

**EVALUATING THE ROLE OF TECHNICAL WORKING GROUPS IN
DECISION-MAKING FOR FISHERIES MANAGEMENT IN BELIZE**

BY

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Abstract

The use of scientific information for evidence-based decision-making is a critical component in addressing marine environmental issues. However, ensuring that the “right” information is available for addressing these issues can be a challenge as this information often resides in different organizations with different management mandates. Consequently, many governmental organizations have utilized a range of approaches, including technical advisory committees, and working groups, to promote the development of robust solutions and recommendations for coastal and ocean management. This study examined the role of multiple stakeholders participating in technical working groups designed to assist in marine fisheries decision-making in Belize. Through interviews with three working groups – The National Hicatee Conservation Network, the Spawning Aggregation Working Group, and the Managed Access Working Group – and decision-makers in the Belize Fisheries Department, the processes of information production and pathways for policy uptake were investigated. The complexities of the science-policy interface associated with each working group were revealed. Common enablers and barriers related to knowledge exchange were identified. Recommendations for improving knowledge exchange, for example knowledge brokering, at the science-policy interfaces are presented.

Keywords: information use, decision-making, interdisciplinarity, working groups, fisheries management, policy-making, barriers and enablers, knowledge exchange, knowledge broker, Hicatee (central American river turtle), spawning aggregations

List of Acronyms

BFD: Belize Fisheries Department

CARICOM: Caribbean Community

CITES: Convention on International Trade of Endangered Species of Wild Fauna and Flora

CRFM: Caribbean Regional Fisheries Mechanism

FAO: Food and Agriculture Organization of the United Nations

ICZM: Integrated Coastal Zone Management

IPO model: Input- Process-Output model

MAWG: Managed Access Working Group

NHCMN: National Hicatee Conservation and Monitoring Network

PM: Policy Maker/ Decision Maker

SPAG: Spawning Aggregation

ToR: Terms of Reference

TURF: Territorial Use Rights in Fisheries

WECAFC: Western Central Atlantic Fisheries Commission

WG: Working Group

UNESCO: United Nations Educational, Scientific and Cultural Organization

Chapter 1: Introduction

1.1 The Management Problem

In evidence-based and evidence-informed decision-making, scientific information is expected to be considered (Gallo, 2017). However, bringing science into the policy arena can be a challenge. MacDonald et al. (2016a) describe the science-policy interface as a complex and dynamic field where various types of information are considered in the decision-making process for public policy. Policy-making and the production of scientific information are inherently different with regard to how questions and issues are addressed. Scientific research is characterised by scientific uncertainty and it is common to have debates on the “correctness” of the results (MacDonald et al., 2016b). On the other hand, public policy is intended to address a public issue or need and is often influenced by political platforms, public awareness of issues, and fast-paced policy cycles (Howlett & Mukherjee, 2017). Furthermore, the demand for information in decision-making depends on its availability from many sources, for instance local knowledge, in addition to scientific advice.

The challenge of adhering to evidence-based decision-making is a global phenomenon. Previous studies on information use in marine environmental and fisheries management contexts have shown that scientific information plays a critically important role in addressing issues, such as, overfishing, loss of biodiversity, and climate change (MacDonald et al., 2016b). However, ensuring that scientific information is available for decision-making can be a challenge as it often resides in different organizations with different management mandates (Cvitanovic et al., 2014). Though there is an exponential growth in the volume of scientific research and information, the implementation “gap” identified needs to be addressed to inform policy and decision-making (MacDonald et al., 2016b). Many reasons have been identified for this gap such as ineffective science communication, timeline differences between information production and policy cycles, and the articulation and assessment of “wicked” problems for decision makers (Cvitanovic, 2016).

Many governmental organizations have utilized a range of approaches including technical advisory committees and working groups, to promote communication of relevant information among stakeholders (Berdej & Armitage, 2016; Kowalski, 2013; Roy, 2012). Engaging multi-

sectoral groups can result in the development of robust solutions and recommendations for coastal and ocean management, given the inclusion of multiple views and the knowledge exchange among members of these groups (Crowston et al., 2015; Pascoe & Dichmont, 2017; Howlett & Mukherjee, 2017).

The Belize Fisheries Department has adopted a technical working group approach to address aspects of fisheries management. However, it is not apparent how many of these working groups produce and communicate information, and how decision-makers use this information. This study examines the role of three technical working groups in producing and communicating scientific information to policy and decision-makers with regard to conservation and fisheries management in Belize. The research will identify the enablers and barriers to producing, communicating, and using information associated with the working group approach.

1.2 Background Information

1.2.1 Belize

Belize is a small developing coastal state in Central America (Approximately 22,806 sq. km land and, 160 sq. km water) with a diverse population of approximately 360,346 (CIA, 2017). It is bordered by Mexico (north), Guatemala (west and south) and the Caribbean Sea (east) (Figure 1). As a member to the Organization of American States, and the Caribbean Community, the country is obligated to adhere to the principles of sustainable economic development and good governance. In accordance with the United Nations Convention on the Law of the Sea (1982), its territorial waters were delineated to twelve (12) nautical miles along the coast. However, in the southern district, from the mouth of the Sarstoon River to Ranguana Caye, a length of only three (3) nautical miles was declared. According to Belize's Integrated Coastal Zone Management Plan, only three nautical miles were claimed considering the proximity with Guatemala and the ongoing dispute between the two countries (CZMAI, 2016). These international and regional geopolitical structures set the context of cooperation and related national policy-making.

Preservation of the marine environment in Belize is considered as a national priority particularly since the Belize Barrier Reef System was designated as a United Nations Educational, Scientific and Cultural Organization (UNESCO) World Heritage Site in 1996. The Belize Barrier Reef System is the second largest barrier reef system in the world spanning the length of the country and consists of three atolls: Turneffe Atoll, Lighthouse Reef Atoll, and Glover's Reef Atoll

(UNESCO, 2017). Belize relies heavily on its barrier reef as it supports an array of activities in tourism and fishing and fosters economic development by supporting many industries (CZMAI, 2016). The fisheries resources provide a primary source of protein to its nationals. Capture fisheries and aquaculture are valued at more than 30 million USD (Villanueva, 2013) and contribute to a significant portion to the country's GDP. The reef structure provides protection from natural disasters. Establishing actions to ensure the resilience of the reef ecosystem to changes caused by natural and man-made factors is extremely important. Consequently, decisions related to the exploitation and management of the reef must be based on sound science and reliable information.



Figure 1. Map of Belize showing the barrier reef and atolls (Belize.com, n.d.)

1.2.2 Fisheries Management in Belize

The main fisheries of the country are spiny lobster (*Panulirus argus*), queen conch (*Strombus gigas*), and finfish (*Lutjanus sp.*) that support approximately 2,500 fishers and their families (CZMAI, 2016). A number of smaller fisheries are also recognized and include, sea cucumber, shark, and other deep-sea species.

Given the inextricable connection with the sea and recognizing the importance of fisheries governance, the Belize Fisheries Department was established in 1977 through the Fisheries Act Chapter 210 of the Laws of Belize. Divided into four units (Policy and Planning, Conservation and Compliance, Ecosystem Management, and Capture Fisheries), the department is responsible for enforcing fisheries law, protecting sensitive biodiverse areas, and managing fish stocks in Belize (Belize Fisheries Department, 2017). The department, along with other sectors, have highlighted their ongoing commitment to achieving national goals for conservation, sustainable fisheries, and coastal zone management (CZMAI, 2016). For instance, the department has addressed the sustainable management of fish stocks by conducting scientific research to provide information to guide the regulation of fisheries (regulatory research or science). Management of each fishery considers the biology of the species, the fishing pressure and existing management plans or policies. For example, management of the queen conch fishery is based on quota allocations and minimum size limits, and is guided by the Convention on International Trade of Endangered Species (CITES) as the species is listed under Appendix II (CITES, n.d.). In another example, management of the spiny lobster fishery is based on minimum size limits, a closed season, and follows the guidelines of regional fisheries bodies (Belize Fisheries Department, 2017).

The development and implementation of management measures are determined by the information available on a regional and local scale through regional management plans and data collected by the department. The common information sources for decision-making by the Belize Fisheries Department include: regulatory research, independent research by external bodies, administrative data collection (licensing), and information from technical working groups. Since the early 2000s, the Belize Fisheries Department has sought the assistance and support of external bodies, including other governmental organizations, academic institutes, non-governmental organizations (NGOs), the fishing industry, and community groups in addressing the different and competing national goals.

1.3 Purpose and Scope of the Research

The objective of the research is to determine the role of three technical working groups in producing and communicating scientific information to policy and decision-makers with regard to conservation and fisheries management in Belize. These working groups are:

- **National Hicatee Conservation and Monitoring Network:** Tasked with the monitoring and conservation of the hicatee turtle (*Dermatemys mawii*).
- **Spawning Aggregation Working Group:** Tasked with the management and monitoring of fish spawning aggregation sites in Belize.
- **Managed Access Working Group:** Tasked with the implementation of a national Traditional User Rights in Fisheries (TURF) system in small-scale fisheries.

The research methods used in the Belize case study were developed during an internship with the Environmental Information: Use and Influence research program (EIUI), in the Faculty of Management, Dalhousie University. Current scientific articles on information use in decision-making and characteristics of the science-policy interface were discussed through weekly meetings. The research proposal was developed during the internship. The main objective of the study of fisheries decision-making in Belize is to highlight how stakeholders representing organizations with different mandates participate in working groups. The role(s) of these multiple stakeholders assisting in marine fisheries decision-making in the groups will be defined. Enablers and barriers to production and communication of information and its uptake by policy-makers and other audiences will be revealed. Insights gained on the influence of technical and interdisciplinary groups in decision-making will be used to determine the effectiveness of the working groups.

Detailed analysis of the characteristics of the information pathways in the working groups will provide recommendations to address and enhance production, communication, and use of information in decision-making. The study will be beneficial in informing future multi-sectoral collaboration in integrated coastal and ocean management in Belize. The results of this study provide a baseline for future studies within this region. The insights and recommendations related to information production, communication, and use in decision-making can guide the working groups in their multi-sectoral collaborations. The results of the study will add to the growing body of literature on information use at the science-policy interface.

Chapter 2: Literature Review

2.1 Outline

A review of the literature on evidence-informed decision-making was conducted to provide current perspectives on collaboration among multiple stakeholders working in marine contexts. Existing theory on the role of information in evidence-based decision-making in marine sectors was also reviewed. Searches of the academic literature in databases such as Web of Science were conducted and relevant articles were retrieved from peer-reviewed journals. Search terms included: working groups, boundary organizations, evidence-based decision-making, and the science policy interface. Section 2.2 describes the existing research and important concepts on the science-policy interface specifically with regard to knowledge production by interdisciplinary working groups. Section 2.3 describes methods of improving and measuring use of information in decision-making for public policy such as boundary organizations, and knowledge brokering strategies. Section 2.4 describes the role of working groups in conservation and fisheries management and provides essential background on the three working groups that are examined in the Belize case study. The characteristics of the three Belize working groups were obtained from public documents obtained through Google searches that were completed prior to the field research. Details of the production, communication, and use of information by the Belize working groups and policy-makers were obtained in the data collection phase described in Chapter 3.

2.2 Important Characteristics of the Science-Policy Interface, Evidence-Based Decision Making, and Information Use

Described by Nutley et al. (2007, p23), “Research is a form of evidence, and evidence is one source of knowledge”. The use of evidence in decision-making assists policy makers to make well informed decisions on public policies (Nutley et al., 2007). It is also important to decipher between knowledge and scientific research to further understand what policy makers receive and utilize in the decision-making process. Scientific research refers to the activities in producing and interpreting data from findings and thereby resulting in scientific information (Roux et al., 2006). Knowledge refers to the larger body of information including experiences and values. Nutley et

al. further theorise that knowledge can be categorized as empirical, theoretical, or experimental where information derived from each is dependent on the methodological approaches.

The science-policy interface is described as a complex and dynamic field where information flow between scientists and policy makers is influenced by different decision-making and policy-making contexts (MacDonald et al., 2016a; Soomai, 2017). Understanding the communication of information at the interface is an increasingly critical field of study given the exponential growth of scientific information produced each year (MacDonald et al., 2016b). Policy makers may need assistance in accessing this information for the development of robust management measures.

The growing body of knowledge on the science-policy interface focuses on strategies used to improve knowledge transfer and promote evidence-based or evidence-informed decision-making. Characteristics that define the interface include the actors; the information itself, including how it is framed and presented; the decision-making context; and institutional arrangements in organizations where knowledge exchange occur (MacDonald et al, 2016b). These characteristics influence the flow of information and its uptake in decision-making as illustrated in the conceptual framework shown in Figure 2. The framing of scientific information for policy-makers also influence the uptake of information in decision-making. Framing scientific research for political gain in debate is an issue when considering scientific research use in the policy arena (Forbes, 2011; MacDonald et al, 2016b). This may negatively affect scientific research being conducted on the issue and can cause undue pressures such as negative public perception on scientific research on the topic and the misuse of information (Forbes, 2011; Roux et al, 2006). A prime example is the scientific information produced on the topic of climate change where initial observations by scientists were communicated and widely misinterpreted and misused to promote climate skepticism (Bertolotti & Catellani, 2014).

Other inherent characteristics highlighted by MacDonald et al. (2016b) include: scientific uncertainty, the politicizing of science, and the misuse of information in decision-making. Though these characteristics are perceived as negative, it is important to recognize and understand how they also influence the process of evidence-based decision-making. All scientific research and information produced also comes with a degree of uncertainty. It is important for scientists and researchers to present this uncertainty to policy and decision makers to allow them

to make appropriate decisions given the full understanding of the risk involved in recommendations given.

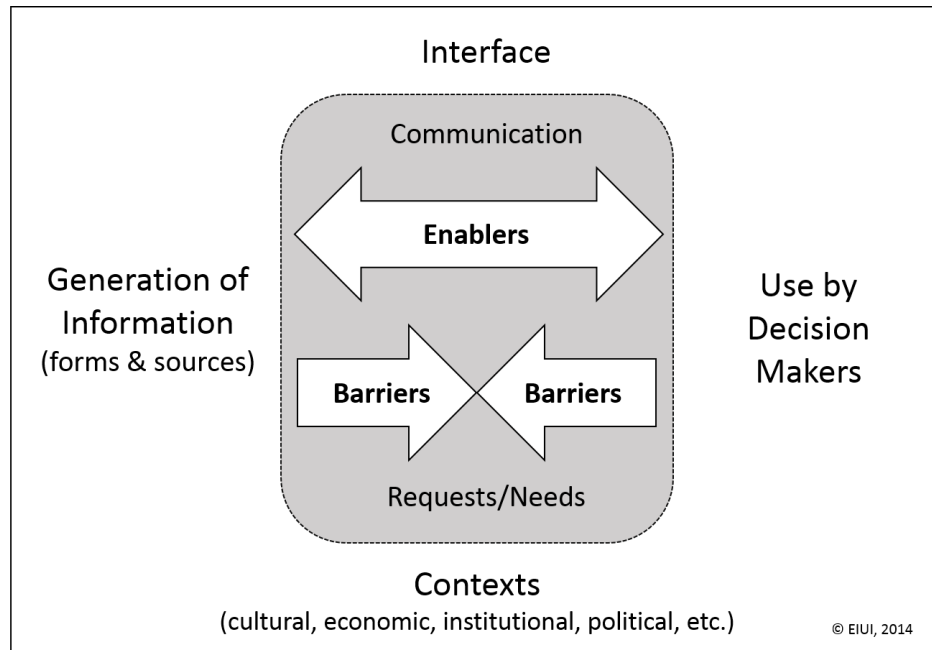


Figure 2 Key elements of information flow at the science-policy interface(s). Taken from MacDonald et al, (2016b, p9)

Dependent on the context of the research being undertaken, results geared towards decision makers need to be communicated in a way that is accessible (Steiner et al, 2014) and, tailored to specific use (Jacobson et al, 2013). This is not an easy process, due to the complex nature of scientific research and scientists may find it difficult to compress findings in a readable document that can influence or enhance awareness of the policy maker (Druckman & Lupia, 2017). Continuing with the example of climate change, interviews done with policy makers in the UK have produced findings that recommendations produced by the IPCC for each region is not specific enough on an individual country context (Howarth & Painter, 2015). Even though climate change is recognized as a major issue by policy and decision makers, the recommendations produced by the IPCC reports are not context specific and may be challenging to implement within some countries (Howarth & Painter, 2015).

The challenge of assessing the interface grows when trying to determine a measure of use and influence of information. Earlier studies have explored what is meant by “information use”. Weiss (1979) outlines seven types of research use: knowledge-driven, problem-solving, interactive, political, tactical, enlightenment, and research as part of the intellectual enterprise society. This categorization method tends to place information use in a linear model that describes a specific use and reason for research. Expanding on Weiss’ categorization, Nutley et al. (2007) describe use of information from research as a spectrum ranging from increased awareness of issues (conceptual) to practice and policy changes (instrumental) (Figure 3) where instead of an incremental linear model, information use may move back and forth between the two extremes of the spectrum. This is considered to be a more realistic understanding of information use rather than the linear model.

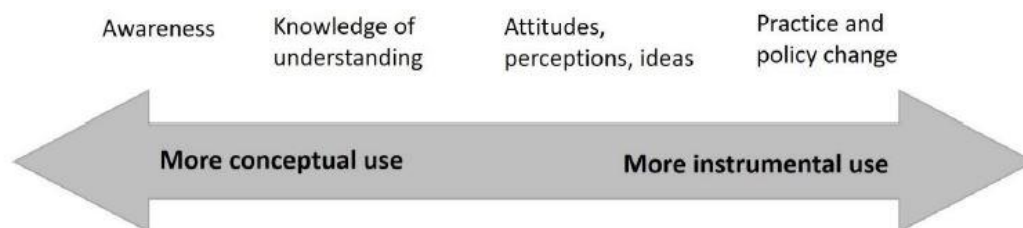


Figure 3 Continuum model of information use (Soomai, 2015, p18 adapted from Nutley, Walter, and Davies, 2007, p51)

The attributes of scientific information – credibility, legitimacy and, saliency (relevance) – can also influence its use in policy and decision-making (Cash et al, 2002). Where, credibility is observed when the actors or users of information perceive the information as meeting the standard scientific requirements. Legitimacy is seen when the user perceives the process by which information is produced as fair and all appropriate parties have been involved. Saliency refers to the relevance of the information to the current issues identified by users. Saarki et al (2014) further explain that a balance and trade-offs among three characteristics need to be considered in ensuring that information is taken up in decision-making processes. These three attributes influence the use of information by decision makers as they are seen as the “best available evidence.” Scientists are advised to consider these characteristics when framing their findings.

2.3 Methods to Improve the Communication of Information at the Interface

Previous studies have focused on the characteristics of the science-policy interface and strategies to bridge the gap between the two disciplines. Some have focused on identifying pathways to which scientific information travel to multiple stakeholders and how policy makers use such information for decision-making (Soomai et al, 2011; Soomai, 2017). Technical reports produced by national and intergovernmental organizations provide an important source of advice for decision-making for fisheries management and for implementing conservation measures in MPA management. However, investigating use by policy makers is dependent on the enabling factors of framing, context specificity, and the accessibility of scientific information (Cvitanovic et al, 2014; Soomai 2017; Soomai et al, 2011). Studies on the use of technical reports and scientific information produced for use in decision-making show that policy makers may use the information provided in such reports to a certain degree based on the spectrum outline by Nutley et al (Figure 3).

While studying the science-policy interface has provided details on the benefits, and challenges of influencing information uptake, important insights to improve information transfer have also been revealed. Many strategies and methods can be used to assist in bridging communication gaps at the interface. For instance, the importance of collaboration among multiple groups. Richards (2017) lists seven beneficial outcomes for developing and maintaining collaboration: effective gathering of information, improved access to information needed for evidence-based decision-making, increased capacity, relevant framing of research findings, opportunity for feedback by involved participants, ability to convene participants more effectively given the established relationship, and increased resources through pooling. By involving multidisciplinary actors and stakeholders in the scientific information production process for policy-making, it may also increase trust and likelihood of the success of policies (Massauae et al, 2016). Collaboration between multiple stakeholders and the government may come at different stages: communication, consultation, and participation where the level of involvement and communication type differs (Massaua et al, 2016). By increasing participation, the legitimacy, credibility and saliency of information may also be increased, thereby influencing its use in policy and decision-making. Information transfer in pathways for decision-making, may be improved by using less technical language, framing issues to fit relevant issues, and increasing meetings between actors (Soomai, 2011). Massaua et al, (2016) stress the importance of

developing institutional arrangements for involving these actors and for incorporating science for successful management and conservation.

Other research on collaboration for evidence-based decision-making are focused on the administrative aspects and the dynamics between actors (Crowston et al, 2015). The literature on organizational discontinuity theory demonstrate the use of participant observations, surveys and, in-depth interviews to describe the strengths and weaknesses of interdisciplinary groups. Meeting frequency and length, geographic location, and different cultures (among disciplines) were identified as common factors that influence the operations and achievement of their goals. The characteristics of the science-policy interface and stakeholder collaboration in information production will be considered in this case study.

Studies on the institutional aspects of the interface describe the creation of roles and organizations to bridge the science and policy disciplines. These individuals or organizations may best be described as boundary or bridging organizations to enable information uptake in decision-making. Boundary work spans the two disciplines (science and policy) and employs specialists to act as a bridge for science communication to policy and decision makers (MacDonald et al, 2016). Gustafsson & Lidskog, (2017) review the concept of boundary work and identify how boundary organizations have evolved to mediate between science and policy to achieve goals in both spheres. There is no one institutional arrangement for a boundary organization or a single method that can be applied to bridge the interface.

Bandola-Gill & Lyall (2017) state that despite the commonalities in roles, creating a single definition for boundary work is problematic due to the different standpoints and perspectives of researchers (science) and decision makers (policy). The term knowledge broker is often used to describe a person or organization performing boundary work to mediate or link researchers and decision-makers in support of evidence-based decision-making (Bandola-Gill & Lyall, 2017; McDonald et al., 2016; Cvitanovic, 2015; Strydom et al., 2010). Cvitanovic (2017) outlines three main benefits of utilizing knowledge brokers in evidence-based decision-making: the individual or organization possesses a strong network of scientists and decision-makers, they can assist researchers in understanding governmental processes, and they can identify the most appropriate pathways in which research may be incorporated into decision-making. Knowledge brokerage is based on three main strategies: it may be information-oriented, relationship-oriented, or co-

production-oriented (Bandola-Gill & Lyall, 2017). Knowledge brokering, and organizational learning are concepts that support the role of boundary organizations, particularly with regard to navigating the socio-political aspects of managing “wicked problems.” For example, the Intergovernmental Panel of Climate Change (IPCC) is commonly regarded as a global boundary organization where climate scientists discuss current research and develop recommendations for governments within each region (Gustafsson & Lidskog, 2017). Bridging organizations and their role have also been explored when understanding their role in different environmental contexts such as tidal power (Wilson & MacDonald, 2018). In this Canadian example, it was found that Government, NGOs, and researchers perform boundary work such as “coordinators, connectors and information mediators.” The actions of these groups, particularly NGOs, are considered to be more credible because the organizations adopt a sense of neutrality rather than promote agendas as do industry actors. These examples offer important insights into the range of boundary work organizations can engage in, depending on the level of involvement of different actors.

Co-production of information is another strategy used by organizations where partnerships among multiple groups allow for the systematic development of scientific information to be used in decision-making (Klenk & Wyatt, 2015). Research policy partnerships offer an opportunity for different disciplines to provide various insights and information into addressing a problem. By incorporating multiple streams of knowledge, credible, legitimate and salient information may be produced. Interestingly, though knowledge brokering and its factors for facilitating information uptake into policy has been widely studied, the timing of the release of information or of boundary work are critical to effective communication at the interface (Knaggård, 2015).

2.4 Importance of Interdisciplinary Working Groups

Interdisciplinary working groups are a common tool used for evidence-based decision-making and policy support and are found in many disciplines and at different scales of governance such as national, and regional scales. Interdisciplinary groups describe an assembly of individuals with different educational or professional backgrounds that collect, discuss, produce and, communicate information on a shared interest or issue (Crowston et al, 2015). The composition and format of such groups can influence information production processes, as seen in Crowston et al (2015) in their investigation of the Data Observation Network for Earth (DataONE) transdisciplinary project created to design a “cyberinfrastructure platform” for readily accessible

science information. Within the study, members identified that given the diverse background of its members, it was able to come up with creative solutions for the design. Thus, having a diverse membership can influence the objectives and outcomes that were set out for the groups.

Working groups in the health sector have also been studied. Working groups are often comprised of experienced medical doctors, pathologists, and veterinarians all of which provide their opinion and diagnosis. Studies have shown that such working groups provide an unbiased assessment to previous controversial studies in health cases (Mann & Hardisty, 2014). Once consensus is reached on possible recommendations, the reports produced from the cases discussed by the working group are passed on to the Centre for Disease Control (CDC) along with recommendations for future studies and tests.

Working groups within the European Union (EU) are designed to act as communication channels for technical and political players in negotiations of policy formulations for EU legislation. Fouilleux et al., (2005) investigated five groups and found that they not only operate on a technical level of providing information but are also political, where members are bound by their national interests. These groups are directly built into the EU institutions and their rules and procedures are shaped by the EU. It was found that the working groups' framing and politicisation of technical and scientific information to support policies and legislation is far more important than the specific policy objectives of member countries.

At its most simplistic form, working groups may be classified as a "team" based on the characteristics of Kozlowski & Ilgen (2006). A team is described as having two or more members who meet or interact regularly to perform tasks to achieve a commonly shared goal. Other features of a team include organizational characteristics, and individual roles and responsibilities. The authors also describe measuring effectiveness of a working group in the Input-Process-Output (IPO) model where effectiveness can be defined as the overall success or achievement of the desired result at each stage in the IPO model.

As illustrated by the examples above, working groups can be used in a variety of management contexts across different disciplines. The studies of working groups at different governance levels provide insights into their procedural aspects and highlight the importance of context in influencing the characteristic of information production within the working groups. Working groups in conservation and fisheries management exhibit similar characteristics of

interdisciplinary research, co-production of knowledge, and framing of scientific information for decision-making.

2.4.1 Fisheries Management Working Groups in Belize

The science-policy interface in fisheries management in Belize is demonstrated in governmental activities related to regulatory and independent research for consideration for policy-making. In fisheries management, the Capture Fisheries Unit (CFU) of the Belize Fisheries Department collects data on economically viable fisheries and conducts analyses to provide information for decision-making. For example, the conch fishery is managed through a quota system that is determined annually by biennial independent surveys as well as annual trends of the fishery. Recently, the adaptive management framework (AMF) was implemented by the department to make informed decisions given the limited data available (McDonald et al., 2017).

The department also utilizes bridging strategies, such as technical working groups, for involving multiple actors and stakeholders in fisheries management. Examples of three working groups that are coordinated by the Capture Fisheries Unit include: the National Hicatee Conservation and Monitoring Network, the Spawning Aggregation Working Group, and the Managed Access Working Group. Each group has a fisheries-oriented mandate and a focal point within the Belize Fisheries Department (BFD). Working group members have either been assigned or volunteered to participate depending on the organization that they represent. The mandate of each working group is described in the following section.

2.4.1.1 National Hicatee Conservation and Monitoring Network

Tasked with the conservation and monitoring of the Central American river turtle (*Dermatemys mawii*), the National Hicatee Conservation and Monitoring Network was formed in 2012 (Rainwater et al., 2012). The group was created in response to the outcome of two assessments showing a significant decrease in the hicatee population size (Polisar & Horwich, 1994; Rainwater et al, 2012). The species is hunted for its meat as it is a source of protein in rural communities (Vogt et al., 2006). Given the current status of the species, it is listed as critically endangered under the International Union for the Conservation of Nature (IUCN). The BFD and supporting environmental non-governmental organizations (eNGOs) have formed this network to further investigate and spread awareness of the critical status of the species. As the current laws stand, the hicatee is not fully protected and is still hunted (Fisheries Regulations, 2003). While

the information produced influences individual organizations and their policies, the recommendations for amendments in regulation are still in revision.

2.4.1.2 Spawning Aggregation Working Group

Spawning aggregation sites in Belize show a significant decline in the abundance of Nassau Grouper (*Epinephelus striatus*) due to heavy fishing pressure (Heyman & Requena, 2002, Heyman et al., 2005). Given the recognition of the management problem highlighted by the supporting research, the Spawning Aggregation Working Group was initiated in 2001. According to Gibson et al. (2007), the objectives of the group were to: provide recommendations for management of spawning aggregations, determine the economic impact of the recommendations, explore economic alternatives to fishing Nassau grouper aggregations, establish a monitoring program for spawning aggregations, prioritize future research objectives, and to explore co-management options. Protection for 13 of the 16 spawning aggregation sites was achieved in 2002. The objectives of the group further evolved to incorporate stakeholder involvement; data collection, storage, and dissemination; and to provide information and build support for management and protection of these sites (Cho-Ricketts 2015; Gibson et al., 2007).

With an established open and closed season for fishing Nassau Grouper, and established protected sites (Fisheries (Nassau grouper & species protection) Regulations, 2009), the working group's work plan (2015) focussed on these information types at different times of the year.

Additional information on this group is available in newsletters, websites (Spagbelize.org, 2017), and published scientific papers on the biology and species identification protocols (Heyman & Requena, 2002). The status of these aggregations is also discussed at the regional level at the Caribbean Fishery Management Council (CFMC)/Western Central Atlantic Fishery Commission (WECAFC)/ Organization of the Central American Fisheries and Aquaculture Sector (OSPESCA)/Caribbean Regional Fisheries Mechanism (CRFM) Working Group on Spawning Aggregation. The terms of reference for the regional working group are similar to that of the Spawning Aggregation Working Group (WECAFC, n.d.).

2.4.1.3 Managed Access Working Group

Over the years, the steady increase of fishing pressure has been recognized by fisheries authorities, co-managers, NGOs, and stakeholders. The strategy of Territorial Use Rights in Fisheries (TURFs) was recognized as a fisheries approach to address compounding problems in

fisheries management such as limited data availability and illegal, unreported, and unregulated fishing. The Managed Access Working Group, comprised of high-level managers and decision makers, was created from the initial taskforce that was formed in 2009 to oversee two TURF pilot projects in Belize. The pilot sites served as a precursor for the implementation of a wider national program (Fujita et al., 2011; Foley, 2012). Testing of the pilot projects required extensive support from stakeholders and the government. Following continuous review and buy in from stakeholders, the pilot projects were considered to be successful. Nair & Howlett (2017, p33) recognize such approaches as policy experimentation where pilot sites are “a predictive tool deployed by various agencies to pre-test different programmes and policies for their likely impacts, process of implementation and stakeholder acceptability in advance of launching them at a larger scale”. In this regard, the Managed Access Working Group was tasked with developing the overall design of the national TURF program.

2.5 Summary

The literature review provided important background and context for investigating the three technical working groups in this Belize case study. The research will consider the characteristics of the science-policy interface and the categories of information use in the context of the operations of the working groups. This current research focuses on empirical knowledge or output produced by working groups that rely on quantitative or qualitative research. Such output includes monthly technical reports and biological and socioeconomic assessments in which management recommendations are presented. The three characteristics of information (credibility, legitimacy, and saliency) will be considered when discussing these information outputs as well as how policy makers use the information they are provided with. These aspects will be explored in Chapters 4 and 5.

Chapter 3: Methodology

3.1 Research objectives and questions

Common methodologies to examine how information is produced by interdisciplinary groups and boundary organization, and communicated to policy makers include: social network analysis (Kowalski, 2013; Wilson & MacDonald, 2017), citation analysis (Cvitanovic et al, 2014; Klenk & Wyatt, 2015), interviews (Crowston et al, 2015; Cvitanovic et al, 2016; Ross 2015; Soomai et al, 2011), focus groups (Crowston et al, 2015), and workshops (Howarth & Painter, 2015). The Belize case study utilizes interviews of key participants in fisheries management to examine the role of three working groups in providing information for policy-making in the Belize Fisheries Department. The research asks three main questions:

1. What are the mandates and composition of each working group?

This question focuses on the characteristics of the groups and will reveal the role of each member representing different organizations.

2. How is information produced in each working group and communicated?

This question focuses on the information production process of each group (the types of output produced, how this information is used by group members, and how it is communicated to decision-makers and other groups). Communication within each working group will also be revealed.

3. How do policy and decision-makers use the output of the working groups?

This question focuses on information use by decision-makers in the Belize Fisheries Department and other decision-making communities.

The research questions provided an opportunity to investigate the barriers and enablers in the information production and communication processes of the working groups through to decision-making by policy makers. Research ethics approval was obtained to conduct the research (Appendix 1). The sample size, data collection, and analysis are described in the following sections.

3.2 Data Collection

3.2.1 Sampling

The case study focused on the operations of the three working groups described in Section 2.4:

- National Hicatee Conservation and Monitoring Network
- Spawning Aggregation Working Group
- Managed Access Working Group

The research targeted working group members and decision makers. The membership of each working group ranges between ten (10) and twelve (12) individuals. There is a total of five (5) decision makers in the Policy and Planning Unit of the Belize Fisheries Department and their responsibility is to advise the fisheries administrator on policy issues, budget, annual planning, and liaising and coordinating with other fisheries technical units within the department. To carry out these activities, members of this unit require the most up to date information on fisheries and marine conservation activities to advise and make the appropriate decisions. E-mails were sent to all individuals of the targeted groups.

The number of respondents was identified as fifteen (15) members from all working groups and two (2) decision-makers from the department (n=17) (Table 1). The response rate is estimated at 50% of the target population of the working groups and 40% of the Policy and Planning Unit. The information collected was considered to be robust as responses from each working group and the policy unit were similar and no new insights or comments were made. The 50% and 40% response rates were deemed to be representative of the views of the respective target populations.

Table 1. Number of policy makers and working group members who were interviewed.

Group	Number of Responses
Policy makers	2
National Hicatee Conservation and Monitoring Network	4
Spawning Aggregation Working Group	6
Managed Access Working Group	5
Total	17

3.2.2 Interviews of working group members and decision-makers

Interviews of working group members were conducted using an open-ended interview protocol (Appendix 2). Policy-makers or decision-makers in the Belize Fisheries Department were

interviewed using a separate interview protocol (Appendix 3). All members of the working groups and the policy unit were contacted via email by the principal researcher using the recruitment message (Appendix 4) and the consent form (Appendix 5). Interviews were conducted in person in Belize in July and August 2017. When a face-to-face interview was not possible, the researcher offered to interview respondents by telephone or Skype.

The interview questions were designed to develop an understanding of the information pathways that is, the flow of information from its production through to dissemination and its use (Appendix 2 and 3). The first section of the interview protocol aimed at working group members was designed to gather information about their professional backgrounds (Appendix 2). The second section was designed to obtain details on the operations of the working groups. Members of the working groups were asked to describe their individual roles in their organization and how they participate in working group activities, including, information production and dissemination. The objectives of the three working groups and the respective organization's mandate of the member of the working groups were examined. The presence of a mandate (aim, mission, vision statement, and terms of reference) specifies the purpose and formation of the organization. By asking each member about the mandate of their organization as well as the objectives or mandate of the working group, insights will be gained on the interests and the contribution of the organization and its representative in the working group. The description of the objectives of the working groups were developed based on the responses of members and policy-makers.

The final section of the interview protocol asked questions about the output from the working groups and its use. The interview protocols for both working group members and decision makers also contained some common questions which allow for comparison of responses. The interview protocol for decision makers was designed to assess the direct and indirect use and influence of information for decision-making in the policy-making process (Appendix 3). The decision-makers were asked to describe the different mandates and expected outcomes of each group. They were also asked to describe how they use the output of the working groups.

Face-to-face interviews provided an opportunity for the researcher to encourage the participants to speak freely and to elaborate on responses to questions. Probing questions were used to gain additional information. By allowing the participants to talk freely, responses to questions

provided further insights specific to each group as well as problems encountered. As a result, the use of expert interviews for the two target populations provided substantial amounts of qualitative data to develop an understanding of the role of the groups in the production, dissemination, and use of information for fisheries and conservation management. The interviews also provided further insights on how membership may influence information production as well as other characteristics of collaboration between organizations. All interviews were audio recorded, and detailed field notes were made.

3.3 Data Analysis

3.3.1 Transcription of Interview Responses

All interview data from notes and digital recordings were transcribed verbatim in Microsoft Word. To ensure the anonymity of individual responses, each participant (both working group members and policy makers) was assigned a unique alpha-numeric code. The working groups were identified as:

National Hicatee Conservation and Monitoring Network- “WG1”

Spawning Aggregation Working Group- “WG2”

Managed Access Working Group- “WG3”

An alpha-numeric code was assigned to each participant. For instance, “WG” refers to “working group”, the first participant in WG3 was labelled as “WG3-1,” the second as “WG3-2,” and onwards. Similarly, policy makers were identified as PM1, PM2, where “PM” refers to “policy-maker.”

3.3.2 Coding and interpretation of interview responses

The textual data from the 17 interviews were analyzed to obtain descriptions of the working group processes, such as, details of information production, communication, and use. Using the methodology described in Coffey and Atkinson (1996), interview responses were coded to generate themes or concepts to enable rigorous analysis of the data. The interview responses were read carefully, at least three times, to identify broad themes that emerged from the data to describe information production, communication, and use. Using this inductive approach, the

interview responses were first coded manually and then imported into the qualitative research software, NVivo 11, for further coding and analysis (QSR International, 2017).

A total of 255 codes were generated. Codes were organized under seven main themes: Working group characteristics, information production and communication, use, policy views, suggestions for improvement, barriers, and enablers. Sub-themes were coded under each of the seven main themes thereby creating a two-level hierarchical coding structure. Appendix 6 contains the list of codes (main themes and sub-themes) that were generated from the analysis. An independent researcher reviewed the coding of the interview data to ensure that there were no biases in the coding process.

Detailed analysis of the interview data was completed in the NVivo software through queries of the multiple codes (main themes and sub-themes) within each working group and across the three groups. Queries of the coded themes in NVivo generated the number of individuals that identified a theme, the number of times each code was used, and the appropriate references (excerpts of the interview data). Codes overlapped in some instances in the interview data. As a result, one reference may be categorized under multiple codes. Common themes with regard to production, communication, and use across the three working groups were observed, in addition to themes that were unique to a particular group.

A summary of the themes from the analysis of the interview data will be discussed in the following Chapter. The themes that were generated were used to develop detailed descriptions of the roles of working group members and policy makers; and the enablers and barriers to producing, communicating, and using scientific information in policy-making for fisheries management and conservation in Belize. A substantive amount of qualitative data was collected to increase understanding of the overall processes in each working group and the science-policy interface associated with each group. The data was also used to determine the effectiveness of the working groups in decision-making.

Chapter 4: Results

4.1. Overview

This Chapter describes the role of the three technical working groups in producing and communicating scientific information to policy and decision-makers with regard to conservation and fisheries management in Belize. The analysis included a comparison of responses of the working group members and the policy-makers to provide insights on the role of group mandates, membership, and information output in decision-making.

Section 4.2 outlines the structure of the working groups by describing the composition, identified roles, and administrative operations. Section 4.3 explains the information production process and includes the methods used, the information products, and how the information is disseminated. Section 4.4 describes how the policy makers use the output of the working groups in policy and decision making. Section 4.5 presents conceptual diagrams to illustrate the information pathways for each working group. Section 4.6 presents the barriers and enablers identified for the information pathways for all working groups. Direct quotations from the interview responses are used to illustrate the perceptions of working group members and policy makers with regard to the identified information pathway and the associated barriers and enablers.

4.2 Working Group Objectives, Membership, and Operation

Working group members who participated in the research belonged to different sectors, including research, non-governmental organizations, and government. (Table 2).

Table 2. Description of policy makers and working group members who were interviewed

Group	Sample Size	Organization Type			Expertise and Back ground				
		Research	NGO	Government	Education/ Teaching	Agriculture/ Aquaculture/ Fisheries	International Relations	Management	Science
Policy Maker	2	0	0	2	0	1	0	1	1
National Hicatee Conservation and Monitoring Network	4	2	0	2	2	0	0	2	4
Spawning Aggregation Working Group	6	3	2	1	1	0	0	2	4
Managed Access Working Group	5	1	2	2	0	0	1	2	3
Total	17	6	4	7	3	1	1	7	12

It is important to note that seven (7) of the 17 respondents were from governmental organizations, and six (6) were from academic institutions. Science was the most common discipline with 12 of the 17 participants having scientific training in addition to other disciplines such as management and education. Membership of the Spawning Aggregation Working Group and Managed Access Working Group also included representatives of the fishing industry, however, were not available for participation.

Two of the three working groups, Managed Access and Spawning Aggregation Working Groups, stated the presence of a Terms of Reference (ToR) describing the objective, activities, and membership. Participation in a working group was sometimes a means of achieving the mandate of an organization. Drawing from the responses of the policy makers, the working groups were created using a similar approach based on the recognition of a problem and the need to obtain information to address the problem, i.e., for evidence-informed decision making.

Participants stated that the National Hicatee Conservation and Monitoring Network was created to conduct activities focused on the awareness, research, and enforcement components of the conservation of the Central American river turtle species in Belize. Core members meet at least once a year to discuss and coordinate awareness efforts, as well as discuss potential research to

understand the biology of the species. The Spawning Aggregation Working Group was created to monitor and determine the status of protected spawning aggregation sites as well as to produce information for public (and policy) awareness. It is the oldest group of all three that were studied. Members gather quarterly to coordinate and plan monitoring as well as discuss public awareness efforts each year. The Managed Access Working Group was created to oversee and to advise the policy process needed to implement a national Territorial Use Rights in Fisheries (TURF) approach in Belize. Members gather quarterly to update components of its implementation: licensing and allocation, enforcement, catch-data collection, and area specific committees.

There were similar and different membership roles within each working group. The common roles in all working groups were: chairman/chairperson/chair, secretary, facilitator, and data collector positions. Based on the interview responses, these roles are defined as:

- The Chair role is the person who sets the agenda, announces and leads working group meetings, and oversees all activities within the working group. The chair is also tasked with the development of an annual report and to record activities of the group. Chairs who were interviewed have highlighted both administrative and technical duties, however, the administrative role is considerably more prominent.
- The Secretary has an administrative role and develops minutes of meetings, draft agendas, and follows up with members for information collection and dissemination. The secretary also plays an important role in communication function within the group.
- The Facilitator is the liaison between the Belize Fisheries Department and the working group, and communicates information from the working group to the policy makers. Though not an explicitly identified role, the facilitator provides a direct route for information flow to influence policy and change.
- The Data Collector or technician is an individual tasked to gather data or information (biological, socio-economic) to report to the group. These members also participate by offering insights and discussion on the analysis of data.

The roles stated above are not mutually exclusive. For example, the chair of working groups may also be the facilitator to the department.

The National Hicatee Conservation and Monitoring Network also have a unique classification for its membership structure. The working group members described these as: Core Members and the Wider Network. These terms indicate the level of involvement where core members are engaged in the activities of the group while members of the wider network only receive information on the activities and are not directly involved in its production. All participants interviewed for this group were core members. The core members are considered to represent the working group while the wider network is viewed as an audience. As one participant emphasised:

In terms of the wider network, they aren't as privy as the core group members in terms of meeting discussions... the wider network just gets updates. If they have concerns or queries, then they communicate back to us via email. A lot of these members from the wider network they aren't as involved in the conservation and management aspects ... they have an interest. WG1-02

Each working group gathers for face-to-face meetings conducted by a chairman and noted by a secretary. Using an itemized agenda, each member is given a chance to update the group on individual activities and to coordinate efforts on upcoming group activities. Meeting frequencies differ across the group. The contribution of each working group varies. For example, the National Hicatee Conservation and Monitoring Network provides updates on individual activities, the Spawning Aggregation Working Group contributes data for discussion and analysis, while the Managed Access Working Group actively formulates plans for policy and operation. There are however, notable differences among the operational aspects of each group. For instance, the chair position of the National Hicatee Conservation and Monitoring Network and the Spawning Aggregation Working Group is rotated within a given time span whereas the Managed Access working group has a fixed chair position with the fisheries department.

4.3 Information production and dissemination

Based on the interview responses, information is produced in two main methods:

- **Individual production:** Organizations collect data (input), produce findings (inhouse production), then they share the information within the group (information sharing) for synthesis or further use.

- **Co-production:** Organizations from different sectors (NGOs, academia, and government) collect data (input), share data with the working group, then produce findings as a group for further use.

Information production processes vary between each working group depending on the intended outcome of each mandate.

Table 3. Type of information output produced by each working group and the percentage of the total of participants that cited each type

Type of Output	Total percentage (%) of Participants	National Hicatee Conservation and Monitoring Network (%)	Spawning Aggregation Working Group (%)	Managed Access Working Group (%)	Policy Maker (&)
Administrative	100	24	35	29	12
Public	88	24	35	18	12
Informal	65	24	18	24	0
Scientific	59	24	24	12	0
Policy	41	24	0	18	0

Five main types of information output have been identified (Table 3) as administrative, public, informal, scientific and policy. **Scientific** information refers to peer reviewed or inhouse technical documents that have been produced by the groups (Table 3). For example, scientific documents produced by the National Hicatee Conservation and Monitoring Network refer to biological surveys of hicatee, socio-economic studies on the communities that hunt the species, and the captive breeding program being undertaken by one of the members. Scientific information produced by the Spawning Aggregation Working Group (24%) includes biological counts and the technical reports of the monitoring of protected spawning sites. The ongoing monitoring of these sites is a priority for the working group given the declining state of resources. Scientific information produced by the Managed Access Working Group include assessments that evaluate the biological and socioeconomic success of the initial pilot sites in Belize as well as related published information for regional conferences on TURFs.

Information related to **policy** include cabinet papers, frameworks, and strategic plans that were generated primarily by the Managed Access Working Group and the National Hicatee Conservation and Monitoring Network. It is clearly seen as the least cited material that groups have produced. Respondents did not mention policy documents for the Spawning Aggregation Working Group because the relevant legislation has already been implemented in the past years (see Section 2.4.2.2). For this latter group, the focus within the past year has been on biological monitoring and enforcement.

The most common information type was **administrative** and includes meeting agendas, minutes, reports, updates, and workplans. The second most common information type named was **public** and include newsletters, website information, and media (visual or audio) used for public education campaigns. **Informal** information refers to email correspondence where questions or clarifications, and updates on activities are communicated. Each group used a combination of individual and coproduction methods depending on the type of information output as described earlier.

Respondents described all administrative and informal communications as a form of coproduction of information in the respective working group. These included determining the priority issues, agendas, minutes, and work plans. They also serve to determine the internal communications associated with each group. Communication of information was noted within the group as information sharing and methods used to disseminate information to external bodies was classified as information dissemination. Email was the most common communication method in each group. Groups also disseminate information through outreach activities which was seen to be the second most common method for communicating information to external bodies and target audiences. Outreach activities also include meetings with high-level decision-makers, such as ministers, and large public events.

Table 4 shows the type of information output and the process observed in the working groups. The core group members of the National Hicatee Conservation and Monitoring Network stated that the production of public outreach information is completed as a group. This coproduction strategy has been implemented so that each member disseminates a common message to the public and the type of output of public information includes: video, brochures, stickers, and booklets. The public awareness campaign for the species is robust and is the most active

component of the group’s mandate. Communication of outreach information is largely through outreach activities planned and conducted with schools and selected communities. Information is also available through websites of NGOs. The scientific information produced by members of the group is done on an individual basis. Most scientific research conducted by individuals are grant funded. Communication of scientific information is done by individual organizations and shared within the group through email updates. Scientific information is also available to external bodies upon request and would be shared through e-mail as well.

Table 4. Information production process undertaken by each working group by information type.

Working Group	Information type and process					
	Public		Scientific		Policy	
	Individual	Co-Production	Individual	Co-Production	Individual	Co-Production
National Hicatee Conservation and Monitoring Network		✓	✓		✓	
Spawning Aggregation Working Group		✓	✓	✓		✓
Managed Access Working Group		✓		✓	✓	✓

Information intended for policy was produced in an individual process and includes organizational strategic plans of individual organizations as well as the network’s efforts to influence changes in the legislation. Policy recommendations are passed on via annual reports, and individually produced scientific reports.

The type of information produced varied at different times of the year. For example, the Spawning Aggregation Working Group depended largely on this factor. Co-production of information intended for the public and policy makers included an annual newsletter in which the working group reports fish counts for each site. Dissemination depended largely on the location of members of the group to target communities within their relevant areas. Dissemination of the newsletter was also conducted through email correspondence and members of the group would

forward the newsletter to their respective networks. Scientific information was produced through co-production and individual methods.

The Spawning Aggregation Working Group has existed for 15 years and is the oldest of the three working groups. Given its longevity, its work plan is based on a standardized monitoring protocol and reporting scheme and a data sharing agreement is in place to integrate datasets. As a result, the group has a recognized, integrated approach to national monitoring efforts. Given the longevity of the group and standardized data monitoring protocols, the information produced can be regarded as credible and legitimate by all members of the group and also decision makers. Scientific research specific to each site is also produced by individual members and incorporated into area specific management plans. Even though policy formulation was not cited by individuals within the past year, this working group has shaped policy and legislation in the past. Through co-production methods, one respondent described how the group analyzed and framed information in collaboration with the Belize Fisheries Department to achieve the protection of spawning sites:

So, there was a lot of discussion with the fisheries administrator you know small groups of the working group would meet with the fisheries administrator to present the case and then we would give written documentation as to the justification for it and she would take it up with the ministry and we would help with the drafting of the legislation. There would be a bit of back and forth and that legislation was passed as well. WG2-04.

Given the mandate of the Managed Access Working Group (Section 4.2), policy related information was produced through individual means and co-production. The managed access working group has an overall an advisory role to policy development and the fisheries department, as the chair of the working group, gives the final approval of all policy documents.

With regard to co-production of information intended for the public, a stakeholder outreach campaign was developed to increase education and awareness of the program as well as to encourage stakeholder participation and support for the program. As one respondent stated, “All the education that has happened with the fisheries was a huge, huge undertaking that has happened nationally. And there’s a lot of material there... a lot of that has been developed by fisheries but there has been a lot of input by the partners” (WG3-01).

Items produced by the group, however, were only disseminated by the department. Scientific information produced by the working group has been used to evaluate the initial pilot sites as well as to present findings at regional and international fora. Though most information produced by the group is for policy and operational aspects, research conducted by the initial task force was done to evaluate pilot sites and initiate national implementation. Technical papers were also drafted for regional and international reporting and a group member noted that “we did have some documentation we had helped with the assessments and evaluations at the pilots which gave recommendations” (WG3-01).

Input from members was used in the development of its framework however, its overall development came solely from the fisheries department. When communicating to high-level ministers, the department as well as group members would participate in sharing information and discussions with the minister (WG3-01).

4.4 Information Use

Based on the interviews conducted with the policy/decision-makers, the information that is produced by each working group is used in a number of ways, including: general information, evidence-based decision making on management measures, operational aspects of management, future planning, and legislation and regulation (PM2).

The Spawning Aggregation Working Group as well as the National Hicatee Conservation and Monitoring Network provided information that relate to the above-mentioned uses. Given the conservation mandate of both groups, the recommendations were considered by policy makers. Recommendations provided by both groups are also considered to be credible and legitimate (more so the spawning aggregation working group due to its longevity and established practices) and used when developing policy and regulations (PM1; PM2).

The public awareness activities from each working group aim to indirectly drive policy through public engagement. Particularly, the managed access working group and their awareness campaign developed a considerable amount of stakeholder-based approaches. Policy makers described how the working group output influences political decision-making. The public use of information greatly influences policy since “the public holds the political capital and the reality is that [small] countries like Belize, the executive responds to a political capital... managed

access was moved primarily because the fishers were at the point where they were now the drivers of the rollout because it is in their best interest in Belize.” (PM2)

As mentioned by both decision-makers, these annual reports of the National Hicatee Conservation and Monitoring Network and the Managed Access Working Group assist in future planning for the annual efforts.

[Reports] are passed on to the ministerial level through two ways: either through your annual reporting because they form a part of the annual report of the fisheries department; or if there is a need for executive intervention for implementation of decision making, then at that particular time, then something would be brought up to them. (PM2)

They also assist in identifying gaps for management and how they may be addressed. Reports from the spawning aggregation working group are also used for future planning and operations in enforcement. Decision makers stated that enforcement officers within the department have collaborated on identifying gaps in enforcing areas to prevent illegal fishing within the protected sites.

With the network, it is useful especially the annual reports to look at the areas that we need to improve the following year and where you need to prioritize in terms of the managed access working group, also, to look at where we are with licensing and where we are with compliant fishers. With the spawning aggregation working group last year, I was engaged in the enforcement aspect ... my enforcement officer was attending those meetings to coordinate enforcement activities in the spawning sites. (PM1)

With regard to general use of information, subscribers, stakeholders, co-managers, and donors used the information produced by working groups for education and awareness, further research and background information, and verification processes for donors.

4.5 Information Pathways in the Working Groups

Based on the descriptions of working groups (Section 4.2), the information production process and dissemination (Section 4.3), and uses of information (Section 4.4), the following conceptual diagrams represent the general information process and pathways of information of each working group. The green dashed line represents the scope of the study.

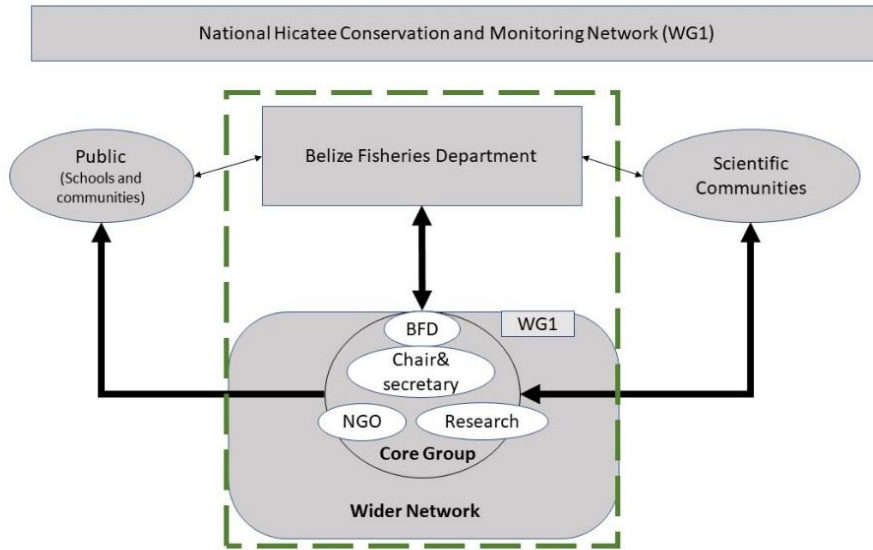


Figure 4. Conceptual diagram of the information pathways of the National Hicatee Conservation and Monitoring Network

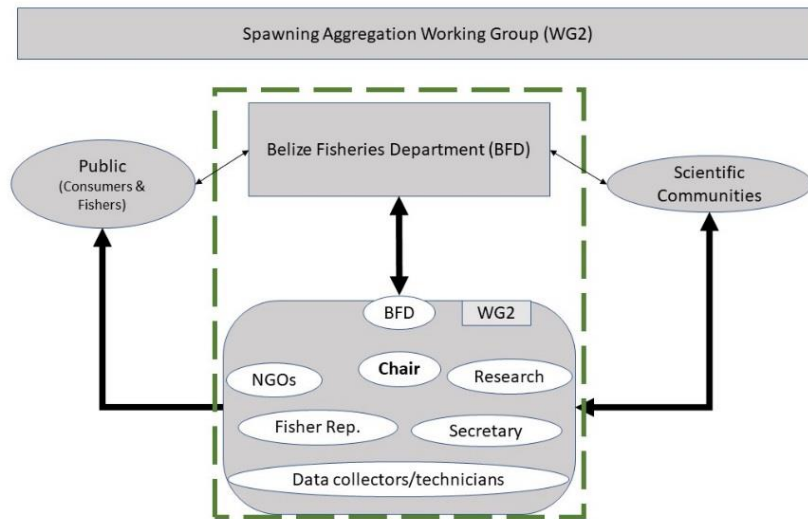


Figure 5. Conceptual diagram of the information pathways of the Spawning Aggregation Working Group

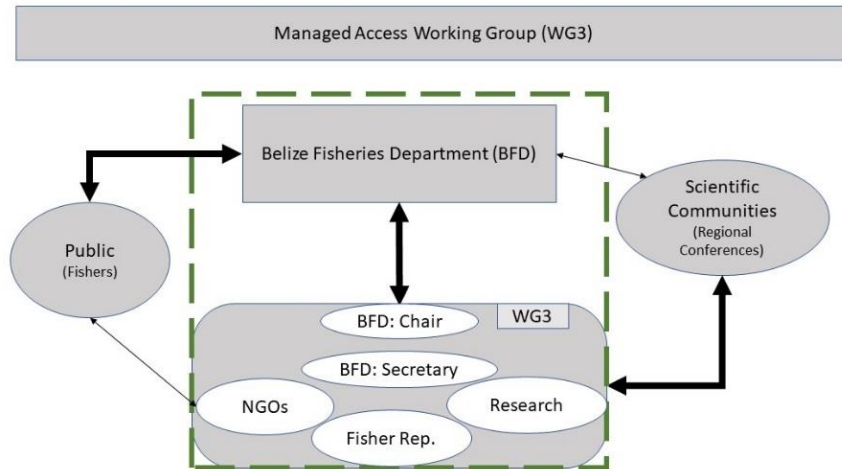


Figure 6. Conceptual diagram of the information pathways of the Managed Access Working Group

4.6 Enablers and barriers to information production

Based on participants description of the information production process, enablers and barriers for information production processes and uses were revealed. Tables 5 and 6 present the important enablers and barriers identified from the interview responses by percentage of participants that mentioned them. Section 4.5.1 will discuss the most common enablers and provides the context within which each identified subtheme was mentioned. Section 4.5.2 describes the most common barriers identified by participants. Section 4.5.3 describes how enablers that were identified by respondents were addressing several of the identified barriers.

4.6.1 Enablers

Coding of the interview responses revealed enablers within three main themes: administrative characteristics, information production, and use and outcome. Within each main theme, multiple enablers were identified. The number of participants that mentioned an enabler was used to determine its importance. The most cited enablers were: commitment, resources, collaboration, and information sharing among others.

Table 5. Percentage of the total number of respondents (N=17) that referenced identified enablers

Enablers						
Code	WG1	WG2	WG3	PM	Total	%
Membership commitment	3	4	3	1	11	64.7
Resources	2	3	0	1	6	35.3
Collaboration	2	2	1	1	6	35.3
Information sharing	1	3	1	0	5	29.4
Leadership	1	2	1	0	4	23.5
Communication	0	1	2	0	3	17.6

Membership commitment was mentioned by 64% of the participants as being an enabler for carrying out working group activities. It is important to note that membership to these groups are voluntary and are sustained by interest in the mandate originally set out to carry out these activities. For example, in the Spawning Aggregation Working Group, a 50% quorum in attendance needs to be met before it is considered an actual working group meeting where members are encouraged to attend through Skype if it is not possible to meet in person (WG2-01). This is especially apparent with the Spawning Aggregation Working Group where its longevity is proven by the commitment compared to the other groups. Financial resources were identified as an enabler by 35% of the respondents where, given the appropriate resources, objectives may be accomplished. The availability of resources also enables the group to sustain its annual activities.

With regard to information production, collaboration as an enabler was cited by 35% of working group members and policy makers, but for different reasons. A policy maker stated that “these groups play a very important role for the successful implementation of any regime, any management strategy, and policy, merely because the regulatory agencies are very much constrained when it comes to human and financial resources” (PM2). Working group members cite collaboration as a means of resource pooling and conducting group activities.

Information sharing was cited as another important enabler by 29% of the respondents for providing and receiving insights into different problems encountered, and for filling information gaps that exist. Information sharing was recognized as vital in data collection activities. For

example, members collected individual data for spawning aggregation sites and shared this with other members to develop a national “picture” (WG2-06).

Leadership was identified as an enabler by 23% of the respondents by directly relating to the chair role of each working group. Responses relate to the leadership role as either encouraging group members to contribute or to keep the groups progress on track thus enabling the production of results.

Other enablers include: operation improvement, proposal development, and stakeholder engagement. One member cited the operational use of the information produced by the managed access working group to develop a list of fishers for managers to know how many fishers were using the area being managed (WG3-04). The National Hicatee Conservation and Monitoring Network has recognized that research enables the development of proposals for grant funding for additional research, and for communication of information to communities and policy/decision-makers. This cycle of information production and access to funds propels the group to produce more information (WG1-03). Assessing stakeholder engagement can be difficult, however the National Hicatee Conservation and Monitoring Network has used the public information produced to target community audiences (specifically schools and children) and has recognized that targeting younger generations will stimulate cultural and behavioural change (WG1-01).

“Follow-up” after working group meetings have concluded was cited as an enabler as enhanced information production rate. The role of the secretary was highlighted as this person is tasked with follow up and gathering information (WG2-03). There is also mention of the need to strengthen the follow-up and communication of members after working group meeting have concluded (WG3-05).

4.6.2 Barriers

Interview coding also revealed barriers within three main themes: administrative characteristics, information production, and use and outcome. The number of participants that mentioned a barrier was tabulated by percentage and produced the top six (6) barriers mentioned. The most cited barriers were: lack of resources, membership availability, infrequent meetings, enforcement, policy support, and limited stakeholder engagement (Table 6).

Table 6. Percentage of the total number of respondents (N=17) that referenced identified barriers.

Barriers						
Code	WG1	WG2	WG3	PM	Total	%
Lack of resources	4	5	4	2	15	88.2
Member availability	3	3	2	1	9	52.9
Infrequent Meetings	3	1	3	1	8	47.1
Enforcement	2	4	1	1	8	47.1
Policy/Ministry Support	2	3	1	0	6	35.3
Stakeholder engagement	1	2	2	1	6	35.3

Lack of resource was cited by 88% of the respondents as the most common barrier across all working groups and operations. This refers to limited resources available to conduct activities in each group. Resources refer to both human and financial resources; financial was the most cited aspect. Membership availability to participate in meetings and working group activities is another major barrier cited by 52% of interview participants for working group operation. Limited resources for instance, is linked to limited membership availability and funding available to travel for meetings has been cited (WG2-03). Also, conflicting schedules and timing due to other individual responsibilities within their host organizations has also been cited as a barrier (WG1-01). It is important to recognize that membership is voluntary and therefore, duties and issues within organizations take precedence.

All working groups stated that the infrequent meetings as a barrier for effective working group operation. Frequency ranged from dormancy (National Hicatee Conservation and Monitoring Network) to ad hoc and unstructured meeting times (Managed Access & Spawning Aggregation Working Groups). Members indicated that more meetings scheduled may increase momentum of working group activity. Members stated that meetings should be conducted quarterly.

Inadequate leadership was cited as another major barrier under the National Hicatee Conservation and Monitoring Network and the Managed Access Working Group. It was recognized that a strong and focused leadership presence is needed to steer the working group (WG2-01). Though the Managed Access Working Group has a fixed chair/leadership role, members have indicated that a stronger sense of ownership of the program needs to be

recognized. As some members of the advisory board are also co-managers of fishing areas, these co-managers need to be further integrated into the governmental bodies.

Communication barriers related to support by policy and decision-makers were also cited by multiple members of all three working groups. A member of the spawning aggregation working group described the difficulties of communication between science and policy makers where, "...there is no use showing [policy makers] the fish counts, that doesn't affect them... It's all bar graphs, pie charts and every time I see a science presentation, its not conclusive enough" WG2-05. The gap between science and policy is clearly seen within the context of conservation and fisheries management. Science information should be written in an understandable manner and the suggested output of the groups should be "scenarios" that frame the scientific information so that policymakers are able to follow (PM2).

All working groups mentioned challenges with operationalizing enforcement within the Belize Fisheries Department even though information produced reveals illegal activities in protected areas and in communities of interest (WG1-02; WG2-05). This gap illustrates the lack of uptake by the department but may be also related to limited resources available to conduct enforcement activities. Policy support has been identified as another main barrier by all working groups. Although information produced by working groups included recommendations to be considered or used in policy and legislation, its use is not apparent. There remains a lack of support to implement recommendations at the ministerial level. Several members described this as "the department cannot proceed without the cabinet's approval. So, although it is a priority, we have to wait until they decide to approve it" WG1-02. This barrier is also linked to the limited financial resources of these groups as a member noted:

Lack of recognition that we are a natural resource-based economy and to make natural resource management decisions, we do need the science ... but if you don't recognize that this information from these groups are important... then you are not supporting [evidence-based decision making] as a part of management. WG2-05

Stakeholder engagement is recognized as a primary activity among working groups. Members of working groups state that the anticipated outcome (cultural/behavioral change and compliance) is not seen. Policy makers and members of the Spawning Aggregation Working Group attribute it to a lack of effective communication and interface with fishers (PM1; WG2-05). Lack of

collaboration among group members and stakeholders was mentioned as a barrier to information production. For instance, the National Hicatee Conservation and Monitoring Network and the Spawning Aggregation Working Group have an individualistic approach to data collection and information production. Coupled with communication barriers, the limited collaborative prevents the groups from becoming aware of the current activities being conducted, thus decreasing the effectiveness of its efforts (WG1-03). Although the Spawning Aggregation Working Group has the most integrated monitoring approach with common protocols and a database for the storage and analysis of data, the inconsistencies with monitoring all sites every year were identified as a barrier. Site data may be collected annually, depending on the availability of funds.

4.6.3 Addressing Barriers by Enhancing Enablers

Numerous participants have commented on the perceived effectiveness of working groups, and all have stated common barriers and enablers that shape this perception. Interestingly, it can be seen that enhancing enablers can also address the barriers identified. This analysis draws on examples from the three working groups to illustrate how the main barriers (Table 6) can be addressed by enhancing the enablers (Table 5).

As the most cited barrier throughout all working groups, resource availability inhibits the operation of working groups, for instance, their ability to produce information and the capacity to respond. However, enablers to collaborating on outreach activities can address this barrier as they can facilitate the pooling of resources. Members of the National Hicatee Conservation and Monitoring Network and the Spawning Aggregation Working Group describe how resource pooling helps to fund activities as well as produce information for public outreach. Members explain that even though funding may be available, groups need to be adaptive and strategic in their activities (WG3-03). It was also cited that by demanding that members prove that they are collaborating on similar efforts such as monitoring, donors may be incentivized to continue contributing because they can verify that there is no duplication of efforts (WG2-03).

Policy makers view the operations of the working groups related to the production of information as a means of facilitating fisheries management in spite of the limited resources. Members have recognized the importance of collaboration with individuals however members also recognize

that it needs to be strengthened. The co-production of information was also seen as an enabler because it provided a unified message where these groups can communicate a common position (WG1-03)

Though information is produced and communicated through the relevant channels, the anticipated outcome and recommended response is not implemented. Enforcement is commonly cited operational aspect suggested by all groups however, the Belize Fisheries Department cannot meet such recommendations due to human and financial resource. Despite the lack of adequate resources and personnel availability, other enforcement strategies have been developed in collaboration with external parties (WG2-02; PM1). Therefore, collaboration within and outside working groups is a recognized enabler.

Another related barrier and enabler was the meeting frequency and commitment by members to attend and participant in group meetings. While infrequent meetings were recognized as a barrier by the National Hicatee Conservation and Monitoring Network and the Managed Access Working Group, if members were more committed and member organizations were held accountable for attendance, this may address meeting frequency throughout all groups. Members of the Spawning Aggregation Working Group described this commitment by members was the main enabler for group activities and outcomes.

Another interesting outcome is the views shared by policy makers and members of working groups on what are considered barriers and enablers. What is characterised as an enabler of a working group may also pose a barrier to effective operations of the group. For instance, the wide geographic span of the group membership provided a country-wide perspective that enables robust decision making. However, members of the working groups describe how limited resources to travel to meetings negatively impacts the operation of the working group.

4.7 Summary of findings

This Chapter has presented the results from coded interview responses. The main findings include:

1. The composition of each group consisted of governmental organizations, academia, non-governmental organizations, including other stakeholders; however, research and governmental organizations had majority membership.

2. The main roles of each working group include: chair, secretary, facilitator and, data technician.
3. Five types of information output are produced by each group: administrative, informal, scientific, public, and policy recommendations.
4. The production process for each information type for each working group includes individual production and co-production.
5. Information is mainly communicated electronically and shared with a number of audiences: policy/government, public, donors, and researchers. Use of information varies between each audience (awareness, planning, and use in policy).
6. The main enablers of information production and use include: commitment, resource availability, collaboration, leadership, information sharing, follow-up, and operation improvement.
7. The main barriers identified for information production and use include: limited membership availability and resources, infrequent meetings, inadequate communication, lack of leadership, lack of collaboration, monitoring inconsistencies, lack of enforcement, little to no policy support, and stakeholder disengagement.
8. Working Groups have shown that barriers of lack of resources, infrequent meetings, and operationalizing enforcement efforts may be addressed by enhancing enablers such as resource pooling and increased commitment.
9. Where members may identify a characteristic as a barrier, policymakers may view it as an enabler. For example, the large geographic range made it difficult to meet with working group members often, however, policy-makers viewed this range as an enabler because it allowed for a quick view of what was happening country wide.

Chapter 5: Discussion

5.1 Important Roles of the Working Groups

This research examined the processes and outputs of three working groups: the National Hicatee Conservation and Monitoring Network, the Spawning Aggregation Working Group, and the Managed Access Working Group coordinated by the Belize Fisheries Department. To recap, the Belize Fisheries Department uses centralized and decentralized approaches to information production and communication for policy and decision making. Centralized approaches refer to regulatory science and research conducted by departmental employees whereas decentralised approaches refer to independent research conducted outside governmental bodies. Working groups are a decentralised approach that complement the centralized approaches of the department. A generalized conceptual diagram was developed to illustrate the flow of information to varying audiences in this decentralized approach (Figure 7). The rectangular shapes represent the governmental organizations- the Belize Fisheries Department and the Ministry of Forestry, Fisheries and Sustainable Development. The ovals represent other audiences identified with whom the working groups communicate.

The green dashed line shows the audiences identified within the science-policy interface, that is, the Belize Fisheries Department and the Working Groups. The numbered arrows depict the identified flow of information. Pathways 1, 3, and 4 are established where they show that working groups operate and communicate on a regular basis, whereas the other pathways are irregular or not formalized. These multiple communication methods and information types targeting different audiences allow the working groups to be effective communicators.

Pathway 1 is represented by a bidirectional arrow where information produced and shared with the department is facilitated by a person (the facilitator). Conversely, the facilitator shares information from the department to members of the working group where updates on the intent and desired direction of the department are noted, and activities of the group may be guided.

Pathway 2 is also represented by a bidirectional arrow where information received by the department is passed on to the ministerial level through annual reports and urgent matters that need executive input through face-to-face meetings and briefings.

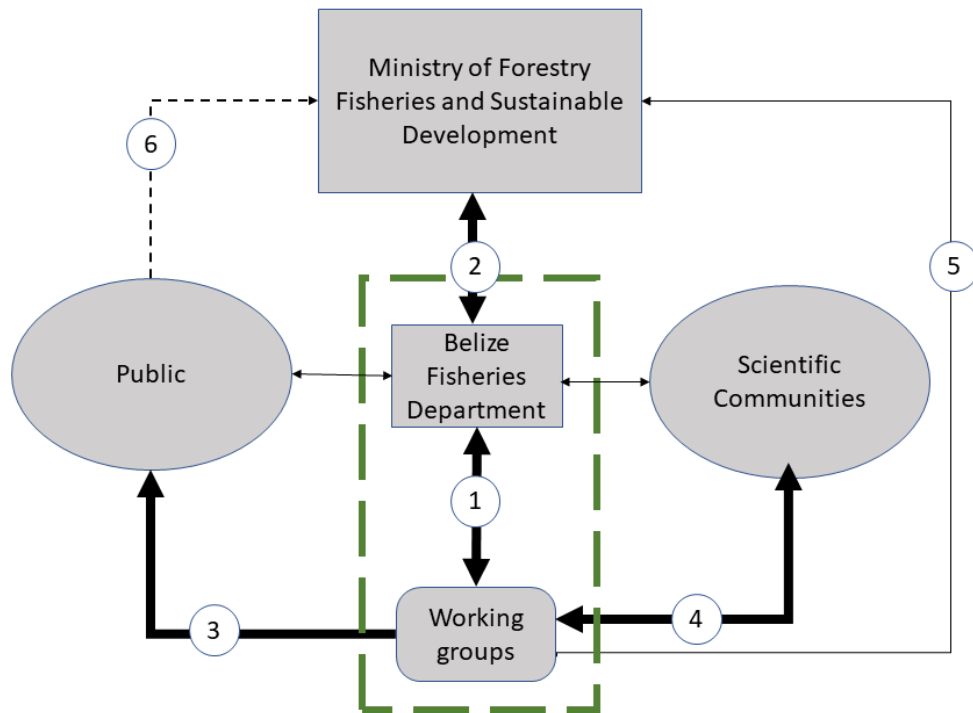


Figure 7. Conceptual diagram to illustrate the flow of information at the science-policy interface.

Pathway 3 represents the information received by the public (fishers, communities, and public). This pathway was recognized in two situations. The unidirectional arrow connects the working group to the public and depicts the public outreach activities conducted by the National Hicatee Conservation and Monitoring Network and the Spawning Aggregation Working Group. The single direction demonstrates that information on Hicatee laws is passed on however there are no activities where information from the public is received by the working group itself. The second arrow connecting the Belize Fisheries Department to the public is used by the Managed Access Working Group where the chair is the Belize Fisheries Department and all information co-produced is disseminated by the Department. This arrow is bidirectional because the department employed specific outreach officers who facilitate the dissemination process while collecting input from fishers. The National Hicatee Conservation and Monitoring Network also promotes this pathway by supplying information on the anonymous tip hotline “Crime Stoppers” where the public may call and report illegal activity.

Pathway 4 is represented by the bidirectional arrow where scientific information (biological and socioeconomic assessments) are produced and shared with research disciplines. The Spawning Aggregation Working Group and the National Hicatee Conservation and Monitoring Network utilize this pathway by collaborating with scientists doing independent or related research in similar topics. Their recommendations, advice, and methodologies are considered in developing working group research activities and information production.

Pathway 5 is represented by a thin unidirectional line because of the infrequent nature of the communication. Working groups have indicated ad hoc face-to-face meetings with ministers and executives to update and discuss the activities and efforts of each group. Such meetings are also considered as policy briefings. Pathway 6 is represented by a thin dotted bidirectional line linking the Ministry of Forestry, Fisheries, and Sustainable Development and the public. It is represented by a thin dotted line because even though working groups are not directly associated with this pathway, it is linked with pathway 3. Groups have indicated that aiming to influence the public to drive policy may be an effective way to influence policy change. This indirect approach may be effective as the public has a larger influence on policy makers given the small population of Belize which is a noteworthy approach taken by the groups to place pressure on policy makers (Section 1.2.1).

5.2 Working Groups as Knowledge-Brokers

The operations of the three working groups clearly demonstrate how multiple organizations come together to provide information, support, and management recommendations for fisheries management. The research showed that working groups are composed of many organizations that gather to discuss a specific issue and to co-operate and assist in implementing or influencing policy and behavioral change. The individual organizations may be classified as boundary organizations. Boundary roles performed by individual organizations in this context, are classified as coordinator and information mediator roles (Wilson & MacDonald, 2018). Coordinators are described as intermediaries that connect and remain as a coordinating role between the organizations. The Belize Fisheries Department is an example of an organization that has a coordinating role. Information mediators provide information needed for decision-making processes that may be inaccessible to other organizations. An example of the information

mediator would be academic representative in the working groups. These roles are performed in working group meetings where it is the interface at which bridging work is conducted.

The working groups also play a knowledge brokerage role. This role is dependent on the unique working group structure and mandate. The role of the three working groups is mainly to inform decision making on fisheries policy however other information dissemination roles have been identified. Three main audiences and information types (specific to each audience) have been identified as the Belize Fisheries Department, the public (including users), and scientific communities. The multiple strategies used in information production, and its use by the three working groups and various audiences in Belize, conform to the description of knowledge brokering as defined in Bandola-Gill & Lyall's (2017).

The background and experience of the working group members revealed that each member had experience in communicating with one of the three audiences identified and therefore influencing the associated output by the working groups. This may further highlight the concept that each member of the working group is a knowledge broker rather than the group as a whole. If so, then the role of the facilitator within the department is imperative whereby their reception and transference of information is the pathway by which information is used in decision making. Therefore, it is important to define the roles of each member within the working group, where defined roles may assist in clearer pathways and information exchange.

When studying co-production strategies, the National Hicatee Conservation and Monitoring Network and the Spawning Aggregation Working Group were identified to use this strategy to produce public information. Where each member provides options and insights into the development of this information material. This ongoing collaboration between actors indicates that these working groups have developed this established partnership to co-produce public outreach information. An advantage of this is the development of strong key messages where all participating organizations use consistently and there are no misunderstandings or misuse of the information produced. It is important to note that even though structures of these groups differ, the strategy is used to develop the same information type such as annual newsletters. Therefore, group structure may not have a direct effect on knowledge brokering strategies used.

The Spawning Aggregation Working Group also uses information-oriented strategies. All members within the group assist in the collection, analysis, interpretation, and dissemination of

findings. In the form of annual newsletters, the findings are shared with the public, stakeholders (fishers) and policy makers. Its reliance on standardized data collection and strong data sharing principles through a data sharing agreement, lead to the development of a robust database where all members record figures specific to their monitoring sites. Given its longevity, the group has had a longer period of time to develop these standardized approaches and the development of data storage abilities.

The Managed Access Working Group uses relationship-oriented strategies where activities for the rollout are conducted by all member organizations of the working group where they actively seek and provide the “know-how” and “know-who” to assist in implementation. As an advisory body for national implementation of the TURF system in Belize, the single mandate of national rollout and member composition of the working group reveals that information is shared upon the request from advice from the fisheries department on how best to proceed with implementation. The production of a framework along with draft regulations to be passed, reveals that the goals set out are policy oriented where information is gathered to assist in this endeavor.

The structures of working groups in addressing each audience differ. These structured approaches have been decided according to the mandate and the intended purpose of each group. For example, in relation to the chair roles, the Managed Access Working Group has a fixed chair while Spawning Aggregation Working Group and, the National Hicatee Conservation and Monitoring Network have rotating chair roles. This may be because the Managed Access Working Group has a direct policy outcome on fisheries management where the role of its members is advisory. The National Hicatee Conservation and Monitoring Network and the Spawning Aggregation Working Group take an equal opportunity approach where the elected chair oversees the activities and outcome of activities.

5.3 What Makes an Effective Working Group?

5.3.1 Characteristics of information production

Nutley et al. (2007) stated that effectiveness may be investigated within working group dynamics by examining the ability to improve research and learning efforts, that is, the concept of organizational learning. Largely in relation to the Spawning Aggregation Working Group, the established rules and norms noted within the group has shown aspects of organizational learning.

Members have indicated that though there has been membership turnover, its longevity is attributed to the established protocols and datasets that have propelled the group to continuously produce credible and legitimate information. Investigation into the concept of organizational learning however, fall outside of the scope of this study.

Using the framework presented by Cash et al. (2002) information saliency, credibility, and legitimacy has been recognized through the co-production strategies of each group. Scientific information produced by working groups may be viewed as salient because the recognition of the problem led to the initiation for these groups therefore it can be assumed that any information produced is salient.

Credibility of information output are also realized by the users of this information. Particularly, the Spawning Aggregation Working Group has addressed this characteristic by introducing a standardized monitoring protocol and data collectors are consistently trained to conduct field work. Such protocols, along with a database that is continuously updated, and the rigorous review of the data in round table discussions have ensured the credibility of the output of the working group.

Legitimacy of the information produced largely refers to the perception of the process involved in creating information. In relation to working groups, its membership and, operation; the procedural aspects have been consistent in all three with the recognition of itemized topics to cover and options to amend. The spawning aggregation working group has mentioned the membership of stakeholders (fishers) and thus directly considered local knowledge into its findings. The Managed Access Working Group, taking into consideration its advisory role, has previously conducted socioeconomic assessments on stakeholders of the fishing sector to assist in shaping the implementation of this regime and the development of its framework. The department has also aimed to legitimize this approach by employing outreach officers to maintain a constant dialogue with stakeholders within their respective communities (WG3-03, WG3-04, PM2).

Working groups have described challenges with framing of information and scientific uncertainty. Members have described these as interlinked challenges encountered by the group due to the technical nature of information presented. Policy and decision makers have also stated that framing of information (packaging) needs to be improved. Though all information comes

with a degree of uncertainty, the data collected should be utilized where recommendations developed should take into account these uncertainty measures. Though politicizing of information was not mentioned, the nature in which the working groups operate, and by targeting the public as well as the government simultaneously may reduce the chance of politicizing of science. These findings indicate that the working groups studied face similar challenges and thus supports the identified characteristics in previous studies of the science-policy interface (Forbes, 2011; MacDonald et al., 2016b; Soomai et al., 2011; Soomai, 2017).

Drawing from the identified enablers and barriers in Section 4.6, effectiveness may also be measured by how groups seek to address barriers and enhance enablers. Briefly described in Section 4.3, a few strategies such as monitoring protocol standardization, review, and refreshers were identified for working group operation to increase the legitimacy and credibility of information. Such strategies were mostly used by the Spawning Aggregation Working Group where its age may be attributed to the learning outcomes and the ability to identify barriers and create context specific solutions to address them.

5.3.2 How effectiveness may be evaluated in working group processes

Due to the large mention of the overall output and critique received by the members, the term “effective” and iterations of such have revealed that perceptions vary within and between groups. Carefully considering what “effectiveness” means for working groups, it is clearly recognized that working groups cannot be compared to each other due to its varying contexts as well as the absence of a set criteria for the overall knowledge brokering strategies employed. Previous studies have used citation analysis measurements; however, these only reveal a small portion of what use and influence entail (Cvitanovic et al., 2014; Klenk & Wyatt, 2015). The research results compare favourably with Nutley et al.’s (2007) continuum of research use from awareness to policy change as use of the working group output was context-specific and difficult to measure. One response summarizes the use and influence of the output which indicates actual policy change:

...all the regulations on spawning aggregations came out of the spawning aggregations working group...all the regulations on hicatee came from members who are associated with the hicatee working group... likewise with managed access because... it is us the

practitioners who are on the ground who are implementing managed access who are now looking at what is required to successfully implement it on the ground. (PM2)

Effectiveness may also be determined by observing administrative aspects. Methods applied in project management, the formulation of clear objectives, and measurable outputs can then be used as an indicator for working group success. A working group member highlighted an example of effectiveness of the operation of the groups that can be improved- summarized below:

I don't think it met enough...meetings were too infrequent and sometimes I think that the preparation for the meeting was all last minute. The agenda didn't go out until the day before. The documents that needed to be reviewed went out later than they were supposed to... planning and preparation was weaker than it could have been for a truly effective organization. (WG3-05)

With regard to science communication to policy, policymakers suggest that there is a need for improvement of “packaging” information for the executive (PM2). The recognized gap in communication revealed the need for a specialized approach of science communication to ministers.

Any procedure used to assess these groups need to relate directly to the objectives and the context each working group operated under. However, the objectives of the working groups may be too broadly defined with regard to stated fisheries management or conservation objectives. For example, the National Hicatee Conservation and Monitoring Network's objective is to conserve the Hicatee turtle for future generations and to ensure sustainable use, however, sustainable use cannot be readily measured. Measurable objectives need to be identified by the Belize Fisheries Department in order to address overall effectiveness of each working group.

Using the findings of this research on working groups, a preliminary criterion (or checklist) for the basis of evaluating working group performance can be developed (Table 5) This criteria is based on the most cited barriers and enablers described by interviewees. Many of the enablers and barriers identified in this study have been previously identified as characteristics of the science-policy interface in Chapter 2 (Knaggård, 2015; Soomai, 2011; Wilson & MacDonald, 2018). As explained in Section 4.6.3, addressing barriers by enhancing enablers may improve the

success of the groups. By integrating the input-process-output (IPO) model described in Chapter 2 (Kozlowski & Ilgen, 2006), and the barriers, and enablers identified in this study, current and future working groups may use the criteria listed in Table 5 to improve working group success.

Table 5: Preliminary criteria to evaluate working group effectiveness

Input	
Composition	Does the working group encompass all stakeholders involved in the issue?
Roles	Are there established roles for each working group member?
	Do members play an active role in the working group?
	Do members adhere to their identified roles?
Leadership	Are leadership roles defined and established in the working group?
Resources	Are resources readily available for working group operations? (Identified/established funding resources)
Data input	Are the collected data consistent and credible?
Process	
Production method	Is information production and/or data interpretation conducted as a working group?
	Are data interpreted and produced into information that provides insights into the issue?
	Is the information produced shared with all members?
Organizational/ group learning	Is there a retrospective evaluation of working group process/ operation?
	Are findings incorporated into new operation methods of working groups?
Framing	Is information developed presented in less technical language or for a specific technical audience?
	Are recommendations developed and supported by information developed?
Output	
Communication	Is there an established pathway for information communication outside the group?
Audience	Did information reach desired audience?
Use & Outcome	Did the output of information achieve the desired outcome?
	Are measurable outcomes identified?

Though simplistic in nature, performing this exercise may assist in identifying gaps where the group may need to improve or place additional focus. It is also important to note that the identified characteristics are dependent upon the context in which the group operates. As such, some identified criteria may not be applicable. These criteria may allow groups to assess each pathway or information type produced instead of assessing the whole working group performance. Given the complex operations of each group, this linear approach may be beneficial in assessing communication gaps in the science-policy interface in fisheries management in Belize.

Chapter 6: Conclusion and Recommendations

The objective of the research was to determine the role of three technical working groups: The National Hicatee Conservation and Monitoring Network, the Spawning Aggregation Working Group, and the Managed Access Working Group in producing and communicating scientific information to policy and decision-makers with regard to the implementation of conservation and fisheries management measures in Belize. The research empirically shows that the creation of working groups and their operations play an important role and need to be emphasised as an valid fisheries management approach to gather information for robust evidence-based and evidence-informed decision-making. Interdisciplinary working groups also play an important role as knowledge brokers.

Through interviews with members of these working groups and the policy makers of the Belize Fisheries Department, the process of information production, dissemination, and use were revealed. Each group consisted of various types of organizations where research and governmental organizations had majority membership. Common roles within each group were: chair, secretary, facilitator, and data technician. By employing a mixed method production process (individual production and co-production) working groups produced: administrative, informal, scientific, public, and policy recommendation information. Groups communicate and disseminate this information electronically and in person. The information is shared with a number of audiences: policy/government, public, donors, and researchers. Use of this information varies between each audience (awareness, planning, and use in policy). Policymakers have identified direct use of working group output, however, framing of scientific findings with recommendations for action need to be improved.

Common barriers and enablers within each group were revealed and are similar to those identified in other studies. For instance, membership and working group administrative functions are necessary to propel information production (Crowston et al., 2015); leadership and the involvement of stakeholders/ public engagement is a key feature to enable information uptake (Cvitanovic et al., 2016) and reduce uncertainty (Soomai, 2017). Barriers revealed included: resources, enforcement, and commitment; irrespective of the context specific mandates. Working group members have indicated the attempt to address barriers by enhancing enablers.

Methodologies employed allowed for a review of qualitative information in a systematic manner to provide a robust analysis. Face-to-face interviews provided an opportunity to encourage the participants to speak freely and to elaborate on responses to questions. By allowing the participants to talk freely, responses to questions provided further insights specific to each group as well as problems encountered. Many researchers have ascribed the importance of this information gathering approach as being reliable and legitimate to current marine issues where formal documentation for example, publications and meeting minutes simply do not provide sufficient evidence to describe and explain the role of information in the working group process and in decision-making (MacDonald et al., 2016b; Wilson & MacDonald, 2018).

Interdisciplinary working groups conduct various knowledge brokering roles at the science-policy interface. This is an important role in producing and facilitating the uptake of information into decision making for fisheries management. These collaborative efforts are shown to perform multiple benefits to the organizations they are situated in (Richard 2017). The results of this study may be beneficial in informing future multi-sectoral collaboration in integrated coastal and ocean management in Belize to improve the effective exchange of information. The interviews conducted revealed that there was gathering of relevant information where it was made readily available to decision-makers through the facilitator role of with working group. Members had the opportunity to provide feedback where ideas and recommendations were further shaped to cohesive ideas thus deeming it relevant, credible and legitimate. Operational aspects were proven to develop established partnerships where resources may be pooled to achieve a common goal. The established network of participants enabled for a stronger partnership in fisheries management in Belize. As such, this partnership may be used in future collaborations.

This research provides a baseline for future studies within this region. The barriers and enablers discussed related to information production, communication, and use in decision-making can guide the working groups studied in their multi-sectoral collaborations for enhancing the framing, communication and use of information produced. Based on the research, the criteria for evaluating working group performance and effectiveness (Table 5) list important questions to assess working group input, process, and output. This preliminary criteria allow for the assessment of single pathways or information types where working group members may identify communication gaps that influence their effectiveness.

Further analysis of the interview responses may augment this preliminary analysis and contribute to a framework for enhancing working group processes and formalizing knowledge broker roles. Further analysis of the coded data from interviews can be conducted particularly with regard to barriers and enablers identified by for working groups using data analysis tools such as Q-methodology. While only policy makers were interviewed for this research, other audiences, including the public/stakeholder and scientific committees can be surveyed to supplement the data set needed to develop a broad view of information use.

Based on the findings of this research, the following recommendations are proposed for consideration by the appropriate parties:

For working groups:

- Review and revise the process of framing or packaging of information for policy makers.
- Regularly review and revise working group processes with regard to information production (every three to five years) to identify gaps and ways to improve the process.

For the Belize Fisheries Department:

- Create support staff within the Belize Fisheries Department who act as “knowledge-brokers” to enhance science communication to policy among all working groups.
- Establish permanency of working groups through policy and regulation, thereby solidifying pathways of information uptake in fisheries decision-making.

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Appendices

Appendix 1: Research Ethics Approval



Faculty of Management Graduate Student Ethics Approval for a Course-based Project

June 28, 2017

Kalene Eck,

I am pleased to inform you that I have reviewed your project "Evaluating the role of working groups for informed decision-making in fisheries management" (file no. 062717), for the course MARA3002 (Graduate Project) under the supervision of Suzette Soomai and Dr. Bertrum MacDonald, and have found the proposed research involving human participants to be in accordance with the *Faculty of Management Ethics Review Policy for Course-based Projects* and the *Tri-Council Policy Statement on Ethical Conduct for Research Involving Humans (TCPS2)*. This project has received ethics approval.

This approval will be in effect until and not exceeding December 25, 2017 (fourteen days from the final date of classes for the 2017 Dalhousie Fall Semester). It is your responsibility to immediately report any adverse events involving participants to both your instructor and to the Research Ethics Officer. Please note that any significant changes to the research methodology, consent form or recruitment materials must be resubmitted to Research Ethics Officer for review and approval prior to their use.

Congratulations on your successful Faculty of Management Graduate Student Ethics Approval for your Course-based Project. I wish you all the best as you begin this next phase of your research. Should you have any questions regarding ethical issues at any point during your project, please do not hesitate to contact me.

Sincerely,

A handwritten signature in black ink that reads "Ashley Doyle". The signature is written in a cursive, flowing style.

Ashley Cummiskey (Doyle)
Faculty of Management Research Ethics Officer
Rowe 2029
Dalhousie University
PO Box 15000, Halifax, NS B3H 4R2
a.doyle@dal.ca

Appendix 2: Interview Protocol for Working Group Members

The interviewer recites following paragraph:

Thank you for taking part in this study. The purpose of this interview is to develop an understanding of how working groups function in the information production process specific to fisheries management issues, and how information produced by these groups is used in policy and decision-making. You will be asked questions about your participation and role within the **[insert working group name]** within the last year. This interview will take approximately 30-45 minutes. With your permission, the interview will be recorded. The recording will be transcribed and used solely for the purposes of this research. Once transcription has occurred, audio recordings will be deleted. All responses will be kept confidential and anonymized. Do you have any questions related to the research before we start?

If the consent is received for participation and for recording the interview, then turn on the audio recorder and begin the interview by stating:

- Date and time

- Interviewee number

Ask the following questions:

Section 1: Organization Information

1. What organization do you represent?
Please give a brief description of its mandate?
2. What position do you hold within your organization?
3. How long have you worked in this organization?
4. Describe your role/duties in the organization.
5. Please briefly describe your career to date.
Tell me about your professional and educational background.

Section 2: Working Group Process

6. How did you become a member of the **[name working group]**?
7. Please describe the mandate of the group
Is the mandate documented?
Is it accessible to the public; where can I find it?
8. In a typical year, how often does the working group meet?
Are you able to attend most of the meetings?
9. Tell me about the operation of the group:
Who sets the agenda for working group meetings?
(Probe questions: Is it the chair and/or members? Do other individuals have an opportunity to set agenda items?)

How are priority issues determined?

(Probe question: Do suggestions come from within or external to the working groups?)

10. Describe your role within the group.

How do you participate in meetings?

(Probe questions: For example, do you come to meetings with prepared documents, updates, and presentations?)

11. How does the group communicate with members outside of the formal meeting sessions?

(Probe questions: Informal meetings, email, phone calls? What is your preferred method of communication with members? What is the purpose of this communication, e.g., to plan activities within or outside of the meeting?)

12. What information is produced by the working group?

(Probes: Formal or informal reports; technical reports, posters, papers?)

How do you contribute to the information produced in the group?

13. How is this information produced by the group disseminated? (Probe: For example, through reports (formal and/or informal), media, name other methods.)

Who or which individuals are the principal audiences for the different types of output?

What is your role in disseminating information? Who do you share it with?

Section 3: Use of Working Group Output

14. When a working group meeting has concluded, how do you use the information (formal/informal) that has been produced?

Do you write any official or in-house documents on the work of the group?

Are all documents produced within the group shared with you?

Are you aware of any other organizations that use information shared?

15. Upon reflection, does the output of the working group influence your work or level of awareness on particular management or conservation issues?

How does the information assist you in your job?

16. In your opinion, what enables the group to meet its objectives?

(Probe questions: Is it the membership, support from your organization and the fisheries department?)

17. In your opinion, are there any challenges that the group faces in meeting its objectives?

What can be done to address these challenges?

18. Given your experience and background in this field, do you have any final comments about your role or contributions to the group?

Inform the participant of the conclusion of the interview and respond to any questions asked.

Turn off the recorder.

Appendix 3: Interview Protocol for Policy-makers

The interviewer recites following paragraph:

Thank you for taking part in this study. The purpose of this interview is to develop an understanding of how working groups function in the information production process specific to fisheries management issues, and how information produced by these groups is used in policy and decision-making. You will be asked questions on your participation and use of the information generated by the working groups in the last year. This interview will take approximately 30-45 minutes. With your permission, the interview will be recorded. The recording will be transcribed and used solely for the purposes of this research. Once transcription has occurred, audio recordings will be deleted. All responses will be kept confidential and anonymized. Do you have any questions related to the research before we start?

If the consent is received for participation and for recording the interview, then turn on the audio recorder and begin the interview by stating:

- Date and time

- Interviewee number

Ask the following questions:

Section 1: Organization Information

This section will provide details on the background of the policy maker in the Belize fisheries department.

1. What department do you work for?
Give a brief description of its mandate.
2. What is the position you hold within the department?
3. How long have you worked in this organization?
4. Describe your role/duties in the department?
5. Can you briefly describe your career to date?
Tell me about your professional and educational background.

Section 2: Working Group Process

Follow up from the answer in question 5 and inform the participant of which working group will be discussed before starting. After each question, ask the participant to compare the responses with the other two groups.

6. Give a brief description of how and why the **[name working group]** group was formed.
(Probe: can you describe the process and reasons for formation? Is there an official mandate?)
Were the other two groups formed in the same manner?
7. How was the membership of the group and composition decided?
Has this composition changed over time?
How is this different from or similar to the other groups?

8. Have you attended or participated in working group meetings [**name working group**]?
Have you been able to attend meetings of the other working groups?
If so, how have you participated in the meeting?
9. In your opinion, what enables the group to meet its objectives?
(Probe questions: Is it the membership, support from your organization and the fisheries department?)
10. In your opinion, are there any challenges that the group faces in meeting its objectives?
What can be done to address these challenges?

Section 3: Output and Use

11. Do you request any documentation or reports from each group?
What type of information do you request from each group? How is it used?
12. At the end of working group meetings, do you receive information from the groups?
(Probe: For example, the minutes of the meeting and other information produced by the group)
13. Is information that was requested or received used in decision-making? (Probe: Is information used or cited in reports?)
Describe how it is used.
14. Do you distribute the information to other policy-makers or organizations?
Describe how do you communicate it to these individuals or agencies? (Probe: email, meetings)
15. Given your experience with the group and its activities, do you have any final comments?

Inform the participant of the conclusion of the interview and respond to any questions asked.

Turn off the recorder.

Appendix 4: Recruitment Message



July 2017

Dear (Participant's name),

My name is Kalene Eck, a Master of Marine Management Candidate in the Marine Affairs Program at Dalhousie University, Halifax, Nova Scotia. You are invited to participate in a study: "Determining and evaluating the role of three working groups in communicating scientific information to policy and decision-makers regarding conservation and fisheries management." This research is a partial requirement for the completion of the Graduate Project (MARA 5002) course. The research is being conducted with the Environmental Information: Use and Influence research program, based in the Faculty of Management at Dalhousie University. The objective of the research is to develop an understanding of the role of fisheries working groups in information creation and its dissemination for decision and policy-making.

This research project will examine the role of multiple stakeholders participating in technical working groups designed to assist in marine fisheries decision-making in Belize. The research will examine characteristics and activities of three working groups: The National Hicatee Conservation and Monitoring Network, the Managed Access Working Group, and the Spawning Aggregation Working Group. The research will highlight current strategies for producing and conveying information for policy-makers and the role of this information in national decision-making for conservation, sustainable fisheries, and coastal zone management. It may also identify barriers and enablers to use of information and will provide recommendations for communication. The results of this study can be beneficial in informing future multi-sectoral collaborations that are addressing similarly complex marine environmental issues.

You have been invited to participate in this study due to your current or previous membership with one of the working groups or your role as a policy-maker in the Belize fisheries department. If you agree to participate, you will be interviewed by the principal researcher, Kalene Eck. The interview will take approximately 35 to 45 minutes and you will be asked questions pertaining to your role within the group related to the production, communication, and use of information. Interviews will be conducted in July and August 2017. The results of the study will be released to you and the Belize Fisheries Department. The final report will be available on the Dalhousie

Research Repository website (<https://libraries.dal.ca/find/dalspace.html>), after completion of the Master of Marine Management program by the principal researcher in December 2017.

Participation in the study is of minimal risk to you. If you agree to participate, your responses and identity will be anonymized. Your permission will be sought if the principal researcher wishes to include quotes from your responses in the final research report. Any quotations used in the final report will remain anonymous. You may voluntarily withdraw your participation from the study at any time before August 31, 2017.

If there are any further questions on the study, please contact Kalene Eck via email at kalene.eck@dal.ca. You can also contact my supervisor, Dr. Suzuette Soomai (suzuette.soomai@dal.ca) or the research team lead, Dr. Bertrum MacDonald (bertrum.macdonald@dal.ca). If you have any difficulties with, or wish to voice concern about, any aspect of your participation in this study, you may contact Ashley Doyle, Research Ethics Officer, Dalhousie University, Faculty of Management (ashley.doyle@dal.ca), or Dr. Mike Smit, Associate Dean of Research, Faculty of Management, Dalhousie University (mike.smit@dal.ca).

Attached is an information consent form for you to sign and email to me if you wish to participate. Please respond on or before July 28, 2017 to indicate your interest to participate in this research.

Kind Regards,

Kalene Eck
Master of Marine Management Candidate
Marine Affairs Program, Dalhousie University
Halifax, Nova Scotia
Canada

Appendix 5: Consent Form

INFORMED RESEARCH CONSENT FORM



July 2017

Dear (Participant's name),

Introduction

I invite you to take part in a research project called "Evaluating the role of working groups for informed decision-making in fisheries management." This study is being completed by Kalene Eck and I am a Master's student in the Marine Affairs Program at Dalhousie University in Halifax, Nova Scotia. This research is a partial requirement for the completion of my Master of Marine Management degree. My research is being supervised by Dr. Suzette Soomai, Faculty of Management, Dalhousie University. The research is being conducted with the Environmental Information: Use and Influence (EIUI) research program in the Faculty of Management. Details of the research and what to expect if you agree to participate is provided in the following sections.

Summary of the Research

The principal objective of the research is to understand the science-policy interface in fisheries management and conservation in Belize. Specifically, the research will examine the role of multiple stakeholders participating in three technical working groups: Spawning Aggregation Working Group, Managed Access Working Group, or the National Hicatee Conservation and Monitoring Network. By studying the characteristics of memberships in the working groups and activities related to information production and dissemination, the research may reveal insights on the role of the groups in influencing policy and decision-making. The research may also identify barriers and enablers in the information pathways (production, communication, and use). The results of the research can guide future collaborations involving working groups, in marine fisheries management and conservation in Belize.

Participation in the Study

You are invited to take part in this study because you are or previously were a member to any one of the three working groups or you are a policy or decision-maker within the policy and planning unit of the Belize Fisheries Department. I will ask you to take part in a semi-structured interview to answer questions based on your role and activities associated with information production and dissemination in one of the three working groups. If you are a policy or decision-maker within the policy and planning unit of the Belize Fisheries Department, you will be asked

questions related to the mandates of the groups and the role of information produced by the groups in decision-making.

Participation in the study is voluntary. If you agree to participate, you will be interviewed by the principal researcher, Kalene Eck, via telephone or in person at a time convenient to you. The estimated time of an interview is 30-45 minutes. The interviewer will ask your permission to record your responses that will be used for later transcription.

A report of the research will be submitted to the Marine Affairs Program for final grading in November 2017. A blog entry about the study and its conclusions will be posted on the EIUI website (www.eiui.ca) which may be accessed publicly. The web link to this summary on the EIUI website will be sent to you. Any reports and papers that result from this study will be made available to the participants and the Belize Fisheries Department. For further information on the results, you may email Kalene Eck (kalene.eck@dal.ca).

Possible Risks

Participation in this study is voluntary and should be of minimal risk to you. You may decide not to answer any question(s) asked during the interview, or you may withdraw consent at any time before August 31, 2017. All data will be aggregated in the data analysis; therefore, your individual responses cannot be identified and you are assured anonymity. The probability of any harm occurring because of disclosing information regarding your role in the working groups of the policy-making process is no greater than risks encountered by you in your daily work life.

Benefits

It is anticipated that there will be indirect benefits to the organizations participating in the working groups and the Belize Fisheries Department as the research will generate substantial new data and information to advance understanding of the role of working groups in communicating scientific information at the science-policy interface.

Confidentiality

With your permission, your responses to questions may be included in publications arising from this research. To ensure anonymity, with your permission, any responses that may be included in publications arising from this research will not be attributed to you but will be designated to your role a working group or as a policy-maker. An alpha-numeric code rather than your name will be assigned to the transcript and notes from this interview. All transcripts and notes from this research will only be accessible to the principal investigator and supervisor and will be retained in secured cabinets and on password-protected computers at Dalhousie University for five years after which they will be destroyed.

If you choose to participate, the attached consent form will be used as a record of your participation in the study. If you wish to participate in the study, please complete and email a copy of the consent form to the principal investigator Kalene Eck (kalene.eck@dal.ca).

I have read the explanation about this study. I understand what I am being asked to do and my questions about the study have been answered. I agree to take part in this study. I know that participating is my choice and that I can leave the study at any time.

I hereby give permission to quote my answers anonymously (Yes) (No)

I hereby give permission to record the interview (Yes) (No)

PARTICIPANT'S SIGNATURE

DATE

RESEARCHER'S SIGNATURE

DATE

Assigned alphanumeric code: _____

If you have any questions, comments, or concerns about your participation in this research project, please contact me, Kalene Eck: (782)-234-2617 or (501)-620-7233; or my supervisor Dr. Suzuette Soomai: suzuette.soomai@dal.ca. If you have any difficulties with, or wish to voice concern about, any aspect of your participation in this study, you may contact Ashley Doyle, Research Ethics Officer, Dalhousie University Faculty of Management (ashley.doyle@dal.ca), or Dr. Mike Smit, Associate Dean of Research, Faculty of Management, Dalhousie University (mike.smit@dal.ca).

Appendix 6: List of Codes

Name	Sources	References
Barriers to	17	160
Information Production	6	10
Capacity	1	2
Information sharing	1	1
Lack of collaboration	2	2
Monitoring inconsistency	2	3
Use	12	50
enforcement	8	14
legislation	3	6
Policy- Ministry Support	6	16
stakeholder engagement	6	12
Working Group Operation	17	100
commitment	2	2
Communication	5	8
Formalization	2	3
Geographic range	3	3
infrequent meetings	8	14
leadership	5	8
member availability	9	11
membership continuity	3	5
repetition	4	4
resource	15	36
Enablers to	16	62
Information production	13	21
collaboration	6	7
different perspectives	1	1
follow-up	3	3
Geographic range	1	1
information sharing	5	6
monitoring and data collection	2	2
Use and Outcome	3	5
Operational improvement	1	1
proposal development	1	2
stakeholder engagement	2	2
WG composition and operation	15	36
commitment	11	15
communication	3	3
formalization	1	1

leadership	4	5
mandate	1	1
membership composition	2	2
resources	6	7
voluntary	1	1
workplan	1	1
Information Production & Communication	17	730
Audience	16	37
donors or board	3	6
In-house personnel	2	2
managers	4	6
Policy	6	8
public	7	14
school	2	2
stakeholders or fishers	6	7
subscribers	4	4
working group members	2	2
Communication Type	17	199
Email	16	30
Google Docs	1	1
Information Dissemination	16	67
accessibility	8	18
Information Sharing	17	104
Meetings face-to-face	9	18
Attendance	13	19
follow up	6	7
minutes	11	13
Action Items-minutes	4	6
special meetings	2	3
WG agenda	14	29
Outreach activities	14	57
stakeholder engagement	2	5
targeted areas- information dissemination	5	13
skype	1	1
telephone	2	2
Data Sources (Input)	17	91
Contribution	14	38
Data	11	51
CPUE-catch data	2	3
Data Analysis	4	6

Data Legitimacy	4	7
data sharing agreement	4	6
Data statistics	3	4
data submission	3	3
Database	11	21
external collaboration	10	25
Geographic Sites	12	30
Information (Output)	17	194
Administrative	17	121
Informal or Inhouse	9	14
Policy	4	4
Public	15	39
Newsletters	5	6
Public outreach info	12	24
Website Information	5	7
Scientific	8	15
Production Method	14	39
co-production	13	24
Individual Production	10	15
Time Dependency	4	5
Working Group Activities	15	48
Individual activities	11	54
citizen science	1	1
MSP	1	2
Research Activities	9	36
Biological research	6	16
Captive Breeding Program	1	1
Monitoring Protocol	3	4
Socio-economic research	4	10
Policy Views	2	59
WG1	2	19
WG2	2	20
WG3	2	20
Suggestions for improvement	8	10
formalization	6	8
Regional Coordinator role	1	1
Use	17	289
Influence	16	65
Culture	4	12
economic benefit	1	5
Management	10	32

adaptive	1	2
Ecosystem Approach	6	10
fisheries management	5	8
management plan	3	12
Information and Influence process	13	42
information request	3	5
Use of Information	17	177
Evidence Based Decision-making	6	17
feedback	4	9
Legislation and Regulation	11	34
Policy	16	59
Problem solving	4	5
Working Group Characteristics	17	790
Composition	17	399
Individual	17	128
Career experience	14	18
Education Background	16	37
Education	3	3
Industry	1	3
international relations	1	1
Management	7	8
Business Administration	1	1
Natural Resource	6	6
tropical coastal management	1	1
Science	12	16
Biology	7	8
Ecology	2	2
Environmental Science	2	2
Marine Science	3	3
Longevity	16	19
Number of years in position	15	17
Number of years in WG	2	2
Position	17	54
outreach officers	3	5
position type	6	6
Roles and duties	17	28
Member Roles	17	188
Chair	15	45
Core Members	3	9
data collector or technician	7	12
Facilitator	6	8

Membership Description	16	53
researcher	5	12
Secretary	7	11
Wider Network	4	7
Organization Information	17	83
Mandate	16	30
alternative livelihoods	1	2
conservation	1	1
Economic	2	2
Sustainability	6	6
Organization Type	17	52
Academia	4	4
co-manager	6	10
Government	9	11
NGO	5	5
Research Organization	2	2
Stakeholder	6	20
Differences	5	5
“effectiveness”	13	39
Operation	16	82
licensing	2	4
other rules	4	6
Preparation	2	4
subcommittee	7	13
Timelines	4	5
Training	6	13
WG Longevity	4	4
Similarities	3	3
WG Creation	12	24
WG Mandate	17	151
Conservation- mandate	6	7
Education- mandate	6	14
Enforcement	14	41
Management- mandate	3	5
Research- mandate	7	20
Resource pooling- mandate	5	5
Status- mandate	6	19