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Enabling problem-solving between science and politics in water conflicts: impasses and breakthroughs in the Everglades, Florida, USA

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Enabling problem-solving between science and politics in water conflicts: impasses and breakthroughs in the Everglades, Florida, USA

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Abstract Water conflicts, such as the one in the Everglades, Florida, USA, are complex and dynamic, and there is no theory that yet provides a comprehensive and sufficient explanation for when and how science may be more or less effective. Using both the literature and the water conflict in the Everglades, it is argued that science is most influential in political negotiations when it is created *with*, not for, stakeholders. The stakeholder negotiators need to know, give feedback on, and eventually vet all stages of the scientific process, which is generating data and possible solutions for them. Such close cooperation is not easy, however. Each group has different goals, jargons, objects to represent phenomena and concepts, and different procedures for working through problems. This paper argues that the political negotiations and technical groups need to jointly create "a common playing field," with a shared purpose supported by a negotiated set of concepts, "boundary objects," and procedures and norms that they use to coordinate their work.

Key words water conflict; water management; public dispute resolution; science and policy; science and conflict; negotiation; consensus building; science and technology studies

Permettre la résolution de problème entre science et politique dans le cas de conflits liés à l'eau: impasses et percées dans les Everglades, Floride, Etats Unis d'Amérique
Résumé Les conflits liés à l'eau, tels que celui des Everglades, Floride, Etats-Unis d'Amérique, sont complexes et dynamiques, et aucune théorie ne fournit aujourd'hui d'explication cohérente et suffisante sur la façon dont et quand la science est plus ou moins efficace. Sur la base de la littérature et du conflit des Everglades, il apparaît que la science a plus d'influence dans les négociations politiques lorsqu'elle est développée avec, et non pour, les porteurs d'enjeux. Les négociateurs des porteurs d'enjeux ont besoin de connaître, de réagir à, et éventuellement de vérifier toutes les étapes de la démarche scientifique qui engendrent pour eux des informations et des solutions potentielles. Cette étroite collaboration n'est pas facile, cependant. Chaque groupe a ses propres objectifs, jargon, objets pour représenter des phénomènes et des concepts, et procédures pour appréhender les problèmes. Cet article soutient que les négociations politiques et les groupes techniques ont besoin de créer conjointement un "terrain de jeu commun", avec un objectif partagé, basé sur un ensemble négocié de concepts, d'"objets frontière", et de procédures et de normes qui permet de coordonner leurs travaux.

Mots clefs conflit lié à l'eau; gestion de l'eau; résolution de différend public; science et politique; science et conflits; négociation; construction de consensus; études scientifiques et technologiques

1 INTRODUCTION

Where stakeholders are in conflict and science is uncertain, science can have a greater impact on decision-making when its approach, assumptions and uncertainties are co-developed with interested government and non-government stakeholders. Experienced mediators carefully coordinate the efforts of scientists with policy negotiations at all stages of each group's work, so that neither proceeds without the knowledge and feedback of the other. Such coordination requires more than just speaking together. Research from various disciplines shows that scientists and lay stakeholders speak different languages (e.g. jargon), interpret the same phenomena in different ways, and use different methods and objects to represent the phenomena in question and imagine possible solutions. To work through these differences, the interacting parties need to create intermediate terms and expressions,

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frameworks for interpreting phenomena, procedures and norms for how they work together, and "boundary objects" for representing the water systems in question and imagining how they can be positively changed.

This paper introduces the challenges that science and scientists face when they try to contribute to decision-making on controversial water management issues, and draws from multiple literature sources and case experience to demonstrate how science can be more effective in these situations. Understanding the challenges and possible breakthroughs is important, because experience over the last three decades has shown that science is losing its authority in decision-making, especially when stakeholders are in conflict (Jasanoff, 1990; Jasanoff & Wynne, 1998; Layzer, 2002). Public dispute resolution theory provides some practical advice in this situation, but it assumes that the parties can communicate effectively with one another (Fuller, 2009a, 2009b; Schön & Rein, 1994). As this paper will show, that is often not the case.

The case used here, the Everglades water conflict in Florida, USA, has lasted for decades. During the period covered by this paper, the parties disagreed vehemently about many aspects of water management in South Florida. Battles in the legislature, courtroom, media, and in ballot initiatives were common and generally nasty. This paper studies the interactions among scientists and political stakeholders in three negotiated processes that occurred one after the other in the 1990s. In the first two of these processes, science played a minimal role in the ultimate political negotiations, while in the third, the Governor's Commission for a Sustainable South Florida (referred to as the Commission herein), it helped stakeholders move from impasse to consensus on many aspects of how water should be managed in the region. The Commission was convened because (a) the previous negotiations had not resolved most of the disagreements; and (b) the State Government wanted to provide stakeholder guidance to the newly-started Central and South Florida Project Comprehensive Review Study, (the Restudy). The Restudy was convened by the Federal Government to consider infrastructure and management changes to the Central and South Florida Project, a system of canals and other water infrastructure created to manage the water flowing into and through the Everglades. The Commission provided consensus guidance and recommendations to the Restudy, and it also authored multiple noteworthy reports and created new programmes to address South Florida's sustainability in water, energy, urban growth and other issues.

1.1 The study approach

This paper seeks to provide insights into the challenges and opportunities that are present when science seeks to inform decision-making when stakeholders are in conflict. The insights presented here come from various literature sources, and are demonstrated by using examples from three negotiations in the Everglades water management during the 1990s. Conflicts like the Everglades are complex and dynamic, and there is no theory that yet provides a comprehensive and sufficient explanation for when and how science may be more or less effective. Experience has shown that stakeholders—divided by their values, cultures and identities—often are unable to resolve their disputes, and that public dispute resolution theory provides only partial guidance about how to overcome these challenges (Bingham, 1997; Fuller, 2009b; Lewicki *et al.*, 2003). Students of local knowledge (Corburn, 2005), deliberative democracy and public policy have argued that public dispute resolution pays too little attention as to how different groups perceive and interpret text, words and phenomena. The concept of "frames" provides insight into how mindsets can prolong conflicts. Parties with different frames can attribute divergent meanings to words, phenomena and actions (Schön & Rein, 1994). Similarly, studies of the interaction between local knowledge and expert knowledge holders show how their divergent practices for creating and vetting knowledge often makes cooperation between them difficult (Corburn, 2005). These problems are also present in manager–expert relations (Walters, 1998) and among multiple scientific disciplines seeking to cooperate on research projects (Galison, 1997).

Analysis of examples from the case study illustrates how the different ideas provide insights into the challenges and breakthroughs. Quotes from particular interviews provide most of the examples, as they provide context and detail about the complexities that illustrate points in ways that aggregated data do not. The empirical data used for this study were generated using open-ended questions to identify and then delve into the challenges and breakthroughs in the negotiations. Data were gathered from archival sources as well as 40 semi-structured, in-depth interviews with participants in the negotiations and key decision makers. Interviewees were asked to give detailed accounts of examples of where deliberations were difficult and key moments in which breakthroughs occurred. They were deliberately discouraged from providing their own theories of what had happened, in large

part because research has consistently shown that the theories practitioners provide (espoused theory) are often different from the theories-in-use, which are the theories that explain their actual actions (Argyris & Schön, 1974; Schön, 1983).

The literature framing the analysis comes from multiple disciplines: public dispute resolution, organizational behaviour, science and technology studies, deliberative democracy and public policy. The paper especially draws from those works that seek to understand how cooperation can occur when the parties' different perspectives and practices remain in place. These theories are introduced in sections 3 and 4 to explain, respectively, the challenges and breakthroughs that occur when science meets negotiation and conflict. The next section introduces the Everglades conflict and the three multi-stakeholder negotiations studied herein.

2 THREE NEGOTIATED PROCESSES

The Everglades has been the topic of debate and intense disagreement for decades. The conflict among environmental and Sugar stakeholders was already decades old when an acting Federal District Attorney in Florida decided to sue the Florida State Government for not enforcing its own state water quality regulations. The litigation that followed was acrimonious and bitter for all the stakeholders involved, including not only state and federal attorneys, but also their scientists (John, 1994; Layzer, 2002).

The state and federal parties decided to negotiate a settlement to their dispute. As part of the process of negotiation, the scientists were brought together to try to reach an agreement on the science. The interactions among the scientists were very difficult. Participating scientists remarked that it was often quite difficult to tackle many of the real issues, as the lawyers present restricted what information their scientists could share (Fuller, 2009a; Jones, 2002). They did reach agreement on a standard for phosphorus leaving agricultural lands. Based on that standard, the federal and state parties reached an agreement.

They soon realized that this agreement would not hold against the legal challenges by Sugar, a group of major sugar growing and refining companies with significant resources and influence. Thus, a second mediated negotiated process, the Everglades Mediation, was convened to include representatives of the non-government groups: Sugar, environmentalists and Indian Tribes. This process started with the Mediated Technical Plan, a blueprint developed by a technical advisory committee with scientists from the different sides (Layzer, 2002). To their regret, the environmental and Indian tribal negotiators said that they could not support the plan (John, 1994). As the negotiations progressed afterwards, the environmentalists and Indian groups found themselves excluded from the main negotiations. The remaining parties (federal and state agencies as well as Sugar) claimed that the exclusion was necessary because the environmentalists would never agree to a practical deal (Fuller, 2009a). Needless to say, the environmentalists and Indian Tribes did not feel that this exclusion was fair. Some environmentalists stated that it was also striking that representatives of the federal Department of Justice, which had filed the initial lawsuit, were sometimes not invited either.

During the negotiations, the remaining parties agreed to the Statement of Principles, in which they provided an outline of the deal they hoped to negotiate. Their continued negotiations did not yield a final deal, however. The Florida State Government then took over, using the ideas from the Mediation to create Florida's Everglades Forever Act 1994, and construct a number of treatment areas to reduce phosphorus levels in the water (Fuller, 2009a).

The Governor's Commission for a Sustainable South Florida (the Commission) was convened shortly afterwards to continue the dialogue among the stakeholders and provide a multi-stakeholder venue that would give guidance to a newly-created federal effort, the Comprehensive Review Study (Restudy), to assess and improve the main water infrastructure system in the Everglades, the Central and South Florida Project (the C&SF Project; Central and Southern Florida Project Comprehensive Review Study, 1999). The C&SF Project is a system of canals and other water infrastructure created to manage the water flowing into and through the Everglades.

To create the Commission, the Governor of Florida issued an Executive Order (State of Florida Executive Order 94-54) to convene the Commission. Over 40 representatives participated, coming from public-interest and business groups, the Seminole and Miccosukee tribes, state and regional agencies; and local and state governments. The Governor's team knew that the Commission could only be successful in influencing the Restudy if its membership was broadly representative and its recommendations were strongly and widely supported. Furthermore, they decided that it would be better for the Commission

to tackle a broader problem: whether South Florida as a whole was sustainable. By using this framing for the Commission, the Governor and other conveners hoped to reduce the focus on the Everglades and build some momentum by getting stakeholders to talk about and reach agreement on less contentious matters (Fuller, 2009a).

One of the distinguishing features of the Commission's work was that it focused on "sustainability" and the "hydro-period." The focus on sustainability was important as it meant that the Commissioners had to consider the health of agriculture in addition to that of the environment, and urban issues as well as rural ones. The "hydro-period" focus meant that the Commissioners had to consider all of the various characteristics of water flows through the Everglades, instead of just the phosphorus levels. For example, the depth of the sheet flows through the system were strongly related to the health of various habitats. All the stakeholders agreed that the C&SF Project's alterations to the hydro-period were of greater concern than phosphorus levels (John, 1994; Fuller, 2009a).

The previous processes and much of the political and scientific debate prior to the Commission had focused on the levels of phosphorus entering the Everglades as a result of agricultural activities, even though all sides acknowledged that changes to the hydro-period were a greater factor. Phosphorus was a problem that many felt (a) could be attributed directly to Sugar's actions, and (b) was an easier issue for litigation and public relations battles. However, fixing the hydro-period required cooperation among many actors across the federal and state governments, as well as Sugar and other agricultural producers.

Over the period of five years, the Commission developed a vision of and recommendations for a sustainable South Florida, and provided crucial guidance and political support to the Restudy. At the end of the Commission's mandate, lobbyists from the normally opposed environmental and Sugar communities went hand-in-hand to lobby for a Comprehensive Everglades Restoration Plan (CERP) in government legislatures.

The features of the three processes are summarized in Table 1.

3 WHY IT IS DIFFICULT TO USE SCIENCE IN WATER CONFLICTS

When it comes to understanding the challenges of making science matter in negotiations, public dispute resolution theory tends to be quite pragmatic, focusing on interests and strategic methods to meet them in groups seeking agreement (Fisher & Ury, 1991; Raiffa *et al.*, 2002; Lax & Sebenius, 2006). The literature also provides descriptions of how the negotiation process can be structured and managed to improve problem-solving when stakeholders are interdependent and have competing interests (Susskind *et al.*, 1999; Moore, 2003; Susskind & Cruikshank, 2006). When it comes to understanding why science struggles to be relevant in water conflicts, these studies generally begin by noting that each side has scientists who can provide evidence that backs up their positions. This leads to scientific stalemate, since each side is usually able to cast doubt on the assumptions and methodologies of the other (Ozawa, 1991), an observation also made in the science and technology studies literature (Ezrahi, 1990; Jasanoff, 1990; Jasanoff & Wynne, 1998).

Such stalemates plagued the first negotiations in the Everglades. Agency officials stated that the relationships and trust among state and federal scientists were amicable before the litigation that necessitated the Settlement Negotiations, but deteriorated as it proceeded. One scientist noted that his team was arrested as they tried to collect data without asking for permission from the other side, something the court had required they do. Others talked about how personal and public the attacks were, as this one stakeholder describes:

> So there was a real tension; a lot of people felt often personally attacked by others on the other side. The drama was being played out on the stage, at such a profile that everything required a reaction or response that ratcheted it up one more notch (Interview, Spring 2003).

Jasanoff (1995) argues that science often loses its ability to help decision-making when it enters the courtroom. Litigation's adversarial environment further promotes attacks on methodologies and assumptions. It also uses different rules for assessing the validity of data and theories, and discourages conversation across the sides, which in scientific deliberations promotes the creation and testing of knowledge.

Once the negotiations commenced, the federal and state scientists met to try to settle some of the technical disagreements for the Settlement Negotiations. However, they were often frustrated in their meetings as the lawyers on either side forbade their scientists from revealing key information in the fear that it might be used in the court case against them. In the end, the scientists produced a standard

Table 1 Science and negotiation in the Everglades.

	Settlement negotiations	Everglades mediation	Governor's Commission
Who participated in the negotiations?	Federal and state lawyers	Initially: federal, state, Sugar, environmentalist, and Indian negotiators Later: federal, state, and Sugar negotiators	State, Sugar, environmentalists, regional and local government Federal participates actively but without an official vote
Results of the negotiation?	An agreement that is not sufficient to end conflict Litigation challenging agreement	Directly: Statement of Principles outlining broad actions and cost-sharing; no agreement on specifics Indirectly: Everglades Forever Act	Restudy finishes plan for fixing Central and South Florida Project in 50% of the normal time
Purpose of scientific deliberations	Choose standard for phosphorus and technology for reducing it	Develop technical plan for restoring Everglades	Develop plan for restoring Everglades through modifying federal Central and South Florida Project
Outcome of scientific deliberations	Standard set as is technology, but both are challenged in court	A consensus plan. Some stakeholders reject plan	A plan created with significant stakeholder and political support
Whose scientists participated in the scientific process?	Federal and state scientists	Federal, state, Sugar, and environmentalists	Federal, state, Sugar, and environmentalists
Who selected the scientists?	State and federal	All parties	State and federal
Lawyers present in scientific deliberations?	Yes	No	No
Can scientists share information freely with each other?	No, because of concern that information might impact litigation	Yes	Yes
Degree of coordination among scientific deliberations and the negotiations?	Mostly separate Results of scientific deliberations fed into negotiations	Mostly separate Results of scientific deliberations fed into negotiations	Interactive Policy and scientific deliberations concurrent and findings actively discussed between the two
Role of policy actors in influencing science?	Scientists selected by parties Scientists restricted by lawyers from sharing information with others Lawyers restrict data sharing	Scientists selected by parties	Scientists selected by federal and state governments Commissioners help choose and vet assumptions, set goals, and give feedback on each iteration of the solution

of 10 parts per billion (ppb) for phosphorus. The lawyers then reached an agreement based on this standard, but Sugar subsequently challenged its scientific foundations.

Meanwhile, a group of scientists drafted the Mediated Technical Plan at the beginning of the Everglades Mediation. The plan was more comprehensive in the problems and solutions it considered. The environmental and Indian stakeholders rejected the plan, despite the fact that all stakeholder groups had sent some of their scientists to the Scientific Group. They stated that the plan did not respect the "polluter pays" principle and contained no assurances about how the phosphorus levels would be reduced to the 10 ppb standard set in the Settlement Negotiations.

This rejection of the Mediated Technical Plan's legitimacy illustrates the observations made by students of public dispute resolution and science and technology studies: in situations of conflict, science struggles to maintain its legitimacy unless its assumptions, methods and solutions are vetted by the stakeholders (Ozawa, 1991; Ehrmann & Stinson, 1999). Even though the group had representatives from the various parties, it never sought feedback from the political parties about its approach and tentative findings. It also did not include the environmentalists' cherished principle of "polluter pays," and it did not show these parties why this principle was not included. The stakeholders' mistrust and beliefs made it easy for them to dismiss the results.

The Commission marked a significant change in the way that the science group and political negotiations interacted. Both groups coordinated actively with one another at all stages of their work. They learned much from each other, helped each other adjust their assumptions and methods, and otherwise worked actively together to put together a politically supportable and scientifically legitimate plan. In the next section, the paper will analyse the breakthroughs the Commission and the Restudy Team made to facilitate this active cooperation.

However, the Restudy's process was not always smooth, and its struggles illustrate one last challenge: the problem posed by differences in interpretative frameworks and practice. Most scientific efforts to improve water and the environmental systems require cooperation among scientists from many disciplines, and the Everglades was no exception. However, while everyone acknowledges the importance of cooperation, it is difficult to achieve in practice, often because of the differences in how each discipline understands and practices its craft. Galison (1997) argued that each scientific discipline can be understood as a sub-culture, with each sub-culture distinguished by the equipment they use, the jargon they speak, and the procedures they follow. In the Restudy Team, scientists interviewed by the author were struck by how different the biologists and the engineers were on the team, and noted that these differences made deliberations difficult at times. More specifically, they stated that the biologists tended to focus on making natural systems work. They prioritized the health of these systems, tended to think in terms of complex systems. They were also risk averse, preferring that the science was ironclad before adopting a solution. In contrast, engineers tended to focus on artificial structures, put human considerations first, preferred more straightforward solutions, and could tolerate greater degrees of uncertainty. They also varied according to the specific procedures they used and the jargon with which they communicated, among other characteristics. One of the scientists, who helped manage the Restudy Team and served as one of its liaisons with the Commission, argued that the differences in beliefs and perspectives were greater among the scientists than among the lay stakeholders.

In the next section, this paper focuses on the breakthroughs made in the Commission and the Restudy Team that were crucial in making the science more effective.

4 BREAKTHROUGHS: MOVING FORWARD ON THE EVERGLADES

Since the Commission was convened, in part, to provide (unofficial) political guidance to the Restudy Team, the two groups were already predisposed to more active cooperation. The stakeholders interviewed agreed that the ensuing, extensive cooperation between the Commission and the US Corps's Restudy Team of scientists and engineers was key to the success of both groups.

By broadening the initial mandate of the Commission to include non-water issues, the Governor hoped that the Commissioners could move beyond the deadlocks around water issues and gain momentum on easier issues first. Gaining that momentum was not easy though, given the significant mistrust among all the parties. For example, one Commissioner described the first six months of meetings of the Commission as "scorpions in a jar." Momentum and trust had to be created.

To facilitate further coordination among federal and state actors, key federal stakeholders and liaisons from the Restudy Team participated actively in the Commission as non-voting members. The Restudy Team played an active role at the beginning in explaining the science to the participants, including the modelling tools they would use. Many Commissioners gave the Restudy experts high praise for these sessions.

The Restudy Team very carefully selected liaisons, who were able to explain the difficult concepts to non-experts in the field. Some Commissioners also stated how humorous one of the liaisons was, noting that his jokes would often lighten the mood of the meetings. Humour, in fact, is both important and often taken for granted (Forester, 2004). Improving relationships greatly improves the effectiveness of a negotiation or other form of cooperative activity (Fisher & Ury, 1991).

The stakeholders and the Restudy Team also had to get a better sense of how they would work together and what they would try to accomplish. One of the first breakthroughs in this area occurred during a crucial moment at a Commission meeting, as described in the next quote. The moment discussed here was, as other stakeholders also noted, one of the first instances where the Commissioners all agreed on the same idea.

> One of the "defining moments" occurred when [Commissioner X] put this little icon on the board [here the interview respondent

> draws the classic sustainability diagram of three overlapping circles representing economy, environment, and community] and said, "Aren't we talking about the environment, the economy and social issues? And realizing there is an overlap on these issues, aren't we trying to increase the overlap?"
>
> . . . So, here's where we are and where we want to go is to [the drawing of three circles with significant overlap]. . . . That was the image of what we're about. But the point that I mean is until we got some consensus of everybody nodding up and down on stuff like that we couldn't even break into groups (Interview, Autumn 2004).

This simple diagram helped Commissioners imagine what they were trying to achieve as a group. They were learning more together about the technical issues and complexities, and discussed these in great depth. And yet, because of their mistrust of each other, they were unwilling to separate into sub-committees until the group had (a) a vision of what the process was really trying to accomplish, and (b) some belief that the others were also working to achieve that purpose. Creating such an overarching vision is an important step in any group (Rubin & Swap, 1994), but especially in situations where parties see themselves as having different values. In such situations, they need a shared purpose or goal that bridges and speaks to their different perspectives and so reframes the negotiation to allow them to see past their own individual needs and beliefs (Susskind & Field, 1996; Wadley, 1999).

This shared purpose grew in depth and complexity during the process. For example, after one frustrating meeting, a staff member of the Commission drafted a story that tried to describe what the Everglades would look like should the Commission succeed. He shared that story informally with a few Commissioners, and they brought it to their group. The Commission liked the idea and worked on the text until a short story emerged that everyone agreed represented a vision they could support. Like the three-circle diagram, the story helped the Commissioners further define the purpose of the process. The negotiations that led to the creation of the story also provided evidence to each of the Commissioners that their peers were willing to work towards some kind of sustainability they could agree upon.

The tangible nature of these two breakthroughs was important. As stories and diagrams on paper, they could be manipulated, negotiated and improved by the group. Once done, these objects were stored as artifacts that captured the shared understandings about what the group was trying to do together.

One such object also helped create a breakthrough in the Restudy Team. As described by members of the Restudy Team, cooperation among the scientists was often difficult because of their discipline-based differences, as presented in Section 3. Like the Commission, the Restudy Team at first lacked a clear purpose to help them focus and coordinate their work. One simple, but important, step they took in that direction was to create a simple banner for their office, with the words "It's the Everglades, stupid." Displayed where everyone could see it, the banner reminded the scientists that they shared a goal and that something needed to be done soon.

The Commission and the Restudy Team were not convened to work alone, and so they also had to work out what they were supposed to do together. Their tussle and then cooperation on *A Conceptual Plan* provides one illustrative example of both the fragility of trust between the two groups and how they worked through it. The plan was initially drafted by members of the Restudy Team as they tried to organize the different problems and projects being considered by the team. In the first draft of *A Conceptual Plan*, projects were organized into various categories and sub-categories, and then placed on a visual map of the Everglades, so that the Restudy Team could get a better idea of how the projects connected together and met the needs of the overall Everglades system.

When one of the Restudy Team's liaisons presented the draft plan to the Commissioners, the latter's first response was suspicion. The Commissioners wanted to know where the plan had come from, who had initiated it, what its purpose was, and so on. Some of that suspicion was based on the expectation that the Restudy Team was supposed to keep the Commission informed about its work.

Once the Restudy Team explained what they were using the plan for, however, the Commissioners became interested in the idea and the two groups started working on the plan together. The end result was both a conceptual map that showed roughly the geographical as well as thematic elements of the different projects and an agreed-upon set of Concepts and broader Themes that was crucial for the ongoing work of the Commission and the Restudy Team. The map is shown in Fig. 1.

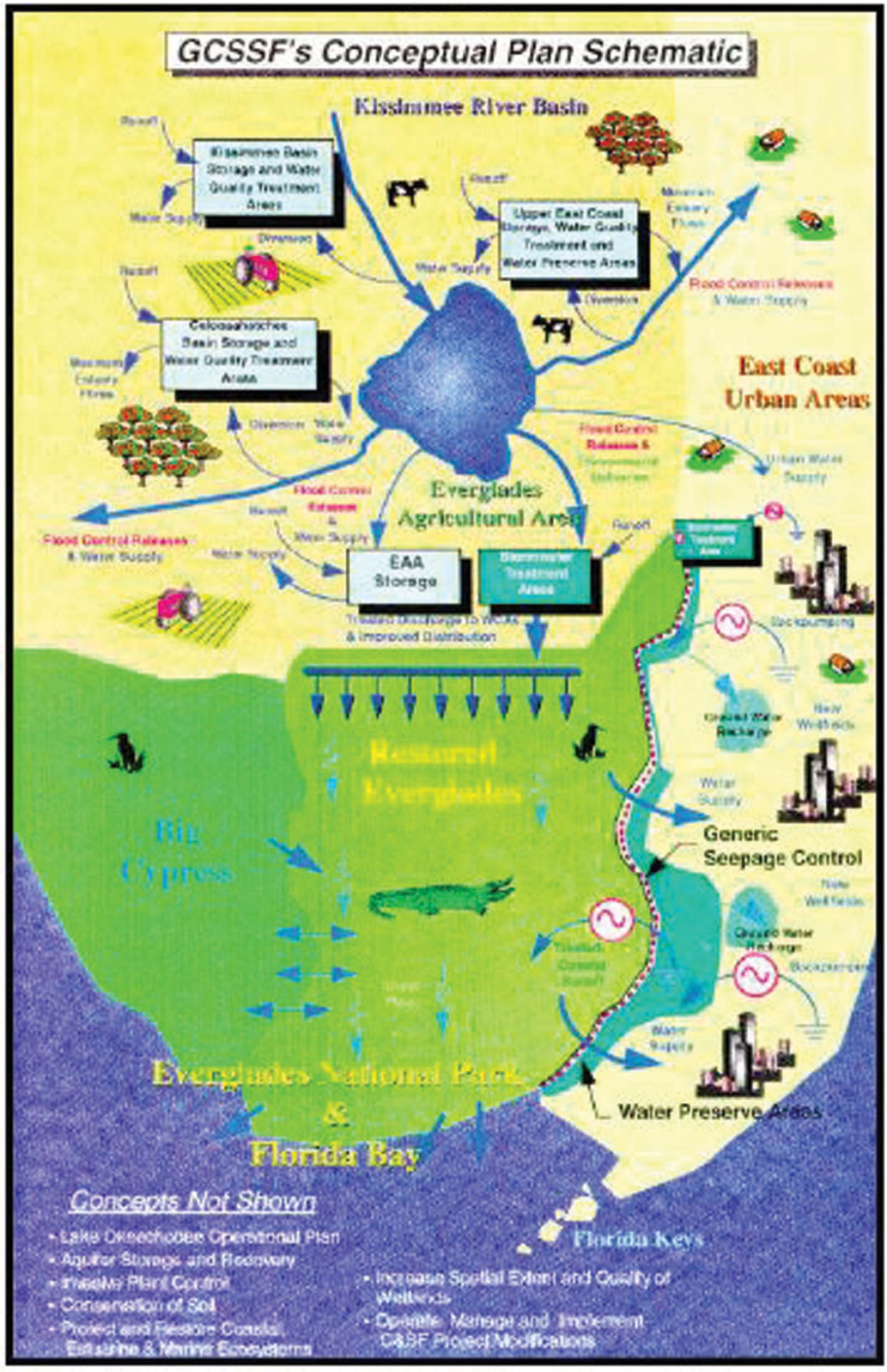

Fig. 1 Conceptual Plan Schematic (Central and Southern Florida Project Comprehensive Review Study, 1999).

This next stakeholder's observations indicate how important the Commissioners felt the plan was:

> Our map, and our goals, and all of that were based on preliminary review or presentations that got into the Initial Report and then the Conceptual Plan. At every step of the way as they were designing [the Restudy], we were following that roadmap and giving comments back. . . . Everyone had their little part of the puzzle they were focused on. Not as many people focused on the whole system (Interview with Commissioner, Autumn 2004).

Essentially, the plan gave concepts, themes and maps that became common reference points for relating individual projects to each other and the system. Many different documents, diagrams and maps became such reference points, capturing agreements, showing links between different projects and parts of the Everglades and, otherwise, keeping the two different groups working towards the same goals.

Students of both organizational behaviour and science and technology studies have stressed the importance of objects, which they call "boundary objects," in facilitating cooperation across multiple disciplines. Carlile (2002, p. 446) defines them as "artifacts that individuals work with—the numbers, blueprints, faxes, parts, tools, and machines that individuals create, measure, or manipulate". When such objects are used, full understanding is not required. Instead, when one party proposes a change, it is presented on the object. The other party (or parties) evaluates the changes using their own perspectives and goals to determine how well it meets their own concerns. Coordination is achieved by iteratively modifying the boundary object until everyone can live with the result. *A Conceptual Plan*, and its individual components, like the map in Fig. 1, were boundary objects that facilitated the problem-solving among the different groups.

The deliberations around *A Conceptual Plan* also demonstrate the importance of establishing the norms and procedures for *how* the two groups would coordinate their efforts. As they worked together, the groups began to develop routines for, and expectations about, what each group would contribute, how they would interact with one another, and so on. In the example given above, the Restudy Team had accidentally gone against the expectations that each side would inform each other of their work. Fortunately, the two groups had developed some trust in each other at this point and were able to move quickly through the disagreement. In other situations, with insufficient trust, maintaining expected roles and following expected procedures can be crucial for developing trust in a group (Meyerson *et al.*, 1996).

Working through their disagreements was not always so easy. There was a moment during the deliberations when the Commissioners asked the Restudy Team to try a different approach in their problem-solving: using the no-infrastructure scenario as the starting point. The Restudy Team had assumed that any solution would involve modifications to the current infrastructure. The Commissioners asked the Restudy Team to examine what would happen if they took out all of the structures in one area and just let the water flow naturally. From there, the solution would evolve by adding only what infrastructure was necessary. The difference in the two scenarios was that the Commissioners' suggested starting point aimed to create a solution with the least infrastructure.

The Restudy Team resisted the idea, as described by a federal participant:

> The [Restudy Team] kept saying, "You can't do that." Everybody else was saying, "You may be right but we want you to try." They said, "We don't have the time or resources—it won't work. Trust us." I said, "Why can't you guys just stop and do what they're asking?"
>
> . . . The engineers sometimes put cultural constraints on the way they think about a problem that this group didn't have. This group [the Commission] could redefine the cultural values, the public values, in terms of sometimes challenging the assumptions of the agencies. It turned out that it was not as bad as they feared, nor as simple as we talked (Interview with federal participant, Spring 2003).

The Restudy Team opposed this request from the Commission because it went against the core methodology and assumptions they had been using in the Restudy. The Commissioners perceived this resistance as the Restudy Team working against the spirit of the cooperation, which was focused on solving problems rather than arguing over whose perspective is right ("It's the Everglades, stupid"). After the Restudy Team ignored the repeated requests, the Commissioners used their significant political influence to force the issue. When the results were discussed, the Commissioners realized that removing the infrastructure did not produce the benefits that they had hoped, while the Restudy Team admitted that it had more promise than they had thought. More importantly, it re-established the norm that each group

should consider seriously the suggestions from the other, even if they were initially unsure of the idea's merits.

Where conflict is low, boundary objects can often be brought in from outside without problem. Where it is high, however, the content, form and use of a boundary object may often need to be negotiated among the participants (Fuller, 2009a, 2009b). This was certainly the case in the cooperation between the Restudy Team and the Commission. If the Restudy Team had not finally conceded and run the model with the new approach, several Commissioners said, the model and its results may have lost some or all of the support from the Commission. The same was true for the minor dispute between the Restudy Team and the Commission around *A Conceptual Plan*.

Public dispute resolution places a strong emphasis on creating clear ground rules for any process (Susskind *et al.*, 1999). These ground rules are not only important for governing the interactions within a group like the Commission, or between a lay and an expert group, but, as Galison (1997) emphasized, agreed-upon procedures for scientific cooperation among multiple disciplines are also important. In public conflict, they may also be applied to communications with the media (Kunde, 1999), constituencies (Fuller 2009a, 2009b), or for many other situations. In situations where parties believe that their values are in conflict, as was the case in the Everglades, ground rules are important for creating a safe space in which stakeholders can move away from automatic opposition and towards greater cooperation in identifying problems and finding solutions (Forester, 1999).

The importance of structured safety is illustrated by the 1996 battle over the "penny per pound" ballot initiative. Before and during the Commission, environmental groups, including groups represented on the Commission, had been trying to get the government to impose a tax of one penny per pound of sugar produced to pay for environmental programmes. In 1996, during the Commission's deliberations, they successfully started a ballot initiative for the proposed tax. The public relations battles before the vote were harsh and often quite personal. This next Commissioner describes how this impacted the group and how they dealt with it:

> At the very last of it, Sugar figured the only way they would survive is to attack the water management district. . . . Sugar spent two weeks before the election running ads on their ineptitude . . . [T]hey were taking it apart publicly, unfairly, viciously.
>
> That gives you an idea of the people who thought they had achieved friendship, consensus and whatnot—and the other guys turned into man-eating tigers. Then, you don't really want to go sit next to a man-eating tiger.
>
> *Author: Yet, you guys got through it, so how did you do it?*
>
> We went and talked about urban sprawl or something for a couple of times [laughs]. We bored everybody back into friendship (Interview with Commissioner, Autumn 2004).

Many of the relationships that had been built before the penny-per-pound ballot initiative almost died during it. Members of the regional water management district were furious with Sugar, as were many of the environmental representatives. Some of the Commissioners wanted to discuss the issue in the meetings, but the Chair and facilitators rejected the idea, saying that it was (a) too volatile, and (b) unlikely to yield an easy solution that the Commission could agree to. He kept the group talking about the issues they had already identified as a group, until they had "bored everybody back into friendship." This worked because the Commissioners were used to deliberating in a certain, deliberative and considerate style. Once they got started on their business-as-usual issues, they fell into their comfortable, safe routine which allowed them to put the other issues aside. The rules and norms of the group provided safety even in uncertain and hostile periods outside the negotiation.

The Commission and the Restudy Team also had to clarify, redefine and create new terms to describe the concepts, phenomena and observations being brought into the deliberations. Sustainability was one such concept that had to be debated, negotiated and eventually agreed upon. Its definition, as described earlier, was partially captured in stories and diagrams, like the three circles. However, the group needed to come up with more formal definitions for the concept of sustainability and many others. These new terms and definitions had to be independent of any one group's jargon. So, instead of one party talking about biology using biology jargon and another talking about socio-economic consequences in that jargon, the Commissioners had to translate their concerns into words and concepts that were familiar to all the parties. Such terms even extended to describing the group's norms and procedures.

For example, the term "pet pigs" became common in Commission deliberations to capture some of their norms, as this Commissioner discusses:

> There was this little saying the people had: "Keep your pet pigs at home." If you are going to have your pet pig, we'll have a pet pig festival. So for a couple of hours everybody will get out their pet pigs and parade them around—then we'll put them away and get back to the job of restoring the Everglades (Interview with Commissioner, Autumn 2003).

"Pet pigs" refers to the specific projects that Commissioners and other participants often wanted to promote in the Commission's deliberations. The expression "keep your pet pigs at home" was a reminder to the group to concentrate on its purpose, which meant that one had to be flexible in considering other ideas and keep the broader needs in mind when proposing solutions.

To summarize, science made a tremendous impact on decision-making when the policy negotiations (the Commission) were actively coordinated with the scientific process (the Restudy Team). The interaction was two-way during the Restudy Team's and the Commission's efforts, unlike the previous processes. Not only did science guide decision-making, but also the lay Commissioners provided guidance to the science. This active cooperation was enabled by the use of boundary objects, the development of norms and procedures for doing the work together, and new or re-defined terms and concepts that were subsequently used by stakeholders as a common language to complement the boundary objects in identifying problems and negotiating solutions.

5 CONCLUSION: MAKING SCIENCE MATTER IN WATER CONFLICT NEGOTIATIONS

Recent literature highlights how important adaptive management is for water management and other complex issues, but making it happen in practice, especially when there is conflict, is difficult (Holling, 1978; Lee, 1993; Schloz & Stiftel, 2005). In the case of the Everglades, when the scientific work was conducted almost independently from the negotiations, it was not effective in guiding decision-making. When the Commission engaged actively with the Restudy Team, the two groups informed and lent legitimacy to each other's work.

If active cooperation is the key to creating more legitimate and wiser water management decisions, then relationships, a shared purpose, boundary objects, norms and procedures, and redefined terms and concepts facilitate that coordination. These elements are helpful and necessary, because the parties in a conflict often (a) do not trust one another, (b) can undermine each other's science in the adversarial forums (the legislature, the courtroom, the public media, and so on) in which decision-making often occurs, (c) are unwilling to accept solutions unless they have participated in and vetted the scientific process which produces the data, and (d) speak different jargons and use different interpretative frameworks.

This last point is crucial, because each member of the Commission and each scientist in the Restudy Team have constituencies, disciplines and professional bodies that expect certain behaviours, terminology, methodologies and so on from them. For example, the environmentalists in the Commission and the biologists in the Restudy Team will each continue to talk about ecosystem preservation using their own jargons when they are together with their peers. When they worked together, however, they talked about sustainability, and considered possible solutions using the terminology and boundary objects they had negotiated and created specifically for their cooperation. The negotiation of these terms and objects was crucial for three reasons. First, each party had to feel that the terms, rules, norms and boundary objects were fair and wise. Second, they had to be able to use the terms and boundary objects to convey the evolving ideas to their constituencies. Third, the process' rules and norms of their interactions had to be seen as legitimate by both constituencies and observers, so that the process was credible.

To make science matter, then, requires recognition of the real differences among parties in how they make, validate, and use knowledge. The effort starts by identifying the boundaries that science has to cross, both among disciplines and between scientific and political groups, and the differences in language, objects, and procedures and norms employed by parties on both sides of the boundary. Subsequent cooperation among parties can then be facilitated by the creation of a bridge across the boundaries whose elements are negotiated and hybrid, in that they make sense to and can be employed by parties on all sides of the boundary.

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