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By

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ABSTRACT

RISK PERCEPTION, SOCIAL NETWORKS, AND MEDIA FRAMES ASSOCIATED WITH HUMAN-CORMORANT INTERACTIONS IN THE GREAT LAKES

By

Bret A. Muter

The dramatic recovery of the double-crested cormorant (*Phalacrocorax auritus*) in the Great Lakes has been accompanied by public concern about the bird's potential effects on the environment, recreation, and economy. Contention exists in regard to the perceived extent of these risks within and among the stakeholder groups who influence, or are affected by, cormorant management. To better understand stakeholder interactions and perceptions of risk related to cormorants, I (a) assess risk perceptions within a social network of agency professionals (n = 47) and non-governmental stakeholders (n = 66) engaged in human-cormorant conflicts around northern Lake Huron, (b) characterize the structure of the social network, and (c) evaluate the nature of cormorant-related newspaper coverage (n = 140 articles) in the Great Lakes from 1978 to 2007. Social networks and mass media are two important channels in which information about cormorant-related risks is communicated, and as a result, influence stakeholders' risk perceptions about cormorants. If human-cormorant conflicts in the Great Lakes are to be alleviated, agency professionals may need to look to beyond current management tools that are primarily based on reducing cormorant abundance. I present theoretical, methodological, and practical implications from this research which may provide agency professionals with new human-dimensions tools and insights to integrate with existing strategies for cormorant management.

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INTRODUCTION

Human-wildlife interactions are increasingly common worldwide as human and wildlife populations expand and interact; some of these interactions may lead to human-wildlife conflicts (HWCs) (Conover, 2002). Conflicts transpire when either people or wildlife cause, or are believed to cause, harmful effects to the other. HWCs can have adverse consequences on the health and safety of both humans and wildlife, as well as environmental, economic, cultural, social, and psychological effects and impacts on the diverse stakeholders involved (Decker, Lauber, & Siemer, 2002; Riley et al., 2002).

Managing HWCs poses substantial challenges for wildlife professionals (Fall & Jackson, 2002) in large part because HWCs tend to include an increasing diversity of stakeholders with conflicting views on how wildlife should be managed and involve a great degree of uncertainty about how to manage for biological and human dimensions (Messmer, 2000). Additionally, there is an increasing trend of conflicts between people and wildlife species that were historically rare, but are now perceived by some stakeholders as overabundant (Decker & Chase, 1997). Common examples of such species include white-tailed deer (*Odocoileus virginianus*) (e.g., Storm, Nielsen, Schauber, & Woolf, 2007), Canada geese (*Branta canadensis*) (e.g., Conover & Chasko, 1985), and beaver (*Castor canadensis*) (e.g., Jonker, Organ, Muth, Zwick, & Siemer, 2009).

Double-Crested Cormorants

Double-crested cormorants (*Phalacrocorax auritus*) are at the center of a HWC in the Great Lakes Basin. Double-crested cormorants (hereafter referred to as cormorants) are

one of 38 species of cormorants and shags found worldwide (Sullivan, Curtis, Chipman, & McCullough, 2006) and the most abundant and widely distributed of the six North American species (Hatch & Weseloh, 1999). Cormorants are large, piscivorous, colonial-nesting waterbirds distributed throughout North America. Similar to other fish-eating birds, cormorants were nearly extirpated in the Basin by the 1970s from the extensive use of commercial contaminants like dichloro-diphenyl-trichloroethane (DDT) and polychlorinated biphenyls (PCBs) (Weseloh, 1995). Federal regulations of these chemical compounds (e.g., the Environmental Protection Agency banned commercial use of DDT in 1972, and PCBs in 1979), as well as additional state, provincial, and federal protections, including the Migratory Bird Treaty Act of 1918 (in the U.S.) and the 1997 Fish and Wildlife Conservation Act (in Ontario, Canada), helped cormorant numbers rebound considerably. Basin populations increased from an estimated 89 to 38,000 nesting pairs between 1970 and 1991 and reached record highs of approximately 115,000 pairs by 2000 (Weseloh, Pekarik, Havelka, Barrett, & Reid, 2002). The increasing abundance of cormorants in the Basin has resulted in the birds being perceived as overabundant (Wire & Cuthbert, 2006).

The cormorant's dramatic recovery has been accompanied by growing public concern about the bird's potential effects on recreational fisheries (e.g., Fielder, 2009; Lantry, Eckert, Schneider, & Chrisman, 1999; Rudstam, VanDeValk, Adams, Coleman, Forney, & Richmond, 2004), aquaculture and fisheries stock (e.g., Johnson & Rakoczy, 2004; MDNR, 2005), island vegetation (e.g., Herbert, Duffe, Weseloh, Senese, & Haffner, 2004; Lemmon, Bugbee, & Stephens, 2004), other colonial-nesting waterbirds (e.g., Weseloh et al., 2002; Wires, Cuthbert, Trexel, & Joshi, 2001), and fishing-related

tourism (e.g., Sullivan et al., 2006) in the Basin. Stakeholder concerns about these perceived threats played a vital role in influencing federal policy decisions about cormorant management (Wires & Cuthbert, 2006), including the U.S. Fish and Wildlife Service's (USFWS) Public Resource Depredation Order (PRDO) (Sullivan et al., 2006). Formalized in 2003, the PRDO authorizes the U.S. Department of Agriculture - Wildlife Services (USDA-WS), federally-recognized tribes, and state fish and wildlife agencies in 24 states – including seven of the eight states that border the Great Lakes – to coordinate and partake in lethal and non-lethal control activities when deemed necessary to protect public resources, which include fisheries (Sullivan et al., 2006).

Management activities, such as harassment, nest destruction, egg-oiling, and lethal shooting, aimed at population control have triggered public concern and displeasure with management (Bedard, 1995). Cormorants have exceeded wildlife-stakeholder acceptance capacity (i.e., the frequency and nature of human-wildlife interactions deemed acceptable by stakeholders) (Carpenter, Decker, & Lipscomb, 2000) for several stakeholder groups, including recreational anglers and aquaculturists (Taylor & Dorr, 2003). Contention exists, however, in regard to the perceived extent of these threats within and among the stakeholder groups who influence, or are affected by, management. Special consideration is warranted when developing management strategies to alleviate human-cormorant conflicts (HCCs) in the Basin because contention persists despite more than five years of management activities. A key need for cormorant management is insight about stakeholder dynamics from which effective information and HCC-related communication can be developed (Weseloh & Lewis, 1997).

Approaches to HWC Management

Conover (2002) identified three fundamental approaches to HWC management that draw heavily upon principles of wildlife damage management. First, there are wildlife-centered approaches that emphasize either removing the problem-causing individual(s) or modifying wildlife behavior. These techniques can include lethal methods, such as culling and egg oiling, as well as non-lethal methods like fertility control, translocation, and harassment. Second, there are habitat-centered approaches that aim to alter the impacted resource, change how it is managed, or modify the habitat or landscape that contains the resource. Examples of these techniques include planting types of crops that are less susceptible to wildlife damage, using unpalatable species of plants for suburban landscaping, or altering harvest schedules to reduce wildlife damage. Finally, there are human-centered approaches that intend to change human behaviors or perceptions so people are more willing to tolerate damage (Conover, 2002). Resolving HWCs almost always requires more than reducing the population of a species causing, or perceived to be causing, damage. Conover (2002) advocated integrated approaches that draw from all of the previously defined strategies to ensure management is economically, environmentally, and socially sustainable. These integrated approaches can provide agencies with new alternatives for management.

Thus far, cormorant management in the Basin has primarily taken a population, or wildlife-centered, approach. Management has focused on reducing cormorant abundance through lethal shooting, egg-oiling, and harassment in localized areas of high cormorant density (Sullivan et al., 2006). Habitat-centered approaches, such as changing fish stocking strategies (e.g., time of day and/or year fish are stocked) to avoid cormorant

predation have also been applied in select locations throughout the Basin (e.g., Thunder Bay, Michigan) (MDNR, 2005; 2009). Human-centered approaches for cormorant management have been minimal; however, agency professionals are involving small groups of stakeholder (e.g., anglers) in cormorant harassment efforts in impacted communities (MDNR, 2005; 2009). Despite these efforts, debate about management persists and much uncertainty remains about how to sustainably manage cormorants in the Basin.

Providing insights about the human-dimensions of cormorant management can provide agency professionals and decision-makers with vital information to develop new and modify existing human-centered approaches; such information can also be integrated with wildlife and habitat-based approaches to more effectively manage HCCs in the Basin. Expanding the breadth and depth of knowledge about the human dimensions of HCCs can inform the revision process and content of Michigan's cormorant Environmental Assessment (EA) in 2010 and the USFWS's national Environmental Impact Statement (EIS) in 2014. Human-dimensions inquiry may also aid the state, provincial, tribal, and federal agencies involved in cormorant management as they explore options for regional management throughout the Mississippi Flyway by highlighting stakeholder attitudes towards cormorants and their management. Empirical inquiry about the perceptions of stakeholders engaged in, or affected by, HCCs is paramount to recognizing these benefits for management.

Risk as a Framework for HWCs

The notion of risk has been characterized in many ways; most definitions include a

technical (i.e., assessed probabilities or incidence of a particular hazard and its consequences) and a subjective component (e.g., value-laden beliefs about a hazard) (Renn, 1998). Risk theories and methodologies are being applied in human-dimensions inquiry and HWC management (Gore et al., 2009). HWCs often result in part because of stakeholder risk perceptions – or instinctive evaluations of risk (Slovic, 1987) – from exposure to wildlife, or risks to wildlife and their associated habitat (Decker et al., 2002). Wildlife-related risks are diverse and multifaceted, and can include risks to human health and safety (e.g., physical injuries from wildlife attacks, wildlife-vehicle collisions, or illness related to wildlife exposure), personal property and agriculture (e.g., pets or livestock killed by predators), aesthetic values (e.g., ornamental plant damage), and to other fish and wildlife resources that humans value (e.g., wolves killing moose that Alaskan hunters like to hunt, cormorants consuming fish that anglers like to fish). Wildlife-related risks also include threats to wildlife health and safety (e.g., sea turtles becoming entangled in commercial fishing gear; Gilman, Kobayahi, Swenarton, Brothers, Dalzell, & Kinan-Kelly, 2007). Wildlife-related risk perceptions can influence public opinions about wildlife and support for management actions (Knuth, Stout, Siemer, Decker, & Stedman, 1992), affect wildlife-stakeholder acceptance capacity (Riley & Decker, 2000a; 2000b; Stout, Stedman, Decker, & Knuth, 1993), garner trust or distrust in management agencies (Kasperson, Jhaveri, & Kasperson, 2001), and incite stakeholder action (Decker et al., 2002).

There is growing interest among and relevance for wildlife professionals to better understand stakeholders' perceptions of risk associated with contentious HWCs, as well as the mechanisms that influence those perceptions. Mass media and social networks

have been identified as two such mechanisms; they serve as important sources of information and experience for the public about risks and risk events (e.g., Ball-Rokeach & DeFleur, 1976; Slovic, 1987). As communication channels, these mechanisms can amplify or attenuate risk perceptions within a community, as well as motivate individuals and groups to take actions to avoid, tolerate, or modify the risk (Kasperson et al., 1988). Both mechanisms are especially influential when personal experience with a risk is minimal or nonexistent (Kasperson et al., 1988).

Previous research has investigated wildlife-related risk perceptions through psychometric (e.g., Riley & Decker, 2000a; 2000b; Stout et al., 1993) and sociocultural (e.g., Gore, Siemer, Shanahan, Schuefele, & Decker, 2005; Muter, Gore, & Riley, 2009) approaches. Psychometric inquiry emphasizes factors that influence individuals' risk perceptions, including the extent to which an individual worries about a particular risk and the degree to which they trust those responsible for managing the risk (Slovic, 1987). Sociocultural approaches consider how peoples' risk perceptions and responses to hazards are shaped by their worldviews, social interactions, or experiences of everyday life (Bickerstaff, 2000; Marris, Langford, & O'Riordan, 1998). Sociocultural approaches look at societal influences, such as the mass media, that affect individual and group perceptions of risk and responses to risk-events (Sjoberg, 1998). Research integrating these two paradigms of risk perception is missing from the wildlife management literature.

My research aims to address this need by integrating principles from both psychometric and sociocultural theories of risk perception to inform the human dimensions of cormorant management. To this end, I (a) assess perceived risks within a

network of stakeholders engaged in HCCs around northern Lake Huron, (b) characterize the social network, and (c) evaluate the nature of cormorant-related media coverage in the Great Lakes over time. In addition to having important practical implications for cormorant and HWC management, this research provides important theoretical insight into how social network structure both influences, and is influenced by, stakeholder risk perceptions.

Thesis Organization

This thesis is organized into four chapters. In Chapter 1, I test a framework proposed by Scherer & Cho (2003) that integrates elements of psychometric and sociocultural theories of risk perception to better understand how risk perceptions associated with HCCs around northern Lake Huron are influenced by interactions among stakeholders in their social network. In Chapter 2, I describe the structure of the social network and discuss practical implications for wildlife-related risk communication. In Chapter 3, I analyze the risk-related content of newspaper coverage about cormorants in the Great Lakes from 1978 to 2007 and discuss the use of risk frames in content analysis to inform risk communication. In the final chapter, I summarize major findings and discuss theoretical, methodological, and practical implications from my research and suggest directions for future inquiry.

REFERENCES

Ball-Rokeach, S. J., DeFleur, M. L. (1976). A dependency model of mass-media effects. *Communication Research, 1*, 3–21.

Bedard, J., Nadeau, A., & Lepage, M. (1995). Double-crested cormorant culling in the St. Lawrence River estuary. *Colonial Waterbirds, 18*, 78–85.

Bickerstaff, K. (2000). Risk perception research: socio-cultural perspectives on the public experience of air pollution. *Environment International, 30,* 827–840.

Carpenter, L. H., Decker, D. J., & Lipscomb, J. F. (2000). Stakeholder acceptance capacity in wildlife management. *Human Dimensions of Wildlife, 5,* 5–19.

Conover, M. R. (2002). *Resolving human-wildlife conflicts: The science of wildlife damage management.* Boca Raton: CRC Press LLC.

Conover, M. R., & Chasko, G. G. (1985). Nuisance Canada goose problems in the eastern United States. *Wildlife Society Bulletin, 13,* 228–233.

Decker, D. J., & Chase, L. C. (1997). Human dimensions of living with wildlife – a management challenge for the 21st century. *Wildlife Society Bulletin, 25*, 788 – 795.

Decker, D. J., Lauber, T. B., & Siemer, W. F. (2002). *Human-wildlife conflict management: A practitioner's guide.* Ithaca, NY: Northeast Wildlife Damage Management Research and Outreach Cooperative.

Fall, M. W., & Jackson, W. B. (2002). The tools and techniques of wildlife damage management – changing needs: An introduction. *International Biodegradation, 49*, 87–91.

Fielder, D. G. (2009). Examination of factors contributing to the decline of the yellow perch population and fishery in Les Cheneaux Islands, Lake Huron, with emphasis on the role of double-crested cormorants. *Journal of Great Lakes Research, 34*, 506–523.

Gilman, E., Kobayahi, D., Swenarton, T., Brothers, N,, Dalzell, P., & Kinan-Kelly, I. (2007). Reducing sea turtle interactions in the Hawaii-based longline swordfish fishery. *Biological Conservation, 139*, 19–28.

Gore, M. L., Siemer, W. F., Shanahan, J. E., Schüefele, D., & Decker, D. J. (2005). Effects on risk perception of media coverage of a black bear-related human fatality. *Wildlife Society Bulletin, 33,* 507–516.

Gore, M. L., Wilson, R. S., Siemer, W. F., Weiczorek Hudenko, H. A., Clarke, C. S., Hart, S. P., Maguire L. A., & Muter, B. A. (2009). Application of risk concepts to wildlife management: Special issue introduction. *Human Dimensions of Wildlife, 14*, 301–313.

Hatch, J. J., & Weseloh, D.V. (1999). Double-crested Cormorant (Phalacrocorax auritus). In A. Poole & F. Gill (Eds.), *The Birds of North America* (no. 441, p. 36). Philadelphia: The Birds of North America, Inc.

Hebert, C. E., Duffe, J., Weseloh, D. V., Senese, E. M., & Haffner, G. D. (2005). Unique island habitats may be threatened by double-crested cormorants. *Journal of Wildlife Management, 69*, 68–76.

Johnson, J. E., & Rakoczy, G. P. (2004). Investigations into recent declines in survival of brown trout stocked in Lake Charlevoix and Thunder Bay, Lake Huron. Michigan Department of Natural Resources. Fisheries Report No. 2075. Lansing, Michigan.

Jonker, S. A., Organ, J. F., Muth, R. M., Zwick, R. R., & Siemer, W. F. (2009). Stakeholder norms toward beaver management in Massachussets. *Journal of Wildlife Management, 73*, 1158–1165.

Kasperson, R. E., Jhaveri, N., & Kasperson, J. X. (2001). Stigma and the social amplification of risk: Toward a framework of analysis. In J. Flynn, P. Slovic, & H. Kunreuther (Eds.), *Risk, media, and stigma: Understanding public challenges to modern science technology* (pp. 9–27). London: Earthscan.

Kasperson, R. E., Renn, O., Slovic, P., Brown, H. S., Emel, J., & Goble, R., Kasperson, J. X., & Ratick, S. (1988). The social amplification of risk: A conceptual framework. *Risk Analysis, 8*, 177–187.

Knuth, B. A., Stout, R. J., Siemer, W. F., Decker, D. J., & Stedman, R. C. (1992). Risk management concepts for improving wildlife population decisions and public communication strategies. In *Transactions of the 57th North American Wildlife and Natural Resources Conference* (pp. 63–74). Washington, DC.

Lantry, B. F., Eckert, T. H., Schneider, C. P., & Chrisman, J. R. (2002). The relationship between the abundance of smallmouth bass and double-crested cormorants in the Eastern Basin of Lake Ontario. *Journal of Great Lakes Research, 28*, 193–201.

Lemmon, C. R., Bugbee, G., & Stephens, G. R. (1994). Tree damage by nesting double-crested cormorants in Connecticut. *Connecticut Warbler, 14*, 27–30.

Marris, C., Langford, I. H., & O'Riordan, T. (1998). A quantitative test of the cultural theory of risk perceptions: Comparison with the psychometric paradigm. *Risk Analysis, 18*, 635–647.

MDNR. (2005). Double-crested cormorants in Michigan: A review of history, status, and issues related to their increased population. Michigan Department of Natural Resources. Report No. 2. Lansing, Michigan.

MDNR. (2009). An adaptive management framework for managing populations of double-crested cormorants in Michigan. Michigan Department of Natural Resources. Lansing, Michigan.

Messmer, T. A. (2000). The emergence of human-wildlife conflict management: turning challenges into opportunities. *International Biodeterioration & Biodegradation, 45*, 97–102.

Muter, B. A., Gore, M. L., & Riley, S. J. (2009). From victim to perpetrator: Evolution of risk frames related to human-cormorant conflict in the Great Lakes. *Human Dimensions of Wildlife, 14*, 366–379.

Renn, O. R. (1998). Three decades of risk research: accomplishments and new challenges. *Journal of Risk Research, 1*, 49–71.

Riley, S. J., & Decker, D. J. (2000a). Risk perception as a factor in wildlife stakeholder acceptance capacity for cougars in Montana, *Human Dimensions of Wildlife, 5,* 50-62.

Riley, S. J., & Decker, D. J. (2000b). Wildlife stakeholder acceptance capacity for cougars in Montana. *Wildlife Society Bulletin, 28,* 931–939.

Riley, S. J., Decker, D. J., Carpenter, L. H., Organ, J. F., Siemer, W. F., Mattfield, G. F., & Parsons, G. (2002). The essence of wildlife management. *Wildlife Society Bulletin, 30*, 585–593.

Rudstam, L. G., VanDeValk, A. J., Adams, C. M., Coleman, J. T. H., Forney, J. L., & Richmond, M. E. (2004). Population dynamics of walleye and yellow perch in Oneida Lake. *Ecological Applications, 14*, 149–163.

Scherer, C. W., & Cho, H. C. (2003). A social network contagion theory of risk perception. *Risk Analysis, 23,* 261–267.

Slovic, P. (1987). The perception of risk. *Science, 236,* 280–285.

Sjoberg, L. (1998). World views, political attitudes and risk perception. *Health, Safety & Environment, 9*, 137–152.

Storm, D. J., Nielsen, C. K., Schauber, E. M., & Woolf, A. (2007). Deer-human conflict and hunter access in an exurban landscape. *Human-Wildlife Conflicts, 1*, 53–59.

Stout, R. J., Stedman, R. C., Decker, D. J., & Knuth, B. A. (1993). Perceptions of risk from deer-related vehicle accidents: Implications for public preferences for deer herd size. *Wildlife Society Bulletin, 21*, 237–249.

Sullivan, K.L., Curtis, P.D., Chipman, R. B., & McCullough, R.D. (2006). The double-crested cormorant: issues and management. Ithaca, New York, USA: Department of Natural Resources, Cornell University.

Taylor, J. D., & Dorr, B. S. (2003). Double-crested cormorant impacts to commercial and natural resources. In K. Fagerstone, & G. Witmer (Eds.), *Proceedings of the 10th Wildlife Damage Management Conference* (pp. 43–51).

Weseloh, D.V., & Lewis, S. J. (1997). Information needs for the double-crested cormorant in Midwestern North America. In *Symposium on Double-crested Cormorants: Population Status and Management Issues in the Midwest* (pp.157–162). Technical Bulletin 1879. United State Department of Agriculture, Animal and Plant Health Inspection Services. Washington, D.C.

Weseloh, D.V., & Collier, B. (1995). *The rise of the double-crested cormorant on the Great Lakes: Winning the war against contaminants.* [Great Lakes Fact Sheet]. Canadian Wildlife Service, Environment Canada, and Long Point Observatory.

Weseloh, D. V., Pekarik, C., Havelka, T., Barrett, G., & Reid, J. (2002). Population trends and colony locations of double-crested cormorants in the Canadian Great Lakes and immediately adjacent areas, 1990–2000: A manager's guide. *Journal of Great Lakes Research, 28*, 125–144.

Wires, L. R., & Cuthbert, F. J. (2006). Historic populations of double-crested cormorant (Phalacrocorax auritus): Implications for conservation and management in the 21st century. *Waterbirds, 29*, 9–37.

Wires, L. R., Cuthbert, F. J., Trexel, D. R., & Joshi, A. R. (2001). Status of the double-crested cormorant (Phalacrocorax auritus) in North America. Final Report to USFWS.

CHAPTER 1

INFLUENCE OF SOCIAL NETWORKS ON STAKEHOLDER PERCEPTIONS OF RISK ASSOCIATED WITH HUMAN-CORMORANT CONFLICT IN NORTHERN LAKE HURON

There is interest among wildlife professionals to increase understanding of stakeholder perceptions of risk associated with HWCs, as well as mechanisms that influence those perceptions (Gore et al., 2009). Stakeholder risk perceptions may not align with expert assessments of wildlife-related risks; however, these perceptions influence public attitudes and behaviors related to wildlife management (Knuth, Stout, Siemer, Decker, & Stedman, 1992). Research on wildlife-related risk has overwhelmingly been informed by the psychometric and sociocultural paradigms. Psychometric studies have identified factors influencing individuals' risk perceptions associated with wildlife, such as demographic variables, attitudes, and wildlife stakeholder acceptance capacity (e.g., Riley & Decker, 2000a; 2000b; Stout, Stedman, Decker, & Knuth, 1993; Vaske, Timmons, Beaman, & Petchenik, 2004). Sociocultural research has explored how public responses to and perceptions of wildlife-related risks are shaped by influences of everyday life, such as the mass media (e.g., Gore, Siemer, Shanahan, Schuefele, & Decker, 2005; Muter, Gore, & Riley, 2009). Little research has integrated elements from both perspectives into a single framework to account for how these elements both influence, and become influenced by, stakeholder's wildlife-related risk perceptions.

HWCs can generate concerns within and across affected communities and often become contentious issues that require management intervention (Minnis & Peyton,

1995; Schusler, Chase, & Decker, 2000). The stakeholders and agency professionals who are involved with, or affected by, HWCs may develop a complex web, or network, of social interactions (Conover, 2002). Social networks are composed of actors (e.g., individuals, groups, or organizations) and their connections (i.e., ties) with one another. Social network analysis (SNA) is the study of "relationships among social entities, and the patterns and implications of these relationships" (Wasserman & Faust, 1994, p. 3). Social networks have been used to describe diverse interactions and relationships among actors including kinship, transfer of resources, communication, and exertion of influence (Wasserman & Faust, 1994).

Theories of risk perception and social networks have been individually applied in human dimensions inquiry; however, no research has integrated both into a wildlife management context. I aim to help fill this void by investigating risk perceptions and social network structure of agency professionals (e.g., federal, state, provincial, and tribal fisheries and wildlife managers) and non-governmental stakeholders (e.g., anglers, birders, and business owners) engaged in HCCs around northern Lake Huron. I conclude this chapter with a discussion about the theoretical and practical implications for risk communication related to contentious HWCs.

CONCEPTUAL BACKGROUND

Social Network Analysis

SNA has been applied to a variety of natural resource management issues and has proved especially useful in helping to characterize and understand relationships among diverse stakeholder groups (e.g., Bodin, Crona, & Ernstson, 2006; Prell, Hubacek, & Reed,

2009). SNA has been used to identify functions of networks in community-based natural resources management (e.g., Lauber, Decker, & Knuth, 2008) and to evaluate the efficacy of collaborative natural resource planning (e.g., Mandarano, 2009). SNA has informed stakeholder-engagement selection processes (e.g., Prell, Hubacek, Quinn, & Reed, 2008; Prell et al., 2009) and been used to explore communication, knowledge, and advice exchanges among stakeholder groups such as farmers (Issac, Erickson, Quashie-Sam, & Timmer, 2007) and charter-boat fishing captains (Mueller, Taylor, Frank, Robertson & Grinold, 2008). Two gaps in the existing literature include the application of social network methods to HWCs and wildlife-related risk perception. SNA may serve as an effective framework for integrating the psychometric and sociocultural perspectives of risk to explore stakeholder risk perceptions associated with HWCs. If effective, this framework may have management implications for how agency professionals interact and communicate with stakeholders involved in contentious HWCs, as well as offer new theoretical insight into: (a) how wildlife-related risk perceptions are formed, and (b) the relationship between wildlife-related risk perception and risk behavior.

Social Network Contagion Theory of Risk Perception

Social networks serve as important channels in which people share, receive, and exchange information about risk and risk-related events (Kasperson et al., 1988). People observe and interact with members of their personal and professional networks to determine if risks are socially acceptable; in turn, these networks may facilitate amplification or attenuation of risk perceptions throughout a community, as well as motivate individuals and groups to take actions to avoid, tolerate, or modify the risk

(Kasperson et al., 1988). Social contagion – the diffusion of tangible or intangible ideas, practices, or technologies through relationships among actors within a network (Borgatti & Foster, 2003; Rogers, 2003) – arises from these social interactions which help people manage and interpret uncertainty (Burt, 1987).

Burt (1987) discussed two models of social contagion: structural equivalence and cohesion. The structural equivalence model compares the positions of actors and their functions within a network. Actors who are structurally equivalent have identical or very similar connections with other network actors, but do not necessarily have direct ties with one another (Knoke & Yang, 2008). Exact equivalence rarely occurs in real world networks (Hanneman & Riddle, 2003); however, in theory, the more structurally equivalent two actors are the more likely they are to adopt similar attitudes or behaviors (Burt, 1987). Investigations of structural equivalence have primarily focused on competitive relationships between actors (Burt, 1992). For example, two competing commercial fishermen may be structurally equivalent if they both market their catch to the same restaurant chains (i.e., they interact with the same set of actors without necessarily interacting with one another).

The cohesion model emphasizes the role of communication between actors; the more frequent communication (i.e., the stronger the tie) between two actors (i.e., a dyad), the more likely they are to adopt similar attitudes or behaviors. Close physical proximity of actors may also influence social contagion (Burt, 1987). Contagion occurs as a result of interactions among actors who are "mutually influencing and informing each other" (Borgatti & Foster, 2003, p. 1005). These interactions – both past and current – aid in the flow of information and influence, and affect individual and group decision making

(Watts, 2004). Neither the structural equivalence nor the cohesion models have been applied to a wildlife management context; however, structural equivalence models are generally applied to groups of expert actors who are "overexposed to information on the objects being evaluated" (Burt, 1987, p. 1328). Wildlife professionals, for example, may be overexposed to information on radio-telemetry technologies for studying movements of small animals (e.g., butterflies). Some of these professionals may initially choose not to adopt the new technology and rely on existing (and perhaps cheaper) alternatives such as mark-recapture techniques; however, once they notice other professionals in their field applying the new method, they adopt the new method (i.e., innovation). Thus, the cohesion model seems more conducive to exploration of contagion among networks including both expert and non-expert actors (e.g., such as the network of agency professionals and non-governmental stakeholders involved in cormorant management in northern Lake Huron).

Theories of social influence and contagion have been applied to diverse disciplines and innovations ranging from smoking cessation (e.g., Christakis & Fowler, 2008) to corporate philanthropy (e.g., Galaskiewicz & Burt, 1991). Although risk is an implicit part of these case studies; few studies have explicitly explored if and how risk perceptions are influenced by social contagion. Scherer and Cho (2003) adapted Burt's (1987) social network contagion theory to analyze the role of risk perceptions associated with management of an environmental hazard in a community setting. They hypothesized that an individual's risk perceptions would be influenced by the perceptions of others in their communication network; similarity in risk perceptions of the negative health impacts posed by a hazardous waste site were related to the frequency of communication

between actors. In other words, the more frequently two individuals communicated, the more likely they were to share similar levels of perceived environmental risk.

Although Scherer & Cho (2003) found that dyadic tie strength predicted similarity in risk perceptions about a contentious environmental issue (i.e., cleanup of a hazardous waste site within a community), they found that dyadic tie strength was not a significant predictor of similarity of beliefs about a benign issue (i.e., belief in science). They speculated that contentious environmental risk issues generate more interpersonal discussions about risk-related events and activate contagion effects throughout a community. Theoretical understanding of the antecedents and consequences of wildlife-related risk perceptions may be greatly enhanced through studying social networks associated with HWCs (which are often viewed as contentious management issues).

I applied Scherer & Cho's (2003) social network contagion theory of risk perception to a network of actors engaged in HCCs. Cormorant management is a contentious management issue in the Basin, at least in part, because of the diversity of stakes and cormorant-related risk perceptions held by stakeholders. A number of psychometric factors can influence an individual's risk perception including experience and familiarity with the risk (Slovic, 1987), trust in decision makers (Slovic, 1993), and dread (Sjoberg, 1998). Gore, Knuth, Curtis, and Shanahan (2006; 2007a; 2007b) applied nine of these factors to HWC in New York: *certainty, control, dread, frequency, naturalness, trust in management, responsiveness of management, seriousness,* and *voluntariness.* I adapted and applied their definitions of the first eight of these factors to HCCs (Table 1.1) and explored how each individual factor is influenced by network structure (e.g., dyadic tie strength). I excluded *voluntariness* (i.e., the degree to which a

person believes their exposure to wildlife is accidental or deliberate) (Gore et al., 2006; 2007a; 2007b), because HCCs are not typically viewed in the context of direct physical interactions between humans and cormorants.

Study Objectives

The purpose of this study was to explore how interactions within a social network of agency professionals (e.g., state, federal, provincial, or tribal fisheries and wildlife managers) and non-governmental stakeholders (e.g., anglers, bird enthusiasts, and business owners) influence risk perceptions associated with cormorant management in northern Lake Huron. My objectives were to: 1) evaluate cormorant-related risk perceptions held by network actors, and 2) assess the relationships between cormorant-related risk perception and dyadic tie strength.

METHODS

Study Population & Location

My study population of interest was agency professionals and non-governmental stakeholders who were involved in, or affected by, HCC in northern Lake Huron (Figure 1.1). I chose to focus my research efforts in this region for several reasons. First, northern Lake Huron serves as an important nesting area for more than 100 cormorant colonies in the Great Lakes Basin (Ridgway, Pollard & Weseloh, 2006; Weseloh et al., 2002). Second, fishing communities in northern Michigan and Ontario that are close to these nesting sites (e.g., Thunder Bay, the Les Cheneaux Islands, the North Channel, and Manitoulin Island) have reported increased HCCs in recent years, evidenced in part by

several documented occurrences of illegal, mass cormorant killings (Wires & Cuthbert, 2006) and high-profile coverage about HCCs in the mass media, including the *New York Times* (e.g., Wilgoren, 2002, p. 12A). This study area was also easily accessible to Michigan State University (MSU) and conducive for studying ties within and across diverse stakeholder groups in both the U.S. and Canada. Finally, cormorant management activities such as harassment, egg-oiling, and lethal shooting have been applied throughout select areas of this region since 2004.

Sampling Frame

I used an adaptive, snowball sampling approach (Goodman, 1961; Thompson & Collins, 2002) to identify study participants and collect data between August 2008 and August 2009. Adaptive sampling designs include any type of sampling procedure that adjusts to observations made while conducting a study, such as identifying new study participants based on links from previous respondents (Thompson & Collins, 2002). Snowball sampling typically begins with a set of actors who hold leadership positions in their community, organization, or agency (Hanneman & Riddle, 2005). Although the method may not identify all actors in the network (e.g., isolates), snowball sampling is effective at identifying hard to find populations (Hanneman & Riddle, 2005). Thus, I began with a group of agency professionals ($n = 20$) directly involved with cormorant management in northern Lake Huron. I created this list after making several calls to management agencies for recommendations on the most appropriate individuals from that agency. As fisheries and wildlife professionals in state, provincial, tribal, and federal government, these actors were responsible for making decisions about cormorants and were connected

with stakeholders who were actively engaged in HCC in northern Lake Huron. I interviewed these individuals and asked them to list the names of up to five agency professionals and five non-governmental stakeholders with whom they had discussed cormorants and their management, specific to our study area, in the last calendar year. New names generated from these interviews were compiled into a list for my second wave of interviews. I repeated this process three times (i.e., through three complete waves). I stopped conducting interviews during the fourth wave because (1) new actors nominated during the interviews did not play a major role [in cormorant management] in their communities (Fink, 1995), (2) study participants were not generating new information [about cormorant-related risk perception] (Lauber et al., 2008), and (3) interview resources (e.g., time and funds) were finite (Hanneman & Riddle, 2005).

Data Collection

Data collection was modeled after Scherer and Cho (2003) and consisted of a semi-structured face-to-face or telephone interview (Appendix A) (Gubrium & Holstein, 2002), and a 13-item questionnaire (Appendix B) that was handed directly to participants at the end of the interview. I initially contacted participants by telephone and asked if they would be willing to schedule a time and place to meet for a face-to-face interview. Interviews usually took place in the participant's home or office (n = 105, 87%). Interviews were conducted over the telephone (n = 16, 13%) only if the participant was unable to meet in person (e.g., interviewee lived out-of-state). Wasserman and Faust (1994) suggested that interviews can easily be conducted over the telephone and be just as effective as face-to-face interviews. Although merging data from different collection

methods can be problematic, recall issues are typically minimized with salient issues (Dillman, Sangster, Tarnai, & Rockwood, 1996), such as cormorant management.

I conducted 121 interviews that varied from 12 to 113 minutes in length (M = 36 minutes, SD = 16). Each interview was digitally recorded with the participant's informed consent (Appendix A). During the interview, I asked participants to list names of actors with whom they had discussed cormorants in the past year and to address their connectivity with each actor they listed (e.g., frequency of communication, type of relationship). Interview questions also queried participants about their (a) sources of cormorant-related information, (b) cormorant-related risk perceptions, and (c) opinions about cormorant management.

Questionnaires obtained personal attributes (e.g., age, education, county of residence) and measured individual factors that may influence cormorant-related risk perception (Table 1.2). All risk perception-related items were measured on 7-point scales. Human dimensions research typically employs either 5 or 7-point scales; however, 7-point scales are often preferred because of their increased precision (Vaske, 2008). Questions assessed participants' perceived likelihood and acceptability of cormorant-related risks (e.g., risks to the environment, economy, and recreational opportunities in northern Lake Huron). Finally, I adapted a question posed by Scherer & Cho (2003) about participant's belief in science (e.g., "Science is the most rational way to approach cormorant management"). I encouraged study participants to complete the questionnaire at the end of the interview so they could be collected in-person; however, if the participant did not have time to complete the survey immediately after the interview concluded, I provided them with postage and a self-addressed envelope. Methods used in

this research were reviewed and approved by the University Committee on Research Involving Human Subjects at Michigan State University (IRB # X07-052).

Data Analysis

Social network data are essentially interpreted as dyadic relationships (i.e., relationships between pairs of actors) (Borgatti & Foster, 2003; Marsden, 1990). I organized data into sets of two-dimensional adjacency and affiliation matrices (Scott, 2000). Adjacency matrices are square matrices that include the same set of items (e.g., a list of actors' names) in both the row and column headings. Affiliation matrices include different sets of items (e.g., a list of actors and attributes such as gender or age) in the row and column headings. My independent variable was dyadic tie strength, measured as the maximum reported frequency of communication between two actors in the network. Study participant names were listed in the row and column headings in a 113 x 113 matrix, representing 12,656 possible interactions between all of the actors. Values ranging from 0 (indicating no interaction between the two actors) to 365 (indicating daily interaction between two actors) were inserted into each of the matrix cells. Reported interactions between two actors were not always reciprocated (e.g., actor *i* might report a tie with actor *j*, but not vice versa), so I chose to symmetrize the matrix with the maximum reported value (Scherer & Cho, 2003). This meant that if actor *i* reported communicating with actor *j* six times a year, we also assumed actor *j* reported a tie of the same strength with actor *i*. I took this approach because my snowball sampling procedure limited the number of actors each participant could nominate to elicit a meaningful, but manageable, sample size (Knoke & Yang, 2008).

Dependent variables (Table 1.2) included: (a) the eight individual risk perception factors proposed and tested by Gore et al. (2006; 2007a; 2007b), (b) a 3-item risk likelihood scale created by averaging the responses on three questions (i.e., how likely is it that cormorants will have negative effects on the environment, economy, and recreational opportunities in northern Lake Huron in the next year), (c) a 3-item risk acceptability scale created by averaging the responses on three questions (i.e., how acceptable are the risks that cormorants pose to the environment, economy, and recreational opportunities in northern Lake Huron), and (d) respondent's belief in science. All risk items were measured on 7-point scales and were conceptually recoded from low risk (0) to high risk (6). Non-risk items were also measured on 7-point Likert-type scales and were coded from strongly disagree (-3) to strongly agree (3).

Control variables included age, education, county of residence, and stakeholder affiliation. I constructed matrices for all dependent variables, as well as age and education to display the difference in response between two actors. For example, if actor *i* was 52 years old and actor *j* was 62, a "10" would be placed in cell *i, j*. Matrices for stakeholder affiliation and county of residence used an "exact match" method. This meant that if actors *i* and *j* were both managers from a state wildlife agency, a "1" would be placed in cell *i, j* (Scherer & Cho, 2003).

I used SPSS 17.0 (2008) to compute descriptive statistics for actor attributes (e.g., age, education, gender, county of residence) and cormorant-related risk perceptions and UCINET 6 (Borgatti, Everett, & Freeman, 2002) to describe and analyze all network data. I did not weight my data because I did not make generalizations to a larger population (Vaske, 2008). I used multiple regression quadratic assignment procedure

(MRQAP) to test the relationships between dependent variables and control variables (Model 1) and with dyadic tie strength, the independent variable (Model 2). MRQAP is a type of permutation test for multiple regression coefficients of matrix or network data (Dekker, Krackhradt, & Snijders, 2005). UCINET 6 (Borgatti, Everett, & Freeman, 2002) generated standardized beta values. MRQAP is not based on ordinary least squares, so p-values for changes in R^2 are not generated.

RESULTS

Ninety-three percent of participants (n = 113) completed both the interview and questionnaire. Respondents reported 700 ties out of 12,656 possible interactions between the 113 actors (network density = 5.53%). Interactions among these 113 actors accounted for 76% of all reported ties. Respondents were 24 to 72 (M = 52, SD = 11.6) years in age. All participants had at least a high school diploma or equivalent. Eleven percent of participants (n = 12) had some college, 3% (n = 3) attended vocational or trade school, 6% (n = 7) had an associate's degree, 17% (n = 9) had a bachelor's degree, and 54% (n = 61) had an advanced degree. Seventeen percent of respondents (n = 19) were female. Primary stakeholder affiliations (Table 1.3) included anglers (22%, n = 25), state and provincial government employees (21%, n = 24), federal government employees (12%, n = 14), business interests (12%, n = 13), and universities (9%, n = 10).

Risk Perception Results

Certainty (M = 5.35, SD = 1.27), *frequency* (M = 5.18, SD = 1.42), *dread* (M = 4.32, SD = 1.91), and *seriousness* (M = 4.15, SD = 2.12) of cormorant-related risks were factors

among the highest concern. *Trust* ($M = 2.96$, $SD = 2.12$) and *responsiveness* ($M = 3.24$, $SD = 2.04$) of management agencies involved in cormorant management were factors of the lowest concern. Participants indicated they thought it was somewhat likely ($M = 3.67$, $SD = 1.91$) that cormorants would negatively affect the economy ($M = 3.79$, $SD = 2.01$), recreational opportunities ($M = 3.72$, $SD = 1.99$), and the environment ($M = 3.51$, $SD = 2.06$) in northern Lake Huron in the next calendar year (Table 1.2). Most respondents reported these risks as unacceptable ($M = 4.12$, $SD = 1.89$). Cormorant-related risks to recreational opportunities in northern Lake Huron were rated most unacceptable ($M = 4.21$, $SD = 2.06$), followed by risks to the economy ($M = 4.18$, $SD = 1.90$), and the environment ($M = 3.91$, $SD = 2.06$). Most participants also felt that science was the most rational way to approach cormorant management ($M = 1.29$, $SD = 1.78$).

MRQAP Matrix Regression

Dyadic tie strength was a significant predictor for five out of the eight risk perception factors (i.e., *certainty, dread, frequency, responsiveness,* and *severity*); the more frequently two actors communicated, the more likely they were to share similar cormorant-related risk perceptions as measured by these items (Table 1.4). The negative coefficients indicate a positive relationship, because the values in the matrices used for analysis represented the degree of dissimilarity in perceptions between two actors (i.e., the larger the number in the matrix, the more dissimilar the two actors) (Scherer & Cho, 2003). Small standardized beta values are also expected from this type of analysis (Scherer & Cho, 2003) because the analysis is predicting more than 12,000 possible interactions from 113 actors. *Control, naturalness,* and *trust* were the only factors not

significantly predicted by dyadic tie strength (all of which, however, were approaching significance of $p < 0.10$).

Dyadic tie strength was a significant predictor of perceived likelihood ($b = -0.042$, $p < 0.001$), but not acceptability ($b = -0.023$, $p = 0.053$) of cormorant-related risks. Stakeholder affiliation and county of residence were significant predictors of both perceived likelihood ($b = 0.094$, $p < 0.001$) and acceptability ($b = -0.093$, $p < 0.001$). Education was the only significant predictor ($b = 0.280$, $p < 0.001$) for *belief in science*.

DISCUSSION

Cormorant-related risk perceptions were moderate to high for most respondents. Factors of greatest concern were items related to individual capacity (e.g., *certainty, dread, frequency*, and *seriousness*) whereas factors of least concern were items related to agency capacity (e.g., *trust* and *responsiveness*) (Gore et al., 2006). These results should be interpreted with caution however; results differ if responses from agency professionals are compared to those of non-governmental stakeholders (see Appendix D) as non-experts tend to have divergent risk perceptions from experts (e.g., Siegrist, Keller, Kastenholz, Frey, & Wiek, 2007; Slovic, 1987). Comparing and contrasting these groups' cormorant-related risk perceptions can inform wildlife-related risk communication efforts. For example, if an objective of cormorant management in northern Lake Huron is to attenuate cormorant-related risk perceptions among non-governmental stakeholders, agency professionals could consider management approaches that address individual capacity to reduce cormorant-related risks. This type of approach might include disseminating information about how individuals can minimize their exposure to

cormorant-related risks (e.g., how to report concerns of cormorant-related risks to the appropriate management agency, or how to start a volunteer harassment program).

One meaningful result of this work is that social networks are clearly an important, and often overlooked, mechanism capable of influencing stakeholder risk perceptions about HCCs in northern Lake Huron. The more frequently two actors communicated (i.e., the greater the dyadic tie strength), the more likely they were to share similar cormorant-related risk perceptions. Increased dyadic tie strength was significantly related to increased similarity of (a) five out of the eight individual factors (i.e, *certainty, dread, frequency, responsiveness,* and *severity*) proposed by Gore et al. (2006, 2007a, 2007b), and (b) perceived likelihood of cormorant-related risks. The factors of highest concern described above (i.e., those related to individual capacity) were also those factors that were significantly predicted by dyadic tie strength.

Dyadic tie strength was not a significant predictor for (a) the individual factors *control, trust,* and *naturalness*, (b) acceptability of cormorant-related risks, and (c) *belief in science*. The latter result is also similar to Scherer & Cho (2003) who speculated that the social network contagion theory of risk perception may only be applicable to contentious issues, because non-contentious issues do not generate risk-related discussions in communities.

Another meaningful finding is that contagion effects were detected in a mixed network of expert (e.g., agency professionals) and non-expert stakeholder groups (e.g., anglers, bird enthusiasts) involved in HCC. Some (e.g., Burt, 1987) have speculated that structural equivalence, rather than cohesion, creates more social pressure among experts to adopt an innovation and is therefore not as effective at predicting expert perceptions. I

found evidence to suggest the cohesion model is relevant for both expert and non-expert stakeholders involved in HCC; however, research is needed to see if contagion effects are greater and more widespread if the network consisted of only non-expert stakeholder groups.

This research highlights the importance for environmental risk communicators to coordinate their risk communication efforts with communities (and their networks), rather than individuals, in mind (Lundgren & McMakin, 2009). Social networks are an important channel through which information about cormorant-related risks are communicated, and as a result influence stakeholders' risk perceptions about HCCs. If deployed strategically, network channels may be used by agency professionals for risk communication efforts that aim to reduce HCCs to a level deemed acceptable for both humans and wildlife (Decker et al., 2002; Gore & Knuth, 2009).

Results reinforce the notion that the social network contagion theory of risk perception is well suited for studying contentious environmental issues. However, the framework has not defined the criteria for what constitutes a contentious environmental risk issue, or the threshold at which an issue moves from occurrence to controversial. Future inquiry should look at participant's perceptions of issue relevance (e.g., how does the issue affect them and their family, is issue new or old) to see if this lends insight into what makes an issue contentious enough to mobilize contagion effects.

Also unclear is the extent to which networks influence, if at all, the risk-related behaviors of different stakeholders engaged in HWCs (e.g., letter writing, poaching, allocation of resources); the network-related relationship between risk perceptions and risk behaviors warrants additional consideration. Understanding the degree to which

social networks mediate the attitude-behavior connection would boost the predictive ability of the model.

One final unanswered question is whether stakeholders form different social networks for different contentious environmental topics. Burt (1987) noted that physical proximity among social entities can influence contagion and the formation of communication networks. Results presented herein suggest physical proximity (i.e., county of residence) is a significant predictor for influencing risk perceptions related to HCCs. Therefore, it is possible that some of the influential, local actors for cormorant management in northern Lake Huron are also influential actors for other contentious fisheries and wildlife issues (e.g., wolf management in Michigan's Upper Peninsula, ban on the spring bear hunt in Ontario). Regardless, managers may find it advantageous to take a proactive approach and provide risk-information to influential stakeholders in a network at the onset of emerging HWCs to curtail risk amplification within communities. Future research should investigate the degree to which the actors of HCC-related networks overlap with actors involved in other HWC-related networks in northern Lake Huron.

REFERENCES

Bodin, O., Crona, B., & Ernstson, H. (2006). Social networks in natural resource management: What is there to learn from a structural perspective? *Ecology & Society, 11*(2), r2. Retrieved October 14, 2009 from http://www.ecologyandsociety. org/vol11/iss2/resp2/

Borgatti, S. P., & Foster, P. C. (2003). The network paradigm in organizational research: A review and typology. *Journal of Management, 29*, 991–1013.

Borgatti, S. P., Everett, M.G. and Freeman, L.C. (2002). Ucinet for Windows: Software for Social Network Analysis. Harvard, MA: Analytic Technologies.

Burt, R. S. (1992). *Structural Holes*. Cambridge, MA: Harvard University Press.

Burt, R. S. (1987). Social contagion and innovation: Cohesion versus structural equivalence. *American Journal of Sociology*, 92, 1287–1335.

Christakis, N. A., & Fowler, J. H. (2008). The collective dynamics of smoking in a large social network. *The New England Journal of Medicine,* 358, 2249–2258.

Conover, M. R. (2002). *Resolving human-wildlife conflicts: The science of wildlife damage management.* Boca Raton: CRC Press LLC.

Decker, D. J., Lauber, T. B., & Siemer, W. F. (2002). *Human-wildlife conflict management: A practitioner's guide.* Ithaca, NY: Northeast Wildlife Damage Management Research and Outreach Cooperative.

Dekker, D., Krackhardt, D., & Snijders, T. A. B. (2005). Sensitivity of MRQAP tests to collinearity and autocorrelation conditions. *Working Paper Series on Research in Relationship Management.* RRM-2005-11-MKT. Retrieved October 2, 2009 from http://www.ru.nl/fm.

Dillman, D. A., Sangster, R. L., Tarnai, J., & Rockwood, T. (1996). Understanding differences in people's answers to telephone and mail surveys. In M. T. Braverman & J. K. Slater (Eds.), *Current Issues in Survey Research, New Directions for Program Evaluation Series*, (pp 45–62). San Francisco, CA: Jossey-Bass.

Fink, A. (1995). *The Survey Kit*. Thousand Oaks, CA: Sage.

Galaskiewicz, J. & Burt, R. S. (1991). Interorganization contagion in corporate philanthropy. *Administrative Science Quarterly, 36,* 88–105.

Goodman, L. A. (1961). Snowball sampling. *The Annals of Mathematical Statistics, 32*, 148–170.

Gore, M. L., & Knuth, B. A. (2009). Mass media effect on the operating environment of a wildlife-related risk communication campaign. *Journal of Wildlife Management, 73,* 1407–1413.

Gore, M. L., Knuth, B. A., Curtis, P. D., & Shanahan, J. E. (2006). Stakeholder perceptions of risk associated with human-black bear conflicts in New York's Adirondack Park campgrounds: implications for theory and practice. *Wildlife Society Bulletin, 34*, 36–42.

Gore, M. L., Knuth, B. A., Curtis, P. D., & Shanahan, J. E. (2007a). Campground manager and user perceptions of risk associated with human-black bear conflict: Implications for communication. *Human Dimensions of Wildlife, 12*, 31–43.

Gore, M. L., Knuth, B. A., Curtis, P. D., & Shanahan, J. E. (2007b). Factors influencing risk perception associated with human-black bear conflict. *Human Dimensions of Wildlife 12*, 133–136.

Gore, M. L., Siemer, W. F., Shanahan, J. E., Schuefele, D., & Decker, D. J. (2005). Effects on risk perception of media coverage of a black bear-related human fatality. *Wildlife Society Bulletin, 33,* 507–516.

Gore, M. L., Wilson, R. S., Siemer, W. F., Weiczorek Hudenko, H. A., Clarke, C. S., Hart, S. P., Maguire L. A., & Muter, B. A. (2009). Application of risk concepts to wildlife management: Special issue introduction. *Human Dimensions of Wildlife, 14*, 301–313.

Gubrium, J. F. & Holstein, J. A. 2002. *Handbook of Interview Research: Context & Method.* Thousand Oaks, CA: Sage.

Hanneman, R. A., & Riddle, M. (2005). *Introduction to social network methods.* Riverside: University of California. Retrieved September 15, 2009 at http://faculty.ucr. edu/~hanneman/

Issac, M. E., Erickson, B. H., Quashie-Sam, S. J., & Timmer, V. R. (2007). Transfer of knowledge on agroforestry management practices: the structure of farmer advice networks. *Ecology and Society, 12*(2), 32. Retrieved October 14, 2009 at http://www.ecologyandsociety.org/vol12/iss2/art32/

Kasperson, R. E., Renn, O., Slovic, P., Brown, H. S., Emel, J., & Goble, R., Kasperson, J. X., & Ratick, S. (1988). The social amplification of risk: A conceptual framework. *Risk Analysis*, *8*, 177–187.

Knoke, D., & Yang, S. (2008). Social network analysis (2nd ed.). Thousand Oaks, CA: Sage.

Knuth, B. A., Stout, R. J., Siemer, W. F., Decker, D. J., & Stedman, R. C. (1992). Risk management concepts for improving wildlife population decisions and public communication strategies. In *Transactions of the 57th North American Wildlife and Natural Resources Conference* (pp. 63–74). Washington, DC.

Lauber, T. B., Decker, D. J., & Knuth, B.A. (2008). Social networks and community-based natural resource management. *Environmental Management, 42,* 677–687.

Lundgren, R. E. & McMakin, A. (2009). *Risk communication: A handbook for communicating environmental, safety, and health risks.* (4th ed). Hoboken, NJ: John Wiley & Sons.

Mandarano, L. A. (2009). Social network analysis of social capital in collaborative planning. *Society and Natural Resources, 22,* 245–260.

Marsden, P. V. (1990). Network data and measurement. *Annu. Rev. Sociol., 16,* 453–463.

Minnis, D. L., & Peyton, R. B. (1995). Cultural carrying capacity, modeling a notion. In J. B. McAninch (Ed.), *Urban Deer: A Manageable Resource? Proceedings of the 1993 Symposium of the North Central Section* (pp. 19–34). St. Louis, MO: The Wildlife Society.

Mueller, K. B., Taylor, W. W., Frank, K. A., Robertson, J. M., & Grinold, D. L. (2008). Social networks and fisheries: the relationship between a charter fishing network, social capital, and catch dynamics. *North American Journal of Fisheries Management, 28*, 447–462.

Muter, B. A., Gore, M. L., & Riley, S. J. (2009). From victim to perpetrator: Evolution of risk frames related to human-cormorant conflict in the Great Lakes. *Human Dimensions of Wildlife, 14*, 366–379.

Prell, C., Hubacek, K., & Reed, M. (2009). Stakeholder analysis and social network analysis in natural resources management. *Society & Natural Resources, 22*, 501–518.

Prell, C., Hubacek, K., Quinn, C., & Reed, M. (2008). Who's in the network? When stakeholders influence data analysis. *Syst Pract Action Res., 21*, 443–458.

Ridgway, M. S., Pollard, J. B., & Weseloh, D. V. C. (2006). Density-dependent growth of double-crested cormorant colonies on Lake Huron. *Canadian Journal of Zoology, 84*, 1409–1420.

Riley, S. J., & Decker, D. J. (2000a). Risk perception as a factor in wildlife stakeholder acceptance capacity for cougars in Montana, *Human Dimensions of Wildlife, 5,* 50-62.

Riley, S. J., & Decker, D. J. (2000b). Wildlife stakeholder acceptance capacity for cougars in Montana. *Wildlife Society Bulletin, 28,* 931–939.

Rogers, E. M. (2003). *Diffusion of innovations* (5th ed.). New York, NY: Free Press.

Scherer, C. W., & Cho, H. C. (2003). A social network contagion theory of risk perception. *Risk Analysis, 23,* 261–267.

Schusler, T. M., Chase, L. C., & Decker, D. J. (2000). Community-based comanagement: Sharing responsibility when tolerance for wildlife is exceeded. *Human Dimensions of Wildlife, 5,* 34–49.

Scott, J. (2000). *Social network analysis: A handbook.* (2nd ed.). Thousand Oaks, CA: Sage.

Siegrist, M., Keller, C., Kastenholz, H., Frey, S., & Wiek, A. (2007). Laypeople's and expert's perception of nanotechnology hazards. *Risk Analysis, 27,* 59–69.

Sjoberg, L. (1998a). World views, political attitudes and risk perception. *Health, Safety & Environment, 9,* 137–152.

Slovic, P. (1987). The perception of risk. *Science, 236,* 280–285.

Slovic, P. (1993). Perceived risk, trust, and democracy. *Risk Analysis, 13,* 675–682.

SPSS Inc. (2008). SPSS Statistics GradPack 17.0. [Computer software]. Chicago, IL: SPSS Inc.

Stout, R. J., Stedman, R. C., Decker, D. J., & Knuth, B. A. (1993). Perceptions of risk from deer-related vehicle accidents: Implications for public preferences of herd size. *Wildlife Society Bulletin, 21,* 237–249.

Thompson, S. K., & Collins, L. M. (2002).Adaptive sampling in research on risk-related behaviors. *Drug and Alcohol Dependence, 68,* S57–S67.

Vaske, J. J. (2008). Survey research and anlaysis: Applications in parks, recreation and human dimensions. State College, PA: Venture.

Vaske, J. J., Timmons, N. R., Beaman, J., & Petchenik, J. (2004). Chronic wasting disease in Wisconsin: Hunter behavior, perceived risk, and agency trust. *Human Dimensions of Wildlife, 9,* 193–209.

Wasserman, S., & Faust, K. (1994). Social network analysis: methods and applications. Cambridge, UK: Cambridge University Press.

Watts, D. J. (2004). The "new" science of networks. *Annu. Rev. Sociol., 30*, 243–270.

Weseloh, D. V., Pekarik, C., Havelka, T., Barrett, G., & Reid, J. (2002). Population trends and colony locations of double-crested cormorants in the Canadian Great Lakes and immediately adjacent areas, 1990–2000: A manager's guide. *Journal of Great Lakes Research, 28*, 125–144.

Wilgoren, J. (2002, January 18). A bird that's on a lot of hit lists. *The New York Times,* p. 12A.

Wires, L. R., & Cuthbert, F. J. (2006). Historic populations of double-crested cormorant (Phalacrocorax auritus): Implications for conservation and management in the 21st century. *Waterbirds, 29*, 9–37.

Table 1.1. Definitions of eight factors of wildlife-related risk perception adapted from Gore, Knuth, Curtis, & Shanahan (2006; 2007a; 2007b) to assess risk perceptions related to human-cormorant conflict around northern Lake Huron, August 2008–August 2009.

Factor	Adapted Definition
Certainty	How convinced an individual is of the causes of cormorant-related risks and how to avoid them
Control	The degree of personal control an individual feels they have over avoiding effects of exposure to cormorant-related risks
Dread	Feelings of concern, worry or anxiety about the effects of exposure to cormorant-related risks
Frequency	How rare (e.g., catastrophic) or common (e.g., chronic) an individual believes the effects of exposure to cormorant-related risks to be
Naturalness	The extent to which an individual believes cormorant-related risks are augmented by natural and human phenomenon
Responsiveness	Perceived ability of management agencies to respond to cormorant related risks in a timely and sufficient manner
Seriousness	Perceived severity of the effects of exposure to cormorant-related risks
Trust	The extent that an individual believes the management agencies involved in cormorant management will manage cormorant-related risks

Table 1.2. Respondents' mean ratings on questionnaire items used to assess risk perceptions related to human-cormorant conflict around northern Lake Huron, August 2008–August 2009. Scores can range from 0 (indicating low perceived risk) to 6 (indicating high perceived risk).

Questionnaire Item	***n***	***Mean***	***SD***
[Certainty] If the cormorant population increases, human-cormorant interactions will increase.	113	5.35	1.27
[Control] I feel that I have control over the risks from cormorants.	112	3.88	1.84
[Dread] I worry about the risks from cormorants.	113	4.32	1.91
[Frequency] Managing the risks from cormorants in northern Lake Huron will continue to be important in the future.	112	5.18	1.42
[Natural vs. Man-Made] Problems involving cormorants are increased by man-made factors.	113	3.58	2.28
[Responsiveness] If there is a problem with cormorants, the resource agencies responsible for management will respond accordingly.	113	3.24	2.04
[Seriousness] Cormorant management should be a top priority for fisheries and wildlife managers in northern Lake Huron.	113	4.15	2.12
[Trust] I trust the resource agencies involved in cormorant management to manage cormorants appropriately.	112	2.96	2.12
***Risk Likelihood Scale* (3 items: Alpha = 0.94)**	**112**	**3.67**	**1.91**
How likely do you think it is that recreational opportunities in northern Lake Huron will be negatively affected by cormorants in the next year?	113	3.72	1.99
How likely do you think it is that the environment of northern Lake Huron will be negatively affected by cormorants in the next year?	112	3.51	2.06
How likely do you think it is that the economy of northern Lake Huron will be negatively affected by cormorants in the next year?	112	3.79	2.01
***Risk Acceptability Scale* (3 items: Alpha = 0.94)**	**112**	**4.10**	**1.89**
The risks posed by cormorants to recreation in northern Lake Huron are acceptably low.	112	4.21	2.06
The risks posed by cormorants to the environment in northern Lake Huron are acceptably low.	112	3.91	2.06
The risks posed by cormorants to the economy in northern Lake Huron are acceptably low.	112	4.18	1.90
***Belief in Science* (1 item)**	**112**	**1.29**	**1.78**
Science is the most rational way to approach cormorant management.	112	1.29	1.78

Table 1.3. Frequency of agency professional and non-governmental stakeholder groups engaged in human-cormorant conflict around northern Lake Huron, August 2008–August 2009.

Agency Professionals	***n***	**%**	**Non-Governmental Stakeholders**	***n***	**%**
federal government	14	21.2	anglers	25	22.1
former government	3	2.7	animal rights	1	0.9
state/provincial government	24	12.4	aquaculture	2	1.8
tribal resource interests	6	5.3	bird interests	3	2.7
			business interests	13	11.5
			commercial fishermen	5	4.4
			other professionals	5	4.4
			policy	2	1.8
			university	10	8.8

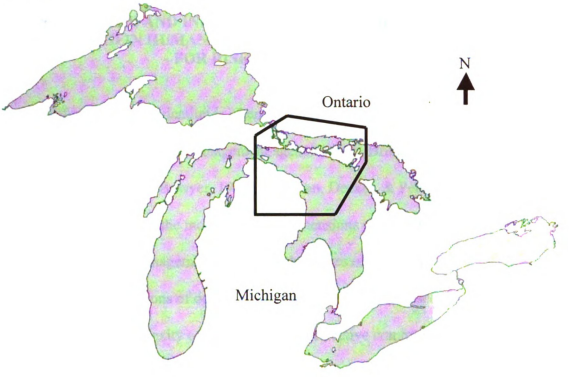
Table 1.4. Multiple regression quadratic assignment procedure (MRQAP) results for models aimed at predicting cormorant-related risk perceptions of network actors engaged in human-cormorant conflict around northern Lake Huron, August 2008–August 2009.

Dependent Variables	*Model 1*		*Model 2*		*Model Fit (R^2)*
	b	*p-value*	*b*	*p-value*	
Certainty					
Age	.042	.171	.043	.168	.003
County	.000	.502	.006	.430	
Education	-.004	.519	-.005	.517	
Stakeholder Affiliation	-.009	.336	-.007	.390	
Dyadic Tie Strength			-.025	**.039**	.003
Control					
Age	.035	.123	.035	.123	.005
County	-.012	.232	-.009	.309	
Education	.020	.244	.020	.265	
Stakeholder Affiliation	-.045	**.020**	-.043	**.021**	
Dyadic Tie Strength			-.019	.090	.005
Dread					
Age	.003	.443	.003	.445	.008
County	-.070	**.001**	-.064	**.002**	
Education	.010	.354	.009	.388	
Stakeholder Affiliation	-.041	**.045**	-.038	**.049**	
Dyadic Tie Strength			-.030	**.017**	.009
Frequency					
Age	-.021	.349	-.020	.366	.010
County	-.021	**.001**	-.076	**.001**	
Education	-.039	.291	-.039	.278	
Stakeholder Affiliation	-.038	.087	-.036	.099	
Dyadic Tie Strength			-.023	**.048**	.011
Naturalness					
Age	.044	**.049**	.044	**.049**	.027
County	.011	.237	.016	.163	
Education	.150	**.001**	.149	**.001**	
Stakeholder Affiliation	-.033	**.045**	-.031	**.041**	
Dyadic Tie Strength			-.021	.052	.028
Responsiveness					
Age	.011	.303	.011	.294	.007
County	-.019	.102	-.011	.218	
Education	.071	**.005**	.070	**.006**	
Stakeholder Affiliation	-.033	**.041**	-.030	**.046**	
Dyadic Tie Strength			-.039	**.002**	.009

Table 1.4. (Con't). Multiple regression quadratic assignment procedure (MRQAP) results for models aimed at predicting cormorant-related risk perceptions of network actors engaged in human-cormorant conflict around northern Lake Huron, August 2008–August 2009.

Dependent Variables		*Model 1*		*Model 2*		*Model Fit (R^2)*
		b	*p-value*	*b*	*p-value*	
Severity						
	Age	.051	.074	.051	.077	.032
	County	-.108	**.000**	-.103	**.000**	
	Education	-.007	.487	-.008	.475	
	Stakeholder Affiliation	-.114	**.000**	-.112	**.000**	
	Dyadic Tie Strength			-.024	**.049**	.033
Trust						
	Age	.030	.092	.030	.088	.016
	County	-.055	**.003**	-.051	**.002**	
	Education	.085	**.002**	.084	**.006**	
	Stakeholder Affiliation	-.052	**.002**	-.050	**.005**	
	Dyadic Tie Strength			-.018	.084	.016
Belief in Science						
	Age	.016	.342	.016	.313	.077
	County	.027	.106	.028	.096	
	Education	.275	**.000**	.28	**.000**	
	Stakeholder Affiliation	.003	.455	.003	.470	
	Dyadic Tie Strength			-.005	.354	.077
Risk Likelihood Scale						
	Age	.014	.304	.014	.271	.020
	County	-.085	**.000**	-.079	**.000**	
	Education	.032	.149	.031	.141	
	Stakeholder Affiliation	-.092	**.000**	-.090	**.000**	
	Dyadic Tie Strength			-.026	**.034**	.021
Risk Acceptability Scale						
	Age	.028	.198	.028	.177	.024
	County	-.102	**.000**	-.097	**.000**	
	Education	.041	.128	.040	.128	
	Stakeholder Affiliation	-.085	**.001**	-.083	**.000**	
	Dyadic Tie Strength			-.023	.053	.024

Figure 1.1. Map of study area: northern Lake Huron in Michigan, U.S. and Ontario, Canada.



CHAPTER 2

STRUCTURE AND INFLUENCE OF A STAKEHOLDER NETWORK INVOLVED IN HUMAN-CORMORANT CONFLICT: IMPLICATIONS FOR RISK COMMUNICATION

Effective communication is often considered to be one of the biggest weaknesses of wildlife professionals and management agencies (e.g., Brunson, 1992; Decker et al., 2002; Lautenschlager & Bowyer, 1985; Shanahan, Decker, & Pelstring, 2001) even though it remains one of the most important dimensions of wildlife management. In contentious wildlife management scenarios, the stakes of effective communication are raised and the implications of deficiency magnified by the increased diversity of affected stakeholders and complexity of their interests. Ineffective communication can damage agency image and negatively impact relationships with the public (Decker et al., 2002). Understanding patterns of information and opinion sharing among and between stakeholder groups can help depict communication processes and outcomes to agency professionals, ultimately contributing to more meaningful methods of stakeholder engagement.

SNA is one method available to help identify and map interactions among diverse stakeholder groups (Bodin et al., 2006). The method has been used to characterize stakeholder interactions as a factor of successful collaboration in natural resources management (e.g., Lauber et al., 2008), and to identify actors for stakeholder engagement processes (e.g., Prell et al., 2008; 2009). Ultimately, SNA unveils how the arrangement of actors in a network can influence the degree to which information and other resources are exchanged and mobilized within the network. This insight would be highly useful for

communication about contentious wildlife management issues where risks to people and wildlife are present, such as HWCs. SNA may also help identify entry points for risk messages, maximize communication efforts, and predict how stakeholder groups may react to changes in management – all to the benefit of improved communication with stakeholders (Mueller et al., 2008). The extant literature is devoid of studies applying SNA concepts to HWCs with implications for risk communication.

Objectives

I analyzed the structure of the network of agency professionals (e.g., state, federal, provincial, or tribal fisheries and wildlife managers) and non-governmental stakeholders (e.g., anglers, birders, businesses) involved in HCC around northern Lake Huron. Specifically, my research objectives were to (a) describe the overall structure of the network, (b) document interactions between stakeholder groups, (c) locate and characterize well-positioned (i.e., influential) networks actors, and (d) identify cliques found within the network. I end the chapter with a discussion of the practical implications for risk communication efforts associated with HWC management.

NETWORK STRUCTURE & POSITIONAL MEASURES

Key measures of network structure include *density* and *centralization*. Position-related measures of individual actors include membership in *cliques* and three types of actor centrality (i.e., *degree*, *betweenness*, and *closeness*). Each of these concepts is defined below.

Network Structure

Density is a network measure representing the number of reported ties, expressed as a percentage of the maximum number of possible interactions among all network actors (Wasserman & Faust, 1994). Density scores range from 0 (i.e., 0%), which indicates a completely disconnected network (i.e., no ties exist among any of the actors), to 1 (i.e., 100%), which indicates a fully connected network (i.e., all actors are directly tied to one another). High density networks facilitate information exchange (Pretty & Ward, 2001) and diffusion of innovations (Abrahamson & Rosenkopf, 1997); however, they also have the potential of becoming too cohesive, which makes it difficult for new actors and information to permeate into the network (Redman & Kinzig, 2003). Although density is a commonly used measure of network structure (Marsden, 1990), its interpretation is limited because different sampling procedures and sample sizes produce different density values. For example, Mandarano (2009) identified a density of 95% for an information exchange network comprised of eight environmental organizations in New York and New Jersey. Prell et al. (2009) found a density of 2% for a network of 147 actors involved in management issues at Peak District National Park. Density tends to decrease with larger sample sizes and when the number of ties an actor can nominate is restricted (Scott, 2000). In this study of 113 actors, the highest density that could be obtained is approximately 9% (because I limited each actor to nominating a maximum of 10 other actors).

The concept of *centralization* is related to density, and is a better measurement of the overall cohesiveness of a network (Scott, 2000). Networks that are highly centralized (i.e., scores closer to 1, or 100%) have one, or few, actors holding the majority of ties in

the network. One advantage of highly centralized networks is that you only need to target a few actors to access the entire network; however, highly centralized networks are vulnerable to collapse when important actors exit the network (Prell et al., 2009). This is especially problematic for contentious natural resource issues, such as HWCs, that require long-term planning and stability of important actors.

Actor Attributes

Knowledge of the characteristics of individual network actors contextualizes relationships among different type of actors (e.g., agency professionals vs. non-governmental stakeholders, local vs. non-local actors, actors from different stakeholder groups), as well as identifies the most influential individuals within the network. One actor attribute that is useful to characterize is whether or not an actor is *local* or *non-local* (Lauber et al., 2008). Local actors live and/or work in communities engaged in HCCs. Local actors are generally non-governmental stakeholders, for example anglers, business owners, and commercial fishermen. Non-local stakeholders live and work outside of the communities engaged in HCCs, such as agency professionals or university-affiliated actors. Lauber et al. (2008), for example, found that local stakeholders were important for exchanging ideas and exerting influence within networks of local and non-local stakeholders involved in community-based management initiatives in New York.

Degree centrality refers to the number of actors an individual is directly tied to (Brass & Burkhardt, 1992). Actors with high degree centrality have many ties and are typically the most visible actors in a network (Knoke & Yang, 2008). For example, a local agency professional who is responsible for implementing management activities

(e.g., egg-oiling, lethal shooting) in the communities affected by HCCs may have high degree centrality, because he or she regularly interacts with both local non-governmental stakeholders and non-local agency professionals. As a result of their popularity, actors with high degree centrality usually have access to diverse resources and sources of information. According to Prell et al. (2009), actors with high degree centrality are important for assembling networks to take action; however, they will not always be able to influence those with whom they interact.

B*etweenness centrality* is another measure of actor centrality that describes how often an individual actor is positioned between two unconnected actors (Brass & Burkhardt, 1993). Individuals with high betweenness centrality function as information brokers. They can facilitate and control exchanges between less central actors (Scott, 2000). Brokers are often responsible for bringing new information into a network (Burt, 2003) and are viewed as important for long term planning as they have ties that reach beyond single communities (Bodin et al., 2006). An agency professional, for example, might interact with both anglers and animal-rights activists about HCCs even though the two groups do not interact. As a result, that agency professional can choose to share, or withhold, information received from one group with the other.

C*loseness centrality* refers to an actor's capacity to independently reach all other actors in the network (Freeman, 1979). Actors with high closeness centrality scores can interact easily with all network actors (Knoke & Yang, 2008). These individuals are also capable of quickly and efficiently disseminating information throughout a network (Rowley, 1997). An actor affiliated with a university, for example, might be able to share new information about cormorants easily because he or she is well-connected to a variety

of agency professionals and non-governmental stakeholders throughout northern Lake Huron.

Cliques are another network feature that describes groups of closely connected actors. Cliques are cohesive groups of three or more individuals who are directly connected to every other member of the clique. In other words, they can all reach each other in one step (Knoke & Yang, 2008; Haythornthwaite, 1996). Cliques may overlap as any individual actor may be a member of multiple cliques (Wasserman & Faust, 1994). Maximum clique size is limited by sampling restrictions. In this study, participants were asked to name up to 10 actors with whom they have talked to about cormorant management in the last calendar year; so the largest clique size in the network described herein is 11 members (i.e., the number of actors a person could nominate plus one). (Knoke & Yang, 2008; Wasserman & Faust, 1994). Clique membership has been used to study risk-related behaviors, such as smoking among adolescents (Ennett & Bauman, 1993).

METHODS & ANALYSIS

I created a 113 x 113 matrix with study participant names listed in the row and column headings (see Chapter 1 for a full overview of methods); the matrix represented 12,656 possible interactions between all of the actors. Values ranging from 0 (indicating no interaction between the two actors) to 365 (indicating daily interaction between two actors) were inserted into each of the matrix cells. The matrix was not symmetrized (unlike the matrix in Chapter 1) so that I could identify the direction of reported ties. I used UCINET 6 (Borgatti, Everett, & Freeman, 2002) to analyze the matrix, compute

network measures (i.e., density and centralization) and actor centrality scores, and to identify cliques. Actor centrality scores were entered into SPSS 17.0 (2008) to calculate mean scores. I used NetDraw (Borgatti, Everett, & Freeman, 2002) to create sociograms, or visual representations of the network.

RESULTS

Network Structure

Fifty-four percent (n = 61) of respondents were local actors; the remaining 46% (n = 52) were considered non-local. Respondents reported 700 ties out of 12,656 possible interactions between the 113 actors (network density = 5.53%).These interactions (Figure 2.1) accounted for 76% of all reported ties. Network centralization was 2.72%. The sociogram (Figure 2.2) displaying actors grouped according to their stakeholder affiliation illustrates that some stakeholder groups (e.g., federal, state, and provincial government, anglers, universities, and business interests) are more greatly represented and have more ties within the network than others; however, most of these ties are within and amongst these more represented groups. Table 2.1 displays a matrix of dichotomous interactions between stakeholder groups.

Actor Centrality Scores

Fifty-five percent of the top 20 (n = 11) degree centrality scores were held by agency professionals: 30% were state or provincial government actors and 25% (n = 5) were federal government actors. Other high degree centrality scores were held by anglers (20%, n = 4), universities (15%, n = 3), and business interests (10%, n = 2). The top 20

degree, betweenness, and closeness centrality scores are displayed for central network actors in Table 2.2.

Seventy percent (n = 14) of the top 20 betweenness centrality scores were held by agency professionals including state and provincial government (40%, n = 8), federal government (20%, n = 4), tribal interests (5%, n = 1), and former government (5%, n = 1). High betweenness centrality scores among non-governmental actors were held by universities (15%, n = 3), anglers (10%, n = 2), and business interests (5%, n = 1).

Sixty-five percent (n = 13) of the top 20 closeness centrality scores were held by agency professionals including state and provincial government (35%, n = 7), federal government (20%, n = 4), former government (5%, n = 1), and tribal interests (5%, n = 1). Other high closeness centrality scores were held by anglers (15%, n = 3), business interests (10%, n =2), universities (5%, n = 1), and other professionals (5%, n = 1).

Group Centrality Scores

Federal government actors held the highest degree (M = 446) and closeness centrality (M = 50) scores. Although both federal and state/provincial government actors had high betweenness centrality, former government actors (e.g., retired actors) demonstrated the greatest betweenness centrality (M = 434). Agency professionals had higher centrality scores than non-governmental stakeholders (Table 2.3). Universities, other non-governmental professionals, business interests, and anglers were the most central non-governmental stakeholder groups.

Cliques

There were many cliques (n = 140) among the 113 network actors. Approximately 79% (n = 89) of actors were members of at least one clique. Ten agency professionals were members of 10 or more cliques (max = 50); only three non-governmental stakeholders were members of 10 cliques. Fifty-one percent (n = 71) of the cliques contained three actors; 38% (n = 54) contained four actors; and 11% (n = 15) contained five actors. Agency professionals, on average, were members of more cliques than non-governmental stakeholders (Table 2.3); however, the majority of the cliques (61%, n = 85) consisted of both agency professionals and non-governmental stakeholders; 31% (n = 44) consisted of only agency professionals; and 8% (n = 11) consisted of only non-governmental stakeholders.

DISCUSSION

The underlying social structure of agency professionals and non-governmental stakeholders engaged in HCCs around northern Lake Huron is dynamic and intricate. Network density and centralization were both relatively low indicating that: (a) new actors can readily enter the network (at least peripherally); (b) new information and resources can be easily exchanged; and (c) there are numerous actors who hold central, or influential, positions within the network. Thus, the structure of the network is fairly resilient to minor changes (e.g., actors entering or exiting the network) – a useful trait for networks involved in long-term management issues, like cormorant management.

Federal, state, and provincial government agencies, anglers, business interests, and universities were the most represented stakeholder groups in the network. These

groups held the majority of positions and ties within the network, tended to belong to more cliques, and typically had higher centrality scores. Conversely, animal rights, aquaculture, policy, and bird interests were the least represented stakeholder groups. Actors from these latter groups held fewer positions and ties within the network, tended to belong to fewer cliques, and were generally less central in the network. According to Prell et al. (2009), these less central stakeholder groups "represent areas of the network where more tie-formation can be encouraged through inclusive dialogue" (p. 513). Stakeholder engagement processes could deliberately target these underrepresented groups.

Social networks serve as vital channels for information about cormorant-related risks for both agency professionals and non-governmental stakeholders. Agency professionals in the network, however, seem to serve as sources of cormorant-related information (rather than seekers of cormorant-related information). This is evidenced by the number of directional ties leading to agency professionals from non-governmental stakeholders (rather than vice versa). In the future, agency professionals may want to reciprocate more ties with non-governmental stakeholders (i.e., engage in more two-way communication).

Because risk communication efforts may be most successful if messages are tailored to specific stakeholder groups and disseminated through the primary communication channels these stakeholders use (Decker et al., 2002), agency professionals could consider using existing networks as a source for disseminating risk messages (Lundgren & McMakin, 2009). HWC-related networks span geographic and political boundaries, as well as connect divergent stakeholder groups; consideration of

social networks while designing communication programs may provide managers with new tools to address wildlife-related risk perceptions. Testing the efficacy of social networks as a source of information for wildlife-related risks would compliment existing work evaluating the impact of other materials (e.g., brochures, magnets) commonly used by wildlife professionals (Gore, Knuth, Scherer, & Curtis, 2008).

Defining network structure has two primary management implications (Haythornthwaite, 1996). First, managers may strategically integrate themselves into central network positions by identifying central actors and groups with whom they would need to establish relationships. This approach may be challenging, yet desirable for (a) agency professionals who are new to HCC-related networks and who want to integrate themselves into the network, or (b) existing agency professionals who find themselves isolated from HCC-related networks and/or desire a leadership position in the network. In both instances, agency professionals can actively seek out highly central non-governmental stakeholders in effort to foster new relationships, garner stakeholder trust in cormorant management, and improve the agency's image (Decker et al., 2002). They can also be aware that their central location in a network will carry certain responsibilities (e.g., addressing stakeholder questions and concerns about cormorants and management).

Second, wildlife professionals may rely on existing central actors (rather than trying to foster new relationships or create new actor positions) as entry points for disseminating risk information (Haythornthwaite, 1996). In the HCC-network, this might mean relying on local agency professionals (i.e., those who are already based in the communities where HWCs occur) to initiate and disseminate risk communication efforts rather than non-local agency professionals – even if they are higher in the chain of

command. Resultant cost and time savings could boost agency efficiency. Comparing this approach to more traditional, targeted interventions such as mass informational campaigns which are not guaranteed to reach their intended audience adds value to the network approach (Lundgren & McMakin, 2009).

This latter approach (e.g., relying on existing actors) seems most appropriate within the context of cormorant management around northern Lake Huron. Agency professionals (both local and non-local) are already well-positioned in central roles in the network; however, central actors identified through SNA may or may not be aware of their power and influence. This is one reason why it is essential that these actors are aware of their role in the network and are also able to effectively communicate about cormorant-related risks. Additional consideration should be given to the cormorant-related risk perceptions of central actors. Thinking specifically about those individual's perceptions may predict the type of frame those individuals use when spreading cormorant-related information throughout the network. Future research should evaluate the effectiveness (i.e., speed of message diffusion, accurateness of information over time) of using social networks for disseminating risk information about HWCs.

Actor centrality scores indicated which influential agency professionals and non-governmental stakeholders are best positioned to disseminate risk information and cultivate new, external relationships. If the objective of the risk communication intervention is to reach disconnected stakeholder groups (e.g., bird and policy interests in the network presented herein) managers should consider selecting actors with high betweeness centrality scores (e.g., actors 0005, 0007, 0031, 0048, and 0001), because of their ability to serve as information brokers (e.g., Prell et al., 2008). In situations of crisis

(e.g., cormorants are found to transmit Newcastle disease to poultry), however, individuals with high closeness centrality scores (e.g., actors 0005, 0007, and 0001) may be particularly vital for quickly diffusing information throughout the network (Lundgren & McMakin, 2009). Actors who hold high scores across all three centrality measures (e.g., actors 0001, 0005, 0007, and 0042) may be able to accomplish multiple tasks simultaneously (i.e., reaching a larger proportion of network actors, while also branching unconnected stakeholder groups, and quickly diffusing information throughout the network).

HCCs have been occurring in northern Lake Huron and throughout the Great Lakes Basin for decades. In the 1970s, cormorants were portrayed as victims of human-cormorant interactions; whereas today, cormorants are perceived as perpetrators of environmental, recreational, and economic risks (Muter et al., 2009). Given the dynamic nature of cormorant management and social networks in general, actors with high betweenness centrality may play essential roles in long-term planning and sustainability of future HCC management.

The overall structure of a network may change whenever established actors leave or whenever new actors enter a network (Wasserman & Faust, 1994). Defining the structure of networks of long-term issues, like cormorant management, may be useful to predict and respond to changes in overall structure, especially when central actors leave a network (e.g., retire). As actors phase themselves out of a network (whether immediately or gradually), the connecting ties they hold will eventually break down. Agency professionals may want to attempt to restore those connections or attempt to develop connections with those groups before they dissolve and become unconnected.

One last unanswered question relates to the extent in which influential network actors are *central* because of their occupation and related responsibilities. In other words, are agency professionals central network actors simply because they are tasked with managing HCCs? Are job titles better predictors of centrality than individual personality traits? Research is needed to assess characteristics of both agency professionals and non-governmental actors with varying degrees of centrality to address this question.

REFERENCES

Abrahamson, E. & Rosenkopf, L. (1997). Social network effects on the extent of innovation diffusion: A computer simulation. *Organization Science*, 8, 289–309.

Bodin, O., Crona, B., & Ernstson, H. (2006). Social networks in natural resource management: What is there to learn from a structural perspective? *Ecology & Society, 11*(2), r2. Retrieved October 14, 2009 from http://www.ecology andsociety.org/vol11/iss2/resp2/

Borgatti, S. P., Everett, M.G. and Freeman, L.C. (2002). Ucinet for Windows: Software for Social Network Analysis. Harvard, MA: Analytic Technologies.

Brass, D. J., & Burkhardt, M. E. (1992). Centrality and power in organizations. In N. Nohria, & R. Eccles (Eds.), *Networks and Organizations: Structure, Form, and Action* (pp. 191–215), Boston, MA: Harvard Business School Press.

Brunson, M. (1992). Professional bias, public perspectives, and communication pitfalls for natural resource managers. *Rangelands, 14*(5), 292–295.

Burt, R. (2001). Structural holes versus network closure as social capital. In K. C. N. Lin & R. Burt (Eds.), *Social Capital: Theory & Research* (pp. 31–56). New York: Aldine de Gruyter.

Decker, D. J., Lauber, T. B., & Siemer, W. F. (2002). *Human-wildlife conflict management: A practitioner's guide.* Ithaca, NY: Northeast Wildlife Damage Management Research and Outreach Cooperative.

Ennett, S. T., & Bauman, K. E. (1993). Peer group structure and adolescent cigarette smoking: A social network analysis. *Journal of Health and Social Behavior, 34,* 226–236.

Freeman, L. C. (1979). Centrality in social networks conceptual clarification. *Social Networks, 1*, 215–239.

Gore, M. L., Knuth, B. A., Scherer, C. W., & Curtis, P. D. (2008). Evaluating a conservation investment designed to reduce human-wildlife conflict. *Conservation Letters, 1,* 136–145.

Haythornthwaite, C. (1996). Social network analysis: An approach and technique for the study of information exchange, *Library & Information Science Research, 18,* 323–342.

Knoke, D. & Yang, S. (2008). Social network analysis (2nd ed.). Thousand Oaks, CA: Sage.

Lauber, T. B., Decker, D. J., & Knuth, B.A. (2008). Social networks and community-based natural resource management. *Environmental Management, 42,* 677–687.

Lautenschlager, R. A., & Bowyer, R. T. (1985). Wildlife management by referendum: When professionals fail to communicate. *Wildlife Society Bulletin, 13,* 564–570.

Lundgren, R. E. & McMakin, A. (2009). *Risk communication: A handbook for communicating environmental, safety, and health risks.* (4th ed.). Hoboken, NJ: John Wiley & Sons.

Mandarano, L. A. (2009). Social network analysis of social capital in collaborative planning. *Society and Natural Resources, 22,* 245–260.

Marsden, P. V. (1990). Network data and measurement. *Annu. Rev. Sociol., 16,* 453–463.

Mueller, K. B., Taylor, W. W., Frank, K. A., Robertson, J. M., & Grinold, D. L. (2008). Social networks and fisheries: the relationship between a charter fishing network, social capital, and catch dynamics. *North American Journal of Fisheries Management, 28,* 447–462.

Muter, B. A., Gore, M. L., & Riley, S. J. (2009). From victim to perpetrator: Evolution of risk frames related to human-cormorant conflict in the Great Lakes. *Human Dimensions of Wildlife, 14,* 366–379.

Prell, C., Hubacek, K., & Reed, M. (2009). Stakeholder analysis and social network analysis in natural resources management. *Society & Natural Resources, 22,* 501–518.

Prell, C., Hubacek, K., Quinn, C., & Reed, M. (2008). Who's in the network? When stakeholders influence data analysis. *Syst Pract Action Res., 21,* 443–458.

Pretty, J., & Ward, H. (2001). Social capital and the environment. *World Development, 29,* 209–227.

Redman, C. L., & Kinzig, A. P. (2003). Resilience of past landscapes: resilience theory, society, and the longue duree. *Conservation Ecology, 7*(1), 14. Retrieved October 14, 2009 from http://www.ecologyandsociety.org/vol7/iss1/art14/

Rowley, T. J. (1997). Moving beyond dyadic ties: A network theory of stakeholder influences. *Academy of Management Review, 22,* 887–910.

Scott, J. (2000). Social network analysis: A handbook. (2nd ed.). Thousand Oaks, CA: Sage.

Shanahan, J. E., Decker, D. J., & Pelstring, L. M. (2001). Communication for effective wildlife management. In D. J. Decker, T. L. Brown, & W. F. Siemer (Eds.), *Human dimensions of wildlife management in North America* (pp. 171–190). Bethesda, MD: The Wildlife Society.

SPSS Inc. (2008). SPSS Statistics GradPack 17.0. [Computer software]. Chicago, IL: SPSS Inc.

Wasserman, S., & Faust, K. (1994). Social network analysis: methods and applications. Cambridge, UK: Cambridge University Press.

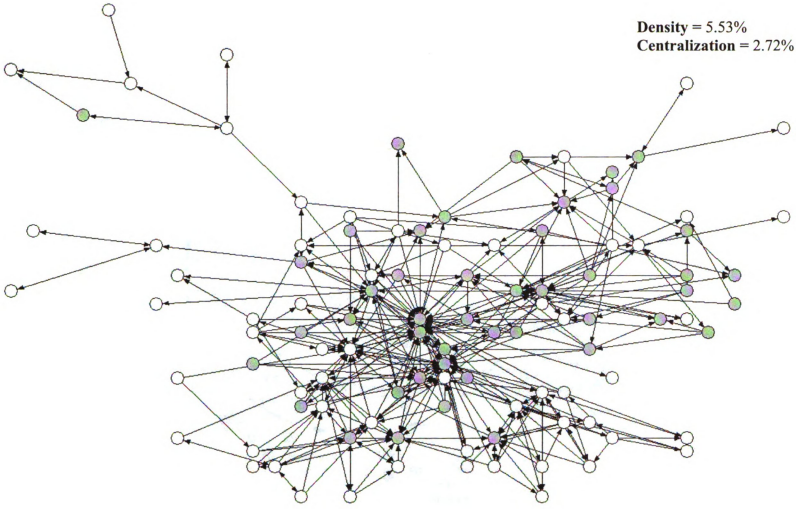


Figure 2.1. Sociogram showing directional ties of agency professionals (n = 47, represented by gray nodes) and non-governmental network actors (n = 66, represented by white nodes) engaged in human-cormorant conflict around northern Lake Huron, August 2008–August 2009.

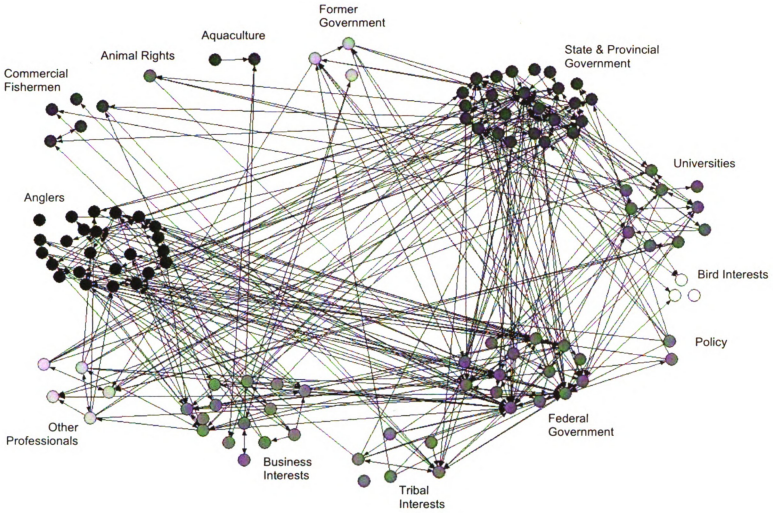


Figure 2.2. Sociogram of 113 network actors engaged in human-cormorant conflict around northern Lake Huron (August 2008–August 2009) and grouped according to their stakeholder affiliation.

Table 2.1. Matrix of interactions between agency professional and non-governmental stakeholder groups engaged in human-cormorant conflict around northern Lake Huron, August 2008–August 2009. An "X" placed in a cell indicates there are ties among actors between the two groups.

	anglers	animal rights	aquaculture	bird interests	business interests	commercial fisherman	federal government	former government	other professionals	policy	state/provincial gov	tribal interests	university
anglers	X	-	-	-	X	-	X	-	-	X	X	-	-
animal rights	-	-	-	-	-	-	X	-	-	-	X	-	X
aquaculture	-	-	X	-	X	-	-	-	-	-	-	-	-
bird interests	-	-	-	-	-	-	-	-	-	-	X	-	-
business interests	X	-	X	-	X	X	X	X	X	-	X	-	-
commercial fishermen	-	-	-	-	X	X	-	-	-	-	X	X	X
federal government	X	X	-	X	X	-	X	X	X	X	X	X	X
former government	-	-	-	-	X	-	X	X	X	-	X	X	-
other professionals	-	X	-	-	X	-	X	X	X	-	X	-	X
policy	X	-	-	-	-	-	X	-	-	-	X	-	-
state/provincial gov	X	X	-	X	X	X	X	X	X	X	X	X	X
tribal interests	X	-	-	-	-	X	X	X	-	-	X	X	X
university	-	X	-	-	-	X	X	-	X	-	X	X	X

Table 2.2. Top 20 degree, betweenness, and closeness centrality scores identified for actors in a network of agency professionals and non-governmental stakeholders involved in human-cormorant conflict around northern Lake Huron, August 2008–August 2009.

ID	Stakeholder Affiliation	Local or Non-Local	Degree Centrality	Betweenness Centrality	Closeness Centrality
0008	angler	local	-	755	54
0020	angler	local	1014	479	52
0032	angler	local	806	-	-
0033	angler	local	949	356	51
0037	angler	local	-	-	51
0040	angler	local	620	-	-
0089	angler	local	502	-	-
0041	business interests	local	540	-	51
0069	business interests	local	462	393	52
0001	federal gov	non-local	673	1133	63
0007	federal gov	local	1183	1420	67
0012	federal gov	local	1339	-	-
0031	federal gov	non-local	-	1196	56
0038	federal gov	local	719	518	-
0045	federal gov	local	1086	-	52
0048	former gov	non-local	-	1175	51
0070	other professionals	local	-	-	50
0002	state/provincial gov	non-local	-	934	56
0003	state/provincial gov	non-local	-	519	-
0005	state/provincial gov	local	701	2761	71
0009	state/provincial gov	local	-	-	54
0022	state/provincial gov	non-local	-	542	52
0042	state/provincial gov	local	907	772	59
0057	state/provincial gov	non-local	-	450	50
0074	state/provincial gov	non-local	511	-	-
0075	state/provincial gov	non-local	-	439	-
0088	state/provincial gov	non-local	530	-	-
0120	state/provincial gov	non-local	459	-	-
0018	tribal interests	local	-	893	55
0030	university	non-local	463	362	52
0056	university	non-local	455	392	-
0058	university	non-local	-	573	-
0116	university	local	453	-	-

Table 2.3. Average degree, betweenness, and closeness centrality scores and clique membership for each stakeholder group involved in human-cormorant conflict around northern Lake Huron, August 2008 – August 2009.

Stakeholder Affiliation	*n*	Degree Centrality	Betweenness Centrality	Closeness Centrality	Clique Membership
anglers	25	242	83	36	2.6
animal rights	1	9	95	39	3.0
aquaculture	2	70	1	24	0.0
bird interests	3	17	0	26	0.7
business interests	13	222	94	39	2.9
commercial fishermen	5	197	88	35	0.2
federal government	24	446	348	50	10.5
former government	3	267	434	42	4.0
other professionals	5	317	35	46	4.6
policy	2	70	0	47	3.0
state/provincial gov	14	246	301	46	6.5
tribal interests	6	54	175	39	2.7
university	10	271	167	45	3.5

CHAPTER 3

Muter, B. A., Gore, M. L., & Riley, S. J. (2009). From Victim to Perpetrator: Evolution of Risk Frames Related to Human-Cormorant Conflict in the Great Lakes. *Human Dimensions of Wildlife, 5,* 366–379.

CHAPTER 3

From Victim to Perpetrator: Evolution of Risk Frames Related to Human–Cormorant Conflict in the Great Lakes

To better understand media coverage and perceptions of risk associated with human–cormorant conflicts, we adapted the notions of "victim" and "perpetrator" to the context of cormorant-related risks and applied them as risk frames in a content analysis. We characterized stories about cormorants in 140 U.S. and Canadian newspaper articles published between 1978 and 2007 to document how coverage has changed through time. The total number of stakeholder groups and risks perpetrated by cormorants identified in coverage increased over our study period, shifting the predominant risk frame applied to cormorants from victim to perpetrator. We discuss the implications of this shift and the use of risk frames in content analyses to inform risk communication.

Keywords: double-crested cormorant, framing, human–wildlife conflict, media content analysis, risk perception

INTRODUCTION

Conflicts linking humans and wildlife are increasing in frequency and intensity worldwide (Conover, 2002). Human–wildlife conflict (HWC) occurs when the actions of either humans or wildlife cause, or are perceived to cause, negative effects on the other. Concern over HWCs is rooted in public perceptions of risk to wildlife and their respective habitat, as well as risks from exposure to wildlife (Decker, Lauber, & Siemer, 2002). Wildlife pose risks to human health and safety (e.g., zoonotic diseases, wildlife

attacks, wildlife–vehicle collisions), personal property, agriculture (e.g., livestock loss due to depredation), aesthetics (e.g., goose droppings on golf courses), and other species of wildlife that humans value (Conover, 2002). Perceptions of these risks shape public attitudes, beliefs, and support for wildlife management activities (Knuth, Stout, Siemer, Decker, & Stedman, 1992), influence wildlife-stakeholder acceptance capacity (Riley & Decker, 2000), affect trust in agencies and managers (Kasperson, Jhaveri, & Kasperson, 2001), and stimulate stakeholder action (Decker et al., 2002).

Many HWCs attract the attention of mass media (Corbett, 1995) because they feature recognizable personalities, polarized perspectives, and have local significance (Price & Tewksbury, 1997). Media often highlight low-incidence, high-consequence events such as wildlife-related human fatalities, and contentious issues like suburban deer management and spotted owl conservation. Media coverage can influence and be influenced by stakeholders' risk perceptions (Gans, 2004); however, the relationship is ill-defined within a HWC context. Clarifying the association between risk perception and media coverage of HWCs may aid wildlife managers in refining outreach interventions, reducing conflict among stakeholders, and more effectively engaging stakeholders in discussions about management (Pelstring, Shanahan, & Perry, 1997). A longitudinal examination of media coverage may provide insight into how and why management of a wildlife species does or does not evolve into a contentious issue.

One species that has received considerable media attention in the Great Lakes Basin is the double-crested cormorant (*Phalacrocorax auritus*). These piscivorous, colonial-nesting waterbirds were virtually extirpated in the Basin by the 1970s due to widespread use of dichloro-diphenyl-trichloroethane (DDT), polychlorinated biphenyls

(PCBs), and other contaminants (Weseloh & Collier, 1995; Weseloh, Pekarik, Havelka, Barrett, & Reid, 2002). News coverage during the 1970s used cormorants as an example of the many avian victims to commercial pesticides. Federal reductions in the use of DDT (i.e., the U.S. Environmental Protection Agency banned commercial use in 1972), and protection afforded by the Migratory Bird Treaty Act of 1918 helped cormorant numbers rebound dramatically. Between 1970 and 1991, the population increased from 89 to 38,000 nesting pairs in the Basin (Weseloh et al., 2002). This exponential increase continued throughout the 1990s and was accompanied by growing public concern about the ecological and economic impacts perpetrated by the birds (Taylor & Dorr, 2003), including the potential risks cormorants posed to recreational fisheries, island vegetation, and other colonial-nesting waterbirds. By 2002, approximately 115,000 breeding pairs of cormorants visited the Basin during migration (Weseloh et al., 2002). Concerns about cormorants and their associated risks in the Basin have influenced federal policies and management decisions (USFWS, 2003).

Cormorants are perceived as overabundant by many stakeholders and appear to have exceeded wildlife-stakeholder acceptance capacity of several stakeholder groups (e.g., anglers, fish farmers) throughout their range (Taylor & Dorr, 2003). For other groups (e.g., bird advocates, animal rights activists), however, the recent population expansion signifies a natural outcome of restoration of Basin ecosystems (Wires & Cuthbert, 2006). Despite more than a decade of management actions to address human–cormorant conflict in the Basin (e.g., hazing, egg-oiling, and lethal shooting activities), debate persists about management, and stories on cormorants still frequent the media. To

this end, we examined 30 years of media coverage about cormorants in the Basin to better understand the media's role in changing risk perceptions.

CONCEPTUAL BACKGROUND & HYPOTHESES

Media, Framing, and Risk

Frames and framing are vague mass communication concepts and are often applied in different situations to mean different things (Scheufele, 1999). Framing effects research has generally focused on how information is presented, the medium employed (e.g., print media), and how that information is interpreted by various publics. Frames highlight certain pieces of information over others in an attempt to make those pieces more conspicuous, memorable, or significant (Entman, 1993). Individuals use frames to organize, focus, and interpret their perceptions (Elliott, 2003). Frames may be influenced not only by how information is communicated, but also by the personal traits of the individual making a decision (Tversky & Kahneman, 1981). Frames help people define problems, make moral judgments about those problems, and offer potential solutions (Entman, 1993; Iyengar, 1991).

The way mass media portray the environment helps the audience interpret environmental issues and shape opinions about those issues (Jensen, 2003). Media frames also function at a sociocultural level and are capable of influencing the publics' emotional responses toward the environment (Cottle, 1993). Journalists and editors use photos, illustrations, attention-grabbing headlines, and text to communicate risks and help frame their stories. Placement and repetition of keywords, phrases, and imagery can make certain information salient (Entman, 1993). Frames of storylines in the mass media may

be influenced by the political orientation of the news medium, and by external politicians, scientists, interest groups, or vocal stakeholders who are interviewed by journalists when forming a news story (Gans, 2004). Media framing can influence readers or viewers by telling them what to think about an issue, a process known as agenda setting, or how to think about an issue (Wimmer & Dominick, 2003).

Framing influences beliefs about how wildlife-related issues should be addressed and resolved (Siemer, Decker, & Shanahan, 2007) and can provide important historical insight into management (Decker, Brown, & Siemer, 2001). Wolch, Gullo, and Lassiter (1997), for example, investigated the *Los Angeles Times'* portrayal of mountain lions between 1985 and 1995 and found that coverage became increasingly negative in the 1990s, which they attributed to escalating human–mountain lion conflicts throughout California. Jensen (2003) acknowledged that everyday communications about social issues (e.g., increasing frequency of HWCs) among publics are likely shaped by storylines presented in the mass media, and those communications can reciprocally influence the evolution of storylines in the media. Similar longitudinal studies on effects of framing can be useful in identifying changing frames in news coverage over the lifespan of an issue (Chyi & McCombs, 2004). Frame changes may be influenced by available information on potential risks and negative events that increase risk (Marks, Kalaitzandonakes, Wilkins, & Zakharova, 2007).

Risk Frames

Risk frames are powerful predictors of public risk perception (Elliott, 2003). Individuals

frame risks according to cognitive or affective characteristics of the risk, or some combination of both (Marks et al., 2007). Unlike cognitive risk perception, which is an individual's assessment, or perceived probability, of a risk (Renn, 1998), affective risk perception relies heavily on intuitive feelings or reactions to a risk (Sjoberg, 1998). Affective risk perception is influenced by feelings of goodness or badness attached to a particular stimulus (Slovic & Peters, 2006). Reporters use both cognitive and affective elements when framing news stories. Media coverage also contributes to public awareness of risks and victimization (Best, 1997). Because most news stories are episodic (i.e., case-study oriented) in nature, coverage generally assigns responsibility to individual victims or perpetrators, rather than to society (Iyengar, 1991). The media can also identify which victims deserve sympathy and which do not (Best, 1997; Ryan, 2002).

The terms "victim" and "perpetrator" are applied to diverse disciplines and offenses, from domestic abuse (e.g., Gortner, Gollan, & Jacobson, 1997) to wildlife poaching (e.g., Lorenzini, 2005). A victim typically is defined as an entity that receives some sort of harm or negative effect, while a perpetrator is described as an entity that inflicts harm or a negative effect (Young, 2007). Renn (1998) and Best (1997) similarly noted that victims are usually typified as innocent and unsuspecting, and typically exposed to risk involuntarily. Claims about victims often fit a template for news coverage of social issues because they (a) can be characterized in dramatic terms, (b) help to build connections between the reader and the victim, and (c) offer hope that some management intervention will occur (Best, 1997). Environmental criminology applies several analytical frameworks based on whom or what plays the role of the victim— humans,

animals, or the environment (White, 2008). In this literature, however, the perpetrator of interest is always human—individuals, corporations, or governments—causing environmental harm or risk (e.g., pollution, poaching).

The concepts of victims and perpetrators may be extended to HWCs, especially when risk is involved. The role of perpetrator may be extended to wildlife when they are perceived, or portrayed, as a source of risk. Wildlife may also be victims when they are perceived, or portrayed, as the recipient of risk or harm. Understanding the risk frames applied to cormorants and how those frames have evolved over the last three decades may help wildlife professionals gain a better understanding of wildlife-related risk perceptions and may have practical implications for how managers respond to media coverage about cormorants (Gore, Siemer, Shanahan, Schuefele, & Decker, 2005).

Hypotheses

Our study sought to evaluate the risk-related content of news coverage about cormorants and their management in the Basin over the last three decades (1978–2007). Our research objectives were to (a) characterize the context of the coverage, (b) document how coverage has evolved over the past 30 years, and (c) evaluate the risk frame (i.e., victim, perpetrator, or neutral) applied to cormorants by the print media. Based on our literature review, we developed the following hypotheses about cormorant-related news coverage:

H_1. The predominant risk frame assigned to cormorants has evolved from victim to perpetrator over our study period.

H_2. Perpetrator coverage will be positively associated with the number of identified

stakeholder groups (per article).

H_3. The total number of identified stakeholder groups (per article) will increase over our study period.

H_4. The total number of identified risks to cormorants (per article) will decrease over our study period.

H_5. The total number of identified risks from cormorants (per article) will increase over our study period.

METHODS

Sampling Frame

In January 2008, we conducted a content analysis of U.S. and Canadian newspaper coverage reporting on cormorants in the Basin. We searched Lexis-Nexis, an online periodical database, for all articles printed between 1978 and 2007 using the key words: "cormorant(s)," "double-crested cormorant(s)," and "Great Lake(s)." Articles did not have to focus primarily on cormorants to be included in our population. We included articles that discussed cormorants in a variety of contexts (e.g., angling, bird-watching, avian diseases, pollution) to better understand risk frame evolution. Articles that did not pertain to double-crested cormorants in the Basin were not included in the population. We also excluded congressional testimonies and transcripts that appeared in federal news services. We found 108 articles suitable for analysis.

We also sampled Newsbank with the key word "cormorant(s)" to search 20 (all available) Michigan newspapers for articles printed between 2005 and 2007. This non-traditional approach was used because our Lexis-Nexis search did not identify any

articles from Michigan newspapers. This was problematic as Michigan has more breeding pairs of cormorants than any other state along the U.S. side of the Great Lakes (Wires, Cuthbert, Trexel, & Joshi, 2001). Other geographic regions in the Basin experiencing human–cormorant conflict (e.g., eastern New York) were represented by articles generated with our Lexis-Nexis search. We used a random number generator to sample articles (n = 32) from Newsbank.

Coding Protocol

Articles were coded based on our study objectives. Training sessions were conducted until percent agreement among coders was over 90% for most variables. Two individuals coded all articles. Coders examined each article for identifying characteristics (e.g., date of publication, origin of news source, section in which the article appeared) and identified the predominant risk frame (i.e., victim, perpetrator, or neutral) applied to cormorants.

Coders also reported the presence/absence of 37 variables organized into four content categories: (a) stakeholder groups (Table 1), (b) risks to cormorants (Table 2), (c) risks from cormorants (Table 3), and (d) attributions of responsibility (Table 4). The phrase "attribution of responsibility" was used to mean that an article made one or more statements indicating some individual or group (e.g., a wildlife management agency) was, or should be, taking action to reduce risks associated with human–cormorant conflict.

Risk Frames

Cormorants were coded as victims when a news story presented them as receiving some negative effect or risk, for example, from commercial contaminants (e.g., DDT), diseases

(e.g., avian botulism), poaching, or management actions (e.g., when cormorants were presented as a scapegoat for other Great Lakes issues). Cormorants were coded as perpetrators when a news story presented them as a source of some negative effect or risk, for example, to the environment (e.g., destruction of vegetation), economy (e.g., loss in tourism dollars in fishing communities), or recreation (e.g., declines in angler success). Some articles presented both victim and perpetrator-oriented risk frames. We adapted the protocol from Siemer et al. (2007) to determine an overall risk frame for each article. We labeled the predominant frame for each paragraph and summed paragraph assignments. If one risk frame occurred in two or more paragraphs more than another risk frame, the article was coded the predominant frame. If neither frame was used, or if there was an equal number of perpetrator- and victim-oriented paragraphs (i.e., or within one paragraph on either side), the story was coded as neutral.

Intercoder Reliability

Cohen's kappa (Cohen 1960; 1968) was used to assess intercoder reliability. Kappa is commonly used to adjust for chance and is appropriate for two coders when categories are exhaustive and mutually exclusive (Capozzoli, McSweeney, & Sinha, 1999). Kappa values were computed for each variable across all 140 articles. A kappa of 0.7 or greater is generally acceptable for exploratory research and represents a strong level of agreement above chance (Lombard, Snyder-Dutch, & Bracken, 2002). We dropped all variables with a kappa < 0.7 from our analysis.

Data Analysis

We used multinomial logistic regression analyses to predict risk frames (i.e., victim, perpetrator, neutral) with two single-predictor models (i.e., article date to test H_1, and total number of stakeholders to test H_2). The perpetrator frame served as our reference, or baseline, category; neutral and victim frames were treated as comparison categories. Wald Chi-Square tests were used to test our hypotheses that regression coefficients for the neutral and victim frames relative to the perpetrator frame would be less than zero. Odds ratios for the coefficients indicated the direction of association. We visually represented the risk frame evolution using predicted probability over time (Figure 1).

We computed the total number of (a) stakeholder groups, (b) risks to cormorants, and (c) risks from cormorants, for each article by summing the number of present variables for each respective content category. These computed variables served as dependent variables in linear regression analyses (i.e., article date was the independent variable) to test H_3, H_4, and H_5. Logistic regression was used to describe associations of dichotomous variables (i.e., presence/absence of individual risks and stakeholder groups) with article date (i.e., through time).

RESULTS

We analyzed 140 articles. More than half (n = 79, 56%) were from six Canadian newspapers: *Toronto Star* (n = 28, 20%), *Globe and Mail* (n = 25, 18%), *Gazette* (n = 9, 6%), *Toronto Sun* (n = 7, 5%), *National Post* (n = 5, 4%), and the *Ottawa Citizen* (n = 5, 4%). The most prevalent of the 20 U.S. newspapers (11 of which were Michigan publications) included *New York Times* (n = 15, 11%), *Bay City Times* (n = 8, 6%),

Grand Rapids Press (n = 6, 4%), and the *Flint Journal* (n = 5, 4%). Fifty-one percent (n = 71) of the articles discussed cormorants in < one paragraph, 9% (n = 13) in two to four paragraphs, and 40% (n = 56) in > five paragraphs.

Risk Frames

We have evidence in support of H_1 (i.e., that the predominant frame changed from victim to perpetrator over our study period). Wald Chi-Square tests of the coefficients for the neutral (χ^2 (2, n = 140) = 8.76, p < .010) and victim frames (χ^2 (2, n = 140) = 16.66, p < .001) relative to the perpetrator frame were both significantly less than zero. Odds ratios for the coefficients (OR = 0.90, p < .010, for the neutral frame and OR = 0.86, p < .001, for the victim frame) demonstrate that the neutral and victim frames became less likely over our study period, while the perpetrator frame became more likely over time (Figure 1).

The data supported H_2 (i.e., that perpetrator coverage was positively associated with the total number of identified stakeholder groups). Wald Chi-Square tests of the coefficients for the neutral (χ^2 (2, n = 140) = 21.25, p < .001) and victim frames (χ^2 = 15.16, p < .001) relative to the perpetrator frame were significantly less than zero. Odds ratios for the coefficients (OR = 0.55, p < .001, for the neutral frame and OR = 0.64, p < .001, for the victim frame) show that the neutral and victim frames became less likely as the total number of identified stakeholder groups increased, while the perpetrator frame became more likely with an increasing number of stakeholder groups.

Stakeholder Groups

The total number of stakeholder groups identified (per article) increased over our study period ($r = .30, p < .001$) providing support for H_3. Articles reported up to 9 (of 15 possible) stakeholder groups ($M = 3.4$). State and provincial government agencies, recreational anglers, and federal government agencies were each mentioned in >50% of the articles (Table 1). Odds ratios indicated positive associations between article date and an article's inclusion of anglers (OR = 1.11, $p < .001$), nongovernmental organizations in support of cormorant management (OR = 1.09, $p = .030$), state or provincial government agencies (OR = 1.09, $p = .002$), and legislators (OR = 1.12, $p = .003$) (Table 1). In other words, the more recent an article was published, the more likely it was for these stakeholder groups to be identified. Only nongovernmental organizations speaking out against cormorant management (OR = 0.17, $p < .001$) declined significantly over time.

Cormorant-Related Risks

The total number of risks to cormorants identified (per article) did not change significantly over our study period ($r = .14, p > .05$); indicating that H_4 was not supported. The majority of articles ($n = 71$, 51%) identified one or more (of eight possible) risks to cormorants; 31% identified one risk, 16% identified two risks, and 4% identified three risks ($M = 0.75$). DDT ($n = 34$, 24%) and management action, when cormorants were portrayed as being wrongfully managed ($n = 22$, 16%), were the most commonly cited risks to cormorants (Table 2). We found a negative association between article date and an article's noting of cormorant deformities (OR = 0.85, $p < .001$) (Table 2).

The total number of risks from cormorants identified (per article) increased over time ($r = .27, p < .001$), providing evidence for H_5. Approximately half of the articles ($n = 72$, 51%) identified one or more (of nine possible) risks from cormorants; 7% identified one risk, 15% identified two risks, 8% identified three risks, and 21% identified between four and eight risks ($M = 1.7$). The most commonly identified risks from cormorants were risks to fish populations ($n = 61$, 44%) and recreational fishing ($n = 59$, 42%) (Table 3). The more recent an article was published, the more likely it was to have mentioned the risks cormorants pose to fish populations (OR = 1.09, $p = .003$), recreational fishing (OR = 1.10, $p < .001$), and tourism (OR = 1.18, $p = .028$) (Table 3). Over time, articles were also more likely to note negative psychological effects (OR = 1.08, $p = .021$) associated with human–cormorant conflict (e.g., worry, fear).

Attributions of Responsibility

The majority of articles ($n = 88$, 63%) attributed responsibility to one or more stakeholder groups; 34% ($n = 48$) attributed responsibility to one group; 26% ($n = 36$) attributed responsibility to two groups; 2% ($n = 3$) attributed responsibility to three groups; and <1% ($n = 1$) attributed responsibility to four groups ($M = 0.95$). Only 4% ($n = 6$) of the articles analyzed suggested that citizens were responsible for resolving negative interactions with cormorants in the Basin. Thirty-six percent ($n = 51$) of articles attributed responsibility to a state or provincial agency for managing human–cormorant conflict, 30% ($n = 42$) to a federal agency, and 16% ($n = 22$) to legislators (Table 4). Article date and attribution of responsibility to state or provincial government agencies (OR = 1.08, $p = .012$) and legislators (OR = 1.15, $p = .003$) were positively associated. Article date and

attribution of responsibility to a federal government agency was negatively associated (OR = 0.94, p = .031).

DISCUSSION

Media coverage about human–cormorant conflict in the Great Lakes Basin has been dynamic over the last three decades. Articles have evolved from depicting cormorants primarily as recipients of risk (e.g., from pesticides, diseases, and lethal management actions) to principally sources of risk (e.g., to fish populations, vegetation, and tourism), shifting the predominant risk frame applied to cormorants by the print media from victim to perpetrator. This evolution of risk frame is reflected in several trends in coverage over our 30-year study period. First, there was an increase in articles identifying the potential risks perpetrated by cormorants to fish populations, recreational fishing, and tourism. There was also an increase in articles noting stakeholders' worry or fear (e.g., negative psychological effects) associated with human–cormorant conflict. Second, the number and diversity of risks perpetrated by cormorants and covered by the media increased. Coverage identified more risks from cormorants (per article) over time. Finally, the number of stakeholder groups identified by cormorant coverage increased throughout our study period. The presence of anglers, nongovernmental organizations, state and provincial government agencies, and legislators—all stakeholder groups who have either advocated for cormorant management or been engaged in implementation of cormorant management activities—increased over time. The dynamic nature of this coverage, coupled with the increasing diversity of stakeholders and cormorant-related risks present

in the articles, suggests that human– cormorant conflict in the Basin remains contentious (Rittel & Webber, 1973).

Examination of media coverage about cormorants and their management over an extended period of time provides a retrospective look at an issue as it progressed through different stages of the issue evolution model, and provides vital entry points for learning about the emergence of management contentiousness (Hahn, 1990). Decker et al. (2002) noted different stakeholders can be at different stages of issue evolution at the same time; therefore it is important for managers to be able to identify where each stakeholder group is along the process. Management environments may change based on the predominant risk frame of the species in question. Assessing risk frames applied by the media may help managers identify where some stakeholders are, and predict where others may be in the future, in issue evolution.

Longitudinal, retrospective inquiry of HWCs may identify trends and changes in risk frames that may not be identified with short-term, cross-sectional approaches. This is important because retrospective studies may identify patterns of change in media coverage, and help managers predict future changes in risk frames. For example, extensive media coverage of emerging diseases, such as type E botulism, which pose serious risks to Basin cormorant populations (e.g., Shutt, Weseloh, Pekarik, & Robinson, 2005) may shift the predominant risk frame of cormorants back to victim in the future.

Our results indicate that the media has assigned wildlife management agencies (i.e., state, provincial, or federal) and legislators with responsibility for addressing human– cormorant conflict in the Basin. This finding differs from Siemer et al. (2007), who found newspapers generally attributed responsibility to individual citizens for

negative interactions with black bears in New York. The difference in these results may be explained by contextual factors, as well as by the nature of risks perpetrated by cormorants vis-à-vis those risks perpetrated by black bears. New York media has generally portrayed human–bear conflicts as personal problems, rather than public issues (Siemer et al., 2007). Coverage on risks associated with black bears has focused primarily on concerns for personal safety and economic losses associated with property damage (e.g., bears getting into garbage). Coverage on risks from cormorants, however, has emphasized potential risks to recreational opportunities in the Basin (e.g., fishing) and the local environment (e.g., denuding islands of vegetation), indicating that human–cormorant conflicts are portrayed as public issues, not personal problems. Extending this finding outside of the Basin, however, may not be appropriate. Media coverage in the southern United States—where cormorant predation costs the aquaculture industry millions in losses each year (Glahn, Tobin, & Blackwell, 2000)—may suggest human–cormorant conflicts are personal problems (e.g., for individual fish producers), not social issues. The external validity of our findings could be assessed through replication of this study in other geographic regions.

Another possible explanation for the difference between findings is that media coverage and risk communication campaigns of wildlife agencies and other organizations can readily offer information about how to avoid or minimize exposure to risks associated with black bears, such as better waste disposal practices (Gore & Knuth, *in press*). Outreach interventions and risk communication efforts offering information about how to prevent or minimize exposure to risks perpetrated by cormorants—with the exception of information targeted for preventing depredation at aquaculture facilities—is

sparse. This, coupled with the federal protection afforded to cormorants in the United States by the Migratory Bird Treaty Act of 1918 (and provincial legislation in Canada), may leave stakeholders feeling they have little or no control over their exposure to risks from cormorants, which may contribute to amplified public perceptions of risk (Slovic, 1987) and escalate human–cormorant conflict. In these situations, agencies might consider a participatory approach that engages different stakeholder groups affected by cormorants in management activities (Schusler, Chase, & Decker, 2000). By actively engaging stakeholders in management planning and implementation, wildlife professionals may increase public trust in management agencies, as well as provide affected stakeholders with a sense of control (i.e., ability to reduce their exposure to cormorant-related risks), reducing human–cormorant conflict in the Basin.

Our study supports the utility of using risk as a framework for understanding HWCs related to birds. Risk frames applied to cormorants by the print media could be one factor that has influenced individual risk perceptions about human–cormorant conflict; however, caution is necessary when making generalizations about the context of news coverage to actual public perceptions. Content analysis alone cannot identify media effects (Wimmer & Dominick, 2003). Risk information can be manipulated by an individual's interpretation of the risk presented in the media (Slovic, 1987). Although newspaper coverage of wildlife is said to be fairly representative of actual perceptions and attitudes held toward wildlife (Kellert, 1985), stakeholder-informed research is needed to assess Basin stakeholders' perceptions of risks related to cormorants to see if they align with current media portrayal.

REFERENCES

Best, J. (1997). Victimization and the victim industry. *Society, 34*(4), 9–17.

Capozzoli, M., McSweeney, L., & Sinha, D. (1999). Beyond kappa: A review of interrater agreement measures. *Canadian Journal of Statistics, 27*, 3–23.

Chyi, H. I., &McCombs, M. (2004). Media salience and the process of framing: Coverage of the Columbine High School shootings. *Journalism and Mass Communication Quarterly, 81*, 22–35.

Cohen, J. (1960). A coefficient of agreement for nominal scales. *Educational and Psychological Measurement, 20*, 37–46.

Cohen, J. (1968). Weighted kappa: Nominal scale agreement with provision for scaled disagreement of partial credit. *Psychological Bulletin, 70*, 213–220.

Conover, M. R. (2002). *Resolving human-wildlife conflicts: The science of wildlife damage management*. Boca Raton, FL: CRC Press.

Corbett, J. B. (1995). When wildlife makes the news: An analysis of rural and urban north-central U.S. newspapers. *Public Understanding of Science 4*, 397–410.

Cottle, S. (1993). Mediating the environment: Modalities of TV-news. In A. Hansen (Ed.), *The mass media and environmental issues*. Leicester University Press.

Decker, D. J., Brown, T. L., & Siemer, W. F. (2001). *Human dimensions of wildlife management in North America*. Bethesda, MD: The Wildlife Society.

Decker, D. J., Lauber, T. B., & Siemer, W. F. (2002). *Human-wildlife conflict management: A practitioner's guide*. Ithaca, NY: Northeast Wildlife Damage Management Research and Outreach Cooperative.

Elliot, M. (2003). Risk perception frames in environmental decision making. *Environmental Practice, 5*, 214–222.

Entman, R. M. (1993). Framing: Toward clarification of a fractured paradigm. *Journal of Communication, 43*(4), 51–58.

Gans, H. J. (2004). *Deciding what's news*. Evanston, IL: Northwestern University Press.

Glahn, J. F., Tobin, M. E., & Blackwell, B. F. (2000). A science-based initiative to manage double-crested cormorant damage to southern aquaculture. U.S. Department of Agriculture, Animal and Plant Health Inspection Service Publication 11-55-010, Washington, D.C.

Gore, M. L., & Knuth, B. A. (2009). Mass media effect on the operating environment of a wildlife-related risk communication campaign. *Journal of Wildlife Management, 73*, 1407–1413.

Gore, M. L., Siemer, W. F., Shanahan, J. E., Schuefele, D., & Decker, D. J. (2005). Effects on risk perception of media coverage of a black bear-related human fatality. *Wildlife Society Bulletin, 33*, 507–516.

Gortner, E., Gollan, J., & Jacobson, N. (1997). Psychological aspects of perpetrators of domestic violence and their relationships with the victims. *Psychiatric Clinics of North America, 20*, 335–352.

Hahn, A. J. (1990). Issue-oriented public policy education: A framework for integrating the process. *Journal of Extension, 28*, 15–19.

Iyengar, S. (1991). *Is anyone responsible?* Chicago: University of Chicago Press.

Jensen, H. R. (2003). Staging political consumption: A discourse analysis of the Brent Spar conflict as recast by the Danish mass media. *Journal of Retailing and Consumer Services 10*, 71–80.

Kasperson, R. E., Jhaveri, N., &Kasperson, J. X. (2001). Stigma and the social amplification of risk: Toward a framework of analysis. In J. Flynn, P. Slovic, & H. Kunreuther (Eds.), *Risk, media, and stigma: Understanding public challenges to modern science technology* (pp. 9–27). London: Earthscan.

Kellert, S. R. (1985). Historical trends in perceptions and uses of animals in 20th century America. *Environmental Review, 9*, 19–33.

Knuth, B. A., Stout, R. J., Siemer, W. F., Decker, D. J., & Stedman, R. C. (1992). Risk management concepts for improving wildlife population decisions and public communication strategies. In *Transactions of the 57th North American Wildlife and Natural Resources Conference* (pp. 63–74). Washington, DC.

Lombard, M., Snyder-Dutch, J., & Bracken, C. C. (2002). Content analysis in mass communication: Assessment and reporting of intercoder reliability. *Human Communication Research, 28*, 587–604.

Lorenzini, R. (2005). DNA forensics and the poaching of wildlife in Italy: A case study. *Forensic Science International, 2*, 218–221.

Marks, L. A., Kalaitzandonakes, N., Wilkins, L., & Zakharova, L. (2007). Mass media framing of biotechnology news. *Public Understanding of Science, 16*, 183–203.

Pelstring, L., Shanahan, J., & Perry, B. (1997). The press and citizen participation: A content analysis. In *Proceedings of the Eighth Eastern Wildlife Damage Management Conference* (pp. 130–139).

Price, V., & Tewksbury, D. (1997). News, values and public opinion: A theoretical account of media priming and framing. In G. Barnett & F. Boster (Eds.), *Progress in communication sciences* (pp. 173–212). Norwood, NJ: Ablex.

Renn, O. R. (1998). Three decades of risk research: Accomplishments and new challenges. *Journal of Risk Research, 1*, 49–71.

Riley, S. J., & Decker, D. J. (2000). Risk perception as a factor of wildlife stakeholder acceptance capacity for cougars in Montana. *Human Dimensions of Wildlife, 5*, 50–62.

Rittel, W. J., & Webber, M. M. (1973). Dilemmas in general theory and planning. *Policy Sciences, 2*, 155–169.

Ryan, S. (2002). Victims and the media in divided societies: Some thoughts about the Northern Ireland conflict. In M. Aguirre & F. Ferrandiz (Eds.), *The emotion and the truth: Studies in mass communication and conflict* (pp. 99–110). Bilbao: University of Deusto.

Scheufele, D. (1999). Framing as a theory of media effects. *Journal of Communication, 49*(1), 103–122.

Schusler, T. M., Chase, L. C., & Decker, D. J. (2000). Community-based comanagement: Sharing responsibility when tolerance for wildlife is exceeded. *Human Dimensions of Wildlife, 5*, 34–49.

Shutt, J. L., Weseloh, D. V., Pekarik, C., & Robinson, J. (2005). Type E botulism-related morality in colonial waterbirds in Eastern Lake Ontario: Implications for the health of waterbird populations. *Annual Conference on Great Lakes Research, 48*, np.

Siemer, W. F., Decker, D. J., & Shanahan, J. (2007). Media frames for black bear management stories during issue emergence in New York. *Human Dimensions of Wildlife, 12*, 89–100.

Sjoberg, L. (1998). Worry and risk perception. *Risk Analysis, 18*, 85–93.

Slovic, P. (1987). The perception of risk. *Science, 236*, 280–285

Slovic, P., & Peters, E. (2006). Risk perception and affect. *Current Directions in Psychological Science, 15*, 322–325.

Taylor, J. D., & Dorr, B. S. (2003). Double-crested cormorant impacts to commercial and natural resources. In K. Fagerstone, & G. Witmer (Eds.), *Proceedings of the 10th Wildlife Damage Management Conference* (pp. 43–51).

Tversky, A. & Kahneman, D. (1981). The framing of decisions and the psychology of choice. *Science, 211*, 453–458.

USFWS. (2003). Final environmental impact statement: Double-crested cormorant management. U.S. Department of the Interior, U.S. Fish & Wildlife Service, Division of Migratory Bird Management, 4401 N. Fairfax Drive MS 634, Arlington, VA 22203.

Weseloh, D.V., & Collier, B. (1995). *The rise of the double-crested cormorant on the Great Lakes: Winning the war against contaminants.* [Great Lakes Fact Sheet]. Canadian Wildlife Service, Environment Canada, and Long Point Observatory.

Weseloh, D. V., Pekarik, C., Havelka, T., Barrett, G., & Reid, J. (2002). Population trends and colony locations of double-crested cormorants in the Canadian Great Lakes and immediately adjacent areas, 1990–2000: A manager's guide. *Journal of Great Lakes Research, 28*, 125–144.

White, R. (2008). *Crimes against nature: Environmental criminology and ecological justice*. Portland, OR: Willan.

Wimmer, R. D., & Dominick, J. R. (2003). *Mass media research: An introduction* (2nd ed.). Belmont, CA: Wadsworth.

Wires, L. R., & Cuthbert, F. J. (2006). Historic populations of double-crested cormorant (Phalacrocorax auritus): Implications for conservation and management in the 21st century. *Waterbirds, 29*, 9–37.

Wires, L. R., Cuthbert, F. J., Trexel, D. R., & Joshi, A. R. (2001). Status of the double-crested cormorant (Phalacrocorax auritus) in North America. Final Report to USFWS.

Wolch, J. R., Gullo, A., & Lassiter, U. (1997). Changing attitudes toward California's cougars. *Society and Animals, 5*, 95–116.

Young, A. (2007). A brief history of the self traumatized perpetrator. In J. G. Biehl, J. Biehl, B. Good, & A. Kleinman (Eds.), *Subjectivity: Ethnographic investigations* (pp. 155–178). Berkley: University of California Press.

Figure 3.1. Predicted probability of each risk frame through time (i.e., article date). The predicted probability of both neutral and victim frames declined over time, while the predicted probability of the perpetrator increased over time.

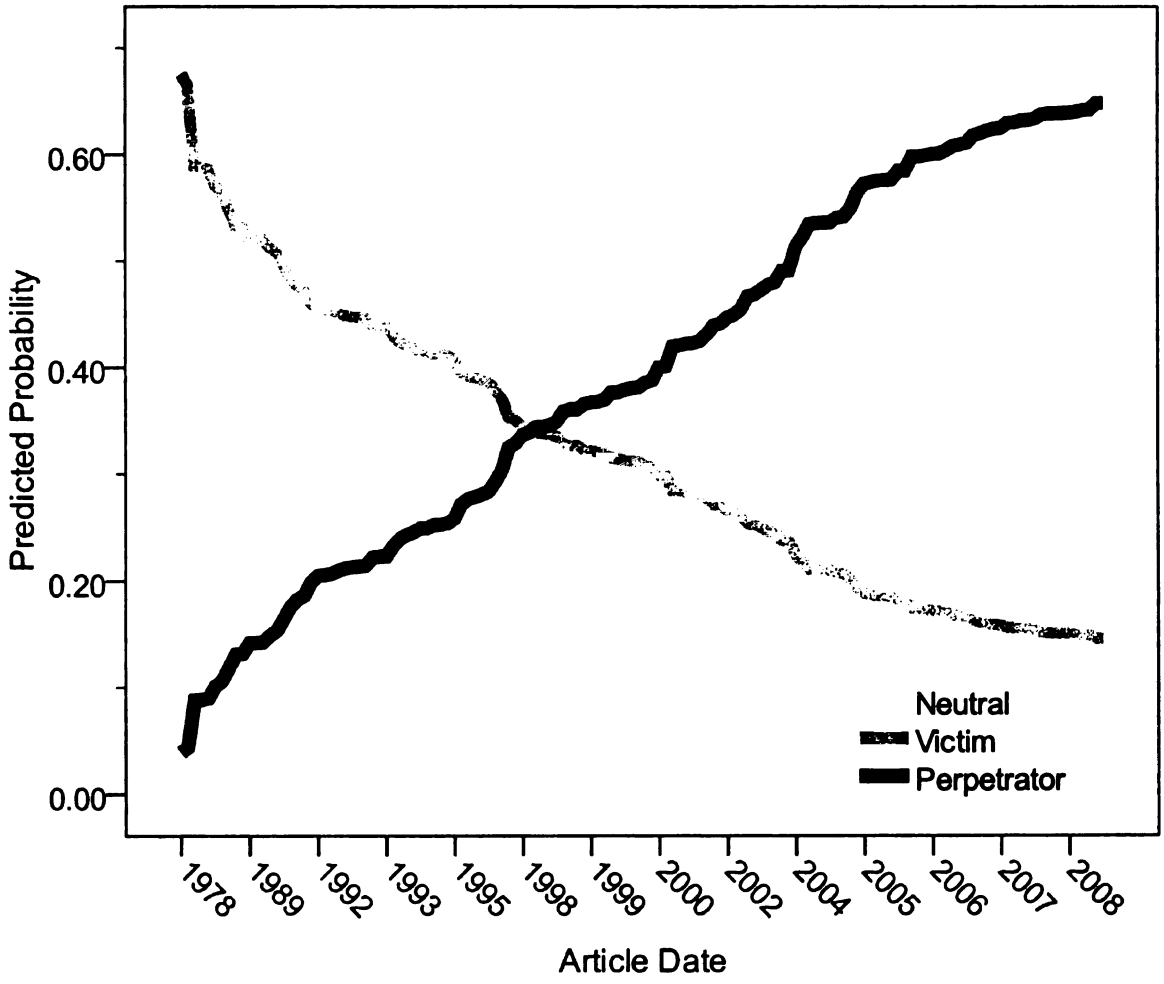


Table 3.1. Logistic regression analyses describing the effect of article date on an article's inclusion of stakeholder groups involved in human-cormorant conflict in the Great Lakes Basin from 1978–2007.

			Logistic Regression					Model[1]	
Dependent Variable	**K**	***f***	**β**	***SE***	**Wald**	**p-value**	**OR**	**χ^2**	**p-value**
anglers	.82	74	.11	.03	13.45	<.001	1.11	15.39	<.001
commercial fishermen	.83	25	.05	.04	1.66	.197	1.05	1.77	.184
fish farmers	1.0	12	.02	.04	0.11	.739	0.99	0.11	.741
hunters	.71	28	.06	.04	2.61	.106	1.06	2.82	.093
ngo (anti-management)	.71	19	-.17	.24	55.04	<.001	1.79	14.38	<.001
ngo (pro-management)	.70	26	.08	.04	4.71	.030	1.09	5.37	.021
local government	.74	6	.05	.07	0.44	.508	1.05	0.47	.493
state/provincial agency	.78	78	.09	.03	9.58	.002	1.09	10.46	<.001
federal agency	.79	72	-.03	.03	1.20	.274	0.97	1.21	.271
tribes	.70	18	.01	.04	0.01	.928	1.00	0.01	.928
business owners	.72	23	.04	.04	0.98	.323	1.04	1.02	.312
birders	.82	28	-.06	.03	3.18	.074	0.95	3.18	.075
animal-rights activists	.78	16	.07	.05	2.51	.113	1.08	2.83	.093
colleges/universities	.84	17	.02	.04	0.16	.690	1.02	0.16	.687
legislators/politicians	.73	34	.11	.04	9.02	.003	1.12	10.92	<.001

[1] $n = 140$, $df = 1$ for all models.

Table 3.2. Logistic regression analyses describing the effect of article date on an article's inclusion of individual risks from cormorants in the Great Lakes Basin from 1978–2007.

			Logistic Regression					Model[1]	
Dependent Variable	**κ**	***f***	**β**	***SE***	**Wald**	**p-value**	**OR**	**χ^2**	**p-value**
DDT	.76	34	.01	.03	0.01	.911	1.00	0.01	.911
PCBs	.79	9	-.08	.05	2.50	.114	0.93	2.44	.118
chlorine	.85	3	-.12	.08	2.26	.133	0.89	2.22	.136
poaching	.85	10	-.01	.05	0.02	.885	0.99	0.02	.886
deformities	.88	18	-.16	.04	14.27	< .001	0.85	17.44	<.001
new castle disease	.89	4	-.12	.07	2.80	.094	0.89	2.77	.096
scapegoat	.83	22	.06	.04	2.08	.150	1.06	2.25	.134
botulism	.72	5	.23	.13	3.03	.082	1.26	5.17	.023

[1] $n = 140$, $df = 1$ for all models.

Table 3.3. Logistic regression analyses describing the effect of article date on an article's inclusion of individual risks from cormorants in the Great Lakes Basin from 1978–2007.

			Logistic Regression					Model[1]	
Dependent Variable	**κ**	***f***	**β**	***SE***	**Wald**	**p-value**	**OR**	**χ^2**	**p-value**
fish populations	.84	61	.09	.03	8.95	.003	1.09	9.92	.002
vegetation	.93	26	.07	.04	3.71	.054	1.08	4.14	.042
other birds	.78	14	.09	.05	2.83	.093	1.09	3.28	.070
islands	.84	19	.08	.04	3.24	.072	1.08	3.68	.055
tourism	.85	10	.17	.08	4.83	.028	1.18	6.90	.009
fishing	.76	59	.09	.03	10.17	<.001	1.10	11.48	<.001
aquaculture	.95	11	-.01	.05	0.03	.862	0.99	0.03	.863
psychological effects	.72	34	.08	.03	5.30	.021	1.08	5.94	.015
private property	.85	3	.12	.12	1.01	.315	1.13	1.29	.257

[1] $n = 140$, $df = 1$ for all models.

Table 3.4. Logistic regression analyses describing the effect of article date on an article's inclusion of the stakeholder groups assigned with responsibility for addressing human-cormorant conflicts in the Great Lakes Basin from 1978–2007.

			Logistic Regression					Model[1]	
Dependent Variable	**κ**	***f***	**β**	***SE***	**Wald**	**p-value**	**OR**	**χ^2**	**p-value**
citizens	.71	6	-.01	.06	0.05	.824	0.99	0.05	.825
state/provincial agency	.70	51	.07	.03	6.25	.012	1.08	6.83	.009
federal agency	.72	42	-.06	.03	4.67	.031	0.94	4.82	.028
legislators/politicians	.71	22	.14	.05	8.62	.003	1.15	11.27	.001

[1] $n = 140$, $df = 1$ for all models.

CHAPTER 4

SUMMARY OF RESEARCH FINDINGS: IMPLICATIONS FOR THEORY, METHODS, & PRACTICE

Research results presented in this thesis make a number of theoretical, methodological, and empirical contributions to the existing literature on risk perception, social networks, and media frames related to wildlife management. Public perceptions of wildlife-related risks are helping inform management decisions about numerous species (e.g., Riley & Decker, 2000a; 2000b; Stout et al., 1993; Wieczorek-Hudenko, Siemer, & Decker, 2008); however, none of these studies have focused on cormorants or on the influence of social networks on wildlife-related risk perceptions. The research reported in Chapters 1 and 2 is novel in the risk perception and human dimensions literature. Roger's (2003) and Burt's (1987) influential work on diffusion of innovations and social contagion has served as a conceptual framework for many theoretical and empirically-based studies on social networks (e.g., Scherer & Cho, 2003). My research, which is contextually different from these studies, offers an opportunity to consider the extent to which previous findings are applicable to wildlife management.

Research herein adapts previous theories and methods applied to wildlife-related risk perception by Gore et al. (2006; 2007a; 2007b), Riley & Decker (2000a; 2000b), and Siemer et al. (2007). Much of the existing literature on wildlife-related risk has focused on wildlife species that pose potential threats to human safety (e.g., black bears, mountain lions). Concerns about cormorants, however, are centered around their potential effects on resources such as recreational fisheries, other colonial-nesting waterbirds, and the aesthetic appeal of Great Lakes islands (Muter et al., 2009). This work provides a unique

opportunity to evaluate which factors influencing risk perception are most applicable to cormorants. These findings should have relevance for other human-wildlife interactions that involve similar perceptions of risk (e.g., conflicts in Alaska over wolf depredation on moose).

Literature on mass media frames and their effects on public perceptions of environmental risks is abundant (e.g., Arvai & Mascarenhas, 2001; Gore et al., 2005). Studies on wildlife-related media have primarily characterized the frequency and types of content (e.g., Corbett, 1995); however, Chapter 3 demonstrates the first time principles from criminology (i.e., *victim* and *perpetrator*) have been adapted and applied to wildlife-related risks. This research was also first to study the content of media coverage about cormorants, and is one of few studies that have explored dynamics of wildlife-related media coverage through time (e.g., Wolch et al., 1997).

Although there is an increasing body of literature on cormorants and their management in the Great Lakes, only one peer-reviewed publication exists (Schusler et al., 2000) that has systematically considered the human dimensions of cormorant management in the Great Lakes. Findings herein help to fill a substantial gap in knowledge and offer a baseline upon which future empirical human dimensions inquiry may occur. Below I will summarize key findings, discuss implications for theory, methods, and practice and make recommendations for future research.

THEORETICAL IMPLICATIONS

Factors of Wildlife-Related Risk Perception

Research presented in Chapter 1 illustrates five factors (i.e., *certainty, dread, frequency, responsiveness,* and *seriousness*) influencing cormorant-related risk perception that can be significantly predicted by dyadic tie strength. Most of these factors (all except *responsiveness*) have been previously categorized as factors of individual capacity (i.e., variables that are internal to an individual's exposure to wildlife-related risks) rather than agency capacity (i.e., variables that are peripheral to an individual's exposure to wildlife-related risks) (Gore et al., 2006). Thus, social networks may be best suited to predict risk perception of factors related to individual capacity.

Dyadic tie strength was not a significant predictor of the *control, naturalness, and trust* factors associated with cormorant-related risk perceptions. *Control* has been cited as conceptually problematic in the human dimensions literature. Gore et al. (2007a), for example, noted that *control* was not sufficiently discussed by campground managers and users in regards to negative human-black bear interactions in New York. In the context of cormorant management, *control* may be related to agency capacity as cormorants are federally protected migratory birds and management actions have overwhelmingly been conducted by agency professionals. Thus, *control* could be related to feelings of helplessness among non-governmental stakeholders who are unaware of what actions they can legally take to reduce their exposure to cormorant-related risks.

Naturalness (i.e., natural vs. man-made risks) has received considerable attention in the environmental and technological hazard literature (e.g., Brun, 1992; Kasperson & Pijawka, 1985), but has also been conceptually problematic for human dimensions

research (Gore et al., 2007b). In its current form, the construct may simply be too abstract as there is an implicit philosophical challenge of trying to separate *natural* from *unnatural*; attempting to measure this construct may be even more difficult. If *naturalness* is to be meaningful for understanding wildlife-related risk perception, future research is needed to revise the current operational definition so that it can be more easily communicated and measured on survey instruments.

If communication is a requisite for social contagion of cormorant-related risk perceptions, this may indicate that *control, trust,* and *naturalness* related to HCCs are not being substantively discussed within communities of network actors. It is also possible that some (or even all) of these factors would be significant predictors of cormorant-related risk perception if the network were restricted to (a) only agency professionals, or (b) only non-governmental stakeholders. Future research could investigate relationships between dyadic tie strength and these eight risk perception factors in expert networks (i.e., agency professionals) and non-expert networks (i.e., non-governmental stakeholders). Comparisons of these smaller, more homogenous networks with the larger network (presented herein) may lend additional theoretical insight into contagion of wildlife-related risk perceptions.

Social Network Contagion Theory of Risk Perception

Social networks – via dyadic tie strength – are an important, and potentially often overlooked, mechanism capable of influencing stakeholder risk perceptions about wildlife, such as cormorants. Chapter 1 included a discussion about the presence of contagion effects in a mixed network of expert (e.g., agency professionals) and non-

expert stakeholder groups (e.g., anglers, bird enthusiasts). Prior research on contagion (Burt, 1987) has speculated that structural equivalence, rather than cohesion, creates more social pressure among experts to adopt an innovation and is therefore not as effective at predicting expert perceptions. This study, however, suggests the cohesion model is relevant for both expert and non-expert stakeholders involved in wildlife management. Future research could investigate the role of structural equivalence (particularly in the network of agency professionals) in influencing risk perceptions about wildlife.

Networks & Risk Behaviors

One inference from my results was that dyadic tie strength was a significant predictor of risk perceptions related to HCCs in northern Lake Huron; however, it did not address whether dyadic tie strength was a significant predictor of risk-behaviors associated with HCCs. Additional research is needed to evaluate how networks influence risk-related behaviors of non-governmental stakeholders engaged human-wildlife interactions. For example with DCCOS, non-governmental stakeholders may use the MDNR's online cormorant complaint form[1], volunteer for cormorant harassment programs, or partake in illegal activities such as poaching.

Issue Contentiousness

Findings presented in Chapter 1 demonstrate utility for Scherer & Cho's (2003) social network contagion theory of risk perception by successfully applying it to wildlife-related risks. Further, this research provides additional support for applying the theory to contentious environmental issues, including HCCs. Contagion of risk perceptions seems

dependent on communication among actors about a particular hazard; however, it is still unclear as to what point an issue becomes contentious enough to mobilize contagion effects. This empirical question may be answered with future inquiry designed to investigate diverse human-wildlife interactions at varying stages of issue evolution and contention (i.e., from emerging to chronic issues).

METHODOLOGICAL IMPLICATIONS

Boundary Specification of Network Sampling

One meaningful implication from my findings is that social networks can extend beyond traditional community or political boundaries (e.g., those that exist on paper). There are many agency professionals (e.g., state, provincial, tribal, and federal) and non-governmental actors (e.g., universities, bird interests, business interests, and anglers) involved in cormorant management, many of whom neither live nor work in the regions currently experiencing conflicts. In Chapter 2, for example, some of the most central, or influential, network actors were considered non-local. This has important methodological implications for boundary specification of network sampling. Although network sampling protocols that are too inclusive can be problematic in terms of data collection (i.e., an overwhelming number of potential network actors), procedures that are too exclusive may fail to identify influential network actors. Future research applying social networks to similar contexts should consider the costs and benefits of more inclusive sampling approaches across wider geographic boundaries, especially when agency professionals (who are often not physically located in the communities experiencing HWCs) are to be included in the sampling frame.

Methods of Data Collection

Most data herein was collected through face-to-face interviews with network actors; however, telephone interviews were also used if necessary. Although there are benefits of conducting interviews in person (e.g., building trust with participants), researchers should not shy away from using multiple methods (i.e., both face-to-face and telephone interviews) to collect network data (especially if the alternative is that an actor is excluded from a sample). For studies with an extensive geographic sampling boundary, telephone interviews may serve as a cost-effective alternative to data collection.

Institutional Review Board (IRB) Issues

One noteworthy challenge of using SNA to investigate applied wildlife management issues is that some of the most meaningful practical findings gleaned from SNA cannot be reported without violating university policies designed to protect research participant privacy. In Chapter 2, for example, I reported centrality measures for agency professionals and non-governmental stakeholders involved in HCC around northern Lake Huron. Actors with high centrality scores represent individuals in the network who are ideally positioned to either (a) connect disconnected groups within the network, or (b) disseminate risk information quickly and efficiently. It would be valuable to all network individuals if the identifies of central (and non-central) actors could be revealed. Identifying individuals as well as their placement within the network could enable wildlife professions to better exploit results from analysis to the benefit of management. When third parties, such as universities, employ SNA methodologies, they should be aware that some meaningful results from analysis (e.g., who actor 0003 is) will not be

able to be shared. If possible, researchers could work with institutional research boards (IRBs) to ensure that collected data can be utilized to the fullest extent without violating participant rights. IRBs may consider modifying existing privacy rules to better accommodate social network methodologies. Management agencies are not bound by institutional review boards; wildlife professional may be able to employ social network methodologies without being subjected to the privacy constraints that are put on university researchers. However, agencies may not be able to collect the same quality of data (i.e., obtain unbiased information) if participants are being surveyed by agency professionals, especially if the public (i.e., potential study participants) has little trust in the management agency. Care would be needed to avoid any threats to validity and reliability.

Coding Scheme

In Chapter 3, a coding protocol was adapted from Siemer et al. (2007) to assign the overall risk frame applied to cormorants (i.e., victim, perpetrator, or neutral) in each newspaper article. This procedure (see Appendix F, Section H) involved assessing each paragraph in the article, assigning a predominant risk frame for each paragraph, and summing paragraph assignments. If a risk frame occurred in two or more paragraphs more than another frame, I coded the article the predominant frame; otherwise it was coded as neutral. This coding scheme was effective; adoption of these methods to assess risk frames in diverse media sources (e.g., internet, television, print media) may be helpful in studying other HWCs. Replication of this work will provide greater insight into

historical trends of wildlife-related media coverage and issue evolution of HWCs (Hahn, 1990).

PRACTICAL IMPLICATIONS

Managing Cormorant-Related Risk Perceptions

Cormorant-related risk perceptions were moderate to high for most network actors. The factors of highest concern were related to individual capacity (e.g., dread, certainty) rather than agency capacity (e.g., trust in management, responsiveness of management). Managers may be able to best address factors of highest concern by providing information about what stakeholders can do if they are concerned about cormorant-related risks. For example, the MDNR currently hosts an online nuisance complaint form that stakeholders can complete and submit to report cormorant activity in their area[1]. Agencies could also provide additional information on their websites about what people can legally do to minimize cormorant-related impacts on their property, or elsewhere, as well as provide information about existing community-based cormorant harassment programs (i.e., groups of citizens trained and overseen by USDA-Wildlife Services who volunteer to harass cormorants through the use of pyrotechnics, lethal shooting, and other means to prevent birds from foraging in locales where fish stocks are vulnerable to predation), or how to explore opportunities to start a new harassment program.

[1]http://www.dnr.state.mi.us/cormorantobs/

Wildlife-Related Risk Communication

There is opportunity to improve the communication capacity and practices of wildlife management agencies (e.g., Madden, 2008; Shanahan, Decker, & Pelstring, 2001). Wildlife professionals should be aware that mass media and social networks are two important channels in which information about cormorant-related risks are communicated, and as a result influence stakeholders' risk perceptions about wildlife and wildlife management. These channels can be employed proactively by agency professionals for risk communication efforts that aim to reduce HWCs to a level deemed acceptable for both humans and wildlife (Decker et al., 2002; Gore & Knuth, 2009).

Agency professionals could benefit by considering more than just individuals when designing and implementing risk communication related to HWCs (Lundgren & McMakin, 2009). Although individual attributes (e.g., age, county of residence, education) are meaningful, inquiry into how social interactions among and between agency professionals and non-governmental stakeholder groups can either impede or enhance management objectives may improve effectiveness of communication programs. Risk communication efforts are usually most successful when risk messages are tailored to specific stakeholder groups and disseminated through the primary communication channels these stakeholders use (Decker et al., 2002). Wildlife-related risk communication designed with consideration of social networks may improve effectiveness because networks cross geographic and political boundaries, as well as host interactions among and between diverse stakeholder groups. Evaluation of the effectiveness (i.e., speed of message diffusion, accurateness of information over time) of

using social networks for disseminating risk information about HWCs may help managers develop better communication programs.

Identifying Intentional & Unintentional Risk Messengers in Wildlife-Related Networks

An important consideration in developing any risk communication initiative is *who* is delivering the message (e.g., Lasswell, 1948). There is extensive literature to describe characteristics of risk messengers (e.g., Lundgren & McMakin, 2009; Slovic, 1986); this research reiterates the need to challenge the assumption that risk messengers are only experts. Research herein illustrates both agency professionals and non-governmental stakeholders may serve as risk messengers and that these individuals may or may not be aware of their power and influence in their networks. In Chapter 2, I described characteristics of central network actors who are best positioned to disseminate risk information. Local agency professionals (i.e., those agency professionals who live and work in the communities in which they deal with wildlife management) were among the most central actors in the network, and as a result may be better positioned for delivering risk messages. Although these professionals may be subordinates to non-local agency professionals, they tended to communicate more frequently with non-governmental stakeholders, and likely have greater influence on stakeholder perceptions. This observation reveals a need for agency professionals at all levels to have some formal training in risk communication about wildlife.

REFERENCES

Arvai, J., & Mascarenhas, M. (2001). Print media framing of the Pacific Northwest forestry debate: Public opinion and environmentalists, *Environmental Management, 27*, 705–714.

Brun, W. (1992). Cognitive components of risk perception: Natural versus manmade risks. *Journal of Behavioral Decision Making,5*(2), 117–132.

Burt, R. S. (1987). Social contagion and innovation: Cohesion versus structural equivalence. *American Journal of Sociology*, 92, 1287–1335.

Corbett, J. B. (1995). When wildlife makes the news: An analysis of rural and urban north-central U.S. newspapers. *Public Understanding of Science 4*, 397–410.

Decker, D. J., Lauber, T. B., & Siemer, W. F. (2002). *Human-wildlife conflict management: A practitioner's guide.* Ithaca, NY: Northeast Wildlife Damage Management Research and Outreach Cooperative.

Gore, M. L., & Knuth, B. A. (2009). Mass media effect on the operating environment of a wildlife-related risk communication campaign. *Journal of Wildlife Management, 73,* 1407–1413.

Gore, M. L., Knuth, B. A., Curtis, P. D., & Shanahan, J. E. (2006). Stakeholder perceptions of risk associated with human-black bear conflicts in New York's Adirondack Park campgrounds: implications for theory and practice. *Wildlife Society Bulletin, 34*, 36–42.

Gore, M. L., Knuth, B. A., Curtis, P. D., & Shanahan, J. E. (2007a). Campground manager and user perceptions of risk associated with human-black bear conflict: Implications for communication. *Human Dimensions of Wildlife, 12*, 31–43.

Gore, M. L., Knuth, B. A., Curtis, P. D., & Shanahan, J. E. (2007b). Factors influencing risk perception associated with human-black bear conflict. *Human Dimensions of Wildlife 12*, 133–136.

Gore, M. L., Siemer, W. F., Shanahan, J. E., Schuefele, D., & Decker, D. J. (2005). Effects on risk perception of media coverage of a black bear-related human fatality. *Wildlife Society Bulletin, 33,* 507–516.

Hahn, A. J. (1990). Issue-oriented public policy education: A framework for integrating the process. *Journal of Extension, 28*, 15–19.

Kasperson, R. E., & Pijawka, K. D. (1985). Societal response to hazards and major hazard events: Comparing natural and technological hazards. *Public Administration Review,* 45, 7–18.

Lasswell, H. (1948). The structure and function of communication in society. In L. Bryson (Ed.), *The communication of ideas: a series of addresses* (pp. 37–51). New York: Harper.

Lundgren, R. E. & McMakin, A. (2009). *Risk communication: A handbook for communicating environmental, safety, and health risks.* (4th ed). Hoboken, NJ: John Wiley & Sons.

Madden, F. (2008). Creating coexistence between humans and wildlife: Global perspectives on local efforts to address human-wildlife conflict. *Human Dimensions of Wildlife, 9,* 247–257.

Muter, B. A., Gore, M. L., & Riley, S. J. (2009). From victim to perpetrator: Evolution of risk frames related to human-cormorant conflict in the Great Lakes. *Human Dimensions of Wildlife, 14,* 366–379.

Riley, S. J., & Decker, D. J. (2000a). Risk perception as a factor in wildlife stakeholder acceptance capacity for cougars in Montana, *Human Dimensions of Wildlife, 5,* 50-62.

Riley, S. J., & Decker, D. J. (2000b). Wildlife stakeholder acceptance capacity for cougars in Montana. *Wildlife Society Bulletin, 28,* 931–939.

Rogers, E. M. (2003). *Diffusion of innovations* (5th ed.). New York, NY: Free Press.

Scherer, C. W., & Cho, H. C. (2003). A social network contagion theory of risk perception. *Risk Analysis, 23,* 261–267.

Schusler, T. M., Chase, L. C., & Decker, D. J. (2000). Community-based comanagement: Sharing responsibility when tolerance for wildlife is exceeded. *Human Dimensions of Wildlife, 5,* 34–49.

Shanahan, J. E., Decker, D. J., & Pelstring, L. M. (2001). Communication for effective wildlife management. In D. J. Decker, T. L. Brown, & W. F. Siemer (Eds.), *Human dimensions of wildlife management in North America* (pp. 171–190). Bethesda, MD: The Wildlife Society.

Siemer, W. F., Decker, D. J., & Shanahan, J. (2007). Media frames for black bear management stories during issue emergence in New York. *Human Dimensions of Wildlife, 12,* 89–100.

Slovic, P. (1986).Informing and educating the public about risk. *Risk Analysis, 6,* 403–415.

Stout, R. J., Stedman, R. C., Decker, D. J., & Knuth, B. A. (1993). Perceptions of risk from deer-related vehicle accidents: Implications for public preferences for deer herd size. *Wildlife Society Bulletin, 21*, 237–249.

Wieczorek-Hudenko, H. A., Decker, D. J., & Siemer, W. F. (2008). Stakeholder insights into the human-coyote interface in Westchester County, New York. Department of Natural Resources, New York State College of Agriculture and Life Sciences. HDRU Series Report 08-1. Ithaca, NY.

Wolch, J. R., Gullo, A., & Lassiter, U. (1997). Changing attitudes toward California's cougars. *Society and Animals*, *5*, 95–116.

APPENDIX A

Interview Guide

Cormorant-Related Social Networks
INTERVIEW GUIDE

Thank you for taking the time to sit down with me to participate in this study. As I mentioned when we talked on the phone, I am a graduate student in the Department of Fisheries and Wildlife at Michigan State University where I am researching attitudes toward double-crested cormorants in northern Lake Huron. This research, which is funded by the Great Lakes Fishery Commission and is the subject of my master's thesis, will also look at communication networks of resource managers and citizens who are actively engaged in cormorant management.

I am very interested in hearing your opinions on this topic. Your participation will not only help me fulfill the requirements of my graduate degree, but will also help us better understand how to more effectively involve the public in resource management decisions, such as those concerning cormorant management.

Throughout the interview, you will be asked for your opinions about cormorant management, as well as to name individuals with whom you have spoken to about cormorants in the last year. Your responses are completely confidential. Your name will not be linked to your responses in any way that a third party could reveal or connect your responses to your name. The entire process will last no longer than one hour.

I would like to use a digital voice recorder during the interview. My research aide and I will be the only people to hear the recording (and the aide will not be given your name, only a unique ID number); however, I am happy to take hand-written notes if you prefer. This interview is 100% voluntary. You may choose not to answer any question or to stop the interview at any time.

Before we begin, I have a brief consent form that I need your signature on. This form indicates your willingness to participate in this study [explain consent form].

Introduction & Ice-Breakers

These questions focus on your experiences with cormorants around northern Lake Huron. By northern Lake Huron, this is the area I am referring to [show map]. This region includes locations in both Michigan and Ontario, like Thunder Bay near Alpena, the Les Cheneaux Islands, and the North Channel.

1. **What types of activities bring you to northern Lake Huron?**

    a. Which of these activities is most important to you?

    b. About how much time have you spent around northern Lake Huron this year?

2. **While visiting northern Lake Huron, have you ever seen double-crested cormorants? (IF NO), have you seen cormorants elsewhere?**

a. (IF YES to either) Tell me about the experience. Where did you see them?

b. How many did you see?

c. How often did/do you see them?

d. What were they doing?

3. **How do/did you feel when you see them?**

Section 1: Knowledge & Information Sources

1. **Have you ever heard about cormorants from the news?**

   a. (IF YES) Can you tell me about it? What was/were the source(s)?

   b. (IF KNOWN) Can you recall the name(s)? What are they?

   c. (If more than one is mentioned) Which one do/did you refer to most?

   d. What can you tell me about the coverage? Did it show cormorants in a positive, neutral, or negative light?

2. **What do you know about the history of cormorants in the Great Lakes?**

   a. Where do you think that knowledge comes from?

3. **If you had a question about cormorants in northern Lake Huron, what would you do to find an answer?**

4. **Are you currently employed in a profession related to cormorant management?**

   a. (IF YES) How many years have you been involved in cormorant management?

   b. (IF NO) Have you ever been employed in a profession related to cormorant management?

      i. (IF YES to b) How many years were you involved in cormorant management?

5. **Aside from your employer, are you involved in any groups in which cormorant management in northern Lake Huron is of interest?**

   a. (IF YES) What are your involvements? What are your roles in these groups?

   b. Which one are you most involved with?

Section 2: Name Generators

People belong to social networks - groups of individuals who are connected in some way. Group members may be friends, family members, neighbors, co-workers and others. I am interested in knowing about who is in your cormorant social network – the individuals with whom you talk to about cormorants or their management.

The next several questions will ask you to name these individuals. These people will be contacted for an interview (if they have not been previously); however, I will not tell them you mentioned their name. I will tell them that their name was generated during an interview.

1. **Have you talked to any natural resource agency employees about cormorants specific to northern Lake Huron in the last calendar year?**

   a. (If yes) Please write down the names (first and last) of all of those individuals.

   b. (If they name more than five) Out of these, which five do you communicate with most frequently?

2. **Have you talked to anyone who is NOT currently a natural resource agency employee about cormorants specific to northern Lake Huron in the last calendar year?**

   a. (If yes) Please write down the names (first and last) of all of those individuals.

   b. (If they name more than five) Out of these, which five do you communicate with most frequently?

Now I would like to revisit the names of those individuals you have mentioned. I am interested in your connection with each person. (The following questions will be asked for each set of 5 individuals named by the informant.)

1. **About how many years have you known X?**

2. **How would you best describe your connection with X?**

☐ Stranger	☐ Co-worker	☐ Stakeholder
☐ Acquaintance	☐ Friend	
☐ Neighbor	☐ Close Friend	
☐ Colleague	☐ Family Member	

3. **About how often do you communicate with X?**

☐ Daily	☐ 5 or 6 times a year	☐ Once a month
☐ Several times a week	☐ 2 or 3 times a year	
☐ Once a week	☐ Once a year	
☐ Twice a month	☐ Less than once a year	

4. **Would you say that X contacts you more frequently than you contact X, you contact X more frequently than X contacts you, or that you contact each other equally?**
   - ☐ X contacts me more frequently than I contact X.
   - ☐ I contact X more frequently than X contacts me.
   - ☐ We contact each other equally.

5. **How does most of your communication with X take place?**
   - ☐ Electronically
   - ☐ Telephone
   - ☐ In-Person

Section 3: Open-Ended Questions

1. **In your opinion, are there risks northern Lake Huron from cormorants?**

   a. (IF YES) What are those risks? Please explain.

2. **Of the risks you have mentioned, which of these is most important to you? Why?**

3. **While some people believe cormorants are the source of risks, others believe cormorants are at risk. In your opinion, are cormorants in northern Lake Huron at risk from people?**

   a. (IF YES) Please explain.

   b. Of the risks to cormorants you have mentioned, which is most important to you?

4. **Are you satisfied with current cormorant management in northern Lake Huron?**

   a. (IF NO) What are your frustrations?

   b. In your opinion, what is the biggest challenge to cormorant management in northern Lake Huron?

5. **Is there anything else related to cormorants that you would like to share with me that you think I missed?**

Before we close, I have a brief but very important questionnaire for you to complete that will address some personal attributes, as well as, questions asking about the risks associated with double-crested cormorants and their management. I'll give you some privacy while you complete the questionnaire. Should you have any questions, please don't hesitate to ask.

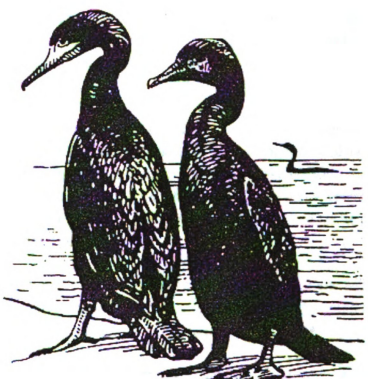
Thank you again for your time. Here is my contact information should you have any further questions or concerns. After this research is completed, I will post a summary of research findings online www.fw.msu.edu. If you would like to give me your e-mail or mailing address I would also be happy to send you the summary of these results when they are available.

APPENDIX B

Questionnaire

A Survey of Your Views About

DOUBLE-CRESTED CORMORANTS IN NORTHERN LAKE HURON



MICHIGAN STATE UNIVERSITY
DEPARTMENT OF FISHERIES & WILDLIFE
13 Natural Resources Building
East Lansing, MI 48824
www.fw.msu.edu

DOUBLE-CRESTED CORMORANTS IN NORTHERN LAKE HURON

A Survey of Your Views

The purpose of this questionnaire is to learn more about your attitudes toward double-crested cormorants and their management in northern Lake Huron. Your views on this topic are extremely important and will be used to help us understand how to more effectively involve the public in resource management decisions, such as those concerning cormorant management.

The interviewer will give you privacy while you complete this questionnaire. It consists of 13 questions and should take approximately 5 to 10 minutes to complete. If you are unable to complete the questionnaire while the interviewer is present, please complete it at your earliest convenience, seal it, and drop it in any mailbox (no envelope is needed). You will be provided with return postage.

Your responses are completely confidential. Your name will not be linked to your responses in any way that a third party could reveal or connect your responses to your name.

If you have any questions or concerns regarding this survey, please write Bret Muter, Project Coordinator, at the address on the back cover of this survey, or at muterbre@msu.edu. You can also reach him by telephone at (989) 284-0976.

THANK YOU FOR YOUR PARTICIPATION!

A. Recreational Experience

1. About how often do you participate in the following recreational activities around northern Lake Huron? (Please check one response for each item).

	Never	Rarely	Occasionally	Frequently
Backpacking	☐	☐	☐	☐
Biking	☐	☐	☐	☐
Bird/Wildlife Watching	☐	☐	☐	☐
Boating	☐	☐	☐	☐
Camping	☐	☐	☐	☐
Canoeing/Kayaking	☐	☐	☐	☐
Fishing	☐	☐	☐	☐
Hiking	☐	☐	☐	☐
Hunting	☐	☐	☐	☐
Nature Photography	☐	☐	☐	☐
Other (Write-in): _____	☐	☐	☐	☐

B. Your Attitudes About Cormorants

2. People have different feelings about cormorants. Which one of the following statements <u>best</u> reflects how you feel about cormorants occurring in northern Lake Huron.

- ☐ I enjoy the presence of cormorants AND I <u>do not</u> worry about problems they may cause.
- ☐ I enjoy the presence of cormorants AND I <u>do</u> worry about problems they may cause.
- ☐ I <u>do not</u> enjoy the presence of cormorants AND I <u>do</u> worry about problems they may cause.
- ☐ I <u>do not</u> enjoy the presence of cormorants AND I <u>do not</u> worry about problems they may cause.
- ☐ I have no particular feelings about cormorants.

3. How likely do you think it is that recreational opportunities in northern Lake Huron will be negatively affected by cormorants in the next year?

Not At All Likely			Somewhat Likely			Extremely Likely
☐	☐	☐	☐	☐	☐	☐

4. How likely do you think it is that the environment of northern Lake Huron will be negatively affected by cormorants in the next year?

Not At All Likely			Somewhat Likely			Extremely Likely
☐	☐	☐	☐	☐	☐	☐

5. How likely do you think it is that the economy of northern Lake Huron will be negatively affected by cormorants in the next year?

Not At All Likely			Somewhat Likely			Extremely Likely
☐	☐	☐	☐	☐	☐	☐

6. To what extent do you agree or disagree with the following statements about cormorants? (Please check only one response for each statement).

	Strongly AGREE	Somewhat AGREE	Slightly AGREE	NEITHER	Slightly DISAGREE	Somewhat DISAGREE	Strongly DISAGREE
If the cormorant population increases, human-cormorant interactions will increase.	☐	☐	☐	☐	☐	☐	☐
I worry about the risks from cormorants.	☐	☐	☐	☐	☐	☐	☐
Problems involving cormorants are increased by man-made factors.	☐	☐	☐	☐	☐	☐	☐

	Strongly AGREE	Somewhat AGREE	Slightly AGREE	NEITHER	Slightly DISAGREE	Somewhat DISAGREE	Strongly DISAGREE
Managing the risks from cormorants in northern Lake Huron will continue to be important in the future.	☐	☐	☐	☐	☐	☐	☐
I believe that I have the opportunity to voice my opinions about cormorant management in northern Lake Huron.	☐	☐	☐	☐	☐	☐	☐
Cormorants have the right to exist wherever they may occur.	☐	☐	☐	☐	☐	☐	☐
I feel that I have control over the risks from cormorants.	☐	☐	☐	☐	☐	☐	☐
If there is a problem with cormorants, the resource agencies responsible for management will respond accordingly.	☐	☐	☐	☐	☐	☐	☐
Science is the most rational way to approach cormorant management.	☐	☐	☐	☐	☐	☐	☐
I trust the resource agencies involved in cormorant management to manage cormorants appropriately.	☐	☐	☐	☐	☐	☐	☐
Cormorant management should be a top priority for fisheries and wildlife managers in northern Lake Huron.	☐	☐	☐	☐	☐	☐	☐
The presence of cormorants in northern Lake Huron is the sign of a healthy environment.	☐	☐	☐	☐	☐	☐	☐

	Strongly AGREE	Somewhat AGREE	Slightly AGREE	NEITHER	Slightly DISAGREE	Somewhat DISAGREE	Strongly DISAGREE
The risks posed by cormorants to recreation in northern Lake Huron are acceptably low.	☐	☐	☐	☐	☐	☐	☐
The risks posed by cormorants to the environment in northern Lake Huron are acceptably low.	☐	☐	☐	☐	☐	☐	☐
The risks posed by cormorants to the economy in northern Lake Huron are acceptably low.	☐	☐	☐	☐	☐	☐	☐
Cormorant population reduction is an acceptable method of reducing risks from cormorants.	☐	☐	☐	☐	☐	☐	☐

7. How do you believe cormorant populations in northern Lake Huron have changed (if at all) in the past 5 years?

Increased Greatly			Stayed the Same			Decreased Greatly	Not Sure
☐	☐	☐	☐	☐	☐	☐	☐

8. How would you like cormorant populations in northern Lake Huron to change in the next 5 years?

Increase Greatly			Stay the Same			Decrease Greatly	Not Sure
☐	☐	☐	☐	☐	☐	☐	☐

9. How important to you is it that the change you indicated in Question 8 occur in northern Lake Huron over the next 5 years?

Not Important			Moderately Important			Extremely Important	Not Sure
☐	☐	☐	☐	☐	☐	☐	☐

C. Background Information

Please answer the following questions on your background to help us better understand your responses. Your answers will remain confidential.

10. Where do you currently live?

County (write-in):_____

Country (check one): ☐ Canada ☐ United States

11. What is your highest completed level of education?

- ☐ Less than a high school diploma
- ☐ High school diploma or GED
- ☐ Vocational or trade school
- ☐ Some college
- ☐ Associate's Degree (2 years)
- ☐ Bachelor's Degree (4 years)
- ☐ Graduate/Professional Degree

12. In what year were you born? 19_____

13. Please use this remaining space for any additional comments or questions that you would like to share.

☐ Please check this box if you would like to receive a summary of the survey results.

Thank You Again For Your Participation!

APPENDIX C

Research Participant Information & Consent Form

Research Participant Information and Consent Form

You are being asked to participate in a research project. Researchers are required to provide a consent form to inform you about the study, to convey that participation is voluntary, to explain the risks and benefits of participation, and to empower you to make an informed decision. You should feel free to ask the researchers any questions you may have.

Study Title: Role of Communication Networks in Influencing Stakeholder Attitudes about Double-Crested Cormorants and their Management in Northern Lake Huron.

Researcher and Title: Dr. Shawn J. Riley, Associate Professor; Dr. Meredith L. Gore, Assistant Professor; and Bret A. Muter, Project Coordinator, MS Student

Department and Institution: Department of Fisheries and Wildlife, Michigan State University

Address and Contact Information: 13 Natural Resources Building; East Lansing, MI 48824, 517-432-4943

PURPOSE OF RESEARCH:
You are being asked to participate in a research study of stakeholder attitudes toward double-crested cormorants (*Phalacrocorax auritus*) and their management in northern Lake Huron. This research will also look at communication networks of resource managers and citizens who are actively engaged in cormorant management. You have been selected as a possible participant in this study because your name was generated as someone who is potentially interested, and engaged, in cormorant management in northern Lake Huron.

From this study, the researchers hope to learn about the role of communication networks in influencing an individual's attitudes towards cormorant management. Your participation in this study will take no longer than one hour. If you are under 18, you cannot participate in this study.

WHAT YOU WILL DO:
This study has two components. The first part will be a face-to-face interview, in which you will be asked for your opinions about cormorant management, as well as to name individuals with whom you have spoken to about cormorants in the last year. After completing the interview, you will be asked to complete a short questionnaire that will address some personal attributes, as well as questions asking about the risks associated with cormorants and their management.

If you wish, you will be provided with an executive summary of the research findings upon completion of the study.

POTENTIAL BENEFITS:
You will not directly benefit from your participation in this study. However, your participation may contribute to a better understanding of how natural resource professionals can more effectively involve the public in resource management decisions, such as those concerning cormorant management.

POTENTIAL RISKS:
There are no foreseeable risks associated with this study.

PRIVACY AND CONFIDENTIALITY:
Information about you will be kept confidential to the maximum extent allowable by law. Your name will not be linked to your responses in any way that a third party could reveal or connect your responses to your name.

Participants will be assigned a unique, confidential identification number for the purpose of data analysis. The data for this project will be kept confidential. All data will be stored on a single, password-protected computer in a locked office in 33 Natural Resources Building at Michigan State University. Hard copies of data and a list of codes and participants will be stored in a locked file cabinet in 33 Natural Resources Building at MSU. The results from this study may be published or presented at professional meetings, but the identities of all research participants will remain anonymous. Interviews will be recorded using a digital voice recorder with your consent; however, if you prefer, the researcher will take hand-written notes.

I agree to allow audio-taping of the interview.

☐ Yes ☐ No Initials_____

YOUR RIGHTS TO PARTICIPATE, SAY NO, OR WITHDRAW
Participation in this research project is completely voluntary. You have the right to say no or to change your mind at any time and withdraw. You may chose not answer specific questions or to stop participating at any time.

COSTS AND COMPENSATION FOR BEING IN THIS STUDY:
You will not receive money or any form of compensation for participating in this study.

CONTACT INFORMATION FOR QUESTIONS OR CONCERNS
If you have concerns or questions about this study, please contact one of the primary investigators Dr. Shawn J. Riley or Dr. Meredith Gore, or co-investigator, Bret Muter at Department of Fisheries and Wildlife, 13 Natural Resources Building, MSU, East Lansing, MI 48824; phone 517-432-4943 or email rileysh2@msu.edu, gorem@msu.edu or muterbre@msu.edu.

If you have any questions or concerns about your role and rights as a research participant, or would like to register a complaint about this study, you may contact, anonymously if you wish, the Michigan State University's Human Research Protection Program at 517-355-2180, Fax 517-432-4503, e-mail irb@msu.edu, or regular mail at 202 Olds Hall, MSU, East Lansing, MI 48824.

DOCUMENTATION OF INFORMED CONSENT
Your signature below means that you voluntarily agree to participate in this research study.

_____ _____
Signature Date

APPENDIX D

Additional Risk Perception Tables

Table A.1. Cormorant-related risk perceptions of agency professionals and non-governmental actors engaged in human-cormorant conflict around northern Lake Huron, August 2008–August 2009.

Questionnaire Item	Professionals			Stakeholders			*p-value**
	n	*Mean*	*SD*	*n*	*Mean*	*SD*	
[Certainty] If the cormorant population increases, human-cormorant interactions will increase.	48	5.48	0.97	65	5.25	1.46	.667
[Dread] I worry about the risks from cormorants.	48	4.15	1.60	65	4.45	2.11	.044
[Natural vs. Man-Made] Problems involving cormorants are increased by man-made factors.	48	4.31	1.81	65	3.03	2.44	.009
[Frequency] Managing the risks from cormorants in northern Lake Huron will continue to be important in the future.	47	5.11	1.13	65	5.23	1.60	.063
[Control] I feel that I have control over the risks from cormorants.	48	3.25	1.78	64	4.34	1.76	.001
[Responsiveness] If there is a problem with cormorants, the resource agencies responsible for management will respond accordingly.	48	2.46	1.81	65	3.82	2.02	.000
[Trust] I trust the resource agencies involved in cormorant management to manage cormorants appropriately.	47	1.98	1.65	65	3.66	2.16	.000
[Seriousness] Cormorant management should be a top priority for fisheries and wildlife managers in northern Lake Huron.	48	3.71	1.96	65	4.48	2.19	.009
Belief in Science	**48**	**.65**	**.863**	**64**	**1.78**	**2.11**	**.011**
Science is the most rational way to approach cormorant management.	48	.65	.863	64	1.78	2.11	.011
Risk Likelihood Scale	**48**	**3.12**	**1.65**	**64**	**4.09**	**2.00**	**.003**
How likely do you think it is that recreational opportunities in northern Lake Huron will be negatively affected by cormorants in the next year?	48	3.35	1.66	65	3.98	2.16	.055
How likely do you think it is that the environment of northern Lake Huron will be negatively affected by cormorants in the next year?	48	2.81	1.92	64	4.03	2.02	.002
How likely do you think it is that the economy of northern Lake Huron will be negatively affected by cormorants in the next year?	48	3.19	1.72	64	4.23	2.11	.002
Risk Acceptability Scale	**48**	**3.45**	**1.74**	**64**	**4.58**	**1.87**	**.000**
The risks posed by cormorants to recreation in northern Lake Huron are acceptably low.	48	3.60	1.94	64	4.66	2.05	.001
The risks posed by cormorants to the environment in northern Lake Huron are acceptably low.	48	3.19	1.89	64	4.45	2.02	.000
The risks posed by cormorants to the economy in northern Lake Huron are acceptably low.	48	3.56	1.84	64	4.64	1.83	.001

*p-values of Mann-Whitney tests to compare group means

Table A.2. Cormorant-related risk perceptions of Canadian and U.S. actors engaged in human-cormorant conflict around northern Lake Huron, August 2008–August 2009.

Questionnaire Item	Canadian			U.S.			*p-value**
	n	*Mean*	*SD*	*n*	*Mean*	*SD*	
[Certainty] If the cormorant population increases, human-cormorant interactions will increase.	25	5.04	1.43	88	5.43	1.22	.038
[Dread] I worry about the risks from cormorants.	25	4.08	1.66	88	4.39	1.97	.179
[Natural vs. Man-Made] Problems involving cormorants are increased by man-made factors.	25	3.60	2.27	88	3.57	2.29	.783
[Frequency] Managing the risks from cormorants in northern Lake Huron will continue to be important in the future.	24	4.92	1.41	88	5.25	1.42	.087
[Control] I feel that I have control over the risks from cormorants.	24	4.38	1.77	88	3.74	1.85	.123
[Responsiveness] If there is a problem with cormorants, the resource agencies responsible for management will respond accordingly.	25	4.60	1.92	88	2.85	1.91	.000
[Trust] I trust the resource agencies involved in cormorant management to manage cormorants appropriately.	25	4.56	1.83	87	2.49	1.98	.000
[Seriousness] Cormorant management should be a top priority for fisheries and wildlife managers in northern Lake Huron.	25	4.12	2.21	88	4.16	2.11	.879
Belief in Science	**25**	**1.04**	**1.70**	**87**	**1.37**	**1.81**	**.388**
Science is the most rational way to approach cormorant management.	25	1.04	1.70	87	1.37	1.81	.388
Risk Likelihood Scale	**25**	**3.64**	**1.95**	**88**	**3.67**	**1.90**	**.939**
How likely do you think it is that recreational opportunities in northern Lake Huron will be negatively affected by cormorants in the next year?	25	3.88	1.92	88	3.67	2.02	.676
How likely do you think it is that the environment of northern Lake Huron will be negatively affected by cormorants in the next year?	25	3.32	2.19	87	3.56	2.03	.636
How likely do you think it is that the economy of northern Lake Huron will be negatively affected by cormorants in the next year?	25	3.72	2.09	87	3.80	2.0	.867
Risk Acceptability Scale	**24**	**3.89**	**2.01**	**88**	**4.16**	**1.86**	**.654**
The risks posed by cormorants to recreation in northern Lake Huron are acceptably low.	24	4.00	2.17	88	4.26	2.04	.626
The risks posed by cormorants to the environment in northern Lake Huron are acceptably low.	24	3.67	2.35	88	3.98	1.98	.825
The risks posed by cormorants to the economy in northern Lake Huron are acceptably low.	24	4.00	2.02	88	4.23	1.88	.634

*p-values of Mann-Whitney tests to compare group means

Table A.3. Cormorant-related risk perceptions of local and non-local actors engaged in human-cormorant conflict around northern Lake Huron, August 2008–August 2009.

Questionnaire Item	Local Actors			Non-Local Actors			*p-value**
	n	*Mean*	*SD*	*n*	*Mean*	*SD*	
[Certainty] If the cormorant population increases, human-cormorant interactions will increase.	61	5.41	1.31	52	5.27	1.24	.172
[Dread] I worry about the risks from cormorants.	61	4.98	1.48	52	3.54	2.06	.000
[Natural vs. Man-Made] Problems involving cormorants are increased by man-made factors.	61	2.85	2.42	52	4.42	1.76	.001
[Frequency] Managing the risks from cormorants in northern Lake Huron will continue to be important in the future.	61	5.66	0.93	51	4.61	1.67	.000
[Control] I feel that I have control over the risks from cormorants.	61	4.23	1.85	51	3.45	1.76	.013
[Responsiveness] If there is a problem with cormorants, the resource agencies responsible for management will respond accordingly.	61	3.46	2.17	52	2.98	1.86	.180
[Trust] I trust the resource agencies involved in cormorant management to manage cormorants appropriately.	61	3.36	2.20	51	2.47	1.94	.038
[Seriousness] Cormorant management should be a top priority for fisheries and wildlife managers in northern Lake Huron.	61	5.23	1.48	52	2.88	2.06	.000
Belief in Science	**60**	**1.67**	**2.05**	**52**	**0.87**	**1.30**	**.063**
Science is the most rational way to approach cormorant management.	60	1.67	2.05	52	0.87	1.30	.063
Risk Likelihood Scale	**61**	**4.72**	**2.43**	**52**	**2.43**	**1.78**	**.000**
How likely do you think it is that recreational opportunities in northern Lake Huron will be negatively affected by cormorants in the next year?	61	4.69	1.51	52	2.58	1.89	.000
How likely do you think it is that the environment of northern Lake Huron will be negatively affected by cormorants in the next year?	60	4.63	1.38	52	2.21	1.95	.000
How likely do you think it is that the economy of northern Lake Huron will be negatively affected by cormorants in the next year?	60	4.90	1.46	52	2.50	1.79	.000
Risk Acceptability Scale	**61**	**5.08**	**1.35**	**51**	**2.92**	**1.77**	**.000**
The risks posed by cormorants to recreation in northern Lake Huron are acceptably low.	61	5.25	1.47	51	2.96	1.99	.000
The risks posed by cormorants to the environment in northern Lake Huron are acceptably low.	61	4.85	1.59	51	2.78	1.99	.000
The risks posed by cormorants to the economy in northern Lake Huron are acceptably low.	61	5.15	1.36	51	3.02	1.82	.000

*p-values of Mann-Whitney tests to compare group means

Table A.4. Cormorant-related risk perceptions of clique actors (i.e., belong to one or more cliques) and non-clique actors (i.e., do not belong to any cliques) engaged in human-cormorant conflict around northern Lake Huron, August 2008–August 2009.

Questionnaire Item	Clique Actors			Non-Clique Actors			p-*value**
	n	*Mean*	*SD*	*N*	*Mean*	*SD*	
[Certainty] If the cormorant population increases, human-cormorant interactions will increase.	89	5.38	1.32	24	5.21	1.10	.156
[Dread] I worry about the risks from cormorants.	89	4.30	1.92	24	4.38	1.91	.867
[Natural vs. Man-Made] Problems involving cormorants are increased by man-made factors.	89	3.79	2.25	24	2.79	2.23	.055
[Frequency] Managing the risks from cormorants in northern Lake Huron will continue to be important in the future.	88	5.18	1.43	24	5.17	1.40	.850
[Control] I feel that I have control over the risks from cormorants.	88	3.74	1.78	24	4.38	2.02	.067
[Responsiveness] If there is a problem with cormorants, the resource agencies responsible for management will respond accordingly.	89	2.94	1.96	24	4.33	1.99	.003
[Trust] I trust the resource agencies involved in cormorant management to manage cormorants appropriately.	88	2.51	1.98	24	4.58	1.86	.000
[Seriousness] Cormorant management should be a top priority for fisheries and wildlife managers in northern Lake Huron.	89	3.94	2.22	24	4.92	1.50	.051
Belief in Science	**88**	**1.23**	**1.67**	**24**	**1.54**	**2.15**	**.868**
Science is the most rational way to approach cormorant management.	88	1.23	1.67	24	1.54	2.15	.868
Risk Likelihood Scale	**89**	**3.50**	**1.89**	**24**	**4.29**	**1.87**	.056
How likely do you think it is that recreational opportunities in northern Lake Huron will be negatively affected by cormorants in the next year?	89	3.55	1.99	24	4.33	1.90	.076
How likely do you think it is that the environment of northern Lake Huron will be negatively affected by cormorants in the next year?	88	3.32	2.05	24	4.21	1.98	.055
How likely do you think it is that the economy of northern Lake Huron will be negatively affected by cormorants in the next year?	88	3.64	1.99	24	4.33	2.04	.088
Risk Acceptability Scale	**88**	**4.02**	**1.88**	**24**	**4.38**	**1.94**	**.273**
The risks posed by cormorants to recreation in northern Lake Huron are acceptably low.	88	4.18	2.04	24	4.29	2.18	.560
The risks posed by cormorants to the environment in northern Lake Huron are acceptably low.	88	3.76	2.05	24	4.46	2.04	.066
The risks posed by cormorants to the economy in northern Lake Huron are acceptably low.	88	4.13	1.93	24	4.38	1.84	.629

*p-values of Mann-Whitney tests to compare group means

APPENDIX E

Additional Sociograms

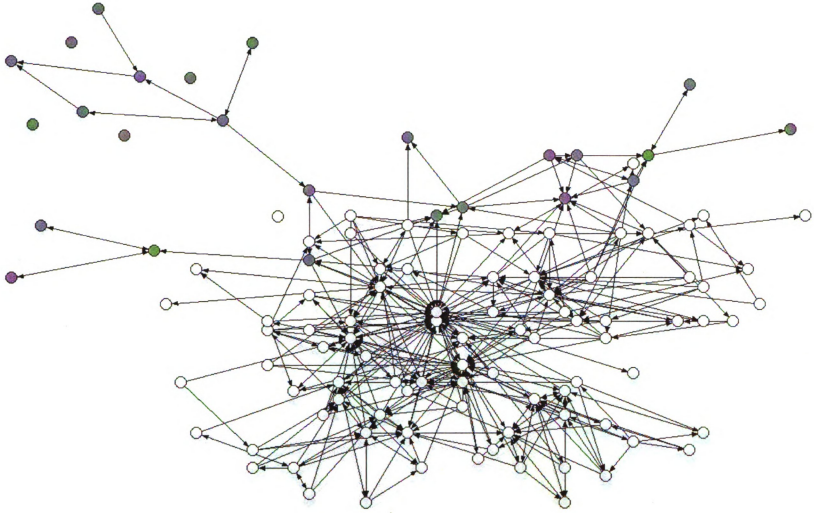


Figure A.1. Sociogram showing directional ties of Canadian actors (*n = 25,* represented by gray nodes) and U.S. network actors (*n = 88,* represented by white nodes) engaged in human-cormorant conflict around northern Lake Huron, August 2008 –August 2009.

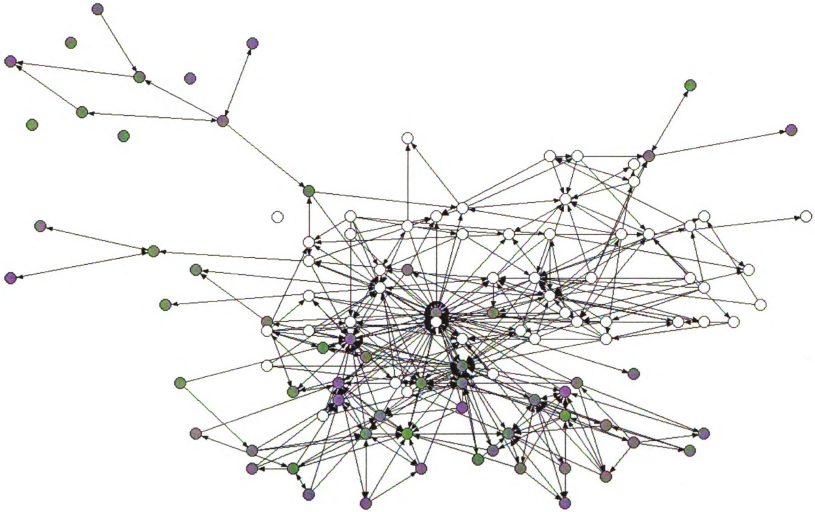


Figure A.2: Sociogram showing directional ties of local actors (n = 61, represented by gray nodes) and non-local network actors (n = 52, represented by white nodes) engaged in human-cormorant conflict in northern Lake Huron, August 2008–August 2009.

APPENDIX F

Content Analysis Protocol

Cormorants in the Media
Media Content Analysis Protocol
Revised December 12, 2007

Contact Information
Project Coordinator: Bret Muter
Email: muterbre@msu.edu
Phone: 989.284.0976

Introduction
Content analysis is an objective and systematic procedure (Wimmer and Dominick, 2003) for examining the content of documented information (i.e., newspapers, magazines, radio/television transcripts). Social scientists have used content analyses for decades (Wimmer and Dominick, 2003); however, the method is becoming increasingly utilized in the fisheries and wildlife arena because it is able to provide historical insight on issues in management (Decker et al., 2006). A few recent studies have looked at how media coverage of a black bear-related human fatality in New York affected public risk perceptions (Gore et al., 2005) and the role of media frames of black bear management in New York (Siemer et al., 2007).

This content analysis will explore how double-crested cormorants (*Phalacrocorax aruitus*) are portrayed in popular media. It will address a variety of questions related to the frequency and type of coverage, as well as media framing. Data from this analysis will be used in at least one peer-reviewed paper, a chapter of the project coordinator's thesis and will be used to inform further human-dimensions exploration of how wildlife and wildlife-related issues are addressed in the media.

Before you begin coding, you'll participate in a coder training session. Coder training is an opportunity for you to work closely with the project coordinator to: (1) learn more about the method of content analysis and its applicability to this research; (2) receive a set of instructions and guidelines for coding; (3) become familiar with the coding instrument; and (4) assist in the refinement of the coding instrument and process.

This protocol will serve as your instruction manual for the coding process. It will compliment the coding sheet that you'll fill out as you code each article. Please feel free to make any notes in the document to keep as a reference.

Study Objectives
The purpose of this study is to examine how double-crested cormorants are framed in the media. Framing refers to the way a piece of information is presented. It is a technique used to make certain information about an issue "more noticeable, meaningful, or memorable to audiences" (Entman, 1993, p. 53).

This project has three objectives: (1) to characterize media coverage of double-crested cormorants in the Great Lakes from 1985 to 2007; (2) to evaluate risk frame of media coverage of double-crested cormorants in the Great Lakes from 1985 to 2007; and (3) to apply Siemer et al's (2007) hypotheses of bear-related media frames to double-crested

cormorants. Several hypotheses under each objective will be tested with the results provided from this analysis.

Your Role: Keys to Conducting a Successful Content Analysis
Conducting a content analysis is not an easy feat, and is very time intensive. Your role as a coder plays a vital role in the success of this study. By following the rules and instructions for coding, you can help ensure accuracy and consistency of results. Here are some important things to keep in mind:

- ***Objectivity is the first key to conducting a successful content analysis.*** It is extremely important that you code only for what is written, not for what is implied. We're not evaluating articles for the accuracy of their information, but for the presence or absence of topics and other variables. You may want to take notes on the article as it will help you as you code and can be referred to later if there are any questions or discrepancies.

- ***Reproducibility is the second key to conducting a successful content analysis.*** Keep in mind there will be multiple coders on this project. The reason for using multiple coders is to identify if two coders classify or identify the same information in the same manner (which is the ultimate goal). A statistical test, known as Cohen's Kappa, will be used to determine this inter-coder reliability (consistency between two coders). ***Refinements can be made to the instrument if needed to increase inter-coder reliability.***

- Please contact the project coordinator immediately if you come across any issues. If improvements are made, the project coordinator will prepare an updated version of the coding sheet (the instrument) and will redistribute to the coders (the revision date will be prominently displayed at the top of the revised coding sheet).

Instructions
Each coder will be given an identical set of 121 articles. Each article will be identified by a unique number (located in the upper right-hand corner). Articles were selected because they contain some discussion related to double-crested cormorants within the Great Lakes; however, cormorants are not the primary topic in all articles (though they will be in many). If you come across an article that you do not think is relevant to the objectives of the analysis, please bring it to the project coordinator's attention before taking the time to code it.

1. Read each article in its entirety before you begin coding.

2. If you disagree with a particular coding scheme or find a poorly defined category please bring it to the attention of the project coordinator. If possible, address these concerns during the coder training session.

3. Always start at the top of the coding sheet and work your way down. You may find that a question, section or sections of the instrument are not addressed or are

not particularly relevant to your article. (In fact, it will probably be very rare that *every* section on the coding sheet will be relevant to a *single* article). You should indicate those question(s)/section(s) is/are not applicable.

4. Instead of printing a hundred copies of the coding sheet for each coder, you will be given an Excel spreadsheet file to insert your coded data. Please take your time to ensure that you have not made any errors in data entry.

5. Finally, if at any time you find yourself in doubt, contact the project coordinator.

Thank you for participating in the study! I look forward to working with you!

Further Instructions & Definitions

The remainder of this protocol will provide you with additional instructions and information to assist you as you begin the coding process. Here, each section of the codebook is expanded upon. This is where you'll find definitions of variables, as well as examples of things you will be "looking for" as you code. Please be sure to read this document several times before you begin to code and be sure to have it next to you at all times. If any of the items below are still unclear, please contact the project coordinator.

SECTION A: GENERAL ARTICLE INFORMATION

This first section gathers general information about the article (title, source, origin, etc.) The first eleven variables will already be coded by the project coordinator (since there should be no discrepancies with these items).

A1: Article Number
Article numbers are already coded ***A001*** through ***A121***.

A2: Name of Publication/Transcript
Already Coded.

A3: Article Date – Month
Article months are already coded ***01*** (January) through ***12*** (December).

A4: Article Date – Day
Article days are already coded ***01*** through ***31***.

A5: Article Day – Year
Article years are already coded ***1985*** through ***2007***.

A6: Newspaper/Program Origin – Country
Country of newspaper origins are already coded ***1*** for United States and ***2*** for Canada.

A7: Newspaper/Program Origin – State/Province
Identify the state or province in which the article/program was published/aired. Add codes as needed.

A8: Section/Desk/Type
LexisNexis provides this information at the top of the article below the story title, typically following "SECTION."

A9: Photos, Tables & Figures
LexisNexis does not actually provide photos, figures or tables (on rare occasion a table or figure will appear in the printout); however, you can determine if a graphic was included if the word "GRAPHIC" appears after the end of the story. Photo/figure captions are also typically included. Only code *1* (yes) for this variable if the caption tells you the photo is of a cormorant(s), or if a figure/graph contains information related to cormorants.

A10: How many words are there in the story?
LexisNexis provides this information at the top of the article below the story title.

A11: How paragraphs in the story discuss or are directly related to double-crested cormorants?

A12: What is the primary article topic?
To determine the primary topic (Variable 11) first use the title. If you are unable to make a distinction from the title, the first couple paragraphs of the story should tell you. Several of topics below may occur in each article; therefore, you should code the topic that is discussed most as the primary topic. Use the table below for descriptions and examples of article topics.

- ***Negative Impacts from Cormorants:*** article discusses one or more negative effects or impacts from cormorants on humans (i.e., health/safety, economic, psychological, etc.) or the environment. Some examples include: impacts of cormorants on Great Lakes fisheries, aquaculture, vegetation, other birds, tourism, local communities, etc.
- ***Agency Response to Cormorants:*** article discusses a management action or response to the "cormorant issue." Some examples include instances of culling, egg-oiling, hazing, embarking on new agency/government-funded research on cormorants and their impacts, etc.
- ***Diseases, Conditions & Negative Impacts (to Cormorants):*** article discusses some kind of disease or condition that is affecting cormorants (and potentially other species of wildlife). In many cases, cormorants will only be briefly mentioned as one of the victims of such conditions. Examples include: DDT, bill and feet deformities, PCB's, Newcastle Disease, etc. Do not code yes for instances of cormorant poaching (as this would be coded as poaching) or for instances of cormorants being killed as

the result of a management action (as this would be coded as an agency response to cormorants).

- ***Aesthetic Values Placed on Cormorants:*** article discusses pleasure with cormorants and their viewing. Will typically be associated with non-consumptive outdoor recreation (i.e., travel, bird-watching, kayaking, camping, boating) in which cormorants are aesthetically viewed. Additional examples include: viewing cormorants as a sign of healthier Great Lakes, sighting(s) of a cormorant(s) in an unusual place, etc.
- ***Consumptive Outdoor Recreation:*** article discusses some form of consumptive outdoor recreation (i.e., hunting and fishing) and mentions cormorants in some context to those activities.
- ***Poaching:*** article discusses an instance of poaching where cormorants (and possibly other birds, like pelicans) are illegally killed. *Examples include:* Little Galloo incident, etc.
- ***Research/Education:*** article discusses a current academic research project on cormorants or an education program designed to teach people about cormorants.
- ***Legislation/Politics:*** article discusses legislation related to cormorants and their management. Also code yes for legislation dealing with controlling or regulating contaminants (which affect cormorants). Examples include: a state or province's new legislation to manage cormorants, etc.
- ***Other:*** articles that don't seem to fit with any of the above coding schemes. Very few articles should fall into this category. If this list gets too large, we will have to revisit these articles to discuss the creation of additional content categories.

A13 – Other Topics Discussed

A20: Variables A13 through A20 list the individual codes from A12 and asks if these topics are also discussed. Code ***yes*** or ***no*** for each of the variables that are mentioned in the article (Note: you should also code ***yes*** for the topic you indicated as the primary article topic in A12). Use the list above if you need to refer to descriptions and examples of each of the listed topics.

SECTION B: STAKEHOLDER GROUPS

This section is designed to identify the stakeholders involved/discussed in each cormorant-related article. Stakeholder groups are groups of individuals that hold some stake in an issue. Examples of cormorant-related stakeholder groups include (a) fishermen; (b) local, state and federal governments; (c) tribes; (d) business owners; and (e) NGO's, etc.

B1 – Stakeholder Groups:

B15: Variables B2 through B14 list a variety of different stakeholder groups that have been linked to cormorant-related issues. Code ***yes*** for those stakeholder groups mentioned in the article. Please let the project coordinator know if any other categories of stakeholder groups are encountered. Some tips are included below:

- If you see the word "anglers" or "sports-fishermen" code ***yes*** for the recreational fishermen stakeholder group (B1).
- If you only see the word "fishermen" (and there is no context to make you believe they are discussing commercial fishing) code ***yes*** for the recreational fishermen stakeholder group (B1).
- Only code ***yes*** for commercial fishermen (B2) if they are referring to catching fish for commercial distribution. Do not include charter fishing captains as commercial fishermen (we will classify them as business owners – B11).
- Examples of business owners (B11) include motels, hotels, bait-shops, charter-fishing companies, etc. Do not code ***yes*** here for aquaculture (since you will have already coding yes for B3).
- Examples of non-profit organizations that want to protect cormorants (B6) might include Cormorant Defenders International, PETA, Audubon Society, etc.
- Only code ***yes*** for animals rights activists (B13) if it said animal rights, animal rights advocates, etc. Do not code ***yes*** for PETA, Humane Society, etc. (as you will have already coded these as NGOs wanting to protect cormorants – B6).
- Similarly, only code ***yes*** for birders or ornithologists (B12) if those or similar terms appear (i.e., "bird watchers," "bird-enthusiasts," "wildlife-watchers," etc.). Do not code ***yes*** for organizations like the Audubon Society or Canadian Society for Endangered and Threatened Birds (as you will have likely already coded these as NGOs wanting to protect cormorants).
- Examples of non-profit organizations that are upset with cormorants (B5) might include local fishing and sporting clubs, etc.

SECTION C: NATURAL HISTORY INFORMATION

This section is designed to see what natural history/biological information the author includes about cormorants, like (a) diet, (b) behavior and (c) history within Great Lakes, etc. Be sure to keep your eye peeled for strategically placed and subtle pieces of information.

C1: Cormorant Diet?

Code ***yes*** if the article mentions aspects of the bird's diet (i.e. eating fish)

- Look for phrases like, "these fish-eating birds..." etc.

C2: Cormorant Behavior?

Code ***yes*** if the article mentions non-diet behaviors. Examples of non-diet behaviors include migration, nesting, breeding, diving, defecating, vomiting, perched with wings out to dry, etc.

C3: Cormorant is Federally Protected?
Code *yes* if the article mentions that the cormorant is a federally protected bird or is protected by the Federal Migratory Bird Treaty Act.

C4: Cormorant History with DDT or PCBs?
Code *yes* if the article mentions that cormorants are falling (or fell) victim to DDT, PCBs and other pesticides. The article may simply say contaminants. Examples might include: mention of cormorant populations following those of bald eagles and osprey in the 1960's and 1970's as a result of commercial use of DDT, discusses how cormorants often suffered with deformities from PCB exposure, etc.

C5: Qualitative information about population?
Code *yes* if the author or someone in the article makes a statement about the population of cormorants without giving a numerical statistic. Some examples might include:

- "The cormorant population explosion..."
- "Cormorant populations skyrocketed."
- "The populations increased greatly since the 1970's."
- "The cormorant population is much larger than it was 20 years ago."

C6: Quantitative information about population
Code *yes* if the author or someone in the article uses numbers or statistics to indicate the current cormorant population or trends in the cormorant population. Some examples might include:

- "In 1970's there were only 12 pairs of cormorants on the island; today there are 1,500."
- "Populations have increased 300-fold."
- "There are over 500,000 cormorants in North America today."

SECTION D: IMPACTS FROM CORMORANTS (Perpetrator Frame)
Variables have been created to record presence/absence of negative impacts (actual or perceived) from cormorants. Impacts may be ecological or economic. Some examples include: (a) destroying vegetation; (b) negative impacts on fisheries; and (c) economic effects associated with cormorants. Please let the project coordinator know if any other categories of impacts from cormorants are encountered.

D1 - Impacts from Cormorants:
D10: Variables D2 through D11 list a variety of different perceived and assessed economic and ecological impacts from cormorants. Code *yes* for those impacts mentioned in the article. Please let the project coordinator know if any other categories of impacts from cormorants are encountered. Some tips are included below:

- Cost does not need to be mentioned to indicate an economic effect. Words like damaged or ruined are a good indicator.
- Code ***yes*** for negative ecological effects to Great Lakes fisheries (D1) if statements are made indicating that cormorants are (or are perceived to be) changing the food web in the Great Lakes (or another body of water), depleting stocks of game fish, stocks of baitfish that game fish depend on, etc.
- Only code ***yes*** for negative economic effects to tourism (D6) if statements are made indicating that tourism in an area is suffering because of cormorants or because of declining fish populations. Must use the word tourism.
- Code ***yes*** for negative impacts to commercial or recreational fishing (D8), if statements are made indicating like: "We don't catch as many fish as we used to," "We have to fish harder to catch the same number of fish that we used to," "Cormorants are eating all of the perch and bass," "Cormorants are eating the baitfish that salmon and walleye depend on," etc.

SECTION E: IMPACTS ON CORMORANTS (Victim Frame)

Variables have been created to record presence/absence of several impacts on or to cormorants. These are impacts that cause physical harm to cormorants either directly or indirectly through effects on the ecosystem. Some examples include: (a) DDT and other pesticides, (b) bill deformities caused by PCBs, (c) diseases, etc. Please let the project coordinator know if other categories of impacts on cormorants are encountered.

E1 – E7: Impacts on Cormorants

Variables E1 through E7 list a variety of different impacts to/on cormorants. Code ***yes*** for those impacts mentioned in the article. Please let the project coordinator know if any other categories of impacts to cormorants are encountered. Some tips include:

- Only code ***yes*** for E7 if the author or someone in the article makes a clear statement that cormorants are being wrongfully accused for depleting fish stocks or are a scapegoat for some other issue that is causing negative impacts. Must use words or phrases like, "scapegoat," "wrongfully accused," "incorrectly blamed," etc.

SECTION F: RISK PERCEPTIONS

Variables have been created to record presence/absence of psychological effects of cormorants (i.e., dislike, worry, etc.) Variables F1 through F4 list a variety of different risk perceptions related to cormorants. Code ***yes*** for those perceptions mentioned in the article. Please let the project coordinator know if other categories of psychological effects are encountered.

F1: Satisfaction with Agency Response

Code ***yes*** if the author or someone within the article makes a statement that they are happy or satisfied with an agency's response or decision to cormorants (i.e.,

management activities). Also code *yes* for statements indicating that someone would like to see the agency carry out more of these types of activities.

F2: Dissatisfaction with Agency Response
Code *yes* if the author or someone within the article makes a statement that they are not happy with an agency's response or decision to/regarding cormorants (i.e., management activities). Code *yes* for statements like: "they shouldn't be killing the cormorants," "this isn't the right way to address the issue," or "they're not doing enough."

F3: Worry or concern about future negative impacts to cormorants?
Code *yes* if the author or someone within the article makes a statement clearly indicating that they are worried or concerned about negative impacts cormorants might face in the future (i.e., from contaminants, disease, persecution, wrongfully being culled, etc.)

F4: Worry or concern about future negative impacts from cormorants?
Code *yes* if the author or someone within the article makes a statement clearly indicating that they are worried or concerned about negative impacts cormorants might cause or continue to cause (i.e., economically, environmentally, or socially) in the future.

SECTION G: PROBLEM, SOLUTION & RESPONSIBILITY ATTRIBUTIONS

G1 – G5: Problem Causes
Variables G1 through G5 list a variety of perceived causes of the "cormorant issue." Code *yes* for those perceived causes if the author suggests or a statement made within the article suggests that problems from cormorants are being causes by the corresponding variable. Some tips include:

- Only code *yes* for G3 if the author or someone within the article makes a statement clearly indicating an agency is not taking action when they should be. Examples: "The government really needs to step in and help," "The government should really do something about the cormorant problem," etc.
- Only code *yes* for G4 if the author or someone within the article makes a statement clearly indicating that an agency is not doing enough to manage cormorants. Examples: "They should be culling more birds," "The government needs to kill them all," etc.
- Only code *yes* for G5 if the author or someone within the articles make a statement clearly indicating that an agency is taking in appropriate action (i.e., in other words they are killing cormorants when they shouldn't be). Examples: "The cormorant problem is all imagined, the government shouldn't be killing them," "Cormorants aren't the problem; the real problem is invasive species. Instead of killing cormorants, the government

should be focusing their efforts elsewhere," or "It's absurd to think that the government would kill cormorants because they are eating fish."

G6 – G12: Problem Solutions

Variables G6 through G12 list a variety of suggestions the author or someone within the article may makes to address the cormorant issue and find a solution. Example solutions include: taking no action, taking lethal action, taking non-lethal action, establishing a hunting season or legislation to manage cormorants, etc. Code ***yes*** for those suggested solutions mentioned.

G13 – G17: Attributions of Responsibility

Variables G13 through G17 list a variety of suggestions the author or someone within the article may make regarding who should is responsible in addressing the cormorant issue (i.e. citizens, local, state or federal agencies, etc.). Code ***yes*** for those suggested individuals/organizations responsibility has been attributed to. *Please note that action that has already taken place or is taking place is a form of accepting responsibility.*

SECTION H: NEWS FRAMES

As mentioned earlier, framing refers to the way a piece of information is presented. In this section we want to find out how the media frames cormorants, and if this framing has changed over time. We also want to know how the articles have been framed to tell their "cormorant story."

H1: Does this article frame cormorants as a victim or as a perpetrator?

We define a victim as someone or something that suffers, loses, is targeted, or serves as a scapegoat. Specifically, we want to define cormorants as a victim if "harm" is being inflicted upon them (i.e., deformities due to PCBs, deaths due to DDT, poaching, etc).

On the other hand, we define a perpetrator as someone or something that inflicts or is accused of causing "harm" (i.e. cormorants depleting fish stocks, causing economic hardships, destroying vegetation, etc). We would also like for you to identify cormorants as a perpetrator when they are targeted by a management action (i.e. culling, egg-oiling, etc.). Although it seems like we could place this instance in the victim category, we are assuming these actions are being carried out, because cormorants were acting as a "perpetrator." The only exception to this rule would be is if the article is about one's displeasure with the management action (in this case, they would in fact be portrayed as a victim).

More than likely both risk-frames will be presented in the same article, therefore you will need to code for the risk frame that is most predominant. To do this, read each paragraph and label each (on the article) that uses a victim frame as a ***1*** and each paragraph that uses a perpetrator frame as a ***2***. If the paragraph is neutral, or doesn't discuss cormorants, label it as a ***0***. Once you've finished labeling each paragraph, count up the number of 1's and 2's.

Disregard the zeros. If your total number of 1's exceeds your number of 2's by more than one, code ***1*** for predominantly victim-frame for variable H1. If your number of 2's exceeds your number of 1's by more than one, code ***2*** for predominantly perpetrator frame for variable H1. If your number of 1's and 2's are equal or within +/- one, than code ***0*** for mixed (or equal) frame for variable H1.

H2: Does this article demonstrate thematic or episodic coverage?
Finally! The last variable asks you to make a determination on whether an article demonstrates predominantly episodic or thematic coverage. In his book *Is anyone responsible?,* Iyengar (1991) details the concepts of both of these frames.

Episodic coverage typically focuses on a single event and serves as a summary of what happened. Episodic stories are typically approached as case studies. Other characteristics of episodic coverage include:

- Describes concrete events that illustrate an issue or issues.
- Reports a specific event or case, but doesn't detail the social or political background or history of that event.

Thematic coverage, on the other hand, looks at the "big picture." An event may be discussed, but that event is placed in general context as it discusses policies or history. Thematic stories examine connections between similar events and look for trends, often asking questions like "how" and "why." Other characteristics of thematic overage include:

- Mentions trends in cormorant populations and negative impacts.
- Serves as a background report to illustrate general outcomes or conditions.
- Presents evidence (i.e., gives information about typical cormorant behavior, etc.)

Identifying an article as either episodic or thematic can be an extremely difficult task, as most thematic articles will have an episodic element. On a similar note, episodic coverage often contains thematic elements. Instead of making a single subjective decision based on each article as a whole, we'll indentify each paragraph within the story as either episodic or thematic.

Starting with paragraph 2, go through the article and identify each paragraph as either predominantly episodic or predominantly thematic. Label each paragraph with an "E" or "T" accordingly.

Once you've labeled each paragraph count up the total number of E's and the total number of T's. Code as thematic if the number of "T"s exceeds the number of "E"s by more than one and vice versa. Code a ***1*** for predominantly episodic and ***2***

for predominantly thematic. In the case that both frames are used equally, or within +/- one, than code *3* for use of mixed frames.

Here are some tips on what to look for when decided on how to label each paragraph.

Example Thematic Elements to Look For:

- Discuss cormorant trends in the area over time – increased populations, etc.
- Give biological (natural history) background information on cormorants.
- Suggestions are made to solve/remediate cormorant problems.
- Attributions of responsibility are made.
- Potential causes of the cormorant problems are addressed.

Example Episodic Elements to Look For:

- Talks about a particular management action in a specific place at a specific time.
- Talks about a specific instance of poaching.

SECTION J: ADDITIONAL INFORMATION

Due to the diversity of articles and topics re: corms in this sample, it's possible we've overlooked something extremely interesting or important. Please use this section to make any additional notes on the article that were not addressed in the previous sections, and let the project coordinator know if you see a recurring theme in articles that is not being addressed in the codebook.

References & Relevant Readings

Decker, D. J., Brown, T. L., & Siemer, W. F. (Eds.) (2001). *Human Dimensions of Wildlife Management in North America.* Bethesda, MD: The Wildlife Society.

Entman, R. M. (1993). Framing: Toward clarification of a fractured paradigm. *Journal of Communication*, 43, 51–58.

Gore, M.L., W.F. Siemer, J.E. Shanahan, D. Schuefele and D.J. Decker. (2005). Effects on risk perception of media coverage of a black bear-related human fatality. *Wildlife Society Bulletin, 33*(2), 507–516.

Iyengar, S. (1991). *Is Anyone Responsible?* Chicago: University of Chicago Press.

Siemer, W. F., Decker, D. J., & Shanahan, J. (2007). Media frames for black bear management stories during issue emergence in New York. *Human Dimensions of Wildlife, 12*, 89–100.

Wimmer, R. D., & Dominick, J. R. (2003). *Mass media research: An introduction.* Belmont, CA: Wadsworth.

APPENDIX G

Content Analysis Codebook

Cormorants in the Media
Codebook
Revised December 7, 2007

ARTICLES COLLECTED BY LEXISNEXIS SEARCH
(November 2007 SPSS Code Sheet)

Coder Initial: _____

Section A: Article Description

#	Variable Description	Code
A1	Article Number	Already Coded
A2	Name of Publication/Transcript	Already Coded
A3	Publication/Air Date – Month	Already Coded
A4	Publication/Air Date – Day	Already Coded
A5	Publication/Air Date – Year	Already Coded
A6	Newspaper/Program Origin – Country	0 = Missing (N/A) 1 = United States 2 = Canada
A7	Newspaper/Program Origin – State/Province	0 = Missing (N/A) 1 = New York 2 = Ontario 3 = Quebec 4 = Pennsylvania **[add more codes as needed]**
A8	Section/Desk/Type	0 = Missing (N/A) 1 = News 2 = Sports 3 = Opinions 4 = People 5 = Metropolitan 6 = Letter 7 = Radio Transcript 8 = Television Transcript **[add more codes as needed]**
A9	Are any photos or graphs/tables related to double-crested cormorants used in the article?	0 = None (N/A) 1 = Photo Only 2 = Graph/Table Only 3 = Both Photo and Graph/Table
A10	How many words are there in the story?	0 = Missing (N/A) 1 = < 300 words

		2 = 300 to 600 words 3 = 601 to 900 words 4 = 901 to 1,200 words 5 = 1,201 to 1,500 words 6 = 1,501 + words	
A11	How paragraphs in the story discuss or are directly related to double-crested cormorants?	1 = 1 paragraph 2 = 2 paragraphs 3 = 3 paragraphs, etc.	
A12	What is the main topic of this article? *See protocol for topic descriptions and examples.*	1 = Negative Impacts from Cormorants 2 = Agency Response to Cormorants 3 = Negative Impacts to Cormorants 4 = Aesthetic Values Placed on Corms 5 = Consumptive Outdoor Recreation 6 = Poaching 7 = Research/Education 8 = Legislation/Politics 9 = Other **[add more codes as needed]**	
#	**Does the article also discuss:**	**Code**	
A13	Negative impacts from cormorants?	1 = Yes	0 = No
A14	Agency response to cormorants?	1 = Yes	0 = No
A15	Negative impacts to cormorants?	1 = Yes	0 = No
A16	Aesthetic values placed on cormorants?	1 = Yes	0 = No
A17	Consumptive outdoor recreation?	1 = Yes	0 = No
A18	Poaching (or illegal killing) of cormorants?	1 = Yes	0 = No
A19	Research or education programs on cormorants?	1 = Yes	0 = No
A20	Politics or legislation dealing with cormorants?	1 = Yes	0 = No

SECTION B: STAKEHOLDER GROUPS

Please add additional stakeholder groups as necessary.

#	Does the article mention the following stakeholder groups…	Code	
B1	Recreational fishermen, anglers, sports fishermen, etc.	1 = Yes	0 = No
B2	Commercial fishermen?	1 = Yes	0 = No
B3	Fish farmers, Fish producers (i.e., aquaculture)?	1 = Yes	0 = No
B4	Hunters?	1 = Yes	0 = No
B5	Non-governmental organization (upset with cormorants)?	1 = Yes	0 = No

B6	Non-governmental organizations (wanting to protect cormorants)?	1 = Yes	0 = No
B7	Local (city or county) government?	1 = Yes	0 = No
B8	State/provincial government agencies?	1 = Yes	0 = No
B9	Federal government agencies?	1 = Yes	0 = No
B10	Tribes?	1 = Yes	0 = No
B11	Business owners (i.e., motel/hotel, bait-shops, charter-captains, etc.)	1 = Yes	0 = No
B12	Birders, ornithologists?	1 = Yes	0 = No
B13	Animal-rights activists?	1 = Yes	0 = No
B14	Colleges/Universities?	1 = Yes	0 = No
B15	Legislators/Politicians?	1 = Yes	0 = No

SECTION C: NATURAL HISTORY INFORMATION

#	**Does the article mention...**	**Code**	
C1	Cormorant diet?	1 = Yes	0 = No
C2	Cormorant behavior (non-diet, i.e. migration, nesting, etc.)?	1 = Yes	0 = No
C3	The cormorant is federally protected or is listed under the Federal Migratory Bird Act?	1 = Yes	0 = No
C4	Cormorant history with DDT or PCBs?	1 = Yes	0 = No
C5	Qualitative information/data about population?	1 = Yes	0 = No
C6	Quantitative information/data about population?	1 = Yes	0 = No

SECTION D: IMPACTS FROM CORMORANTS (PERPETRATOR-FRAME)
Please add additional negative impacts from cormorants as necessary.

#	**Does the article mention actual or perceived...**	**Code**	
D1	Negative ecological impacts of cormorants to Great Lakes fisheries (i.e. food webs, etc)?	1 = Yes	0 = No
D2	Negative ecological impacts of cormorant droppings?	1 = Yes	0 = No
D3	Negative ecological impacts of cormorants to vegetation?	1 = Yes	0 = No
D4	Negative ecological impacts of cormorants to other species of birds?	1 = Yes	0 = No
D5	Negative ecological impacts of cormorants to Great Lakes islands?	1 = Yes	0 = No
D6	Negative economic impacts of cormorants on tourism (must say tourism)?	1 = Yes	0 = No
D7	Negative economic impacts of cormorants on small businesses (i.e. bait shops, motels, charter-fishing companies, etc.)?	1 = Yes	0 = No
D8	Negative impacts of cormorants on recreational or	1 = Yes	0 = No

	commercial fishing?		
D9	Negative economic impacts of cormorants on aquaculture?	1 = Yes	0 = No
D10	Cormorant-related damage to residential/personal property?	1 = Yes	0 = No

SECTION E: IMPACTS ON CORMORANTS (VICTIM-FRAME)
Please add additional impacts on cormorants as necessary.

#	**Does the article mention...**	**Code**	
E1	Deaths of cormorants due to DDT?	1 = Yes	0 = No
E2	Deaths of cormorants due to PCBs?	1 = Yes	0 = No
E3	Deaths of cormorants due to chlorine?	1 = Yes	0 = No
E4	Deaths of cormorants due to poaching?	1 = Yes	0 = No
E5	Deformities (twisted beaks, clubbed feet, etc.) of cormorants?	1 = Yes	0 = No
E6	Deaths of cormorants due to New Castle Disease?	1 = Yes	0 = No
E7	Someone (or group) is making cormorants a scapegoat?	1 = Yes	0 = No
E8	Deaths of cormorants due to botulism?	1 = Yes	0 = No

SECTION F: RISK PERCEPTIONS

#	**Does the author or statements made within the article mention...**	**Code**	
F1	Satisfaction with an agency's response to cormorants (i.e., management activities)?	1 = Yes	0 = No
F2	Dissatisfaction with an agency's response to cormorants (i.e., management activities)?	1 = Yes	0 = No
F3	Worry or concern about future negative impacts **to** cormorants?	1 = Yes	0 = No
F4	Worry or concern about future negative impacts **from** cormorants?	1 = Yes	0 = No

SECTION G: PROBLEM ATTRIBUTION

Problem Causes

#	**Does the author or statements made within the article suggest that problems from cormorants are being caused by...**	**Code**	
G1	The increasing number of cormorants?	1 = Yes	0 = No
G2	Cormorants expanding their range?	1 = Yes	0 = No
G3	Agencies/managers failing to take action?	1 = Yes	0 = No
G4	Agencies/managers taking insufficient action?	1 = Yes	0 = No
G5	Agencies/managers taking inappropriate action?	1 = Yes	0 = No

Problem Solutions

#	**Does the author or statements made within the article suggest that problems with cormorants be addressed by...**	**Code**	
G6	Taking no action?	1 = Yes	0 = No
G7	Non-lethal control methods?	1 = Yes	0 = No
G8	Lethal control methods?	1 = Yes	0 = No
G9	Establishing a cormorant hunting season?	1 = Yes	0 = No
G10	Establishing legislation to deal with cormorants?	1 = Yes	0 = No
G11	Academic research?	1 = Yes	0 = No
G12	Education/outreach efforts?	1 = Yes	0 = No

Attributions of Responsibility

#	**Does the author or statements made within the article suggest that:**	**Code**	
G13	A citizen **is** taking action/responsibility or someone in the article is suggesting that citizens **should** take action/responsibility?	1 = Yes	0 = No
G14	A local (i.e. town, village, city, county, etc.) agency **is** taking action/responsibility or someone in the article is suggesting they **should** take action/responsibility?	1 = Yes	0 = No
G15	A state or provincial agency **is** taking action/responsibility or someone in the article is suggesting they **should** take action/responsibility?	1 = Yes	0 = No
G16	A federal agency **is** taking action/responsibility or someone in the article is suggesting they **should** take action/responsibility.	1 = Yes	0 = No
G17	Legislators **are** taking action/responsibility or someone in the article is suggesting they **should** take action/responsibility.	1 = Yes	0 = No

SECTION H: NEWS FRAMES

*Victim vs. Perpetrator** Do for all articles.

H1	Does this article frame cormorants as a victim or as a perpetrator? *See protocol for definitions and examples.*	0 = Neither 1 = Victim 2 = Perpetrator

*Episodic vs. Thematic** Do for all articles.

H2	Does this article demonstrate thematic or episodic coverage? *See protocol for further instructions.*	1 = Episodic 2 = Thematic 3 = Mixed

SECTION I: ADDITIONAL INFORMATION

I1	Is there anything else about this article you think is noteworthy? Please use this space to make any additional notes.