quick scan-ability. The visited links did not show a distinct color change. The content did not score in the category of navigation due to broken links and resource redundancy. Look and feel did not score. All other usability and design measures were fulfilled. These measures included: a simple search engine, the PDFs were reserved for manuals and big documents, the font size was flexible, page titles were descriptive and short, there was no animation, ads or pop-ups, the design was consistent with other web pages, the links worked as simple hypertext reference, and the answers and main ideas were visible as such. Table 7.4 D shows the checklist for design and usability for Wikipedia.

Table 7.4 D Wikipedia checklist for design and usability.

Wikipedia Checklist for Design and Usability	Scores
1.simple search engine	1
2. PDFs are reserved for manuals and big documents	1
3. Visited links change color	0
4. Text is written for online reading and supports scan ability	0
5. Font size is not fixed or too small	1
6. Page titles are descriptive and short	1
7. No animation, advertisements nor pop-ups	1
8. Design is consistent with other web pages and sites	1
9. Links work as simple hypertext reference, new windows do not open	1
10. Answers and main ideas are visible as such.	1
11.Navigation	0
12. Look and Feel	0
Total	8

7.4.5.Wikipedia Information Interactivity

The checklist for interactivity and public engagement had seven components in the research template. Wikipedia had five of the seven components. The page had all interactivity functions except open comment fields and interactive applications/ media for wireless devices. The available items included: user support and help functions, advanced or user-customized search options, folksonomy and tagging applications, a web 2.0 component, and specific requests for citizen input on topics. Table 7.4 E shows the checklist for interactivity and public engagement for Wikipedia.

Table 7.4 E Wikipedia checklist for interactivity and public engagement.

Wikipedia Checklist for Interactivity and Public Engagement	Scores
1. User support/ help functions	1
2. Advanced or user customized search options	1
3. Open comment fields	0
4. Interactive media or applications for wireless devices	0
5. Folksonomy and tagging applications	1
6. Offers a web 2.0 component/ or endorses citizen science program	1
7. Specific requests for citizen input on topics	1
Total	5

7.5. Wikipedia and the GIV Citizen Framework

Wikipedia had no specified user groups on the home page to reflect a specific audience for whom the entity has information. The entity specified that the information was for people of all ages, cultures and backgrounds. In the case of Wikipedia this included all types of citizen information seekers. The entity focuses on all citizen categories of the GIV framework and no specific connections were made. Table 7.5 A shows Wikipedia's lack of specificity in distinguishing citizen user groups.

Table 7.5 A Wikipedia citizen users and GIV citizen user groups.

GIV Citizen User Group	Wikipedia Citizen Users as listed by the entity's Web Site
Private Citizen	People of all ages, cultures and backgrounds
Attentive Citizen	People of all ages, cultures and backgrounds
Deliberative Citizen	People of all ages, cultures and backgrounds
Citizen Practitioner/Publisher	People of all ages, cultures and backgrounds
Corporate Citizen	People of all ages, cultures and backgrounds

Table 1 A and 1 B, from chapter three (p. 36) discuss the definitions for the scope of the analysis and define the information needs that pertain to each citizen user category. The analysis of the types, topics, and formats that were available from Wikipedia allowed the following percentages to be calculated showing the percentage of information available for each user group. Wikipedia had information types, topics, and formats that were most beneficial and applicable to the attentive citizen with twenty-four percent. The citizen publisher/practitioner and the deliberative citizen both had the least amount of information needs fulfilled with seventeen percent. In between were the corporate citizen with twenty percent and the private citizen with twenty-two percent. Figure 7.5 A shows Wikipedia's percentages of available content for each citizen user group.

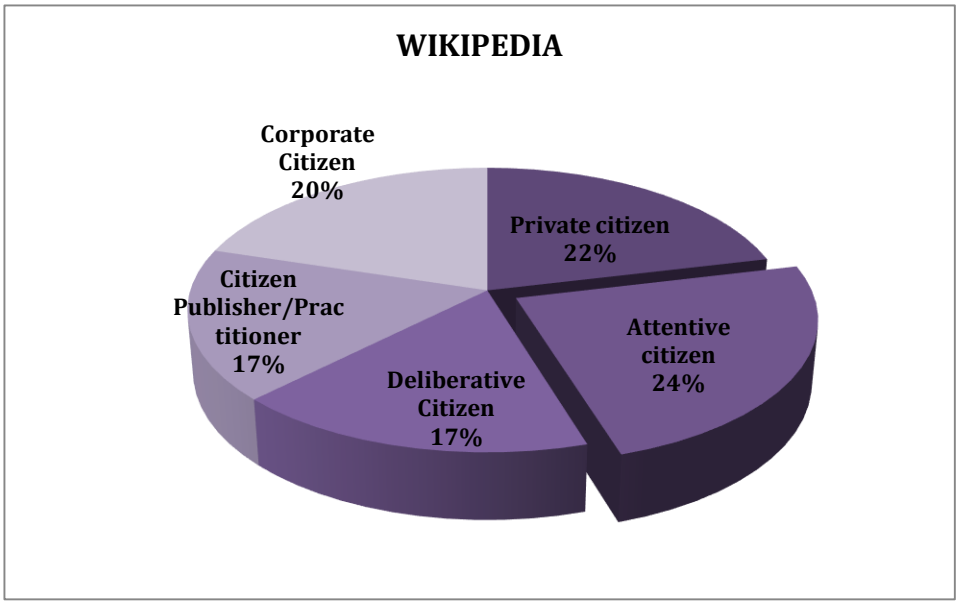


Figure 7.5 A Wikipedia and GIV citizen user content percentages.

7.6. Wikipedia First Impressions

The Wikipedia page was dense with text, links, and references. The page looked more like a textbook page at first glance. It was evident that the page was edited by several different organizations because the list of references at the end was extensive. The lists contained articles and websites in several languages.

Navigability, Design and Interactivity

The page followed the design of a standard wiki page and was easy to navigate. The headers provided visible categories even though the content was densely packed. There were many images and all were small in scale. The pictures and their captions did not break up the density of the text. The wiki design contained a table of contents that allowed for easy access to specific topic areas. The table of contents linked to the individual topic headings within the CCD page. The links did change color, but it was difficult to differentiate between the two colors. External links did contain small icons to indicate a redirect away from the wiki. These pages opened a new window for each resource. This page scored high in public engagement quality measures because it functioned as a wiki. Users could rate the page, edit content, and add links or references.

Information Topics

The content for the Wikipedia CCD page was comprehensive**.** The wiki function allowed for multi-faceted information. Some topics went into great detail, such as the regional specificity of CCD occurrences in North America and Europe. There were discussions addressing controversial subtopics.

Issues pertaining to GMOs, ideas about electromagnetic wave disturbances, and organic farming were discussed. Another topic that was discussed was nutritional supplement information. Since Wikipedia had

different operational components than the standard web page, the institutional focus subtopics referred solely to the discussion of the focus of other institutions on the page. Wikipedia was not affiliated with any particular institution or governing body. Institutional focus was a lower scoring topic.

Information Types and Information Formats

Wikipedia scores were high for both type and format of information topics. The volume of information on the page created a high score for the number of internal and external links, PDF files, scholarly articles and government documents.

Information Quality

Readability and IQ scores were average. The anonymity of the authors and editors to the wiki ruled out a score for source authority although institutional affiliations and bibliographic citations existed on the page. Misinformation was also uncovered. The information about established myths was not labeled as a myth. This misinformation occurred with information about the theory that cell phone towers and electromagnetic waves disturb the honeybee in flight. The myth was not explained, or if it had been, was edited without mention that the original scientist who proposed it later refuted the idea.

7.7. Wikipedia Discussion of Results

Wikipedia's web site statement was less of a mission statement and more of a definition of the function of Wikipedia. The statement defines Wikipedia as, "a multilingual, web-based, free-content encyclopedia project based on an openly editable model, Wikipedia's articles provide links to guide the user to related pages with additional information" (Wikipedia, 2012). The entity's defining focus of free content that is openly editable could reflect specific results from the analysis of the CCD page. The comprehensive coverage of the information topics could be a result of the contribution of many different sources. Wikipedia would not regulate the type of content. High interactivity scores would also be a result of this focus. Anyone with access to the web could edit the page. This feature also caused low scores in other areas of information quality. In particular source authority could be low because of the inability to connect embedded information to the editing source. Results displayed a high level of links both internal and external. This finding also aligns with Wikipedia's described function as a guide to related pages with more information. In the case of the CCD page, internal links were more prevalent than external links. This result was unexpected when compared to the amount of external contributions. The internal links could reflect the occurrence of contributing entities creating and editing other Wikipedia pages and linking text to them.

According to the results of the analysis, *Wikipedia could be a resource for accessing information about all of the topics except future research*. The results also indicated that *Wikipedia could be a recommended resource for users who needed information types that included basic information and*

scholarly articles. Users looking for information in the form of internal and external links, PDF files and/or interactive format would be advised to go to Wikipedia's CCD page. Finally, *Wikipedia could be considered a resource that provides information quality in the form of interactivity components and accuracy*. In this instance, the entity shows a high level of interactivity as the concept is defined within the scope of the study. Information accuracy was unexpected, as Wikipedia's content was not created by any one known source. However accuracy as defined by the study found Wikipedia to be accurate. The analysis found that the lowest level of information was available for the citizen publisher/practitioner user group and the deliberative citizen user group. While the user groups are all addressed by the content available, *the user group with the most available information material was the attentive citizen user group*. This result is congruent with Wikipedia's openly editable design. Attentive citizens could be considered as a major contributor to the content on the CCD page. The equality of the citizen user group ratio also reflects this focus. All five user categories remain between fifteen and twenty-five percent of available information material.

In this chapter the results of the research for all five entities were reported. Each entity was individually covered using the parameters as defined in the research design in chapter three. These results, in combination with the results from the social network analysis and the comparative summary of the content analysis from chapter four, set the stage for chapter six. Chapter six begins with the discussion and implications section that highlight the main lessons learned through the study and ends with a conclusion that addresses the limitations of the research and proposes avenues for future research.

CHAPTER 6
DISCUSSION AND IMPLICATIONS

In the previous two chapters the results of the research process were reported and discussed. The individual entities in the analysis included; the EPA, the USGS's NBII, the USDA, the US FWS and Wikipedia. The analysis focused on the page of each entity's website that relayed information about CCD and included an analysis of the links and content that were directly associated with this specific page and the entity's home page. Additionally, the data for the social network analysis portion of the research process was mapped and reported. These results show connections among the entity pages as a neighborhood within the network of CCD information on the Web. Connecting the external links from the source page to their target pages revealed these connections. The results for the five entities were also compared with one another. Finally, the following chapter discusses the overall findings of the study highlighting the most important implications of the research. Additionally, the findings are compared with previous research from other studies. Limitations and future research extensions of the study are also addressed.

Discussion and implications of results

From the research conducted in this thesis several ideas have been strengthened. The first research question asked what the main sources of CCD information were and how the entities interacted with one another. *Through the research it became apparent that there was myriad information available from different websites.* This dearth of information can be seen when looking at the resources listed on Wikipedia or on NBII's CCD page. The information from the three other government entities (the EPA, the USDA, and the US FWS) was contained within a specific web of information that was connected in a one-directional manner to the USDA. *Through the social network analysis component the research uncovered the USDA's role as the central CCD information source among the government entities.* All entities linked to the USDA CCD page, but the USDA page did not link to any other government entity with CCD information. This finding translates into a more central yet limited view of CCD information. As Mahler and Regan (2007) note, "Agencies that have more elaborate and sophisticated online presences may be more likely to have more orchestrated and controlled messages...typically the leadership within the organization must take an interest in and support that Web site for it to become large and sophisticated" (p. 511). The USDA scored high in information quality according to the research framework, but the information available did not provide a connection to potential available content accessible from other resources. For example, the EPA and Wikipedia both offer information about subtopics related to the topic of controversy. A user would not be able to find information on issues such as the Clothianidin conflict from the USDA CCD page.

A significant difference was noted between the Wikipedia CCD resources and the e-government resources in terms of quantity of information and level of interactivity. *Wikipedia content did not supply*

the same measure of information quality as the government sites. This is congruent with Chua et al., (2011) who find the web 2.0 wiki application type to be inapplicable with previously defined measures of information quality because the wiki by design focused on information acquisition from resources external to a governing body. At the same time, the significant amount of material and connections available to the user cannot be overlooked. The spectrum of citizen users would be more likely to find an information source that supported their needs from this page. Stvilia et al., (2008) support the need for further analysis of the wiki as information resource. "We believe that the study of those evolving debates and processes and of the IQ assurance model as a whole has useful implications for the improvement of quality in other more conventional databases" (p. 1000).

Addressing the results that illustrate the role that the now cancelled NBII played in the network of CCD information dissemination also exemplifies the importance of the network analysis method to understanding the landscape of available CCD information. At the onset of the research in January 2011, the NBII was a fully functioning entity. There was no indication that the program would be cancelled in the fall of 2011. *The NBII was unique as a central information source because it was both an information hub (similar to the wiki, it provided several resource connections external to the federal government information infrastructure), but at the same time it was a government entity with the source authority and participants from the government-supported studies.* As Sepic & Kase (2002) noted, "...the program's motto "Building Knowledge Through Partnerships" reflects its goal of uniting the intellectual capital of the private sector with the government's commitment to meeting the information needs of the country's natural resource managers and stewards" (p. 408). *The NBII would have been considered a bridge between the Wikipedia resources and the federal government CCD information*. Now that the program has been cancelled, this link is no longer functioning. Further investigation is recommended to understand the implications of removing this node from the information network and to assess the resiliency of the network of information to connect to the myriad non-government information resources such as Wikipedia provides. Areas for further analysis would also include consideration of the strengths and weaknesses of the NBII CCD page to understand and reformulate an entity with greater attention to information quality.

The second research question asked about the information that was available. The content analysis portion of the study revealed specific gaps of information topics, types, formats and information quality measures. *The framework shows that the EPA and the USDA have the most consistent information amounts and information quality measures overall. The NBII and the US FWS have the lowest amount of topics, types and formats and consistently scored lower in information quality.*

Overall *the highest characteristics were information about the topic of potential causes, discussed as basic information, using the internal link format. There was a high level of usability and design quality to the majority of this information*. It is significant to note that the most commonly used formats are all

formats that exist externally of the actual CCD web page. This means that the CCD information pages are consistently used as a linking element or an information hub to a number of resources that may or may not be relevant to the information seeker. The citizen user group with the most information applicable to the user was the attentive citizen user category. According to the definitions of the user categories as discussed in Chapter 3, the results indicated that *the most information overall would be available for users such as hobbyist beekeepers, small-scale farmers, consumer advocates, and land- use and planning experts.*

On the opposite end of the four measured characteristics *the lowest amount of resources were available that dealt with public participation*. The resources consistently did not have information as data visualizations and did not provide frequently asked questions as an information type. The two formats least used were audio and data files. Interactivity and public participation were the lowest scoring measure of information quality across all the entities. There was very little information about the topic of future research. Table 8 A shows the overall highest and lowest scoring measures in each category.

Table 8 A Overall highest and lowest scoring measures in each category.

Overall	High	Low
Topics	Potential Causes	Future Research
Types	Basic Information	FAQs Data Visualization
Formats	Internal Links	Audio, Multimedia, Data
IQ	Usability	Interactivity
GIV	Attentive Citizen	Citizen Publisher/Prac.

It is apparent from the content analysis that *the government entities as a whole do not often address matters of uncertainty and controversy that exist within the CCD discussion among the stakeholders.* As the literature from previous studies in post normal science theory have discussed (Bradshaw & Borchers, 2000; Fischer, 2000; Funtowicz & Ravetz, 1999; Jasanoff, 2003; Maxim & van der Sluijs, 2007) there is a need for including the citizens in the deliberative discussions surrounding such complex environmental problems because the public sphere provides two important elements. First, society involvement brings insight into factors from across domains and cultures to create an understanding of the problem and what solutions or protective measures can be implemented. Second, the citizens are treated justly as the stakeholders in the discussion. In the case of CCD and in other similar issues such as climate change, the policies and regulations that are formulated today will have a direct effect on the well being of communities in the future. For example, the collapse of the honey bee colonies will devastate the production of several of the major foods consumed in America, most integral being the alfalfa production that feed livestock for the beef and dairy industry. As recommended by Funtowicz and Ravetz (1999), "For these new problems, quality depends on open dialogue between all those affected" (p.7).

These results are congruent with Eschenfelder and Miller's suggestion that the current level of agency analysis is insufficient because it does not take into account the specific content of the documents in relation to the intended audience. By employing a multifaceted content analysis similar to the framework constructed by Eschenfelder and Miller in their 2007 article the research also shows how Bimber's 2003 proposal that "increased governmental use of technology will lead in part to a period of 'information abundance' facilitating citizen and civil society involvement in governance" (Eschenfelder and Miller, p.2) may not yet be occurring. *As illustrated when looking at the avenues for facilitating involvement in governance, interactivity was the lowest scoring area of information quality overall*.

Providing the public sphere with this information requires that user groups have materials that are applicable to the current communities and their information needs. This is growing ever more important with the technological innovations and applications that are being implemented globally. Chua et al., (2011) have observed that, "To keep up with the growing sophistication of their citizens, many governments are striving to offer high quality online experiences via their websites" (p. 3). *The research showed that there are some types of materials that are missing which are applicable to the dissemination of CCD information. In particular, the content analysis portion showed the lack of any data visualization applications or types of information that addressed frequently asked questions. The dialogue between the information seeker and the information resource provider is not evident at this time.*

The third research question asked about the quality of the available information. As noted by Rubin (2004) in his information science text, "all databases have their limitations, biases, and deficiencies and we know that the web is filled with unreliable information" (p. 336). *The results of the study have shown that areas of misinformation and limitations do exist on these entity pages.* Overall there were specific issues that were consistently deficient according to the parameters set up by the framework other than interactivity and public engagement. Information currency measurements were in alignment with Cho's (2010) findings in her survey of CCD in newspaper articles and external web media sources from 2007-2009. "The media articles in 2009 lacked a sense of urgency compared to 2007 and 2008 articles. The cause or impact of CCD was not mentioned as much in the later articles; some articles briefly brought up the issue as a passing comment" (Cho, 2010, p. 8). *The results of the research indicate a significant decline in the reporting of new information after 2009.* When the date of page revision was clearly presented on the page, there was little evidence within the content on the page to support the revision as most of the material was dated from 2006-2009. As was shown in Figure 2.4 G, the percentages for the information currency scores reflect the deficiency in current information. Three out of the five entities had information about cancelled programs or projects. The scores are indicative of the importance that interactivity can play in creating current information. Wikipedia's score for updated information is one hundred percent. An engaged public sphere can provide a mechanism for keeping information currently updated. Whether in the form of a wiki, an

open comment section, or a discussion forum, interactivity is an important component to information currency. One implication of this research is the suggestion for increased interactivity as it benefits not only the information seeking public, but also provides a larger pool of current resources to those within the entity relaying the information.

Other issues specific to the overall information quality aspect of the analysis for the five entities included *a lack of sufficient source information*. This is congruent with previous research from Fritch and Cromwell (2001) who found that Internet information often lacks a specific formal author and citation so the information seeker often has to derive meaning solely from the reputation of the institution or agency. Similar results were shown in chapter four, Figure 2.4 E. The USDA and the US FWS were the only two entities that scored consistently for all measures of source authority, though the US FWS has significantly less information than the USDA. The other government entities all provided simply evidence of institutional affiliation. Warnick (2004) also discussed the ambiguity of the web stating that it can be an "authorless environment where the author's identity is of little or no importance " (p. 264). *The USDA was the single entity in the current study that named a specific author of the information and provided contact information for this individual.*

Additionally, the IQ literature noted issues of design and construction. Hackley (2003) found that the systems are often constructed and seen in a similar light to that of professional documents and not designed to support the specific nature of Web use in the public sphere. The online environment is less conducive to the government text document method of structuring. This statement is in agreement with the results from this research. While usability as a whole according to the framework was ranked the highest in the category of information quality, the type of information and the format of the information played a role in the structure of the material. Hackley's (2003) finding was seen in the results as lack of multimedia, audio, and images. *The most information types and formats appear as embedded text, basic information and as internal links to pages and pdf documents without dimensions of interactivity or visualization beyond the written word*.

Because of the consistent levels of quality and content delivery demonstrated by the results for the USDA, this entity is recommended as the overall best choice for CCD information. Clearly, the centrality of the entity shown by the network analysis component of the study suggests that the network landscape of CCD information on the web positions the entity as the major source. *Due to the lack of content and consistent information quality on the US FWS page, this entity is the least recommended for CCD information overall the entities in the analysis.* This result is also congruent with the network analysis component of the study that shows the US FWS as the least connected of the entities, linking only to the USDA.

The content analysis also showed the limitations in information format that were made available to the user. *There were no data files available and no information in the form of audio files*. Both of these formats play a role for certain users. Audio and multimedia files are integral components to users with specialized learning needs such as those who have sensory impairment or learning disabilities. Access to data files is important because it provides the citizen user with full transparency on issues of research they may desire to explore. Scientists and citizen experts may find the provision of such files to be an integral aid in constructing further discussions and backing up the position of community stakeholders.

The areas where gaps were found relate to the major missing element of interactivity and public engagement applications. *The topic of citizen interaction with and about the information provided was consistently missing among all government entities. Wikipedia provided interactivity because it is by design an interactive application, however there are issues with information quality and source authority that coincide with the information from Wikipedia.* For example, Wikipedia discloses information about one myth related to the prevalence of cell phone signals correlated with a rise in CCD. The scientist who originally conducted the research refuted this study but the page's information at the time of this thesis research did not state this second element of the information. The constant changes to content by public editors make the wiki susceptible to different forms of bias and stakeholder agenda on a given day. Thus, *the need for information that contains interactive elements with more secure information quality measures remains apparent and is an implication of the research that presents an extension for future research endeavors.*

Finally, this research showed a way in which a framework can be constructed that provides a multi-faceted approach to evaluating information dissemination practices about a complex problem. The use of Eschenfelder and Miller's (2007) Government Information Valuation parameters in conjunction with the content analysis and social network analysis elements created a more complete picture of the current state of government information about a complex problem. The GIV allowed the study to take the spectrum of citizen users into account to supplement the post-normal science theory that seeks to understand the public not as a singular unit, but as a spectrum of information seekers with very specific, diverse needs. The highs and lows in the information framework illustrate the nuances in the information provided and serve as a way to understand which resources may be a better fit for specific user groups and seekers of specific information topics types and formats. These recommendations are as follows:

In four out of the five areas of information characteristics Wikipedia was the highest scoring entity. These four areas were by topics, types, formats, and the amount of material pertaining to all citizen user categories. The USDA scored highest in IQ. From these results it can be seen that Wikipedia has more information quantity wise. In addition each of the pages has strengths and weaknesses in the content provided. From these results recommendations for the information seeker can be tailored according to the

needs of the seeker. Table 8 B shows the entities with the highest and lowest ranking for each measured category.

Table 8 B Highest and lowest scoring entities for each category.

	Topics	Types	Formats	IQ	GIV Scores
Highest	Wikipedia	Wikipedia	Wikipedia	USDA	Wikipedia
Lowest	US FWS	US FWS	EPA	NBII	US FWS

Users should go to the EPA if they need basic information about potential causes. The user will be able to access the most information in the form of internal links. The recommended user is the attentive citizen. Users who need information about the potential consequences of CCD and the importance of honey bees, users seeking scholarly research, those looking for information about frequently asked questions or visualization of data or those in the private or deliberative citizen user groups would be advised to look elsewhere. Table 8 C shows the recommendations and the contraindications associated with the EPA.

Table 8 C EPA highs and lows.

EPA	High	Low
Topics	Potential Causes	Consequences/ Importance
Types	Basic Information	Scholarly Research
Formats	Internal Links	FAQs, Data Visualization
IQ	Usability	Interactivity
GIV	Attentive Citizen	Private and Deliberative

Users would have been advised to go the NBII for information on the importance of honeybees and the consequences of CCD. Those in need of resource lists and information in the form of external links would also have been advised to access the NBII. Users who considered usability and design to be essential quality elements would have also been recommended to look here. The private citizen would have been the user group with the most information available to them from the NBII CCD page. Citizen practitioner/publishers, those seeking information about future research, in need of government or official documents, or who required information currency would have been advised to go elsewhere. Table 8 D shows the high and low measures for the NBII across all five analysis categories.

Table 8 D NBII highs and lows.

NBII	High	Low
Topics	Importance, Consequences	Future Research

Types	Resource Lists	Gov/official documents
Formats	External Links	Images
IQ	Usability	Currency
GIV	Private Citizen	Citizen Publisher/Practitioner

Users seeking information about potential causes should be advised to go to the USDA. Also, users seeking basic information or who are in need of internal links to more information should go to the USDA. When consistent information quality across several common IQ parameters is of specific importance users would find this from the USDA. The entity would be most applicable as a recommendation for the attentive citizen user. Users who are considered deliberative citizen users, those who seek information about the controversy surrounding CCD, those who need scholarly research articles, those who are looking to find external links to other entities or those users who desire interactivity and public engagement would be advised to go elsewhere. Table 8 E shows the strengths and weaknesses for the USDA across all five analysis categories.

Table 8 E USDA highs and lows.

USDA	High	Low
Topics	Potential Causes	Controversy
Types	Basic Information	Scholarly Research Articles
Formats	Internal Links	External Links
IQ	All (consistency) except	Interactivity
GIV	Attentive	Deliberative

Users seeking information about potential causes and those who are in need of basic information should be advised to go to the US FWS. Also, users seeking information formats with attention to external links would be advised to go to the US FWS. Users who need information quality specific to usability and design would also be advised to go to the US FWS. Users in the private citizen category should be advised to visit the US FWS. Users in the citizen publisher/practitioner user group, those who are seeking information about the consequences of CCD, those who require government and/or official documents, those looking for a large amount of the embedded text format, or those concerned with finding the most current information would be advised to go elsewhere. Table 8 F shows the high and low measures for all five analysis categories.

Table 8 F US FWS highs and lows.

US FWS	High	Low
Topics	Potential Causes	Consequences

Types	Basic Information	Gov. and Official Documents
Formats	External Links	Embedded Text
IQ	Usability	Currency
GIV	Private Citizen	Citizen Pub/Pract.

Users seeking information about potential causes should be advised to go to Wikipedia. Also, users who seek basic information should be advised to go to Wikipedia. Users who are looking to find the major format of information as internal links should also go to Wikipedia. In particular those who desired public engagement and interactivity should also be directed to the Wikipedia CCD page. The page had the most information available for the attentive citizen user group. Citizens in the deliberative or the practitioner/publisher user groups, those who required information about future research, those who were looking for information types that included government or official documents, those looking for information formats that included audio, media, or data files or users who required a firm source authority as an information quality measure would be advised to go elsewhere. Table 8 G shows the strengths and weaknesses for Wikipedia across all five analysis categories.

Table 8 G Wikipedia highs and lows.

Wikipedia	High	Low
Topics	Potential Causes	Future Research
Types	Basic Information	Gov./Official Documents
Formats	Internal Links	Audio, Multimedia, Data
IQ	Public Engagement	Source Authority
GIV	Attentive Citizen	Deliberative/PublisherPrac.

Research Limitations

The research for this study was limited because it was an individual endeavor susceptible to constraints based on the amount of time and any personal bias that might have occurred. Further studies would strive to include both a larger social network analysis with the secondary content analysis. Researchers would seek advice in specific content from professionals within the CCD and government information research domains. The research did not consult any of the four government entities or Wikipedia administrators for an internal perspective on their specific role in disseminating CCD information. There may have been unknown factors that played a role in determining what the web page administrators are able to produce. Examples of these factors include funding, staff, legislation, attention to other subject matter deemed higher priority, or lack of information resources available to the web page administrator. Interviews with such individuals could add another valuable component to the current picture

of the information landscape. Extensions to this study should take some of these possibilities into account. Another research extension for consideration would include the application of the analysis matrix to another wicked problem. In the process of applying the matrix to other issues, it is important to note that the matrix was developed as a tool to aid in the general analysis of an information landscape of a complex or wicked problem. The tool gives an overview and needs to be used in a general context as a unit. Research that requires greater depth in one specific component (e.g. information accuracy, usability, etc.) would need to apply another framework or an additional element to achieve the desired granularity.

Conclusion

This research has taken a mixed method approach to understanding the information landscape of a wicked problem. Through the study a framework was implemented that assessed a portion of the landscape of colony collapse disorder information from the federal government via the Web. Using a government information valuation framework that takes into account a spectrum of citizen user needs, the research was able to look at the information content within the context of the public sphere and to apply the lens of post normal science theory to understand the essential nature of public participation to the provision of quality, equitable information. This study contributed to the research in the field of information science and e-government studies by making several observations and strengthening perspectives on specific issues.

First, the social network analysis component of the study showed how the now cancelled USGS's NBII played a role as a bridge between the web 2.0 collaborative aspects of Wikipedia and the government entities that provide information. The social network analysis also confirmed that the USDA was the central resource in the network of government entity information, however it also found that the USDA could have used links to external resources in order to create a more diverse picture of the CCD phenomenon. The content analysis of the five entities showed that Wikipedia had the most comprehensive amount of information in comparison with the government entities, but the USDA had more consistent quality measures. The USDA is seen here as the recommended source for CCD information over all analysis categories. The least recommended source is the US FWS because of the lack of currency, consistently less quantity, and little to no degree of connectivity within the network. More research is needed to determine other contributing factors to findings such as this.

The study suggests that the entities besides the USDA should give author information and contact information. More information should be made available for the citizen who is not a scientific researcher or stakeholder but who participates in the discussion as a deliberative citizen and a citizen publisher/practitioner. In particular these citizen user groups are in need of integration of interactivity and public engagement applications to facilitate a two-way flow of information. This framework provides a starting point and a tool for use in future studies that examine the network of e-government information

available about specific complex and wicked problems. Future research would take an in depth look at the changing landscape of CCD information after the termination of the NBII. Extensions could assess other newer resources available from the federal government, such as the CCD web page associated with NASA's web site, which was not known at the inception of the research. Exploration could also include the application of the framework to other wicked problems. Comparison of the framework in two separate and equally wicked instances would create a deeper understanding of the framework and its functionality.

LIST OF REFERENCES

Alexander, J. E., & Tate, M. A., (1999). *Web Wisdom: How to Evaluate and Create Information Quality on the Web.* Lawrence Erlbaum Associates. 1-152.

Barabásia, A. L., Jeonga, H., Nédaa, Z., Ravasza, E., Schubert, A., & Vicsek, T. (2002). Evolution of the social network of scientific collaborations. *Physica A: Statistical Mechanics and its Applications, 311*(3-4), 590-614.

Bastian M., Heymann S., & Jacomy, M., (2009). *Gephi: open source software for exploring and manipulating networks.* International AAAI Conference on Weblogs and Social Media.

Bastian, M., Heymann, S., Jacomy, M., & Venturini, T., (2011). *ForceAtlas2, A Graph Layout Algorithm for Handy Network Visualization*. Draft: Technical Paper.

Bonati, M., Impiociatore, P., & Pandolfini, C., (1998). Quality on the Internet. *BMJ*, 317(28), 1500-1501.

Bradshaw, G., & Borchers, J., (2000). Uncertainty as Information: Narrowing the Science Policy Gap. *Ecology and Society, 4*(1), 1-12.

Byrne, P. F., Namuth, D. M., Harrington, J., Ward, S. M., Lee, D. J., & Hain, P., (2002). Increasing public understanding of transgenic crops through the World Wide Web. *Public Understanding of Science,* 11(3), 293-304.

Calderone, N., (2010). *AAPA Position Statement on the Health of the US Honey Bee Industry*. American Association of Professional Apiculturists.

CCD Steering Committee Working Group, (2007). *Colony Collapse Disorder Action Plan*. Beltsville, MD: United States Department of Agriculture, Agricultural Research Services.

Cho, A., (2010). Silence of the bees: A study of scientific representation in media. Berkeley. Retrieved from *nature.berkeley.edu/classes/es196/projects/2010final/ChoA_2010.pdf*.

Chua, A., Goh, D., & Ang, R., (2011). Web 2.0 applications in government websites: prevalence, use and correlations with perceived website quality. *Online Information Review,* 36 (2).

EPA, (2011). *Clothianidin Response Letter*. Retrieved from http://www.epa.gov/pesticides/about/intheworks/clothianidin-response-letter.pdf.

EPA, (2012). *Environmental Protection Agency.* Retrieved August 4, 2011, from United States Federal Government: http://www.epa.gov/

Eschenfelder, K., & Miller, C., (2006). What public information should government agencies publish? *A Comparison of Controversial Web-Based Government Information* 1-32. Retrieved from https://docs.google.com/viewer?a=v&q=cache:Nb2kdNV4mGYJ:arizona.openrepository.com/arizona/bitstream/10150/105318/1/submit_cwd_states_0809_with_citations_fixed.doc.

Eschenfelder, K., & Miller, C., (2007). Examining the role of Website information in facilitating different citizen-government relationships: A case study of chronic wasting disease Websites. *Government Information Quarterly,* 24 (1), 64-88.

Eysenbach, G., & Diepgen, T. L., (1998). Towards quality management of medical information on the Internet: evaluation, labeling, and filtering of information. *Information in practice BMJ* 317(1), 496-502.

Flottum, K., (2011). 7 (yes, 7) causes of colony collapse disorder. *The Daily Green: the consumer's guide to the green revolution,* (January 18, 2011). Retrieved from http://www.thedailygreen.com/environmental-news/blogs/bees/colony-collapse-disorder-causes-0118.

Fischer, F., (2000). *Citizens, Experts, and the Environment: The Politics of Local Knowledge*. Durham and London: Duke University Press.

Fritch, J. W., & Cromwell, R. L., (2001). Evaluating Internet resources: Identity, affiliation, and cognitive authority in a networked world. *Journal of the American Society for Information Science and Technology,* 56(2), 499-507.

Funtowicz, S. O., Martinez-Alier, J., Munda, G., & Ravetz. J. R., (1999). *Information tools for environmental policy under conditions of complexity*. Luxembourg: European Environmental Agency.

Goldberg, J., & Silwa, S., (2011). Communicating actionable nutrition messages: challenges and opportunities. Paper presented at *the Symposium on Nutrition: Getting the Balance Right in 2010*, University of Ulster, Coleraine.

Gregory, J., & Miller, S., (1998). *Science in Public: Communication, Culture, and Credibility*. Cambridge: Basic Books.

Hacklay, M. E., (2003). Public access to environmental information: past, present and future. *Computers, Environment and Urban Systems, 27,* 163-180.

Hanneman, Robert A., & Riddle, M., (2005). *Introduction to Social Network Methods*. Riverside, CA: University of California, Riverside (published in digital form at http://faculty.ucr.edu/~hanneman/ .)

Holmes, D., & Robins, J., (2008). Aesthetics and credibility in web site design. *Information Processing and Management. 44*(1), 386-399.

Jasanoff, S., (2003). Technologies of humility: Citizen participation in governing Sscience. *Minerva, 41*, 223-244.

Jobe, M., (2006). Going local: Environmental information on the Internet. *The Haworth Press, Inc.* Retrieved from http://www.haworthpress.com/web/REF. doi:0.1300/J120v45n94_15.

Johnson, R. (2010). *Honey Bee Colony Collapse Disorder CRS Report for Congress*.

Kahn, B. K., Strong, D. M., & Wang, R. Y., (2002). Information quality benchmarks: Product and service performance. *Communications of the ACM, 45*(4ve).

Katerattanakul, P., & Siau, K., (1999). Measuring information quality of Websites: Development of an instrument. Paper presented at the *Proceedings of the 20th International Conference on Information Systems* Charlotte, North Carolina, United States.

Klobas, J. E., (1995). Beyond information quality: fitness for purpose and electronic information resource use. *Journal of Information Science, 21*(2), 95-114.

Knight, S., & Burn, J., (2005). Developing a framework for assessing information quality on the World Wide Web. *Informing Science Journal, 8*, 159-172.

Kules, B., & Schneiderman, B., (2004). Categorized graphical overviews for web search results: An exploratory study using U. S. government agencies as a meaningful and stable structure. *Institute for Systems Research, 71*, 1-8.

Lingaard, G., Fernandez, G., Dudek, C., & Browntilde, J., (2006). Attention web designers: You have 50 milliseconds to make a good first impression! *Behavior and Information Technology, 25*, 115-126.

Mahler, J., & Regan, P., (2006). Crafting the message: Controlling content on agency Web sites. *Government Information Quarterly, 24*(2007), 505-521.

Marin, A., & Wellman, B., (2009). Social network analysis: An introduction. In P. Carrington & J. Scott (Eds.), *Handbook of Social Network Analysis*. London: Sage.

Maxim, L., & van der Sluijs, J. P., (2007). Uncertainty: Cause or effect of stakeholders' debates? Analysis of a case study: The risk for honeybees of the insecticide Gaucho. *Science of the Total Environment, 376*, 1-17.

Meric, F., Bernstam, E. V., Mirza, N. Q., Hunt, K. K., Ames, F. C., Ross, M. I., et al., (2002). Breast cancer on the World Wide Web: cross sectional survey of quality of information and popularity of websites. *BMJ, 324*, 577- 580.

Michailidou, E., Harper, S., & Bechhofer, S., (2008). Visual complexity and aesthetic perception of web pages. Paper presented at the *Proceedings of the 26th Annual ACM International Conference on Design of Communication*, Lisbon, Portugal.

NAPPC, (2007). *Honey Bee Disappearance (CCD) and What You Can Do*. North American Pollinator Protection Campaign. 2.

National Science Foundation, (2002). *Information Quality Guidelines. 1-17.*

NBII, (2011). *National Biological Information Infrastructure*. From United States Geological Survey: http://www.nbii.gov/

Nielson, J., (2011). Top 10 mistakes in web design, *Jakob Nielson's Alertbox.* Use-it.com. Accessed online 06/01/2011 from http://www.useit.com/alertbox/9605.html.

Office of Management and Budget, (2002). Guidelines for ensuring and maximizing the quality, objectivity, utility and integrity of information disseminated by federal agencies: Notice, republication. *Federal Register*. 67 (36). 3451-3460.

Philpott, T., (2010). Leaked document shows EPA allowed bee-toxic pesticide despite own scientists' red flags. *Grist, December 10, 2010*. Retrieved from:http://www.grist.org/article/food-2010-12-10-leaked-documents-show-epa-allowed-bee-toxic-pesticide-.

Pilatic, H., & Feldman, J., (2010). Beekeepers ask EPA to remove pesticide linked to colony collapse disorder, citing leaked agency memo. *Pesticide Action Network and Beyond Pesticides*.

Rubin, R., (2004). *Foundations of Library and Information Science* (2nd edition ed., pp. 323-359). New York: Neal-Schuman.

Schweizer, S., Thompson, J., Teel, T., & Bruyere, B., (2009). Strategies for communicating about climate change impacts on public Llands. *Science Communication, 31*(2), 266-274.

Sepic, R., & Kase, K., (2002). The National Biological Information Infrastructure as an e-government tool. *Government Information Quarterly, 19*, 407-424.

Stvilia, B., Gasser, L., Twidale, M. B., & Smith, L. C., (2007). A framework for information quality assessment. *Journal of the American Society for Information Science and Technology, 58*(12), 1720-1733.

Sylvers, E., (2007). Case of the disappearing bees creates a buzz. *New York TImes,* (Sunday, April 22, 2007). Retrieved from http://www.nytimes.com/2007/04/22/technology/22iht-wireless23.1.5388309.html.

USDA, (2012). *United States Department of Agriculture.* Retrieved August 4, 2011, from United States Federal Government: http://www.usda.gov/wps/portal/usda/usdahome.

USFWS, (2012). *United States Fish and Wildlife Service*. Retrieved August 4, 2011, from United States Federal Government: http://www.fws.gov/.

Wang, R. Y., & Strong, D. M., (1996). Beyond accuracy: what data quality means to data consumers. *J. Manage. Inf. Syst., 12*(4), 5-33.

Warnick, B., (2004). Online ethos: source credibility in an "authorless" environment. *American Behavioral Scientist, 2004*(48).

Wardekker, J., van der Sluijs, J., Janssen, P., Kloprogge, P., & Petersen, C., (2008). Uncertainty communication in environmental assessments: views from the Dutch science-policy interface. *Environmental Science and Policy, 2*, 627-641.

Wikimedia, (2012). *Wikipedia*. Retrieved August 4, 2011, from Wikimedia: http://www.wikipedia.org/.

Zeist, R. H. J., & Hendriks, P. R. H., (1996). Specifying software quality with the extended ISO model. *Software Quality Journal, 5*(4), 273-284.

APPENDIX

A1: Definitions for terminology involved in the evaluation framework.

Information Topics:	Classifies the material by delineating subject areas
Definition of CCD:	Must include three of the five: who, what, when, where, and why.
Potential Causes	Discusses the theories of CCD causes. Must address more than one reason and the unknown status of the cause.
Proposed Solutions	Discusses theories of action that have been proposed in the light of uncertainty. Must provide an explanation for the proposal.
Consequences of CCD	Mentions one or more of the following; economic loss, diminished food supply, threatened livelihoods, species decline, future large- scale environmental decline.
Importance of honeybees	Mentions one or more of the following: food production and supply, plant pollination, economic value, medicinal value, research endeavors
Future Research	Mentions one or more of the following: genetic research, future institution involvement, new monitoring practices, new plans for funding, ideas not yet in action
Current Research	Discusses what researchers are currently working on. Must mention one or more of the following, genetic screening, pesticide testing, recreating diseases and stressors, monitoring hives, natural miticides and antibiotics.
Myths	Discusses common misconceptions. Must provide an explanation for why this is a popular misconception. Topics include: cell phone towers and signal issues, bees as pests, past occurrences of CCD and disbelief in the actual existence of CCD.
Uncertainties	Identifies/explains areas of difficulty in determining specific theory regarding CCD. Mentions one or more of the following: regional differences, absence of dead bees near the hive, multifaceted phenomenon, research discrepancies. Must state as a contributing factor to uncertain or unclear or undetermined issues.
Controversy	Discusses the main debates. Must explain more than one perspective on an issue of contention. Needs to include one or more of the following: Genetically Modified Organisms, organic farming, pesticide testing methods, nutrient supplements, the influences of corporations and their agendas
Institutional Focus	Speaks directly about the mission and role of the institution in the current and future endeavors surrounding CCD. Must include one or more of the following: policy formulation and regulation, research management and funding, public outreach, provision of data services or another related focus
Public Participation	Involves the information seeker in the process by discussing one or more of the following: how to help, requesting information from citizens, asking for comments and questions or profiling national, regional and local programs for involvement.

Information Types:	Classifies information functions un-related to format or topic. For this study information types are defined by their function and ranked according to their usefulness per GIV citizen user group. Usefulness is defined by the ability of the type to align with the GIV recommended types of information for each citizen group.
Basic Information	This information is broad and essential meaning it does not require any prior knowledge of the issue and if a technical term is used, the definition is readily available in the immediate text or through hyper link.
Frequently Asked Questions	Presented in a question and direct answer format, simulates a dialogue. Must be labeled as FAQs and technical terms are defined immediately or with hypertext links to a definition.
Latest News	The most recent available information on programs, events, projects, research findings or problems. Recent is defined within 2 years of the current date June 2011.
Feature Stories	These highlight a specific story of programs, events, projects, research findings or problems. Unlike latest news, they may be current or from the past. Must be separate from the basic information see def. above.
Government and Official Documents	Documents that serve as a guideline, a report, or a resource to a governing body. Will usually be in the form of a pdf file or a hyperlink.
Scholarly Research Articles	Supporting information in the form of a paper composed by a scholar and submitted to a peer-reviewed journal for publication.
Data Visualization	A visual interpretation of recorded data in the form of a map, graph, table, chart or other pictorial figure. The image must be visible on the page or labeled as such in a link to the image.
Administrative Information	Information about the people and institutes that work to combat CCD. Could include such content as an organizations history, members, mission, funding or partnerships.
Resource lists	Lists of places to go for more information. Usually these lists contain links to the internal and external web pages with a brief annotation about the resource

Information Formats	Information product form classifications
Embedded Text	Textual information that is part of the web page, not located on a separate file from the source code.
Image	An image file: 2D material jpg, png, giff/tiff
Audio	A sound file
Multimedia	Video, animation or podcast: requirements are that the materials contain more than one type of sensory media transmission.
Data	A file that contains the results of a research activity during a specific period of time. Specifically, this is processed (graph or chart) or unprocessed (raw file) results of a scholarly study.
Internal Links	Clickable hypertext, pictures and tabs that transfer the user to another page within the website. Located throughout the page.
External Links	Clickable hypertext, pictures and tabs that transfer the user to another site page outside the website. Located throughout the page.
PDF Files	Clickable links, pictures and text that enable the user to download a document on to their computer in the form of a pdf file. Located throughout the page.
Interactive Application	A feature that allows for the user to physically interact, respond to, or work with the information

Physical Components of the Web Page	Defines the elements that consistently make up the physical space of the website page layout.
Header Content	Content under the website banner. Separate from the central text and not part of the banner.
Central Content	The content that makes up the body of the page. Usually seen as text in paragraph format, but may include additional formats of information.
Left Menu Bar	A list located on the left hand side provides linked access to related topics available from the web site.
Left Column Content	Content located to the left of the central content, often supplementary. If left menu bar exists, it is found underneath.
Right Column Content	Similar to the left column, right column content is located to the right of the central content, in a separate column.
Footer Content	Content found underneath and separate from the central content and side columns.
Horizontal Menu Bar	Located across the top or bottom of the page, it provides a list of categorized links to other material on other pages throughout the site. May or not be related to the page.

Information Quality	Elements that define quality information according to the needs of the user
Currency	Consists of 3 criteria: 1. The page has no broken links. 2. The page has been updated within the past 2 years (from 6/20/2011). 3. The page has no information about canceled programs or projects.
Source Authority	Consists of 3 criteria: 1. Authorship is disclosed. 2. Contact information is available. 3. Institutional affiliation is cited.
Accuracy	Consists of 3 criteria: 1. Content is free of known errors. 2. Content is free of misinformation. 3. The page delivers the information it promises
Usability and design	Checklist of 10 criteria as defined by Jakob Nielsen: 1. Simple search engine 2. PDFs are reserved for manuals and big documents 3. Visited links change color 4. Text is written for online reading and supports scan ability 5. Font size is not fixed or too small 6. Page titles are descriptive and short 7. No animation, advertisements or pop-ups 8. Design is consistent with other web pages and sites 9. Links work as simple hypertext reference; new windows do not open 10. Answers and main ideas are visible as such.
Additional Measures of Usability and Design definitions	11. Navigability: Ease of access and movement to information. To be scored as easy to navigate a page must have no broken links, no areas that are slow to load, no broken tabs, and no redundant resources. 12. Look And Feel: The design and layout reflect and support the content. It is consistent among the pages. The colors are harmonious and the graphics are appropriate to the content not detracting from the information.
Interactivity and Public Engagement	Checklist for Interactivity and Public Engagement 1. User support/ help functions 2. Advanced or user customized search options 3. Open comment fields 4. Interactive media or applications for wireless devices 5. Folksonomy and tagging applications 6. Offers a web 2.0 component/ or endorses citizen science program 7. Specific requests for citizen input on topics

CCD Government Information Valuation Framework	The spectrum of citizen users defined by Eschenfelder and Miller 2007, with one additional category of citizen user created to facilitate the analysis of CCD information seekers.
Private Citizen:	Needs information as an individual citizen to make private decisions or take private actions. Every person is a private citizen however many fall into other categories as well. Examples of specifically private citizens are students, teachers, parents and guardians, consumers, Gardeners, hobbyist farmers and small business owners
Attentive Citizen:	Requires a 2-way flow of info: assessment of agencies policies and performance, government. collects citizen opinion and feedback to expert opinion. This information needs to be comprehensive to facilitate this 2-way flow. Examples of attentive citizens are hobbyist beekeepers, small-scale farmers, consumer advocates, and land use and planning experts.
Deliberative Citizen:	Needs information to formulate, articulate and defend in public forum. They need a range of facts and interpretations for informed debate including information about the stakeholders without messages that are persuasive to a particular agenda. Examples are environmental analysts, economic analysts, grassroots organizations, community level leaders such as a mayor or a commissioner, and editorial journalists.
Citizen Practitioner/ Publisher:	Requires a horizontal and multi-dimensional flow of information. Civil society and government info is not focus but supports and reflects their active role in the creation of new information material. Examples are university affiliated researchers, NGO administration, policy analysts, agricultural engineers, apiculturists, scientists from related fields (e.g.; Chemists), journalists and media specialists, information specialists
Corporate Citizen:	Interests cater to a specific company or agenda. The citizen has a vested interest in the economic impact of specific decisions related to the dissemination of information to the public sphere. Especially relevant to this group is current updates about regulations and policies with continued avenues of communication and documents which focus on backing up the information presented. Examples are lawyers, chemical company affiliates, food production affiliates, scientists employed by these corporations and political leaders.

Definition of Information Topics as presented by the GIV	Definitions for this analysis of the information topics used by Eschenfelder and Miller 2007. Definitions provide background for aligning previously defined user needs with specific CCD information components (types, topics, and formats) in this analysis.
Core Information:	Content recommended for all members of the public, core information is generalized information about the disease created with speed of understanding in mind. Supplements other materials.
User Community Specific:	This information must acknowledge that it is produced for a specific group of users. Parameters may be regional, cultural, job related etc.
Reports: Working Group/ Progress:	Reports are official documents created by an organized agency to provide a current assessment of the issue, and/or report on observed changes over a period of time. These reports will be labeled and the author must be acknowledged.
Action Plans/ Strategies:	These are also documents drawn up by an organized agency to identify the mission of the group and to delegate responsibilities and funding appropriately to facilitate the best possible outcome. These reports will be labeled and the author must be acknowledged.
Sides of the Debate:	Issues of contention are recognized as such and the material addresses both or multiple perspectives of the argument
Gap Disclosure:	Areas of uncertainty are identified as such. Must clearly address that there is no known answer at this time.
Citizen Participation Tools:	Applications and materials that allow any individual to get involved, make comments, or provide additional information.
Information Dissemination Assistance:	This may include: Instructions for using citizen tools or contact information to offer services and information or materials provided for community education practices such as posters, fact sheets and workshop guidelines.
Links to Databases and Forums:	Directs the user to an avenue for searching, sharing, debate and/ or discussion. These databases and forums must be related specifically to the issue of colony collapse disorder and pollinator health.
Agreements and Partnerships:	Statements and documents that acknowledge the relationship between two or more organizations. Must provide an explanation of the partnership parameters not just a hyperlink.
Updates to events, regulations, and policies:	Must be current (within one year) and authorship must be acknowledged with any explanation.

A2: Comparative summary of scores from all five entities

Information Element					
Information Topic	**High**	**MidHigh**	**Middle**	**MidLow**	**Low**
Definition of CCD	5	**4**	**4**	**3**	**3**
Potential Causes	7	7	7	5	3
Proposed Solutions	5	4	3	2	2
Consequences of CCD	5	4	2	0	0
Importance of honey bees	3	3	3	2	0
Future research	3	2	**1**	**1**	0
Current research	**5**	**5**	3	**1**	**1**
Myths	3	**2**	**2**	1	0
Uncertainties	4	3	2	2	1
Controversy	3	1	0	0	0
Institutional focus	3	**2**	**2**	**1**	**1**
Public participation	**2**	**2**	**1**	**1**	0
Total	**WIKI**	**USDA**	**EPA**	**NBII**	**USFWS**
Information Types	**High**	**MidHigh**	**Middle**	**MidLow**	**Low**
Basic Information	**11**	**11**	9	6	3
Frequently Asked Questions	0	0	0	0	0
Latest News	2	0	0	0	0
Feature Stories	4	2	1	0	0
Government and Official Documents	7	5	4	1	0
Scholarly Research Articles	6	2	1	1	0
Data Visualization	0	0	0	0	0
Administrative Information	1	1	0	0	0
Resource lists	7	3	3	2	1
Total	**EPA**	**USDA**	**USFWS**	**NBII**	**WIKI**
Information Formats	**High**	**MidHigh**	**Middle**	**MidLow**	**Low**
Embedded Text	2	1	1	1	1
Images	5	4	3	2	1
Audio	0	0	0	0	0
Multimedia	1	0	0	0	0
Data File	0	0	0	0	0
Internal Links	174	46	32	20	18
External Links	115	35	22	12	3
PDF Files	20	19	4	3	1
Interactive Applications	3	2	1	1	1
Total	**WIKI**	**USDA**	**NBII**	**US FWS**	**EPA**
Information Accuracy	**High**	**MidHigh**	**Middle**	**MidLow**	**Low**
Content has no known errors	12	11	10	9	2

Content has no misinformation	11	11	10	9	5
The page delivers what it promises	12	11	10	9	9
Total	**WIKI**	**USDA**	**EPA**	**US FWS**	**NBII**
Information Currency	**High**	**Mid-High**	**Middle**	**Mid-Low**	**Low**
Page has no broken links	11	10	9	0	0
Content has been updated in the past two years before 8/2011	12	11	9	9	0
Page has no information about cancelled programs	11	9	0	0	0
Total	**USDA**	**EPA**	**US FWS**	**WIKI**	**NBII**
Information Source Authority	**High**	**Mid-High**	**Middle**	**Mid-Low**	**Low**
Authorship is disclosed	11	9	3	0	0
Contact Information is provided	17	15	10	7	7
Institutional Affiliation is cited	12	11	9	9	9
Total	**WIKI**	**USDA**	**EPA**	**US FWS**	**NBII**
Checklist for Design and Usability Definition	**High**	**High**	**High**	Mid-Low	Mid-Low
1. Simple search engine	1	1	1	1	1
2. PDFs are reserved for manuals and big documents	1	1	1	1	0
3. Visited links change color	1	1	1	1	0
4. Text is written for online reading and supports scan ability	1	1	1	0	0
5. Font size is not fixed or too small	1	1	1	1	1
6. Page titles are descriptive and short	1	1	1	0	0
7. No animation, advertisements or pop-ups	1	1	1	1	1
8. Design is consistent with other web pages and sites	1	1	1	1	1
9. Links work as simple hypertext reference, new windows do not open	1	1	1	1	0
10. Answers and main ideas are visible as such.	1	1	1	0	0
11.Navigation	1	1	0	0	0
12. Look and Feel	1	1	1	0	0
Total	**USDA**	**EPA**	**USFWS**	**WIKI**	**NBII**
Checklist for Interactivity and Public Engagement	High	Middle	**Low**	**Low**	**Low**
1. User support/ help functions	1	1	1	1	0
2. Advanced or user customized search options	1	1	1	0	0
3. Open comment fields	0	0	0	0	0
4. Interactive media or applications for wireless devices	0	0	0	0	0
5. Folksonomy and tagging applications	1	0	0	0	0
6. Offers a web 2.0 component/ or endorses citizen science program	1	0	0	0	0
7. Specific requests for citizen input on topics	1	0	0	0	0
Total	**WIKI**	**USDA**	**EPA**	**NBII**	**US FWS**

Citizen user category	High	MidHigh	Middle	MidLow	Low
Private Citizen	11	9	8	6	4
Attentive Citizen	17	15	10	7	7
Deliberative Citizen	9	4	3	3	3
Citizen Practitioner/Publisher	8	7	5	2	1
Corporate Citizen	3	2	2	1	1
Total	**WIKI**	**USDA**	**EPA**	**NBII**	**USFWS**

A3: Entity PDF pages for August 2011.

http://www.epa.gov/opp00001/about/intheworks/honeybee.htm
Last updated on 05/10/2011

About Pesticides

You are here: EPA Home Pesticides About Pesticides Pesticide issues in the works
Honeybee colony collapse disorder

Pesticide issues in the works: Honeybee colony collapse disorder

Current as of February 18, 2011

The 2010 *World of Pollinators* posters are all gone. 2011 posters are coming soon!

Discovering a problem

During the winter of 2006-2007, some beekeepers began to report unusually high losses of 30-90 percent of their hives. As many as 50 percent of all affected colonies demonstrated symptoms inconsistent with any known causes of honeybee death: sudden loss of a colony's worker bee population with very few dead bees found near the colony. The queen and brood (young) remained, and the colonies had relatively abundant honey and pollen reserves. But hives cannot sustain themselves without worker bees and would eventually die. This combination of events resulting in the loss of a bee colony has been called Colony Collapse Disorder (CCD).

Though agricultural records from more than a century ago note occasional bee "disappearances" and "dwindling" colonies in some years, it is uncertain whether the colonies had the same combination of factors associated with CCD. What we do know from the most recent data from beekeepers for 2009 is that that CCD appears to still be with us.

Dead bees don't necessarily mean CCD

Certain pesticides are harmful to bees. That's why we require instructions for protecting bees on the labels of pesticides that are known to be particularly harmful to bees. This is one of many reasons why everyone must read and follow pesticide label instructions. When most or all of the bees in a hive are killed by overexposure to a pesticide, we call that a beekill incident resulting from acute pesticide poisoning. But acute pesticide poisoning of a hive is very different from CCD and is almost always avoidable.

There have been several incidents of acute poisoning of

Other issues in the works:

- Nanotechnology, the science of small
- Pesticide volatilization

Other Resources

- Pollinator Protection

Questions on Pesticides?

- National Pesticide Information Center (NPIC) 1-800-858-7378
  EXIT Disclaimer

Status of Clothianidin Bee Studies

- Clothianidin – Registration Status and Related Information
- Clothianidin Letter (PDF) (6 pp, 529 k, about PDF)
- EPA Response to Clothianidin Letter (PDF) (4 pp, 1 MB, about PDF)

U.S. Fish & Wildlife Service

Pollinators

- Pollinators Home Page
- Featured Pollinator
- Threats to Pollinators
- How We Help Pollinators
- What You Can Do to Help
- More About Pollinators
- Outreach and Educational Materials
- Pollinator Links

Main Interior Auditorium, Department of Interior, Washington D.C.,

Date: October 25, 2007
Time: 9:00 to 10:30 a.m.
More Information (pdf)

September 6, 2007: Genetic Survey Finds Association Between CCD and Virus (U.S. Department of Agriculture's Agricultural Research Service)

Fish and Wildlife Service Home

Colony Collapse Disorder

A honeybee settles onto a wildflower. Photo credit: Department of Energy, Fermi National Accelerator Laboratory

Colony Collapse Disorder (CCD) is the name given to the current ailment striking honey bee colonies in the United States. In affected colonies, the worker bees leave the hive and never return, leaving only the egg-laying queen, brood and a few attendants. There are a variety of theories as to what is causing the collapse of honeybee colonies, including: stress leading to a weakened immune system, varroa mites (a parasite known to attack honey bees), a pathogen (such as a virus, bacteria or fungus), stress from the movement of colonies, and/or sublethal effects of pesticides. Sublethal means it does not cause death. The U.S. Department of Agriculture Agricultural Research Service is collaborating with several universities to determine the cause of Colony Collapse Disorder as part of the Colony Collapse Disorder Working Group.

Honey bees are important to agriculture, although they are not native to the U.S. It is estimated that honey bees provide approximately $15 billion dollars annually in pollination services in the U.S., primarily for vegetables, fruits, and nuts. In addition, some colonies are maintained by bee keepers for honey production. Native bees, such as bumblebees, also pollinate crops, with the value of their services recently estimated at $3 billion dollars annually in the U.S. Little is known about the status of native pollinators.

In addition to the important role of pollinators in human food production, pollinators are also important to wildlife – an estimated 25% of birds and mammals rely heavily on fruit and seeds as part of their diet.

More information on Colony Collapse Disorder (U.S. Department of Agriculture):

- Overview
- Want To Learn about CCD - (Links to other sites with information on CCD)

More information on wild pollinators

Conservation
Threats to Native Species
Air Pollution
Climate Change
Colony Collapse Disorder (CCD)
Diseases
Habitat Loss
Introduced and Invasive Species
Parasites
Pesticides
Transgenic Corn Pollen
Viruses

"colony collapse disorder" location:usa - Google News

Google News
Showing 10 Results (Top 1)

Vanishing of the Bees Movie Review - Shockya.com

Vanishing of the Bees Movie Review
Shockya.com
Co-directed by George Langworthy and Maryam Henein, the movie explores the phenomenon of so-called **Colony Collapse Disorder** (CCD), mainly through the experiences and eyes of two longtime commercial beekeepers — David Mendes, of Florida, ...
The 'honeybee underground' rescues bees, promotes backyard beekeeping in a ...Pasadena Star-News

all 3 news articles »

Colony Collapse Disorder (CCD)

Colony Collapse Disorder (CCD) has been reported to be occurring in at least 24 states in North America, and in India, Poland, Switzerland, Germany, Spain, Portugal, Italy, Greece, and Great Britain. The phenomenon involves the collapse of bee colonies resulting from the unexplained disappearance of worker bees that supply the queen bee and larvae with food. What sets this disorder apart from other known causes of bee colony collapse is the apparent lack of dead bees or bodies in or around the colony. Hives are usually found with only a queen bee and larvae remaining, and they are sure to starve without worker bees supplying the hive with food.

Significant losses of honey bee colonies have occurred at several times in history, but they were attributed to numerous causal agents including habitat loss, pesticide impacts, diseases and parasites (tracheal and varroa mites), and the gradual decline of the beekeeping business. The phrase "Colony Collapse Disorder" is now used to describe the recent unexplained and rapid increase in bee colony disappearances.

The exact character of Colony Collapse Disorder is still being debated by scientists, and very little is known about the possible cause or causes. This page lists a limited number of credible resources on the subject.

Colony Collapse Disorder Resources

Showing 31 Results (Top 15) Search Reset

Bee Colony Collapse Disorder
Description: This article provides information on Colony Collapse Disorder (CCD) and other diseases and parasites that have effected bees in the past. It also discusses the effects of the loss of bees.
Resource Type: Issue Overviews

NEW BOOK on Colony Collapse Disorder

Cover illustration for the book A Spring Without Bees, How Colony Collapse Disorder Endangers Our Food Supply, by Michael Schacker, June 2008, Lyons Press.

A Spring Without Bees, How Colony Collapse Disorder Endangers Our Food Supply, is the first comprehensive, authoritative book focusing specifically on colony collapse disorder, its most likely causes and the best solutions. The author, Michael Schacker debunks the myth of cell phones and other theories and reveals the research data and information previously unreported by the media and even the top U.S. agricultural sites...

more...

CCD References

Berenbaum, M. R. March 29, 2007. **Colony Collapse Disorder and Pollinator Decline**. Statement Before the Subcommittee on Horticulture and Organic Agriculture, Committee on Agriculture, U.S. House of Representatives.

Calderone, N. W. May 2, 2007. **Bee Colony Collapse Disorder**. Cornell University College of Agricultural and Live Sciences Department of Entomology.

vanEngelsdorp, D., Cox Foster, D., Frazier, M., Ostiguy, N. and J. Hayes. December 15, 2006. **Fall Dwindle Disease: A preliminary report. "Fall-Dwindle Disease": Investigations into the causes of**

News & Events

Questions and Answers: Colony Collapse Disorder

Beginning in October 2006, some beekeepers began reporting losses of 30-90 percent of their hives. While colony losses are not unexpected during winter weather, the magnitude of loss suffered by some beekeepers was highly unusual.

This phenomenon, which currently does not have a recognizable underlying cause, has been termed "Colony Collapse Disorder" (CCD). The main symptom of CCD is simply no or a low number of adult honey bees present but with a live queen and no dead honey bees in the hive. Often there is still honey in the hive, and immature bees (brood) are present.

ARS scientists and others are in the process of carrying out research to discover the cause(s) of CCD and develop ways for beekeepers to respond to the problem.

Latest ARS news about CCD:

A comprehensive and sensitive analytical survey was done for the presence of 200 pesticides in bee, comb, and pollen samples from 23 states. No specific pattern of pesticide residues emerged that correlates with honey bee deaths March 2010

Pathogen Loads Higher in Bee Colonies Suffering from Colony Collapse Disorder August 2009

Survey Reports Latest Honey Bee Losses, April 2010

Why should the public care about honey bees?

Bee pollination is responsible for $15 billion in added crop value, particularly for specialty crops such as almonds and other nuts, berries, fruits, and vegetables. About one mouthful in three in the diet directly or indirectly benefits from honey bee pollination. While there are native pollinators (honey bees came from the Old World with European colonists), honey bees are more prolific and the easiest to manage for the large scale pollination that U.S. agriculture requires. In California, the almond crop alone uses 1.3 million colonies of bees, approximately one half of all honey bees in the United States, and this need is projected to grow to 1.5 million colonies by 2010.

The number of managed honey bee colonies has dropped from 5 million in the1940s to only 2.5 million today. At the same time, the call for hives to supply pollination service has continued to climb. This means honey bee colonies are trucked farther and more often than ever before.

Honey bee colony health has also been declining since the 1980s with the advent of new pathogens and pests. The spread into the United States of varroa and tracheal mites, in particular, created major new stresses on honey bees.

2010 CCD Progress Report

2009 CCD Progress Report

Is there currently a crisis in food production because of CCD?

While CCD has created a very serious problem for beekeepers and could threaten the pollination industry if it becomes more widespread, fortunately there were enough bees to supply all the needed pollination this past spring. But we cannot wait to see if CCD becomes an agricultural crisis to do the needed research into the cause and treatment for CCD.

The cost of hives for pollination has risen this year. But much of that is due to growing demand. Some of the price increase may also be due to higher cost of gas and diesel and other increases related to energy and labor costs. Commercial beekeepers truck hives long distances to provide pollination services, so in particular they must deal with rising expenses.

Are there any theories about what may be causing CCD?

Case studies and questionnaires related to management practices and environmental factors have identified a few common factors shared by those beekeepers experiencing CCD, but no common

Colony collapse disorder

From Wikipedia, the free encyclopedia

Honey bees entering a beehive

Colony collapse disorder (**CCD**) is a phenomenon in which worker bees from a beehive or European honey bee colony abruptly disappear. While such disappearances have occurred throughout the history of apiculture, the term *colony collapse disorder* was first applied to a drastic rise in the number of disappearances of Western honey bee colonies in North America in late 2006.[1] Colony collapse is significant because many agricultural crops worldwide are pollinated by bees.

European beekeepers observed similar phenomena in Belgium, France, the Netherlands, Greece, Italy, Portugal, and Spain,[2] and initial reports have also come in from Switzerland and Germany, albeit to a lesser degree[3] while the Northern Ireland Assembly received reports of a decline greater than 50%.[4] Possible cases of CCD have also been reported in Taiwan since April 2007.[5]

The cause or causes of the syndrome are not yet fully understood. In 2007 some authorities attributed the problem to biotic factors such as *Varroa* mites and insect diseases (i.e., pathogens[6] including *Nosema apis* and Israel acute paralysis virus).[7][8] Other proposed causes include environmental change-related stresses,[9] malnutrition, pesticides (*e.g.*. neonicotinoids such as clothianidin and imidacloprid), and migratory beekeeping. More speculative possibilities have included both cell phone radiation (e.g.[10][11]) and genetically modified (GM) crops with pest control characteristics,[12][13] though no evidence exists for either assertion.

It has also been suggested that it may be due to a combination of many factors and that no single factor is the cause.[14][15][16] The most recent report (USDA - 2010) states that "based on an initial analysis of collected bee samples (CCD- and non-CCD affected), reports have noted the high number of viruses and other pathogens, pesticides, and parasites present in CCD colonies, and lower levels in non-CCD colonies. This work suggests that a combination of environmental stressors may set off a cascade of events and contribute to a colony where weakened worker bees are more susceptible to pests and pathogens."[17]

Applying proteomics-based pathogen screening tools in 2010, researchers announced they had identified a co-infection of invertebrate iridescent virus type 6 (IIV-6) and *Nosema ceranae* in all CCD colonies sampled.[18] The study is the first to conclude that co-factors, the virus and fungus, were present in all of the collapsed colonies studied.[19] However, scientists in the project emphasize additional research is still needed to consider how environmental factors like temperatures, drought and pesticides might play a role, if any, in CCD.[19]

VITA

Reid is a Knoxville, Tennessee native with a bachelor's degree in ceramic arts from the Maryland Institute College of Art in Baltimore, Maryland. Currently preparing to begin his doctoral studies in information sciences and communication, his research interests focus on the intersection of e-government and e-science, citizen involvement in complex scientific problem solving, and the systemic function of large-scale data infrastructures for environmental science research. Reid has been fortunate to work as a graduate teaching and research assistant for Dr. Vandana Singh and Dr. Dania Bilal during his time as a master's degree student at the University of Tennessee School of Information Sciences. He also performed a role as a paid intern at the Oak Ridge National Laboratory's Distributed Active Archive Center for Biogeochemical Dynamics (DAAC) and contributed to NASA's FLUXNET network database and other climate change data archiving projects at the DAAC.

In the future Reid's goal is to achieve a position as a research professional, publishing scholarly work as a representative of an academic institution and to teach students as a professor of information sciences specializing in science communication studies. In his spare time, Reid loves to play with his retired racing greyhound. He also likes to hike, cook, and read.