

set of plausible alternative futures was discarded by the imposition of federal resources. The federal capital was accessed again in the 1970s, 1980s, and 1990s, but these times it was in the form of negative incentive, in terms of constraining the options for management available to the state water managers. The constraints were in the form of mandating water quality concerns and water supply needs for federally held properties in the Everglades. So the remembrance process—tapping into capital at larger scales—was critical in both creating and confining options for renewal in Everglades policy following smaller-scale crises that revealed the inadequacies of that policy.

Summary and Conclusions

In this chapter, we have used the heuristics of the adaptive cycle (Holling 1992; Chapter 2) and panarchy (Gunderson et al. 1995a; Chapter 3) to examine some similarities between ecological and social systems. We used a case history from the Everglades to illustrate linkages between ecological and social systems. In most of these systems the linked or composite system followed the four phases of the adaptive cycle. As new institutions (social rules, norms, and structures) matured, they became more and more vulnerable to disturbances or perturbations from the outside. In some cases, those disturbances were part of unforeseen or nonrecorded variation in key processes of the ecological system. In other cases, the effects of those disturbances were exaggerated by previous management actions, leading to an increased vulnerability of the social system. This is apparently the case in the history of many technologically based systems—including wetland systems such as the Everglades, where water level is the key management target.

Other similarities exist between ecological and social systems, in the back loop (renewal and reorganization phases) of the adaptive cycle. Many social systems focus on buffering mechanisms to maintain their resilience. Those institutions actively pursue ecosystem management actions to mitigate impacts of disturbances and maintain their stability through tolerable perturbations. Other institutional settings show a remarkable ability to reinvent themselves or create totally new solutions.

CHAPTER 13

THE DEVIL IN THE DYNAMICS: ADAPTIVE MANAGEMENT ON THE FRONT LINES

Frances Westley

*Once upon a time, everything seemed fixed and solid.
Now everything in the universe has begun to slide under our feet: mountains,
continents, life, and even matter itself. To make future progress science must
peel away all the coverings of apparent stability in the world.*

—Teilhard de Chardin

This chapter focuses squarely on the management aspect of adaptive management. Much work has been done exploring, describing, and modeling the ecosystem dynamics. The phases of Holling's four-box cycle have been charted and analyzed in ecosystems around the world, and our understanding of the complex and unpredictable aspects of those dynamics has increased as a result. Less work has been done on exploring, describing, and modeling the social system dynamics and their interaction with the adaptive environmental cycles. However, here too, steady progress has been made. Gunderson, Holling, and Light (1995a) explored the interactions between management approaches and ecological crisis and renewal from a historical perspective. Holling and Sanderson (1996) have been developing a political ecological approach; Berkes and Folke (1994, 1998) with colleagues have been documenting and exploring the role of traditional ecological knowledge (TEK) in maintaining ecological resilience. For the most part, however, these studies have focused on the macro level, in order to apprehend the slow variables (institutions, laws, and cultures) and the ways in which particular management practices embedded in institutions support or undermine ecological resilience.

This chapter will take a micro-level perspective, in an effort to complement the work done from the institutional perspectives. It will focus on the case of one manager, Evan Karel, and a series of resource management challenges in which he tried to manage adaptively. Our concern is at the level of the individual decision maker, and at the level of the relationships in which he is embedded and seeks to work. We will explore how the larger institutional forces affect the individual decision maker, and to what extent the

relationships that the manager forges within his or her own organization, and across the social system in which that organization is embedded, form a complex, adaptive system, acting as a response network, to provide the manager with social resources for dealing with crisis and surprise at the ecosystem level. To put it another way, this chapter is an exploration of what Gunderson, Holling, and Light (1995a) describe as the key to the reality of the adaptive management of complexity: "that individuals and small groups of individuals exert extraordinary influence by performing certain distinct roles within and outside institutions." This chapter seeks to explore in more detail the nature of these roles and the decisions and actions of the individuals that shape them.¹

Adaptive Management and Managerial Decision Making

In his groundbreaking study of managerial work, Henry Mintzberg revealed the fragmented and chaotic world of most managers' work lives, far removed from the planning, controlling, and coordinating that the literature said was an accurate description of the manager's job (Mintzberg 1973). Since then a number of thinkers and writers about managerial decision making have challenged the idea that it is a rational or even logical process. Political pressures often intervene (Allison 1971), and contextual dynamics introduce uncertainty and surprise (March and Heath 1994). Complexity and incomplete information result in behavior. Action demands a logic very different from analysis (Brunnson 1982), and in general decision points can be determined only retroactively through a process of sense making (Weick 1995). Nonetheless, the challenge of choice for key system actors remains a critical one for understanding the human system response to ecosystem dynamics.

Evidence from the historical cases of ecosystem management suggests that certain management regimes, clusters of beliefs, and practices dominate for periods as long as twenty years, their erosion precipitated only by ecosystem crisis (Gunderson et al. 1995a). This rigidity has in part been attributed to a mechanistic and reductionistic worldview, a command and control approach to management, and a commodification of nature (Holling, Berkes, and Folke 1998). In recent years, proponents of adaptive management have suggested alternatives to the approach, based on a systems perspective, the interaction between social and natural dynamics (Holling 1978; Walters 1986; Lee 1993). But what would this mean for a manager and individual decision maker, particularly one who is working within the more traditional management regimes? Institutional theory suggests that institutions do change, but only through major crisis (such as that explored in Gunderson, Holling, and Light 1995a) or through a gradual shift in perspective of a critical mass or group within the organization (Greenwood and Hinings 1996). This chapter explores the choices and decisions of a manager working within the context of an agency in a time of institutional change.

The descriptions that follow are based on extensive, in-depth interviews with a single manager. As such, the accounts are clearly biased. No effort was

made to introduce other perspectives, and therefore the accounts of the events in each case must be viewed as subjective. Our focus here is on the sense-making process of a key actor who attempts to manage a complex, adaptive system. The account searches for depth of understanding as opposed to breadth and hopes to provide a rich enough description of the process to allow for comparison with other accounts of individual managers. In that sense it is offered as a complement to the more system-level approaches of other chapters.

Evan Karel: An Adaptive Manager

Evan Karel grew up on the shores of Great Lake, during the collapse of the walleye fishery, and this event, for him and for those he knew, had a powerful, shaping effect. Walleyes for the fishermen of that lake had an almost religious significance. Their demise was part of an ecological collapse that was experienced as a tremendous loss by Karel in the formative years of childhood:

We were avid anglers and as a little kid, I remember going out at night and hanging a lantern out the end of the pier and the emerald shiners would come up to the light and the walleyes would follow them up. We'd bait our hooks with emerald shiners, and you'd catch walleyes as fast as you could throw your line in the lake. And then the mayflies . . . [I]n late May and early June the lake flies, we called them Canadian soldiers, would be a foot deep on the streets and the street sweepers would be out at night sweeping them up. And in 1953 the lake stagnated, went anaerobic on the bottom, and they all died and they never came back.

When Evan was growing up, there were more than forty-five commercial fisheries on the lake, and by the time he was a teenager, there were only two. His grandfather, who was a naturalist and avid angler, kept "putting it in perspective. He told me how there used to be cisco and whitefish in the lake. We were shanty Irish, and when I was a kid a big deal was to have a baked whitefish. But by the time I was in junior high school there were no more whitefish. I lived through these changes. I remember my grandfather saying that nobody gave a damn and industry was going to develop the shoreline and mills were going to dump pollution into the lake and all the fish were going to be gone in his lifetime . . . and they were."

This experience shaped Evan's values in a number of important ways. He developed a keen sense of conservation, a proletarian suspicion of the rich and powerful (his other grandfather was a union leader), a faith in the people, a love of fish, a fascination with chemistry and its relation to lakes, and a systems view of their dynamics. These values had a strong impact on his ideas about resource management and his decision making.

His early family experiences also prepared him well for both conflict and collaboration. His stepfather, in particular, a firm, fair man, was tough but

just. The rules in Evan's household were clear. You shared, you weren't selfish. You tested the line, you paid:

My stepfather was a very value-driven, principled man. He was judgmental but could also be tolerant of people very unlike himself. He had a terrible temper. I remember when I was about ten or twelve, he told me to take the trash to the town dump before he came home for lunch. I didn't, and I talked back to him sarcastically when he said, "There's going to be hell to pay when I get home tonight if this trash is not gone." I responded, "There is always hell when you're around," and he picked me up by the collar and shook me. Then he threw me out the locked screen door and said, "When you can do that to me, then you can talk back." Then, surprised at how far I sailed through the door, he silently checked to see if I was all right. Confirming that, he repeated that the trash better be gone when I get home and fix the latch on the screen door, too. He was not unfair, and the rules were clear. He expressed a steady, undemonstrative love, behind the conflict. This is perhaps why I'm not afraid of conflict.

Evan went to college at Central State University, earning a degree in aquatic zoology. He had started in chemistry but then switched to limnology because he got a job as a biochemist on a boat one summer. He then received a master's degree in limnology, researching the translocation of copper through walleye lakes. His first job was as a research assistant at the Natural Resources Institute at Central State University, and then he went on to join the Central State Department of Natural Resources, in inland fisheries research, in 1963. During his time at Central State, he began to get involved in projects and studies with very active citizen involvement. He was particularly impressed by a study he participated in on the socioeconomics of Central State fishermen:

This had a great impact on me. What struck me as interesting was that up 'til then I'd seen the greedy side of the sports fisherman, people who only wanted more and more fish without limit. We had worked with several insurance companies to develop some value questions at the end, which were designed so that you couldn't just lie. They detected subtle connects to the angler's deep beliefs and values. It turned out that these people were really connected to the environment. So my attitude toward anglers evolved from seeing anglers as only interested in exploiting the resource to one that recognized that anglers are really good people, who care deeply for the resource, not just greedy exploiters of it. The other thing that the questionnaire demonstrated was how much they valued the aesthetics of fishing on clean water. They needed to catch fish, but almost as important was the *idea* that they might catch one. This made me

realize from a management perspective, that you had to manage more than fish, you had to deal with the experience, the expectations, and values.

Evan brought this holistic perspective, systemic from the point of view of both ecosystems and social systems, to the variety of challenges that he faced in his career. In 1974 he joined the Northern Department of Natural Resources (DNR) as regional fisheries supervisor. In 1986 he was promoted to director of the Bureau of Fisheries Management, in 1987 to administrator of the Division of Resource Management, and in 1997 he became director of the Bureau of Integrated Science Services, where he is today. What follows are a number of case stories, representing both challenges and successes, that describe his style and philosophy of management. Contained in these stories is evidence of four adaptive management strategies, which combine to present a singular picture of the challenges of managing complex adaptive systems.

Managing Complexity

Few managers are so clearly confronted with the need to deal with complex adaptive systems as the natural resource manager within a given ecosystem. It is questionable in fact whether any individual or group can *manage* such systems, which are characterized by high levels of diversity, continuous change and learning, and complex interconnections that render them unpredictable. Rather, images of agency in such systems tend toward improvisation (Weick 1998), story telling (Gardner 1995), humor (Weick and Westley 1999), discovering of harmony (Coveney and Highfield 1990), and sense making (Weick 1995). It would appear that managing in such systems is about self-reference (understanding and maintaining commitment to core values or competencies); emergent pattern recognition; and openness to diversity, change, and new information (Wheatley 1992).

Karel's career, like all careers of excellent managers, is a tapestry of successes into which are woven a few spectacular failures, by his own admission. For Karel, managing complexity means "never taking action with just one objective in mind." He approached most problems with multiple objectives, four of which are recurrent enough to provide conceptual focus: managing *through*, managing *out*, managing *in*, and managing *up*.

Managing *through* refers to Karel's commitment to a scientific approach to management. His own training and experience convinced him of the value of a scientific approach, which treated management interventions as experiments to learn from, as opposed to solutions to be implemented. This drove his own passion to treat ecosystems from a truly systemic point of view. One of his objectives was always to diffuse such an experimental and scientific attitude through his department and among the stakeholders with whom he dealt.

Managing *out* refers to the commitment to involve external groups or stakeholders in management processes and decisions: "Much of what we [managers] do actually gets in the way. We need to get people out into the community. In the past when a manager got too close to the communities we would say they have 'gone local.' Well, in fact we should all 'go local.' But when I say that, people get very anxious. We should be defining important principles but not micromanaging the details. Leadership in this context is generating the communication and mediating between groups."

Managing *in* refers to the need to also manage position and influence within the department or organization. Moving through a career, Karel occupied various formal roles within his own organization. Depending on his position and the particular personalities with whom he was involved, maintaining internal support for his experiments and his external stakeholder activities was more or less difficult and required different kinds of skills.

Managing *up* refers to the need to take into account the larger political context in which Karel's career and strategies unfolded. Even success at the agency level could be easily undercut at the level of the state legislature in Northern. Unless actions taken at the community, organizational, or scientific level were considered from the point of view of the larger political arena, much excellent effort could be ended with the slash of a pen.

It is helpful to envision these four kinds of strategies as four balls, which the effective manager seeking to harness complexity must juggle (Figure 13-1).

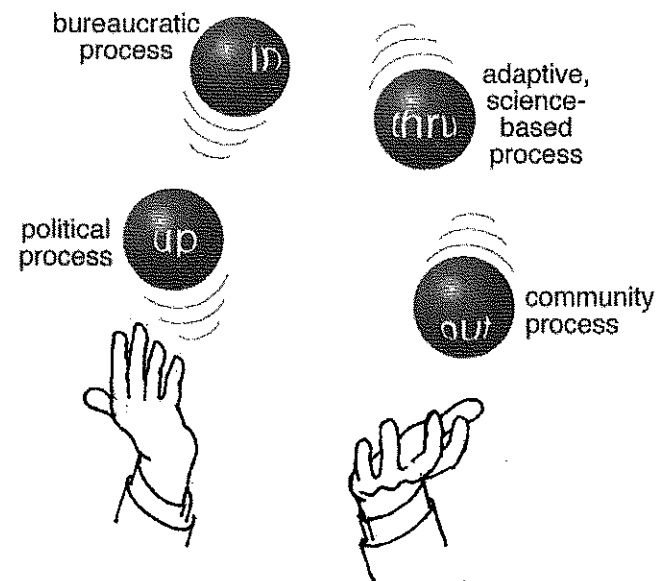


Figure 13-1. Four processes represented as four balls, which an effective manager who seeks to harness complexity must juggle simultaneously.

Depending on his or her values and skills as well as his or her formal position and contextual factors, it is easy to drop one or more balls. Extending the metaphor, *surprise* may act like a sudden wind, looping a ball into a new dynamic, or like a sudden shift in terrain, which causes the juggler to lose his footing and his balance. The trick is to keep the eye on these four balls and somehow, with peripheral vision, *adjust* to those surprises as they unfold, or, even better, *use* them like the good golfer or tennis player uses the wind. The key, however, is that, as Karel puts it, "The devil is not just in the details, it's in the dynamics." In complex, adaptive systems, disequilibrium and surprise are the rule, and failure is as instructive as success. We will review a number of these cases, as seen through Karel's eyes, with a particular focus on the patterns that emerged as Karel's to try to determine the role each of these strategies and their interactions played in both generating and responding to surprise.

The Salmon-Raising Experiment

This particular case is one that Karel remembers vividly, as it occurred during the first few weeks of his move to Northern State. Considerable tension had been building up over the issue of snagging salmon. Snagging, a practice whereby hooks were dragged through a salmon run to catch fish, had become popular in the lake. Native Americans had used the practice to harvest fish, as had pioneers and other foragers, but by the turn of the twentieth century it had been deemed unecological as well as unsportsmanlike, and DNR wardens worked hard to stamp it out by arresting poachers. Now the solution to a new problem, stocking Pacific salmon to curb the invasion of alewife into the lake, had brought snagging back into vogue in Northern State, at least by some groups.

The problem started when salmon was stocked in the lake in an effort to deal with the alewife problem. After swimming upriver to lay their eggs, the stock salmon would die, polluting the rivers and shores of the lake. Central State had responded to this crisis by allowing snagging. Northern had maintained a ban on the practice, however, and either hauled away the dead fish or let them lie. Although anglers could still catch some fish with artificial lures and bait, their success was much less that that of a skilled snagger. Many Northern anglers favored the more liberal snagging regulations—e.g., being allowed to keep foul-hooked or accidentally snagged salmon—but others strongly opposed this practice. The continued ban and a fairly evenly divided public caused much tension among various groups that held strongly different positions on snagging and foul hooking. Karel explains:

One segment of the angling community felt that these fish were going to die and would be wasted anyhow, so you should take them by any method. They felt that these were stocked fish that don't reproduce... you aren't killing spawners. These were the "get them out of the stream proponents." They were sportsmen (the sports-

men were divided), local community folks that didn't want the dead fish (sanitation people, local government people), and the tourist interests (attract fishermen and keep the lakes clean). Then there were the skeptical and undecided... they would occasionally foul-hook [snag] fish "accidentally" and felt this should be allowed. Then there would be some more conservative types: conservation wardens, most fishery managers, members of the fishing community who remembered how hard it was to stop poachers from snagging walleye and northern pike and feared it would train a whole new generation of poachers and that it was not ethical. Northern's outdoorsmen have always had high ethical standards.

The opinions of these groups were extraordinarily strong and polarized... they would get into physical fights on the piers. The intensity of this debate was incredible... some were laying ladders against chain-link fences to snag... others would come with trailers and can salmon all weekend. The further you got from the lake, the stronger the feeling was. It was almost a simple black and white, wrong and right. The majority of the angling community was against it.

The first week on the job, Karel was asked by his boss to give a talk on salmon hatcheries to a meeting of an important fishing club in one of the regions under his jurisdiction. Karel knew he was walking into an ambush: the week before all of the officers of the club had been arrested on the grounds of intent to snag. He had read all the background materials and knew that the warden who had done the arrests was on shaky ground, as the law did not in fact include a penalty for intent to snag.

I had read all the citations, and I thought the wardens had really screwed up. They had gotten overambitious. These anglers were kind of taunting the wardens. The rules said you couldn't snag... nothing about intent to snag. The guys were snagging but not catching fish, so they came up with this jargon about intent to snag. I could win the club by saying these were pig-headed wardens, they were wrong, so go to court; but I figured that's going to really build a good relationship with the wardens... and they have a network critical to the fisheries programs' success. So I figured the only thing I could do was to say I wasn't there, I don't know what you were doing.

Fresh out of a university research position and new to the job, Karel decided to take his wife along. They arrived before dinner and enjoyed a cordial meal. However, Karel noticed that one of the officers who had been arrested kept heading back to the bar, and he figured there was going to be trouble. After dinner he stood up to begin his speech on the state salmon fisheries, and as soon as he put up the first slide, the officer, quite drunk by now, was on his feet:

As soon as I started talking, ——— was up moaning about "You know what happened to us? What's your opinion on snagging?" The president of the club, instead of shutting him up, said to me, "Just answer the question, and then we'll be able to get on with it." So I answered, "I don't think snagging is appropriate in this case," and he said, "Well, the wardens must agree with you because I got arrested." Then I just started with "I wasn't there... I don't know what happened. If you think you were wrongfully arrested, you should go to court." "Well, what do you think your warden was trying to do?" "I wasn't there." He kept taunting me and finally he started swearing, and then one of the women shouted out, "Sit down, ———" He ignored her, and then the president said, "Sit down, ———, he's told you what he can." Finally, two big guys came over and sort of stood next to him, and he sat down. I finished my speech and afterwards, the president came over and said, "I think ——— wants to buy you a drink."

Interestingly, this trial by fire seems to have established Karel's credibility with the group. The fact that he didn't lose his temper despite the fact that he was taunted impressed them. ("I have a terrible temper, so I don't lose it. In those situations I really separate my person from my role.") As a result, after the talk, the club members approached him with a second frustration. In a nearby area, salmon were being reared in a salmon pond, partly to produce fish for the big regional salmon fishing competition. This pond had never been a big success, but the fishing club had wanted to try it. They had heard from friends in a major nearby city that fishing groups were raising salmon in cages in the harbor, and they wanted to try it in their own salmon pond. The local fish manager was against it, and they were aggrieved. Every year salmon had been dying in the pond, and the fish manager wanted to get rid of it.

This was a bit of a dilemma for Karel: "So here I was... I'd met this fish manager once, and now I'm his boss and they're after me to get him to change his attitude." Karel promised to look into it, but when he got back to the office, he found that the situation was even more complicated than he had realized:

Now it just happened that the chairman of the critical committee of the legislature was from this town [where the fishing club was based]. He was a very aggressive legislator and liked to throw his weight around. So when I got back to the office and told the director what had happened, he said, "You've got to do something for these people, because we're going into a budget year and the secretary will be calling me if the chairman isn't happy. Make him happy and try not to get the fish managers unhappy when you do it."

Karel's response to this dilemma was to set up the first adaptive experiment in Northern State. He personally agreed with the local fish manager

that raising salmon in cages was a bad idea, but he felt that the only way to convince the local fishermen of that was to let them try it. So he organized a group of fishermen interested in the project, convinced the fish managers to join the discussion, and set up an experiment. The local fish manager remained unconvinced and hostile. He knew it wouldn't work and felt it was a waste of his time, but Karel was determined that he would be involved. ("I said I would be project leader, but he needed to get involved because it was his ward.") Karel also brought in some salmon culture experts and laid out a plan with an evaluation component that was to run for three years.

The first year we raised them we had all the problems we anticipated. I'd drive from the city and sit all night with these guys watching the fish getting sick. The second year the water had been warmed by rain and it was killing them, so we chained all the floating cages together and towed them out into the lake with a chartered boat, but this was a big group thing. These people were steady. There was someone watching those fish twenty-four hours a day between April and July. They were really invested. This was their experiment.

When it came time for the third year's experiment, I sat down and said what do you want to do? And they said, you really think it won't work? I said, well, I don't think so, but I promised you three years, so that's what you're going to get. They said, "We're spending a lot of time killing fish." "Well, that's what Ron [the fish manager] was telling us." "Maybe we ought not to do it this year." And so the experiment was abandoned.

We didn't kill everything. Of about fifty thousand fish fingerlings, about twenty-five hundred got stocked out in the lake. Our goal had been fifteen thousand. But we had built a real collaboration. Elsewhere in the state anglers and managers were at war over size limits and other issues, and down in our district we were working together with anglers and had turned around potentially serious conflict and built a successful collaboration with local anglers.

Karel felt that this experiment not only represented a particularly notable success, but also embodied a number of key values, which he worked for throughout his career. Most notably this was a case of managing *out*. As he said, his efforts to involve the citizens of the community in an experiment that he felt was bound to fail, and at the risk of alienating his network of fish managers (who were essential to him), were based on his profound feeling that the power of government really does reside with the people: "We may be right in terms of what we know technically, but unless it's right for the people we're doing it to or for, it will be a failure; because they'll reject it."

This value perspective, as noted earlier, was an enduring disposition, or self-referent, as Wheatley (1992) would call it. According to complexity

theory, such dispositions allow for greater flexibility in dealing with change, chaos, and diversity. In this case, this value orientation allowed Karel to economically juggle managing out and managing through. For him, making it right for the people meant employing a form of citizen science. He believed (and still believes) that if citizens can become engaged in the science itself, there is a much greater potential for building a relationship between the professionals managing the resource and the local populations. When managers, viewing themselves as scientists, also become "priestlike, seeing themselves above the people," a major breakdown in communication occurs. The sword cuts both ways—citizens get angry at what appear to them to be arbitrary decisions (even when those decisions are based on good scientific judgment, as in the case described above), and meanwhile the professionals feel pressured to "do things we just couldn't do without extraordinary outlays of energy and resources." From Karel's point of view, the answer lies in building a bridge through understanding. For him, the bridge was founded on his fundamentally democratic belief in the capacity and right of citizens: "My hope was that if we could explain what the system was capable of, the people were smart enough to get us into the options that were viable."

This confidence was rewarded, as we have seen, in the citizens' decision to suspend the salmon-raising experiment after two years. It would also be rewarded in many other situations that Karel sought to address over the years (most notably in the Lake Algonquin case described below). Most important, this case illustrates how a manager intent on adaptive management can attempt to apply good experimental science while building stakeholder commitment to policy. The two balls are juggled in such a way that their rhythms are synchronized, creating a dynamic that assists the juggler.

Similarly, the reference to the state legislator and the director's political concern with keeping people happy so the politician would be happy hints at another synergy, between managing out and managing up, which we will consider in the next cases.

The Spruce Lake Case

From Karel's point of view, "We couldn't get anything through the bureaucracy, unless I got the people we were doing it for demanding it." As employees of a government department, managers in Natural Resources were subject to pressure from above, from elected politicians in the state legislature, in particular. One of the things that Karel learned, however, was that by managing out, he could find the clout to successfully keep the managing up process alive. This image of managing politics by going directly to the people was an outgrowth of the proletarian values of his parents and grandparents.

These values combined with Karel's love of lakes to fuel his determination to secure fishermen access to all lakes in Northern State. Northern State law and agency policy supported reasonable boat access to all lakes.

The laws had been established with logging companies in mind, but for many lakeshore owners in Northern, reasonable boating represented a threat to their privacy and to their property values. The department created a lake-use task force to deal with this issue and over a period of fifteen years finally managed to reach a consensus with the Association of Lake Owners that access would be assured on 85–90 percent of the lakes. This took tremendous patience on the part of all managers: “We went in and got options and had big wars with the local communities, but we tried, as well, to understand local property owner’s needs, and when we were able to do that and follow through, they kind of became allies.”

In one community in particular, Beech Lake, the lake owners were mostly factory workers who had bought property on the lake when it was cheap. They objected to DNR’s campaign to get access to their lakeshore because nearby Spruce Lake was locked up by very rich, influential landowners, and no lake access seemed possible since lakeshore owners there were politically connected and powerful. Karel promised that he and other managers would go after access there, too, if the Beech Lake Association worked with him. He was true to his word. The Spruce Lake Association wouldn’t even talk to the DNR managers, but Karel fell into a more direct approach:

State law provides that all approved subdivision plots on lakeshores have sixty feet of public access on a lake, but on Spruce Lake, they had turned it into this little park... but they had no parking within about two miles of the site. One time I came with a friend in my canoe and we were carrying the canoe all across the park and the town constable came to issue a citation to me. We told him we wanted to create a test case since we hadn’t been able to get anyone to deal with this access issue. He leaves. Next the town chairman comes down and tells us off.

Things didn’t move quickly in terms of obtaining access there until some time later when Karel came back to the Spruce Lake area to give a talk to the local garden club. It was a routine talk, aimed at grandmothers, warning them about contaminants in fish and how much of lake fish it was safe to feed to children. He always threw in his pitch about lake access and how important it was to provide it. At the end of this talk, he was approached by a woman who congratulated him on the talk and then pointed out that there was no access to Spruce Lake.

“My husband is chairman of Town Board, and I don’t think this is right,” she said. I said, “I’ve met your husband.” She said, “You’re a very nice boy.” Next thing I get a call from the chairman saying, “You’ve been talking to my wife. I’d like to talk with you.” So I found some prairie plants and took them to her house, and that started negotiations. It took about several years, but between her ha-

ranguing him and our managers taking easements or buying access on other lakes, we finally got the town to provide proper access.

This method of mobilizing forces in his favor in order to get the job done was played out on a much larger scale in the numerous conflicts that have confronted DNR in the years that Karel has worked there. For Karel, when such conflicts arise, the most important element is to get the groups talking to each other, as opposed to both groups pressuring the DNR. The goal is to “feed those people back and forth to one another”:

Basically you’ve developed a process by which you manage conflict with a process which creates cross-fertilization. I’ve always tried not to be at the apex of the triangle, but rather to get the groups that want to triangulate on the agency and get us to referee their debate, to hold their debate and not even serve as a mediator, but more as a facilitator of the discussion and in most cases they ask our opinion. It’s almost an intuitive political process.

Ultimately, by building bridges with particular individuals and groups in the community, an adaptive manager builds up a constituency whose energy can be tapped to manage up, and affect the larger-scale political processes that shape legislation. This image of political influence is very different from lobbying or insider connections. Yet relationships with key individuals represent vertical social capital that is critical to mobilize when conflict erupts in a domain (Chapter 8). For Karel this is often a very personal and particular process of introducing key individuals to each other. (“I’d like you people to talk, because I know Andy and I know Joe, and although I get angry with them about some things, they’re pretty good people.”) As he builds loyalty across the system, his ability to make these connections (to bridge structural holes, as Burt [1992, 1997] would say) increases. Managing out and managing up have close and useful affinities. So do managing up and managing through, as the next case illustrates.

The Lake Algonquin Case—Managing All Balls at Once

In the case of Lake Algonquin, Karel had the opportunity to put many of his ideas about adaptive management to the test. One of the largest lakes in the state, its proximity to the state capital and to several important research institutions gave it a high visibility. While the lake had been the subject of intensive study and management since the 1940s, it was nonetheless suffering from eutrophication due to agricultural runoff as well as pollution from the municipalities on its shore. Karel saw promise in a trophic cascade approach to managing Lake Algonquin (Carpenter et al. 1985). This approach used the introduction of carnivorous fish species such as the walleye to reduce the number of fish that eat zooplankton, thereby allowing the zooplankton population to increase and consume more of the algae that polluted the lake. It appealed to Karel on several points:

- from a water management point of view, it dealt with the pollution problem and so would increase water transparency in the lake;
- from a fisheries management point of view, it would increase the number of walleyes in the lake, which would be attractive to the anglers;
- from a political point of view, new funds just opened through the Federal Aid for Fisheries Restoration Program made such a large experiment viable;
- from an agency point of view, it represented a chance to disseminate internally an emerging set of tools (including modeling and evaluation techniques) developing within the scientific world.

Karel therefore saw the project as a chance to keep all the balls in the air at the same time and create strategic synergies. He insisted that the project be run in the state capital:

I said that if I was going to do something that important, I wanted to do it in the capital. I had a political constituency there, because I had large numbers of groups that were trying to raise and stock walleye, and they would work with us on it. My feeling was that if I could demonstrate it in the state capital, where the politicians and the population are, that people would begin to think in terms of systems. And the other thing was that it was a lot easier to get a legislator out on Lake Algonquin than on a lake up north. You're balancing goals: your own interests, educating an active, university community, capitalizing on the momentum already present in the demand for walleye.

The chief opposition to the project came from inside the DNR. Two dynamics presented obstacles and had to do with turf issues: control of scientific data and control of capital resources, both fish and operational funds. One of the DNR scientists who was particularly interested in the recovery process had been quietly gathering plankton and chemistry data on Lake Algonquin for the past ten or fifteen years (against the advice of his supervisor, who thought it was a waste of time). The result was a "pivotal, incredible data set." When Karel realized this, he spread the word, much to the scientist's annoyance; he didn't want to share his data:

I brought him in and told him I was going to take the data, as it was state data, and I was going to kick him off the project, unless he figured out a way to get along with the other scientists. Then I went to the others and told them to figure it out. One of them went out of his way to act as a mentor and bring him along. It was a classic case of scientific paranoia... he thought people were going to steal data.

The second, even more difficult internal barrier was the other staff in the DNR. While a number were very interested, many, including Karel's subsequent chief of fisheries, hated the idea. To launch the project required moving fish from northern districts south, which wasn't popular with the

other fish managers. "Every fish manager has groups who want walleye, and I said you're not going to get a lot of walleye for the next few years." For this and other reasons, Karel's superiors tried to talk him out of it, over a period of six months. The feeling was that "there was too much of our political capital tied up in one high risk investment." Ultimately, Karel needed to sell the idea to the secretary:

I went to the secretary, who was a pretty savvy biologist himself, a brilliant man and who was generally prepared to take risks. I sat down and said to him, "What I'd really like is to take this chance. We could spend up to 30 million dollars and produce only scientific results. I don't know if we'll produce any management solutions right away, maybe in three or four generations, but not right away. But I can produce a world-class walleye fishery in the state capital that will make a lot of people happy. So there will be short-term returns. The downside is that we won't allow them to catch them because we need to keep them in the system. So we've got to sell catch and release. He said, "I understand what you're saying, but how are you going to sell that politically?"

The secretary indicated that Karel's next step was to sell the idea to the politicians and policy makers. The policy-making body at this time was a citizen board elected from all over the state. Karel knew the chairman of this board fairly well, as they were fishing buddies, and after "endless discussion while fishing (and over brandy in the shack)," Karel convinced him that it was worth a try. Support from other board members was forthcoming, as at that period the board had an unusually experimental and dynamic composition: "The board members we had at that time were literally brilliant people. One of them had completely revamped a major failed network of companies, another was an investment banker who understood probabilistic issues and would go for the edge, and another had worked with air pollution. They all understood that what we had been doing was kind of a façade... feeding people's needs without addressing underlying problems."

With a green light from both the DNR and the policy board, Karel went ahead. The results were in themselves surprising. Enormous amounts of scientific learning occurred, and a lasting link was made between the university and the department, but the walleye fishery never flourished to the required degree. Two reasons have been given for this. The first was biological: "The lake didn't want to grow walleyes. It wanted to grow small-mouth bass. So that's one miscalculation we made. It didn't have the spawning habitat... the community structure wasn't there. It was so disturbed that we couldn't see that before we started. We had a huge die-off of cisco as a fortuitous event, and that reduced the planktivore population. So the concept of the cascade was correct."

The biggest miscalculation, however, was social. The project was launched to much media fanfare, and despite the fact that the DNR had set a fairly restrictive bag level, the interest in the project resulted in a sevenfold

increase in anglers, attracted by the enhanced opportunity of catching walleyes. This kind of phenomenon has been labeled the Paradox of Enhancement, "the rapidly rising public expectations that exceed the capacity of the resource... common to enhancement programs" (Johnson and Staggs 1992). This effectively intervened to counteract the experiment.

From Karel's viewpoint, this can effectively be viewed as a failure of managing out. While the project was begun with considerable support from local groups, as it progressed, communication between scientists and citizens broke down. Key to this breakdown was a turnover in personnel, both in the agency and in the conservation groups that had partnered the original initiative; but there was also a drift away from the partnership itself:

We had a huge people turnover. The life cycle of a conservation group is about four years, and if you don't reinvest in terms of bringing the next generation along, it's almost a new game. In order to have made this work, we needed to have gone to the anglers earlier. If we had done it as an education effort, most of the anglers would have come in on our side. We initiated the project with a massive involvement of anglers, but as we moved through the cycle, they fell out of the process. Our field people saw this as an imposition. It's a hell of a lot more work to use volunteers than to do it ourselves. In 1992 or 3 we started losing the citizen ownership... they said the hell with raising fish, I'm going fishing. People move, people get busy with other things. Two key postdocs left. I moved out, and the guy behind me was reluctant...

Karel's own promotion to director of fisheries and then to division administrator also placed him in a new relationship to managing through and managing out. While the move up allowed him to continue to hold the project together through clout, it also brought its own distractions. A legal battle over Native American spearing rights and political maneuvering around stocking practices, among other things, pulled his attention and energy elsewhere: "I didn't invest my personal time and energy in debriefing... in making it come back as a more adaptive system... in closing the loop with local groups."

Finally, the reluctant managers within DNR, those who had resented the project in the first place, took the first opportunity to close the project down. According to Karel, "We didn't get one year beyond what we said we were going to do... as soon as we met the five-year stocking commitment, boy, they slammed the door."

The Lake Algonquin experiment really exhibits the tensions and challenges of keeping all four balls in the air at the same time. While the cases of salmon hatcheries and Spruce Lake illustrate the synergies that the adaptive manager can discover between some of these dynamics, the Lake Algonquin case also illustrates some of the inherent contradictions.

First of all, it illustrates how precarious it is to try to manage through while managing up and out. While the project was sold on the basis of al-

lowing for good science, an enhanced and therefore politically attractive fishery, citizen involvement, and agency showcasing, in fact, each of these goals in turn kept being threatened. Controlling the experiment would have meant insisting on a catch-and-release policy, which was hard to sell politically. Good science might have indicated that the lake was unsuitable for growing walleyes, which would not have been welcome politically. Compromises between managing through and managing up were made, despite the apparent synergies.

More significant, however, were the tensions between managing up and through and managing out and in. The science itself was so exciting and involving that those who owned the experiment were distracted from maintaining the citizen involvement. In an odd way, the experiment resulted in something of a social cascade, equivalent to the trophic cascade. Karel's ability to manage up, never more apparent than in his championing of this initiative, may have led (in part) to his being moved up within his organization. Removing him from intensive interactions with other stakeholder groups, however, meant that those relationships fell victim to at best reluctant debutantes and at worse antagonists who failed to follow through on a project they had never supported. As those relationships died, citizens drifted away, and the crucial communication concerning the effects of the increased angling never occurred.

As Karel put it, from an adaptive management perspective, the second loop of double-loop learning never happened. It appears then, that managing up is sometimes in tension with both managing out and managing in. Politically, the profile of the agency and Karel's career advancement resulted from the project. Scientifically, much good data were collected. But the managing out and managing in balls were dropped, with the result that the social system did not adapt as fully as all had hoped.

Overall, it is perhaps the managing in relationship that threatens the really good adaptive manager. As he or she turns attention to managing up or out (and at times even through), "back home" support is weakened, and sometimes opposition is mounted. In addition, the further managers move up the hierarchy, the more cut off they are from citizens, grassroots groups, and other constituencies. This can result in unpleasant surprises, as we will explore in the final two cases.

The Deer Hunting and Spearing Cases

In the years after being promoted to a research director position, Karel encountered several frustrating cases in which surprise was a clear element. As in the case of Lake Algonquin, the surprises stemmed from the social system, but they served, nonetheless, to weaken Karel's immediate ability to manage adaptively. The first concerned the deer hunting quota system, the second the game fish quota system.

Deer hunting in Northern State is something of a sacred pursuit, and the issue of hunting quotas has always been controversial. Whether to hunt

bucks or does and how many to take and how many to leave are hotly debated. On one side of the controversy is the Conservation Congress, a statewide body whose mission is to give advice to the Department of Natural Resources. Every year, each county elects three people to this congress; it then sets up study committees for different areas of concern. Historically, this group had been in opposition to the DNR, challenging its formulas for determining harvest levels. Over a fairly long period of time DNR biologists had come up with a formula for calculating population based on harvest data. While in Karel's opinion "it was almost impossible to calculate this realistically," the biologists found it very predictive.

However, the model was counterintuitive and difficult for the citizen groups to understand. This had fueled the conflict. The public had also realized that the formula, as a tool, limited their ability to modify and make policy, as it didn't allow for negotiations around nonbiological or social issues. Feeling ran high on both sides.

When Karel got involved in the situation, the debate appeared to be about no more than 2 percent of the deer. He therefore saw it as a trivial issue from a biological point of view and felt it should be approached as a social issue. Using his established collaborative approach, he recommended the creation of a task force, a joint committee of citizens (farmers, hunters, insurance reps, and animal rights people), including representatives from the conservation committee and the scientists. However, as DNR scientists insisted on playing an expert role, he insisted that they act only as observers.

The process was a lengthy one that created considerable resentment among the DNR scientists. However, the results proved again that given enough information and training, citizens could come up with recommendations that were biologically sound on the one hand and politically sensitive on the other. Karel was pleased.

Others were not so pleased. The biologists complained that they had been disempowered. They did not see the value of consensus. Karel, who was not a wildlife manager, had aggravated them by challenging their model. They further resented the extra work that the task force created. The conservation committee was also not pleased, as it felt that the lines of authority had been messed up by the creation of the task force. Karel had succeeded only in turning the opponents into a coalition against his initiative. The upshot was that both groups complained to the Natural Resources Board, whose secretary called Karel on the carpet.

In looking back, Karel questioned why he had failed to secure support in his own organization. He attributed it to two factors. The first was that he was "diffused." "In my new position I had seven other programs to worry about." The second was "a touch of arrogance... had it been nonscientists, I would have taken the time to try to understand them. As it was, I felt frustrated and impatient. I felt I was the expert, and I wanted them to understand me."

The spearing issue also occurred after his promotion to director. A recent court victory had made it possible for Native Americans to spear fish,

as they had traditionally. Spearing had always evoked violent reactions from sports fishermen. They would call Native Americans they saw spearing derogatory names and would throw rocks at their boats. From the point of view of the DNR, the change induced a crisis. The spearing was a threat to the fishery, as Karel saw it. He needed to go to court and convince a federal judge to protect the fishery.

Karel went about collecting the data to demonstrate the stress that the spearing created from a fishery viewpoint. He had hoped to go directly to informal negotiations with the two groups, but once the challenge reached the courts, that kind of compromise was difficult. The result was that he had to reduce the bag limits of the sports fishermen, an unpopular and controversial move. The governor's response was to stock more fish, which the DNR scientists felt would further damage the stock. Karel was involved in an intense process of managing up. He was sent to represent his department in court, where a lengthy battle ensued. In addition, he had to go personally to the governor's home to defend the actions of the department and to encourage the governor to protect the fish stocks and follow management advice. In the process he found himself in an adversary role vis-à-vis both the governor and the tribes. A delay was all he could achieve.

Both these cases represented frustrations for Karel when compared with the salmon hatcheries or Lake Algonquin projects. Interestingly, they both also occurred after his promotion. In the first case, the surprise came in the DNR resistance to Karel's task force initiative, even when it proved successful at building consensus. The managing out and managing in dynamics proved to be in tension. However, it could also be argued, as Karel himself argues, that in his promotion he was pulled into an arena where managing up became the critical issue and that he had to delegate the work of building the bridges to others. The result was that the ball of managing in was dropped.

In the second case, the particular dynamics of managing up become apparent. Scientific principles came into direct contact with political will and legal decisions. The surprise here came when a change in the legal system that was not anticipated by the DNR simultaneously increased conflict between the two groups (Native Americans and fishermen) and made building informal bridges unlikely. In his new position, Karel continued to use his skill at managing up, but managing through became more of a defensive position than scientific inquiry. Managing in and managing out became more difficult and problematic.

Summary and Conclusions

First and foremost the description of these cases indicates the incredible complexity of managing adaptively when seen from the individual's perspective. Second, when seen from the wider system perspective, it suggests that the unit of analysis for understanding adaptive management is the problem domain, not the organization, or even the institution. Third, it suggests that

successful adaptive management involves an understanding of how the dynamics of overlapping problem domains interact to allow for action and successful response (corridors of movement) on the one hand and resistance and inaction (congestion of corridors) on another. We will deal with each one of these in turn.

The Adaptive Manager as Decision Maker

What is adaptive decision making, and how does it differ from rational decision making? While rational decision processes are closely linked to logical choice and to rule following, they are not necessarily intelligent. On the other hand, traditional knowledge may be a poor match for present contexts. The key to improving adaptiveness in the individual decision maker is to strengthen the match between decisions and the demands of the decision environment (March and Heath 1994). In the case of adaptive management of natural resources, there are at least four decision environments: the ecosystem, the political system, the organizational system, and the interorganizational system. In addition to the sheer complexity of environments is added what March and Heath refer to as adaptive inefficiencies: temporal lags between decision and environment; responding to local as opposed to global feedback; the historical path of previous events and decisions; unpredictable diffusion of decision impacts across multiple concurrent problem domains; mutual adaptation of environment and decision maker; and the way individual decision makers are linked to others in "ecologies of adaptation" (March 1994).

Given the level of this complexity, we agree with March's (1994) conclusion that "the efficiency of any decision process is sensitive to the relation between the rate of exploratory variation reflected by the practice and the rate of change in the environment." Under circumstances of such complexity, no practice or approach is in itself adaptive; no philosophy will work as an *idée fixe*. Rather, the adaptive manager is perhaps best equated with the knight-errant, perhaps even Don Quixote, who said, "For a knight-errant to make himself foolish for a reason warrants neither credit nor thanks; the point is to be foolish without justification" (Cervantes).

In practical terms, therefore, this means one needs to eschew a best practices approach to adaptive management in favor of an approach that focuses on goals, values, aptitudes, and skills. Among the lessons or insights about adaptive management that emerge from these cases are the following:

- To manage adaptively requires strong values as opposed to rational analysis. In the case of Karel, as we have noted, he grew up with a love of science and a respect for people in almost equal measures. He loved lakes and held a strong conservation ethic. He valued collaboration and wasn't afraid of conflict. Throughout these cases he adhered to those principles: trying to build collaborations, encouraging citizen science to build bridges between

scientists and citizens, working toward conserving resources based on scientific estimates. In themselves the values were not unusual. What was unusual was the tenacity with which Karel used them as a guide across a wide variety of situations. He showed huge patience when it came to identifying the stake each group had in the problem and in bringing different stakeholders together to negotiate, always using the language of science to build common ground. With commitment to these core values giving his management style an enduring identity, he was able to be adaptive or responsive to the particular constellation of interests and energies each case represented.

- To manage adaptively and respond to complexity, it is necessary to juggle multiple strategies and goals (Figure 13-1). The danger is to become too focused, a danger that might be labeled as the peril of simplicity. The adaptive manager must have aptitudes for being a scientist, collaborator, politician, and agency manager simultaneously. Managing in avoids the peril of forgetting roots and the importance of back home commitment for any domain decision and action. Managing out by building social capital across different organizations and groups avoids the perils of going it alone and, ironically, of going too quickly. Managing up helps to avoid surprises coming from the wide political system (such as the change in the spearing regulations) and ultimately the peril of becoming locked in political confrontations that make flexible responses to different situations nearly impossible. Managing through science is the anchor that ties all decisions to ecosystem dynamics. A commitment to good science avoids the peril of becoming drawn into political infighting or going local to such an extent that special interests begin to prevail over larger system goals.
- To manage adaptively requires strong control of emotions, little fear of conflict, and great humility. Karel mentioned when discussing the deer hunt controversy that he had perhaps been affected by a touch of arrogance and that he had grown angry at the DNR people because they hadn't understood what he was trying to do with the task force: "I thought in this case I was the expert and they should listen to me." It would appear that humility is a mind-set that opens the individual to what is going around him or her and pride, the overestimation of oneself and one's immediate environment that acts as a barrier to new information, even when it is crucial for organizational survival (Deutsch 1966). Flight crew members who think they can rely on themselves in emergencies generally do badly when the emergency, which requires a team response, actually occurs (Weick and Westley 1999). Heedfulness, staying open and responsive to those around you

and to what is happening, is a key feature in dealing with rapid change, crisis, and the unexpected (Weick 1995).

Of course, this kind of receptiveness and humility is impossible if an individual is blinded by fear or anger. Karel noted that emotional control was an important aspect of his behavior in cases where he felt he had managed adaptively. In the salmon hatcheries episode, for example, he kept his temper firmly intact by separating his role (which was being attacked) from himself. In this he was following March's first rule of adaptive decision making: "Treat the self as a hypothesis. . . treat decision making less as a process of deduction or negotiation and more as a process of gently upsetting preconceptions of what is desirable or appropriate" (March 1994). By not taking himself too seriously, by admitting that despite his formal position he had no answers and knew very little, Karel began a process of trust building that gently shifted both the DNR and the salmon fishermen away from their normal positions and toward a ground on which they could begin to collaborate. Emotional control and humility working together are key qualities of the adaptive manager.

- In order to manage adaptively, the manager needs to capitalize on the energy and movement of others. The experience of managing in complex adaptive systems is more similar to catching waves or looking for emergent corridors for action than pulling strings or working levers. The historical moment is hence important. It is possible to look at the successes and failures of Karel's management approach from the point of view of same process, different context. In particular, in comparing the salmon hatcheries case with the deer hunting case, we can see him responding in similar ways to two different but similar problems. In both cases there was conflict between the DNR and sports groups, and in both cases Karel insisted on involving the citizens in scientific explorations and decisions. In the first case, however, the opponents were of lower status than he was and under his direct control. In the second, he was dealing with peers who were not under his direct control. Although Karel was promoted largely on the basis of his successful management of citizen groups and his success with citizen and normal science, it appears that the closer he came to the top, the farther he was from the environment. It is as if organizations really should be drawn as circles rather than triangles, with the apex represented by an inner circle, most removed and disconnected from the environment.

Perhaps more important the domain around the salmon hatcheries was not as organized as that of the deer hunting issue and so the motivation to collaborate was higher (Figure 13-2). In the latter case a recognized body, the Conservation Congress, had

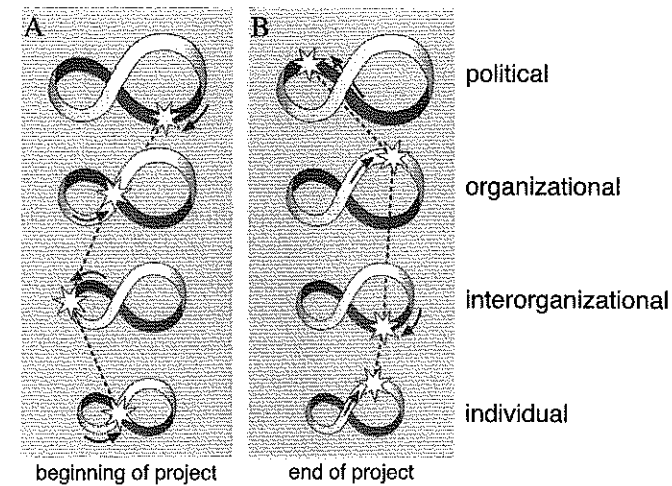


Figure 13-2. Use of separate adaptive cycles to depict phases of issues as interpreted in four systems—political, organizational, interorganizational, and individual. Managers, actions, and solutions must account for the dynamics of these systems.

long adopted a position critical of the DNR scientists and their tools for estimating deer populations. The DNR scientists on the other hand had worked long to develop an effective, although counterintuitive, means for making those estimations. Motivation to collaborate had been reduced by the rigid stances of both organizations and a clear delineation of roles. While the task force created apparent collaboration, it was a forced one from the point of view of the DNR scientists. They complained to the Natural Resource Council that the process had disempowered them. The result was that Karel was sanctioned, which brings us to the consideration of what this case reveals about what it means for the adaptive manager to manage the social system holistically.

The Social System as Problem Domain

The above cases show that the social system that the adaptive manager seeks to manage does not correspond to a single institution or even to a single organization. Rather, it is the problem domain, the system of actors brought together by their stake in a particular problem, that is the relevant unit of analysis.

This system has both vertical and horizontal dimensions. The horizontal dimension contains three nested social systems: the political system, the organizational system, and the stakeholder or interorganizational system. Each of these has its own dynamic on which the adaptive manager can seek to capitalize. For example, the political, when it is in a creative destruction or renewal phase, may make resources available for adaptive experiments. This

occurred in the case of the Lake Algonquin project when changes in the legislation opened up resources for ecosystem restoration. At other times, because of changes in the political climate, such resources will not be available. The adaptive manager, managing up, can spot these phase shifts and take advantage of them (Figure 13-2).

Similarly, the organizational system can cycle between risk taking and conservation. This is partially a result of cascade effects from the political system, but it is also an effect of the particular personalities in decision-making positions. Even when the organizational system is in the conservation, or K, phase, the backing of a particular individual, for example, can allow for the adaptive manager to create innovative and adaptive programs. And a failure to manage in may result in a blockage of resources for the adaptive manager even in the exploitation phase of the adaptive cycle. This was probably what happened in the deer hunting case, where the DNR scientists, having developed and consolidated a good set of tools for management, were unwilling to respond to initiatives stemming from the interorganizational, or stakeholder, system.

At the interorganizational, or stakeholder, system level we can see the most direct effects of the individual manager such as Karel. Around a particular issue or problem domain, the release phase represents a state of disorganization, in which the different stakeholders may not even know that they have a problem. For example, in the snagging case described here, it was the dead and dying salmon that alerted stakeholders such as tourism and fishing groups to the issue and put the problem of snagging on the public agenda. At the renewal stage, groups with conflicting and perhaps ill-formulated ideas may come into conflict. The adaptive manager works hard to bring them into dialogue and to find common ground. At the exploitation phase, the groups have found common ground and appear to be prepared to exchange information and even resources to solve the problem. From that point on, the stakeholder system can either move forward to a more formal, consolidated organizational form (such as a Conservation Congress or other elected referent organization), or dissipate as it did in the Lake Algonquin case, with stakeholders losing interest and moving on to other things.

The enterprising adaptive manager, successfully juggling all four balls, can strategically use the dynamics of these three nested systems to find windows of opportunity (or corridors of indifference) through which he or she can drive scientific, adaptive initiatives. The best example of this in these cases is that of Lake Algonquin. Here Karel explicitly identified such a window of possibility. The political system was in a phase of releasing resources for ecosystem renewal. The organizational system, though not so receptive and clearly entering into a conservation phase, could be managed because it contained risk-taking individuals both on the conservation board and within the organization. The interorganizational/stakeholder system was in an exploitation phase (with a responsive network, open to and keen on citizen science). All three hierarchical systems, although not in the

identical phases, were aligned for action on the part of the manager (Figure 13-2).

Of course, such moments are rare and transitory. The kaleidoscope shifts, the window disappears. In the case of Lake Algonquin, while the political system remained relatively open, the organizational system, due to the departure of key personalities (including Karel because of his promotion) slammed the door on the project. And the stakeholder system, on an even shorter cycle (which Karel identified as five years), simply dissipated. New people had taken up positions in the involved organizations, and without ongoing networking the original interested citizens drifted off to more compelling pursuits (Figure 13-2).

Overall, however, these cases indicate that not one of these subsystems considered alone can help to reveal the interactive dynamics of social system and ecosystem that confront the adaptive manager. Rather, the entire network of interacting individuals and organizations at all three levels represents the social system. It is clear, therefore, that to manage adaptively is a question of creating the right links, at the right time, around the right issues to create a responsive system. As noted above, it is not a question of identifying best practices or institutional arrangements.

The Devil is in the Dynamics— The Problem of Contagion and Cascades

As if the dynamics described above were not complicated enough, these cases suggest two further levels of complexity. The first is that all three social systems are structured by meanings, not just by rules, roles, and resources.

The same system and therefore the same people not only respond differently to the same issue at different times, but also respond differently to different issues occurring at the same time. So, for example, the agency may be in the conservation phase around the deer hunting issue but in the renewal stage when it comes to lake management issues. A stakeholder group may be in the conservation phase when it comes to lake access, in the exploitation phase when it comes to stocking, and in the renewal stage when it comes to hatcheries. The adaptive manager not only must deal with three nested systems, cycling at different rates through adaptive cycles in his decisions and actions, but also must recognize that the same systems will be in different phases when it comes to different issues.

An interesting lateral or horizontal dynamic may then occur, as a result of the manager's need to handle multiple projects simultaneously. The three cases of failure or unanticipated surprise described above seemed to occur after Karel's promotion. At one point, describing the failure to close the loop with the stakeholders and educate them further as to the scientific experiment in the Algonquin project, Karel noted that he was distracted, as he had six or seven other issues to deal with. One of these was the spear-hunting problem; another was the ongoing issue of the deer hunt. Above we suggested that

perhaps promotion in an organization makes it more difficult to manage out. Another more holistic explanation is that the dynamics of one problem domain cascaded or spread to affect the dynamics of adjacent problem domains coexisting in time, through the agency of the adaptive manager.

The fact that Karel was distracted by dealing with the spearing case meant that his attention was drawn into a problem domain in which unanticipated legislation had created a legal standoff in the political system (gridlock characteristic of a domain in the late exploitation or early conservation phase). Simultaneously, it created an organizational crisis (characteristic of the late conservation or early release phase) in the agency. These two nested dynamics made it impossible for Karel to use his normal managing out techniques and bring the parties together to begin a renewal process. More interesting in terms of the point we are making here, however, was that they simultaneously caused Karel to drop the managing out ball in the Lake Algonquin case, resulting in the dissipation of stakeholder support and understanding. The dynamic from one problem domain spread to infect another. In the reverse direction, Karel's success in the salmon case created a renewed and reorganized group of citizen scientists that helped move the Lake Algonquin experiment quickly into the exploitation stage (Figure 13-3).

We are now dealing with levels of complexity that would be difficult to handle strategically or deliberately. Indeed, the dynamic of contagion or horizontal cascade resembles what March (1994) identified as the garbage-can model of decision making: "In important ways, decision processes build on... temporal categories, combining people problems and solutions in terms of their simultaneity. Problems and solutions are attached to choices,

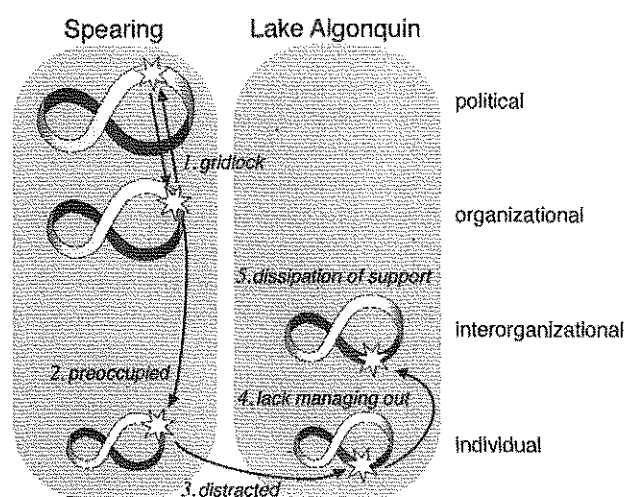


Figure 13-3. Example of how the dynamics of one problem domain can spread to those of another. The success in the salmon case created a renewed and reorganized group of citizen scientists that helped move the Lake Algonquin experiment quickly into the exploitation stage.

and thus to each other, not because of any means-ends linkage but because of their temporal proximity." Under these circumstances, it is clear that Karel was not acting strategically, as he was when he searched for action synergies and corridors of indifference across the vertical systems. Rather, he was at the mercy of interactive dynamics that made deliberate action almost impossible. This perhaps is the chief source of surprise for the adaptive manager: the unanticipated consequences of contagion between problem domains that coexist temporally. If this is true, it may be that surprise, from the perspective of the manager, occurs more frequently at higher hierarchical positions, when the manager becomes responsible for more projects simultaneously. This is a paradox of resilience: more hierarchical control, less system control.

Questions for Future Research

We started this chapter with the statement that it described the case of a single manager. As such the questions and issues we have raised are purely exploratory. More studies of practitioners seeking to manage adaptively in complex situations are needed to put some flesh on these bones. The story of Evan Karel as manager raises some tantalizing questions, however, about decision making and its role in adaptive management:

- Are strong values, emotional control, and interpersonal skills critical to adaptive managers? If so, are such characteristics essential across time and social place?
- Is the juggling of four strategies (managing up, in, through, and out) as important in all cases as in those described here? Do successful cases of adaptive management combine all four strategies in single initiatives?
- Are the best adaptive managers those who are in the closest immediate contact with both the physical environment and the stakeholder environment? Is moving up the same as moving in, making it difficult for managers who climb too high to manage adaptively? Or does it mean they need to switch roles, to become supporters and anchors for frontline managers? Do we need to search for adaptive management teams as opposed to individuals?
- What is the critical structuring force behind adaptive cycles in social systems? If a social system can be in one phase on one issue and simultaneously in another around a second problem, what does it mean to talk about management regimes or institutions that are more responsive or adaptive to ecosystem dynamics and hence more resilient? Is enduring, self-referent identity, in the form of consistent value orientation, the critical factor? How is that ensured in organizations where the individual managers turn over rapidly?

- If contagion or horizontal cascades are occurring across problem domains that the manager seeks to manage at the same time, is his or her agency the critical link? Are other factors at work to combine or recombine elements and induce phases across problem domains, which overlap in time (and social space)?
- Is the horizontal cascading/contagion dynamic described here similar to or different from the cross-scale interactions in panarchies?

Note

1. The names of people and places have been deliberately changed in the interests of protecting confidentiality.

CHAPTER 14 PLANNING FOR RESILIENCE: SCENARIOS, SURPRISES, AND BRANCH POINTS

Gilberto C. Gallopín

Of all the environmental policy concepts to emerge in the last twenty years, none is more compelling than that of sustainability. The concept was put on the international policy agenda by the Brundtland Commission by formulating the classic definition of sustainable development, namely, development that “seeks to meet the needs and aspirations of the present without compromising the ability to meet those of the future” (World Commission on Environment and Development [WCED] 1987). The same goal has guided other international policy endeavors, notably the Earth Summit in 1992 and the climate negotiations that began in Kyoto in 1997. The introduction of these concepts has raised the important question of whether humanity at the global scale is currently on a sustainable or an unsustainable path.

On the one hand, the world is now moving through a period of extraordinary turbulence, reflecting the genesis and intensification of deep economic, social, political, and cultural changes associated with the current technologic-economic revolution. In addition, the speed and magnitude of global change, the increasing connectedness of the social and natural systems at the planetary level, and the growing complexity of societies and their impacts upon the biosphere result in a high level of uncertainty and unpredictability. These changes pose new threats but also new opportunities for humankind.

On the other hand, the current trends are seen to be unsustainable for both ecological and social systems. The need to reverse these trends was officially recognized at the Earth Summit in June 1992. However, a new direction has not yet been clearly defined because discussions and recom-