"Silence of the Bees": A Study of Scientific Representation in Media

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ABSTRACT

Misrepresentation of scientific knowledge in the media is common across a range of environmental issues and has caused confusion among the public. The representation of Colony Collapse Disorder (CCD) in print media has been changing since it was first reported in 2004. This is a case study on how the discrepancies in representation of CCD between scientists and media affect public's perception on environmental issues. I read scientific and media articles using Melvyl and LexisNexis, noting the perceived causes and discrepancies. Although the number of scientific articles about CCD was relatively constant over the past three years, the number of media articles about CCD decreased significantly along with the sense of urgency regarding CCD. As time passed, the scientific articles suggested different varieties of perceived causes of CCD, while the media articles narrowed their focus to the three most commonly perceived causes; pesticide, pathogens, and parasites. CCD continues to be regarded as "uncertain" and a "mystery" in science and media articles, indicating that public awareness of honeybee decline is low as a result of both disagreement among scientists and misrepresentation of scientific knowledge in the media.

KEYWORDS

Colony Collapse Disorder, public perception, mass media, discrepancies, uncertainty

INTRODUCTION

Misrepresentation of scientific knowledge in the media is common across a range of environmental issues, such as global warming and honeybee decline, and has caused confusion among the public despite increased media attention on environmental issues in recent decades. Since the early 1960s, public awareness and political concern about environmental issues received increased exposure in the media (Hansen, 1991; Dunlap, 1992; Murphy, 2005). Rachel Carson's *Silent Spring (1962)* was a major catalyst for the emergence of the environmental movement (Hannigan, 2006), sparking debates in editorials, opinion columns, news articles and television broadcasts (Murphy, 2005). In the late 1980s, concerns over the environment grew, as major national news organizations effectively established the importance of global environmental issues in the American culture and politics (Mazur and Lee, 1993). Even though media coverage and awareness increased, a gap in scientific representation between science and the mass media pervades in areas such as exaggerating scientific claims, and confuses the public's perception on environmental issues (Weingart et al, 2000).

The vanishing of honeybees (*Apis mellifera*), called Colony Collapse Disorder (CCD), drew considerable media attention (Schacker, 2008) and has become one of the most important environmental concerns today. Initially labeled "bee die offs," the mysterious disappearance of honeybees has beset beekeepers in the United States since late 2006 (Johnson et al, 2009). According to US Agriculture Secretary Mike Johanns, "this crisis threatens to wipe out production of crops dependent on bees for pollination," since migratory beekeeping and commercial pollination are crucial to a full third of all US crops, such as almonds, blueberries, apples, cranberries, peaches, tomatoes, pumpkins, and many other crops, estimated to be worth more than $15 billion (Schacker, 2008). Many articles have quoted Albert Einstein's prediction that "if bees were to disappear, man would only have a few years to live" to draw attention to the gravity of this phenomenon (Cambray, 2007).

Despite increased media attention, there is low public awareness of CCD due in part to misrepresentation of scientific knowledge in the media. Media representation on CCD has been changing since it was first reported in 2004 (Schacker, 2008). The potential causes of CCD range from chemical residue/contamination, pathogens, parasite, stress,

GMO crops, radiation, global warming and more (Kluser and Peduzzi, 2007). By early 2007, Colony Collapse Disorder began to cause a mild hysteria in the media, as media reported cell phones as another possible cause of CCD (Watanabe, 2008). Although this hypothesized cause of CCD was debunked, the public remained confused and many still think that cell phone tower radiation is a potential cause of the decline of honeybee population (Schacker, 2008). In general, the perception and understanding about CCD took divergent discussion among the different groups of scientists and media just as it has been for the changing perceptions of climate change (Weingart et al, 2000). While there are many studies that recognized the misrepresentation of environmental issues in media coverage, such in the case of global warming, there has not been a study on how CCD is represented in the media, that explains why there has not been an improvement in building the awareness of CCD in the public.

In this case study, I explore how CCD's representation in media and scientific journals changed over time. I observed two questions: 1) how have scientists and media explained the causes and impacts of CCD over the last three years? 2) how do the scientific and media representations of CCD differ? By analyzing the discrepancies between the scientific and media representation on CCD and their respective progress, I hope this study will be a useful source for improving the awareness of CCD by narrowing the gap of scientific knowledge between science and media.

METHODS

I reviewed scientific journals and newspaper articles on CCD, noting: 1) the different perceived causes of CCD, 2) how the focus of these possible causes evolved over time, and 3) what specific impacts are mentioned in both the scientific and media articles. I categorized them by perceived causes, modeling a list found in a literature review published by UNEP (Kluser and Peduzzi, 2007).

Scientific representation of CCD I located scientific articles by using Melvyl, the online catalog for the University of California's library system. I used the keywords "colony collapse disorder" to search for science journals. I noted the main cause of CCD that each article proposed, the impact of CCD that was mentioned, and any other information that stood out or that was consistently repeated.

Media representation of CCD I used LexisNexis Academic to gather newspaper articles, using "colony collapse disorder" as the keyword search term. I selected articles from the US prestige press, e.g., the *New York Times*, the *Washington Post*, the *Los Angeles Times*, and the *Wall Street Journal* (Boykoff and Boykoff, 2004).

Comparison between science and media representation of CCD I compared and contrasted representations of CCD in science journals and the media articles. I searched for any discrepancies, scientific or technical inaccuracies, misquotations, significant omissions, exaggerations, and distortions of emphasis (Corbett and Durfee, 2004) within the media articles that I read.

RESULTS

Results of Searches I found a total of 61 scientific articles and 47 media articles on CCD published between 2007 and 2010 (Table 1). I retrieved and reviewed more than 50% of the scientific journal articles located on Melvyl. I only found media articles from *New York Times* and *Washington Post* and read all of them.

Table 1. Number of scientific and media articles on CCD.

	Science		**Media**		
	Found	Used*	*NYT*	*Wash Post*	Total media used
2007	**24**	15	17	12	**29**
2008	**16**	9	4	7	**11**
2009	**21**	14	2	5	**7**
Total	**61**	38	23	24	**47**

The number of media articles related to CCD dropped significantly over the years. In general, the number of articles regarding CCD was quite small, less than 100 in total. *Some scientific journal articles were unavailable, but were able to retrieve more than 50%

Scientific representation of CCD Many scientific articles identified the pathogen, Israeli acute paralysis virus (IAPV), as the most widely perceived cause of CCD consistently throughout the three years studied. However, none of the articles claimed that the pathogen itself was the direct cause to CCD, but rather, a combination of different perceived causes contributed to lowering the immune system of the honeybees, making them vulnerable to viruses such as IAPV. Over the three years studied, scientific articles suggested more explanations for CCD (Figure 1). Despite the increased number of studies, the adjective "mystery" followed CCD nonetheless.

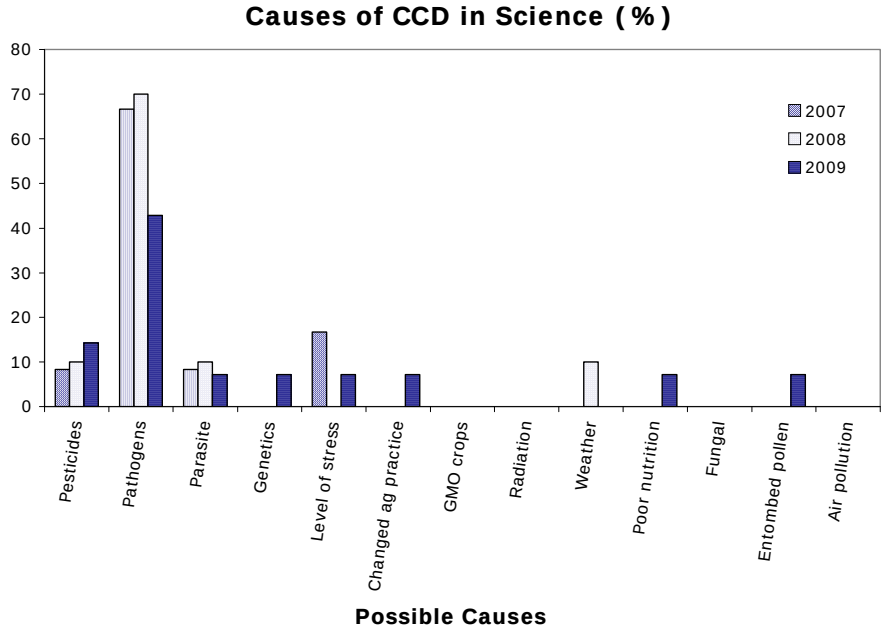

Figure 1. Causes of CCD in science articles, 2007-2009. Pathogens, by far, have the highest frequency compared to the others. There seems to be more variety of suggestions for the cause of CCD in recent years.

There were disagreements within the science community in 2007 and 2009 (Table 2). In 2007, one article stated that "CCD does not follow the pattern of an infectious disease (Kievits, 2007)," contradicting to the other 8 articles that claimed pathogens as the main contributor of CCD. In 2009, a specific study was done that expanded the study on IAPV as the highly correlated causal factor of CCD, but could not replicate the results of previous studies. Another study directly claimed that pesticides had no connection to CCD, while two other articles supported pesticides as one of the main contributors. Some misrepresentation due to ideological bias was evident in a 2007 article in the Pesticide News Science Journal (Table 2) that identified pesticides as a cause of CCD.

Table 2. Suggested causes of CCD in the science and media articles over time.

Causes	**2007**		**2008**		**2009**	
	Science	Media	Science	Media	Science	Media
Pesticides[1]	1*	6	1	1	2, -1	1
Pathogens[2]	8, -1	10	7	3	6, -1	2
Parasite (Varroa Mite)	1	7	1	1	1	1
Genetics		1			1	
Level of stress[3]	2	3			1	
Changed agriculture practice[3]		3		1	1	
GMO crops		-2				
Radiation[4]		-2				
Global/local climate change[5]		2	1			
Others		poor nutrition		air pollution	dietary pyrethrum deficiency	
		fungal 3			entombed pollen	

There is a strong preference for pathogens/disease as the main cause of CCD. A clear rejection or disapproval of a suggested cause of CCD has been indicated with an ' – '. Disagreements occur in pesticides in 2009 and pathogens in 2007 and 2009.

* Written in a Pesticide News science journal (possible bias)

[1]Chemical residue/contamination = Pesticides

[2]Pathogens (disease or virus)

[3]Level of stress = competition, loss of habitat, etc. Changed agriculture practice (trucked long distance) is also a stress factor, but separated because there were specific mentions of it.

[4]Radiation = cell phone towers

[5]Global/local climate change = drought or weather

Table 3. Modified table of suggested causes of CCD in science and media articles over time. Units in frequency (%)

Causes	**2007**		**2008**		**2009**	
	Science	Media	Science	Media	Science	Media
Pesticides	8.33	16.67	10	14.29	14.29	25
Pathogens	**66.67**	**27.78**	**70**	**42.86**	**42.86**	**50**
Parasite	8.33	19.44	10	14.29	7.14	25
Genetics		2.78			7.14	
Level of stress	16.67	8.33			7.14	
Changed agriculture practice		8.33		14.29	7.14	
GMO crops						
Radiation						
Weather		5.56	10			
Poor nutrition		2.78			7.14	
Fungal		8.33				
Entombed pollen					7.14	
Air pollution				14.29		

Pathogens have the highest frequency. The discrepancies were not considered in this table. This table is used to generate grphs.

Media representation of CCD Pathogens, pesticides, and parasites were the most commonly identified causes of CCD given in the media articles (Table 2, Figure 2). The 1:2:1 ratio of pesticides, pathogens, and parasites stayed relatively constant over the years (Figure 2). Although some articles focused more on pathogens as the main perceived cause of CCD, the three were consistently linked as main contributors to CCD. Throughout the periods studied, the media articles focused only on these three issues, not mentioning the other factors as much (Figure 2).

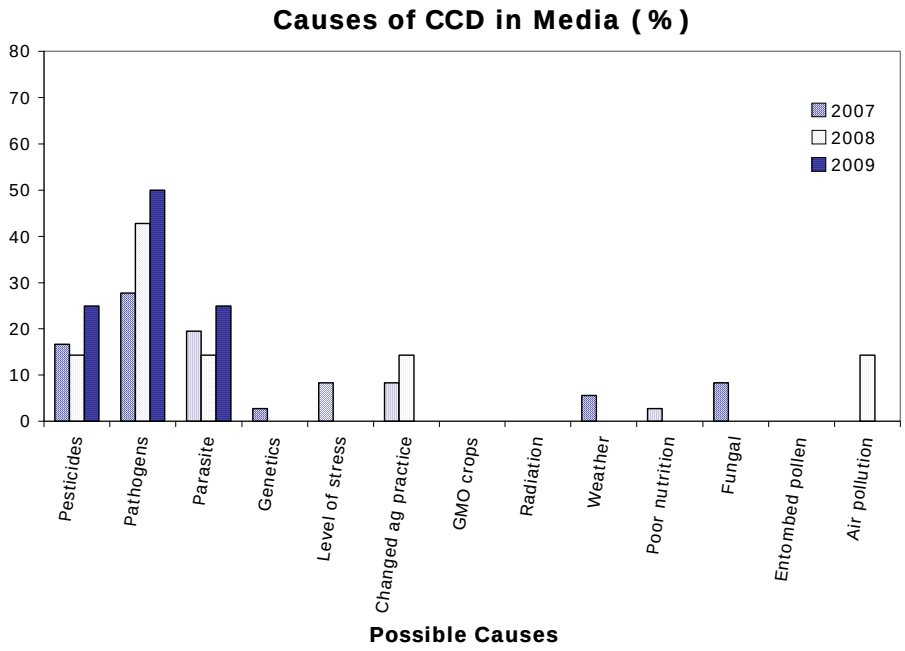

Figure 2. Causes of CCD in media articles, 2007-2009. The top three possible causes of CCD are pathogens, pesticides, and parasites, with a consistent 1:2:1 ratio throughout the given time period. The perceived cause of CCD narrowed down to the top three over the years.

CCD was misrepresented in the media by exaggerated languages, distorted emphasis, and assumptions. In 2007, some articles stated, "*Nobody* has *any* information to give (Randall, 2007)," "*No* bees, *no* almonds (Pollan, 2007)," "*No* one knows why the collapse occurs. We have *no* solution (Lerner, 2007)." Unlike the urgent tone depicted in articles from 2007 by exaggerations and words like "alarm," "wake-up call," and "crisis," the later articles of 2008 and 2009 generate a relaxed, matter-of-fact tone. In 2009, CCD was described as "*slowly* killing the world's honeybees (Dvorak, 2009)," when there were reports on how sudden the population of honeybees decreased earlier. One article reported that beekeepers lost "90 percent of their hives" when it was generally agreed and

claimed that up to 75 percent of the colonies were lost (Kluser and Peduzzi, 2007). Some misreporting was grounded in false assumptions, such as identifying CCD as "a *disease* that *causes* honeybees to suddenly mysteriously disappear from their hives (Black, 2007)."

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. There was a general assumption that most people knew about CCD, as some reported about movie premiers, advertisements by Haagen-Dazs, and government-related stories. Some articles in 2009 do not even mention the cause or impact of CCD, but rather an irrelevant story of how dogs should be included in the agriculture official staff to inspect the cause of CCD (Johnson, 2009).

Comparison between science and media representation of CCD While the number of scientific articles slightly decreased from 2007 to 2008 then increased in 2009, the number of media articles on CCD decreased dramatically over the last three years (Table 1, Figure 3). As the scientific articles suggested a wider range of perceived cause of CCD, the media articles narrowed their focus to the three most common issues of pesticide, pathogens, and parasites (Figure 4). Generally, the media articles quoted from bee experts rather than the scientists who published the scientific articles. If there was any acknowledgement, the media articles simply categorized the source as "scientists" instead of specifically naming the person.

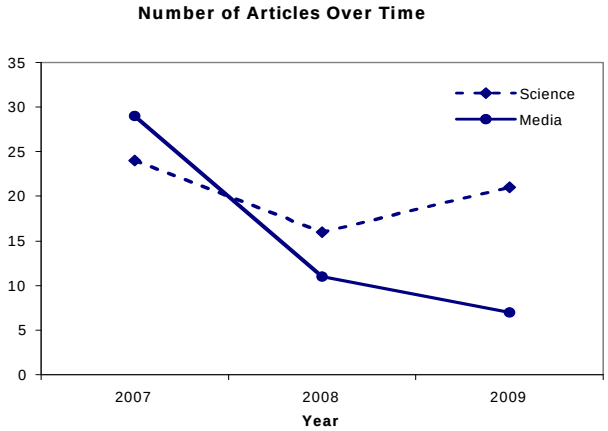

Figure 3. Number of articles over time. There is a clear decrease in media coverage of CCD over the years, while scientific representation on CCD has been relatively steady and even slightly increasing in recent years.

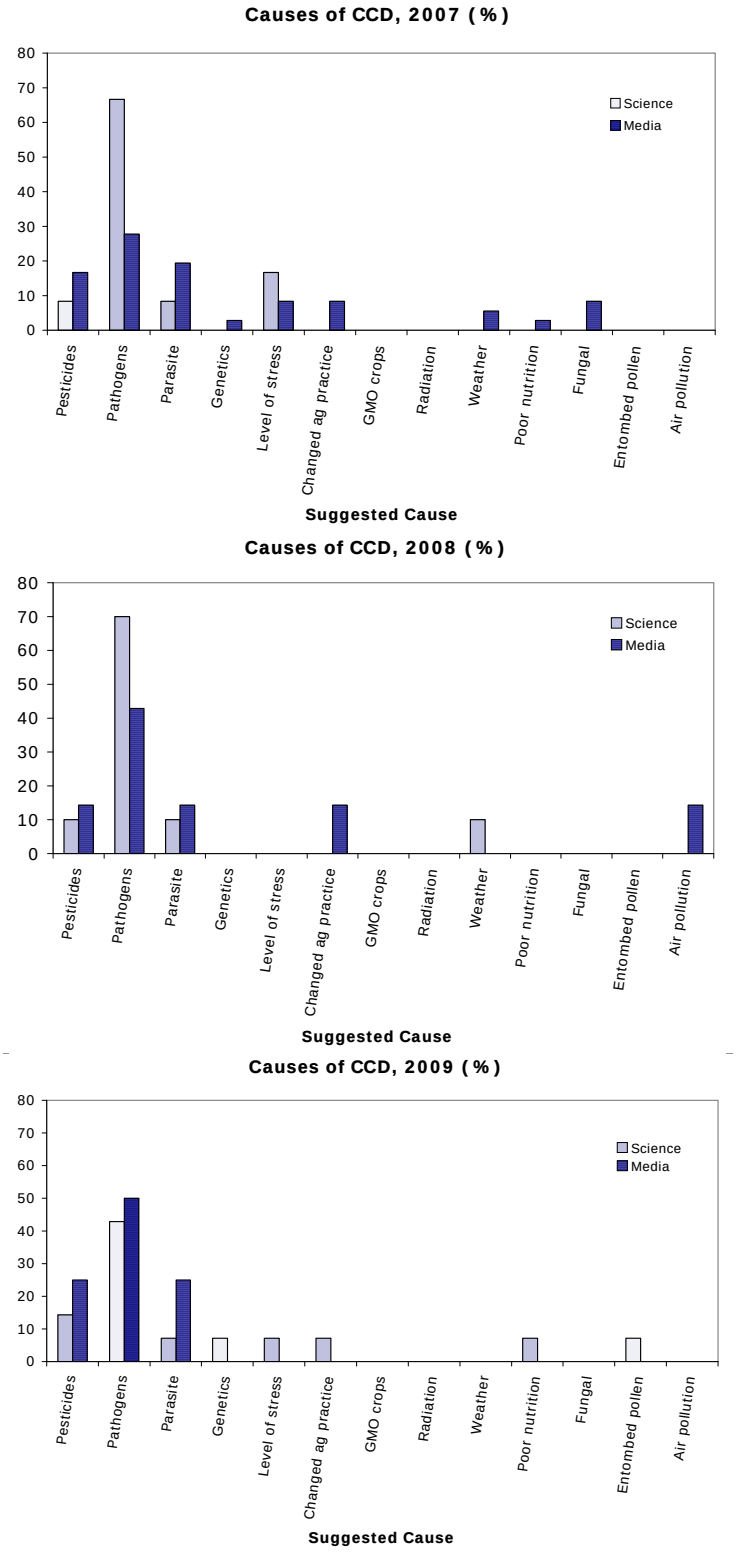

Figure 4. Comparison between suggested causes of science and media articles, 2007-2009. Scientific articles suggested a variety of causes for CCD over the year, while media have narrowed significantly down to pesticides, pathogens, and parasites. These graphs show a clear contrast between science and media's change over time.

Both the scientific and media articles offered no definitive solutions. Some scientists suggested future research directions, including collecting more surveys and data, analyzing samples, conducting hypothesis-driven research, and proposing mitigation and prevention measures. Some solutions recommended by journalists included improvements in home gardening, finding and breeding bees that are mite-resistant, and integrating pest management to balance beneficial insects and pests.

Both scientists and the media emphasized impacts of CCD on the multi-billion dollar agricultural industry. However, while science articles continue to mention the impacts, the media articles omit the impacts towards 2009. There was no noticeable time lag between the science and media articles. The word 'mystery' is constantly associated with CCD both in science and media articles.

DISCUSSION

I explored how CCD has been represented in media and scientific journals, observing how scientists and journalists have explained the causes and impacts of CCD between 2007 and 2010. Overall, both the scientific and media articles indicated pathogen, pesticide, and parasite to be the main contributors affecting the immune system of the honeybees. While scientists have broadened their range of possible causes of CCD through more research, the media on the subject diminished in their number of articles as well as their sense of urgency of the issue.

Scientific representation of CCD Scientists identified the pathogen, IAPV, as the main contributor, but note that other factors act as multiple contributors that weaken the immune system of the honeybees. While IAPV remained the most commonly identified factor associated with CCD, more research was done focusing on other contributing factors, such as dietary pyrethrum deficiency and entombed pollen. This is probably due to the advancing state of knowledge on the topic, with more research leading to the identification of more possible causes of CCD. The increase in research, however, does not suggest increased information or knowledge, but rather increased uncertainty because, as Latour suggests, science is certain while research is uncertain, and this disparity causes controversies and "feeds on all of those to render objects of inquiry familiar (Nowotny et al, 2001)."

An article from Pesticide News Science Journal proposed pesticides as the leading cause of CCD (Table 2). The fact that a pesticide-related journal would write the only article that suggested pesticide to be the main contributor of CCD arouses questions about possible bias created by focusing on a relevant topic. Because it is a relevant topic of the pesticide related journal, it may have created bias to make the readers of this pesticide-related science journal to think that pesticide is the leading cause of CCD.

The disagreements within the science community in 2007 and 2009 can lead to scientific uncertainty and confusion among journalists. Similar to the case of global climate change, the emphasis on controversy or disagreement among scientists constructs uncertainty, as controversy and disagreement can often raise an unnecessary commotion (Zehr, 2000). Disagreement among scientists can provide journalists with biased information because it appears that the journalists are presenting both sides with a "balanced" coverage of science (Boykoff and Boykoff, 2004). Even though each scientist may be certain of his or her findings, the lack of a scientists' collective agreement aggravates scientific uncertainty (Zehr, 2000).

Media representation of CCD Media articles generally elicit confusion for readers by making exaggerations, inflating the issue to seem more controversial to catch the attention of the public. The exaggerated use of language "*No* bees, *no* almonds (Pollan, 2007)" is an example of a "Cassandra syndrome," which involves initiating catastrophic discussion in order to catch public attention (Weingart, 1998). Similar to controversies found in global warming, controversies in general influence the readers' perceptions of its certainty (Corbett and Durfee, 2004). Media's emphasis on honeybee's charm or CCD's impact on fruits acts as an icon that people can easily identify with (Anderson, 1997). The honeybee campaign initiated by Haagen-Dazs or the focus on "The Bee Movie" premiere to represent CCD is an example of how modern systems of communication still demand 'media friendly' representation, accommodating to the values of profit-making organizations (Anderson, 1997).

Some misreporting grounded in false assumptions also cause confusion. In terms of climate change, one out of six news coverage stories contained significant misreporting (Bell, 1994). Journalists' personalization, dramatization, or assumptions significantly colored the objective aspect of reporting, thus leading to deficient information in mass-

media coverage of human contributions to climate change from 1988 through 2004 (Boykoff and Boykoff, 2007). In this case, the misreporting resulted from misinformation due to assumptions by the journalist, such as stating CCD as a "disease that causes honeybees to suddenly mysteriously disappear from their hives (Black, 2007)." The press was fairly slow to adopt the environmentalist stance in the past, because they only reported to a shallow level, partially reflecting the concepts advocated by scientists (Schoenfeld et al, 1979). It is an issue on which there is little certainty and little agreement (Anderson, 1997) and this kind of superficial reporting creates confusion in the public.

The initial sense of urgency evident in newspaper articles in 2007 declined over time. The dramatic decrease in the number of media articles is one indication (Figure 3). Even though most Americans believed that global warming is real and considered it a serious problem, global warming remains a low priority relative to other national and environmental issues and lacks a sense of urgency, because Americans perceive climate change as a moderate risk that will predominantly impact geographically and temporally distant people and places (Leiserowitz, 2007). Similarly, the decreased sense of urgency regarding CCD can be explained by the public's perception which views CCD as a moderate risk that does not affect the public personally.

The advancements in technology, and the increased accessibility of information through television, radio, and the Internet, enabled dramatic increase in environmental media coverage in which environmental meanings are produced and consumed (Burgess, 1990). But instead of gaining more knowledge, the overwhelming number of sources may be more of a bewilderment for the public. As in the case of global warming, CCD is another example of a mass communication problem that has yet to be adequately solved. Although people may be aware of this problem in a general sense, their understanding of the causes, possible consequences, and solutions is far more limited (Stamm et al, 2000).

Comparison between science and media representation of CCD The number of scientific articles fluctuated over time, while the number of media articles dramatically decreased. In 2009, there was a lack of media representation of CCD despite scientists' increasing efforts to gain more knowledge on the causes of honeybee decline. Similar to previous environmental issues, scientists and environmentalists have discussed this 'new'

global problem well before it was noticed as public issues in 2007 (Mazur and Lee, 1993). As soon as CCD gained attention from the media, journalists started to suggest practical solutions. While scientists were still trying to decide on the cause of CCD, media "moved on." No definitive solutions were given because the cause itself is still uncertain and not agreed upon scientists, so the emphasis on specific solutions lessened, stating that "we may not be able to do much more than lay some ground for the future (Hirshey, 2008)," that we need to gather more "accurate information about the bees' disappearance (Farley, 2008)" and "help maintain the balance of wildlife (Lerner, 2009)." The generalized statements contributed to the diminished sense of urgency in the tone of the media articles. This also reflects the fast-paced nature of media and the relatively short attention span of the American public. CCD representation in the media goes through the "issue-attention cycle" as it confirms the five stages: "pre-problem stage; alarmed discovery and euphoric enthusiasm; realization of the cost of significant progress; gradual decline in public interest, and finally, post-problem stage (Bodensteiner, 2005)."

Media articles employed different techniques to gain the attention of the readers. The reporters mainly quoted from either government-related officials or experts related to the honeybee field rather than quoting specific scientists, whom the readers most likely do not know. The studies that the reporters refer to are simply called "studies" by "scientists." This kind of "piecemeal information" given to the public, instead of increasing in their knowledge about CCD, can also confuse the readers (Dispensa and Brulle, 2003).

Both science and media emphasize the economic and agricultural impacts of CCD in 2007. However, while science articles continue to mention the impacts, the media articles do not. While the primary aim of most scientific studies was to help narrow the future efforts to identify the cause of CCD, the media articles tried to recommend practical solutions to prevent bee population loss. The motivation for scientific journals is to receive more governmental funding since scientists need more money for further research. On the other hand, the media assumes that the government is already informed and does not have the motivation to keep pursuing the building of CCD awareness unless another controversy is introduced.

Overall this study confirms that CCD is misrepresented in media in similar ways that previous environmental issues such as global warming have been controversial. Uncertainty in the public is created not only because of discrepancies through exaggerated reporting, but also the disagreement among scientists. Media loses interest and the public becomes even less informed, causing more confusion and eventually results in the public's ignorance of the issue as a whole, lowering the public awareness regarding environmental issues. Since environmental policy is made only when popular concern leading toward action is aroused (Caldwell, 1992), the decreased representation of CCD in media may slow down the process of policymaking that could resolve the honeybee problem.

This study was very limited in its resources, since I only used Melvyl and LexisNexis as the source of data. And because I alone read everything, I could have been biased as to what I note due to a limited control of my methods. This study alone cannot represent the entire scientific and media representation on CCD because I could not find any information prior to 2007 and stopped collecting data after 2009, and therefore limited inference for honeybee representation as a whole. The time lag in scientific literature, time of research to time of publication, is another limitation to this study that could have contributed to the ambiguity in this study.

Future research can involve a future study that systematically analyzes the contents of the articles in order to produce more accurate results. A study on comparing the case of global warming and CCD to learn how to successfully reach the public's attention will be helpful. We must search for methods to diminish the confusion among journalists and even scientists to increase the public's perception on CCD for the future.

Conclusion

Similar to the case of global warming, colony collapse disorder has received increased amounts of attention from the media. Not only because of its misrepresentation in media, but also the disagreement among scientists create uncertainty among the public. The tag "mystery" remains with the term colony collapse disorder even to recent years in both science and media articles. Media loses interest and the public becomes even less informed, causing more confusion and eventually results in ignorance of the issue as a

whole, lowering the public awareness regarding environmental issues. As indicated by Jeff Pettis, the Department of Agriculture's bee expert, "the problem is that everyone wants a simple answer [when] it may not be a simple answer (Press, 2007)." By improving methods of communication between and within media and science, I hope to see an increased awareness of CCD among the public. And because environmental policy deals with the interactive relationships only when they arouse popular concern leading toward action (Caldwell, 1992), increased public awareness will have significant political implications in the future.

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REFERENCES

Anderson, A. 1997. Media, Culture, and the Environment. Rutgers University Press, NJ.

Bell, A. 1994. Media (mis)communication on the science of climate change. Public Understanding of Science **3**: 259-275.

Black, J. 2007, September 10. Weather may account for reduced honey crop. *The Washington Post*, p. A05.

Bodensteiner, C. A. 1995. Predicting public and media attention span for social issues. Public Relations Quarterly **40**: 14–19.

Boykoff, M.T. and J.M. Boykoff. 2004. Balance as bias: global warming and the US prestige press. Global Environmental Change **14**: 125-136.

Boykoff, M.T. and J.M. Boykoff. 2007. Climate change and journalistic norms: a case-study of US mass-media coverage. Geoforum **38**: 1190-1204.

Burgess, J. 1990. The production and consumption of environmental meanings in the mass media: a research agenda for the 1990s. Transactions of the Institute of British Geographers **15**: 139-161.

Caldwell, L.K. 1992. Between two worlds: science, the environmental movement, and policy choice. Cambridge University Press, NY.

Cambray, G. 2007. The all important bees in the biodiesel equation. Science in Africa – Africa's First On-line Science Magazine.
Retrieved from http://www.scienceinafrica.co.za/2007/april/beesbiodiesel.htm

Corbett, J.B. and J.L. Durfee. 2004. Testing public (un)certainty of science. Science Communication **26**: 129-151.

Dispensa, J.M. and R.J. Brulle. 2003. Media's social construction of environmental issues: focus on global warming – a comparative study. International Journal of Sociology and Social Policy **23**: 74-105.

Dunlap, R.E. 1992. Trends in public opinion toward environmental issue: 1965-1990. American environmentalism: the U.S. environmental movement 1970-1990. Taylor & Francis, WA, 89-121.

Dvorak, P. 2009, June 3. The perfect pursuit in this urban hive; a growing buzz surrounds the increasing number of capital beekeepers. *The Washington Post*, p. B01.

Farley, J.D. 2008, June 30. Bee by bee. *The New York Times*, p.19.

Hannigan, J.A. 2006. Environmental Sociology. Routledge, NY.

Hansen, A. 1991. The media and the social construction of the environment. Media, Culture, and Society **13**: 443-458.

Hirshey, G. 2008, November 30. Sharing a taste of honey, on an international scale. *The New York Times*, p.1.

Johnson, J. 2009, March 5. Retriever on trail of a big sting; md. Employs dog to find diseases in bee colonies. *The Washington Post*, p. PG03.

Johnson, R.M., J.D. Evans, G.E. Robinson and M.R. Berenbaum. 2009. Changes in transcript abundance relating to colony collapse disorder in honeybees (*Apis Mellifera*). Proceeding of the National Academy of Science (PNAS) **106**: 14790-14795.

Kievits, J. 2007. Bee gone colony collapse disorder. Pesticide News **76**: 3-5.

Kluser, S. and P. Peduzzi. 2007. Global pollinator decline: A literature review. UNEP/GRID-Europe.

Leiserowitz, A. 2007. "Communicating the risks of global warming: American risk perceptions, affective images, and interpretive communities." Creating a climate for change: Communicating climate change and facilitating social change. Cambridge University Press, Cambridge, UK: pp.44-63

Lerner, J.M. 2007, March 17. We need bees' help – and they need ours. *The Washington Post*, p. F4.

Lerner, J.M. 2009, February 14. Your garden as a haven for nature's little helpers. *The Washington Post*, p. F04.

Mazur, A. and J. Lee. 1993. Sounding the global alarm: environmental issues in the US national news. Social Studies of Science **23**: 681-720.

Murphy, P.C. 2005. What a book can do: the publication and reception of Silent Spring. University of Massachusetts Press, MA.

Nowotny, H., P. Scott and M. Gibbons. 2001. Re-thinking science: knowledge and the public in an age of uncertainty. Blackwell Publishers Inc., MA.

Pollan, M. 2007, December 16. Our decrepit food factories. *The New York Times*, p.25.

Press, A. 2007, June 11. Have you heard the buzz?; honeybees are disappearing, and some crops could be affected. *The Washington Post*, p.C12.

Randall, D.K. 2007, March 4. Beekeepers confronted by demise of colonies. *The New York Times*, p.7

Schacker, M. 2008. A Spring Without Bees: How colony collapse disorder has endangered our food supply. The Lyons Press, CT.

Schoenfeld, A.C., R.F. Meier and R.J. Griffin. 1979. Constructing a social problem: the press and the environment. Social Problems **27**: 38-61.

Stamm, K.R., F. Clark and P.R. Eblacas. 2000. Mass communication and public understanding of environmental problems: the case of global warming. Public Understanding of Science **9**: 219-237.

Watanabe, M.E. 2008. Colony collapse disorder: many suspects, no smoking gun. Bioscience **58**: 384- 388.

Weingart, P. 1998. Science and the media. Research Policy **27**: 869-879.

Weingart, P., A. Engels and P. Pansegrau. 2000. Risks of communication: discourses on climate change in science, politics, and the mass media. Public Understanding of Science **9**: 261-283.

Zehr, S.C. 2000. Public representations of scientific uncertainty about global climate change. Public Understanding of Science **9**: 85-103.