Chapter 2 – A $100 Bottle of Wine and a Hammer: Principles of Strategic Conservation

In an unusual experiment (Messer and Borchers, 2014), Kent and his colleague Allison Borchers of the USDA Forest Service presented individuals attending conservation and environmental conferences with bottles of wine and asked them a simple question (see Figure 2.1). Which did they prefer—one bottle of a French Bordeaux that costs $100 or four bottles of a French Bordeaux that each cost $25? The total cost was the same but quality of the wines was not. The differences in the wines were demonstrated using Robert Parker's Wine Advocate ratings of 0 to 100 for each type of wine. The ratings showed that all of the wines were high in quality with the $25 bottles' ratings ranging from 83 (B, Good) to 88 (B+, Very Good) and the $100 bottle rating at 94 (A, Outstanding).

[Figure 2.1 Wine buying choices presented in the experiment]

[Table 2.1 Wine Advocate Rating System]

More than 200 conservation professionals from more than 75 organizations were asked this question. What did they choose? They overwhelmingly—approximately 70%—opted for four bottles of $25 wine. Not surprising perhaps. After all, the wines all scored at least a Good rating, and the opportunity to receive four times as much good wine seems like a great deal, especially since most of us likely consider a $25 bottle of wine expensive.

What does wine buying teach us about conservation?

Kent's experiment was designed to demonstrate the value of strategic conservation. Among those 200 or so individuals involved in conservation and environmental quality professionally, nearly three-quarters chose

to acquire their wine resources strategically—they purchased multiple excellent-quality wines rather than a single outstanding-quality wine, extending the wine-drinking benefit of their overall purchase.

Ironically, when choosing to acquire or preserve natural resources for their organizations (either directly or by providing funding), no such strategy is applied. Most federal and state agencies use ranked-based methods referred to as benefit-targeting (BT) to evaluate and select conservation projects. Had they applied this approach to their wine choices, the clear winner would have been the $100 bottle of Château Brane-Cantenac, which had the highest score at 94 (Outstanding according to the Wine Advocate Rating System) and could be purchased with the available budget. BT measures the benefits of the options available (wine to drink), ranks them from highest to lowest, and selects the top-ranked projects until the budget is exhausted. The system implicitly ignores the relative costs of the options available and thus provides no information about whether a project's benefits are "a good deal" for the price.

The question, for wine enthusiasts and conservationists, is whether the $100 bottle of wine was truly the best deal. In both cases, the benefits can be difficult to measure and compare. But if the goal is to do as much of something as possible, whether to drink good wine or to protect a forest, the rank-based choice had a limited effect; one exceptional resource was acquired but four very good resources were lost. Convert a bottle of wine to 80 acres of at-risk forest, and the rank-based approach saved 80 acres but lost 320.

The experiment shows why it is important for conservation organizations and funders to carefully consider how they choose projects on the much larger scale of millions of taxpayer dollars in an effort to conserve resources that will otherwise be destroyed. Because most conservation programs worldwide currently follow a BT approach, they wind up buying that $100 bottle of wine, which acts as a budget sponge, absorbing most of the funds, and in the process losing out on acquiring a much larger stock of very good wines—and forests. Consumers are generally very concerned about getting high quality at a relatively good price so they can make the most of their budgets. Strategic conservation is motivated by our belief

that conservation organizations and funders should be more like consumers and actively seek out good deals—sets of projects that deliver the greatest value given the funds available. There is never enough money to do everything a conservation group wants to do. With strategic conservation, the groups can make the best possible use of the funds available and prudently spend public dollars to conserve and reclaim the environment. Sometimes, that $100 bottle of exceptionally fine wine will be the best choice; however, we want to come to that conclusion after a strategic analysis that considers multiple factors—quality, cost, and competitors. Strategic conservation can help identify those times as well. A bit later in this book, we will discuss the implications when these wines are threatened with extinction … by a hammer!

The dangers of a budget sponge

In 2016, the U.S. National Park Service marked its 100th anniversary, celebrating a century of protecting some of the most beautiful landscapes and historical treasures in the nation. On its anniversary, the park service maintained more than 84 million acres with parks in all 50 states and several territories. Yellowstone, the Grand Canyon, and Yosemite are household names, and the parks literally range from A (Arcadia in Maine) to Z (Zion in Utah). The parks hosted more than 305 million visitors in 2016.

In his PBS documentary on the U.S. national park system, Ken Burns called it "America's Greatest Idea." The goal from its inception was to protect the environment for the enjoyment of the public instead of exploiting such areas for their abundant natural resources or allowing them to be privately owned and solely benefit the rich. In the past 100 years, the idea of public national parks has expanded dramatically both in the United States and throughout the world. In the United States, federal government agencies have expanded the system by establishing 129 national monuments and more than 700 national wilderness areas that collectively preserve approximately 107,000 million acres, and cities, counties, and states have protected millions of more acres of park land. Internationally, the number of protected areas in 2016 was

estimated at 1,052 and the United Nations Educational, Scientific, and Cultural Organization's (UNESCO's) World Heritage Center had identified more than one thousand environmentally or culturally important sites.

When the National Park Service protected "priceless" irreplaceable treasures such as the Rocky Mountains in Colorado (1915), the Grand Canyon (1919), and the Great Smoky Mountains (1934), there was no competitive process in which multiple similar tracts of land vied for protection. And as one of the country's earliest conservation organizations, the National Park Service poured the mold into which future selection processes would be crafted. The legacy of treating each conservation project as an irreplaceable and "priceless" opportunity is reflected in marketing materials by conservation organizations such as The Nature Conservancy, which used to describe part of its objectives as saving "Earth's Last Great Places." As a result, the cost of projects offered was not incorporated into conservation despite its evolution into a highly competitive environment with multiple projects or organizations seeking funding from a relatively limited budget. An omission that mattered little in the early days of the US Park Service now makes little sense since even the Park Service's conservation efforts are addressing problems such as climate change and poor water quality—a ton of carbon emitted into the atmosphere does essentially the same damage regardless of whether it comes from South Dakota or India. Likewise, conservation funders typically must choose from numerous somewhat-similar tracts of wetlands or agricultural fields because they cannot fund all of the available properties. Consequently, the next generation of environmental protection must leave behind a century-old approach and adopt strategic conservation.

To understand the gravity of the situation, consider how the National Park Service made its conservation selections in 2012. As documented by Kent and his colleague Allison Borchers (2015), the 34 projects on the national priority list collectively offered nearly 93,000 acres that cost approximately $110 million, far more than the $25 million budget available that year. The park service ranked the projects from highest to lowest based on the quality of the benefits they would provide and selected the highest-ranking projects until the budget was exhausted. As a result, two projects in Florida were funded: 43,000 acres in

Big Cypress National Preserve at a cost of $5.5 million and 477 acres in Everglades National Park at a cost of $25 million.

Had the National Park Service taken cost into account when ranking the projects, it could have instead allocated the $25 million to 28,607 acres of high-quality landscapes in other states instead of protecting less than 500 acres in the Everglades. The same amount of public taxpayer money would have protected 67% more acres and benefited a greater number of states (and taxpayers). That difference is the key advantage of applying the principles of strategic conservation—the ability to balance costs and benefits and identify net benefits from the funds invested.

Now, a skeptic may wonder whether those 477 acres of Everglades were truly outstanding and perhaps represented a once-in-a-lifetime type of opportunity that exceeded the value of the other 28,607 acres in other locations throughout the country. This is a question we cannot answer definitively, as the National Park Service did not provide that type of comparison in its publicly available data. However, the pattern of buying the best regardless of price is observed in many conservation efforts and there is little evidence to suggest that it didn't happen in this case. However, even if this was an exceptional political case, it still would be worthwhile for the National Park Service to be clear about how and why it made this potentially costly choice.

The magnitude of cost ineffectiveness

Since the U.S. National Park Service was established more than 100 years ago, tremendous resources have been invested in protecting and maintaining parks, wilderness, endangered species, farm land, open space, and a variety of other lands that provide ecosystem services. Much of the money has come from public (taxpayer) sources. For example, in the United States, USDA allocated $25.7 billion for various environmental programs in the 2008–2012. Farm Bill. Some of the funds ($1.2 billion) went to permanently preserve farm land through the federal Farm and Ranch Land Protection Program (Farmland

Information Center, 2013) and some to programs that protect working agricultural land such as the Environmental Quality Incentives Program and the Conservation Stewardship Program. Nearly $13 billion went to USDA's CRP, which pays owners to retire agricultural land temporarily. The CRP had enrolled more than 24.3 million acres and was paying landowners more than $1.6 billion annually as of 2015 (USDA, 2015). Between 1989 and 2004, federal, state, and local agencies in the United States spent more than $11 billion for the protection and recovery of endangered species (Langpap and Kerkvilet, 2010).

States, cities, and counties spent about $2 billion over the past 30 years to permanently protect 1 million acres of agricultural land (American Farmland Trust, 2010) and many more acres in parks and environmental activities. In addition to protections for agricultural lands, a variety of open space referenda between 1998 and 2003 authorized more than $31 billion (Trust for Public Lands, 2009). Conservation groups spend about $3.2 billion annually (Lerner, Mackey, and Casey, 2007), and the more than 1,500 private land trusts in the United States have protected more than 37 million acres (Aldrich and Wyerman, 2006).

Globally, annual funding of conservation efforts has been estimated at $20 billion as of 2017. The EU planned to spend €35.4 billion on agri-environmental programs between 2007 and 2013 (EU, 2009), and large-scale conservation programs in Australia have spent billions of dollars to preserve millions of acres (Gole et al., 2005; Stoneham et al., 2003; Oliver et al., 2005). A number of environmental initiatives are ongoing in developing countries. For instance, the Sloping Land Conversion Program in China has spent an estimated $48 billion to preserve land and to establish forests on former wastelands and agricultural areas (Xu et al., 2010).

Many environmentalists seem to equate the problems experienced when designing conservation programs for governmental and large NGOs as relatively insignificant —"typos" that are inevitable, questioning whether these "small details" really make a big difference, and the unfortunate answer appears

to be yes. Study after study has shown that cost-ineffectiveness has real environmental costs. Consider a couple of examples.

- We looked at agricultural preservation in Delaware and showed that cost-effective selection could have preserved the same number of acres and achieved the same level of aggregate environmental benefit using $21 million less, a savings of nearly 20% (Messer and Allen, 2010).
- In an application related to endangered species protection, Ando and co-authors (1998) found that savings could have amounted to as much as 75% if costs had been systematically accounted for in process.
- Polasky and co-authors (2001) found that correctly accounting for land costs would have generated a ten-fold improvement in the cost-effectiveness of protecting terrestrial vertebrates in Oregon.

The problem of budgets and who provides the money

Environmental conservation and preservation efforts depend on funds being spent in a fiscally prudent manner, and it is well established in the conservation literature that conservation efforts by public and private organizations rarely meet the most basic standards for efficiency (Babcock et al., 1997; Ferraro, 2003; Messer and Allen, 2010; Ribaudo, 1986; Duke et al., 2014). BT, the most common selection method used in conservation programs, is not cost=effective. In fact, it is not even close. The BT approach generally considers a variety of projects for funding, ranks the available projects according to their environmental benefits from highest to lowest, and then selects the project with the highest rank, working down the list until the budget is exhausted. This approach is widely used by governmental organizations and large NGOs and has been applied to efforts to establish and expand national parks (Babcock et al., 1997; Wu et al., 2001; Messer and Borchers, 2015), protect fish and wildlife (Wu, 2004; Weist et al., 2014), preserve forests

(Fooks and Messer, 2012) and agricultural land (Messer et al., 2016), and prevent nonpoint pollution (Fooks and Messer, 2013).

In economic terms, a fundamental problem facing conservation is the fact that their budgets are too constrained. In a truly "economically efficient" process, all potential conservation projects for which the social benefit exceeds the social cost will be funded. In other words, there is a compelling need to protect the ecosystem services provided by land and conservation activities in locations where the benefits of conservation exceed the costs. This does not mean that every piece of land should be conserved; certainly some land should be allocated for provision of a variety of goods and services provided to humans, including food and fiber production, housing, industries, and infrastructure. However, it is often cost-effective to provide those goods and services via conserved land.

From a societal perspective, then, large conservation budgets are a good thing since they allow for funding of all of the projects needed to effectively provide benefits to society (Babcock et al., 1997; Arnold et al., 2013). In fact, if the budget is large enough, selecting projects is not a problem because no tradeoffs are required. Thus, the first efficiency problem in conservation is that the budgets are too small. And combining small budgets with poor selection methods makes a bad problem worse. Optimization and cost-effective selection methods are most important when budgets are too small because they help the organization purchase the best bang for its limited bucks.

By definition, any selection process that is not cost-effective ultimately sacrifices some of the achievable benefits that could otherwise be obtained for society. Conservation projects are primarily funded by three groups: governmental agencies funded by taxes, NGOs such as land trusts funded by governmental programs and private donations, and individual actions and donations. By far the largest actor in terms of dollars spend is governmental agencies—local, state, and federal entities that spend tax dollars to achieve conservation objectives directly or by funding NGOs. The programs funded vary in scale from small local projects to national and international programs with large budgets that request

applications for funding for projects by NGOs, which vary from local land trusts to large international organizations such as World Wildlife Fund. These programs require the most strategic planning since they use public money to achieve public objectives. If the selection processes of these large government-sponsored programs can be improved, then, like a line of dominos, the positive benefits will flow down the line of conservation organizations and their activities.

NGOs sometimes obtain funding from government sources such as the U.S. Land and Water Conservation Fund, USDA Forest Legacy program, and the U.S. Department of Defense's Readiness and Environmental Protection Initiative (REPI). They also obtain funds (and property) from private foundations and individuals. The Mt. Cuba Foundation in Delaware, for example, traditionally donates tens of millions of dollars of its own money annually to conservation projects. Projects selected for funding by NGOs depend on the environmental benefits they provide and on the organizations' historical goals, political connections, and other considerations. While we believe that it is wise for all environmental conservation groups to follow the methods of strategic conservation proposed here, we recognize that private foundations and individuals have unique motives and preferences and should not necessarily be held to the same standards of accountability as government agencies in terms of maximizing the public benefit of funds invested.

Land trusts and other similar NGOs primarily address local problems and typically select from a relatively small number of projects. Those organizations frequently take advantage of their knowledge of the region and work with local contacts to identify high-quality projects with willing sellers. Such groups often buy (and at times serve as long-term caretakers for) properties that are identified for a particular project or goal (ad hoc) and acquire properties through private donations. Consequently, their responsibility, ultimately, is to track the cost of the long-term care of those lands. Their challenge is to know whether new acquisitions that arise from an ad hoc process are truly cost-effective and whether the acquisitions fit into a broader strategic vision for protecting the environment in that area.

Large environmental NGOs with national and international scopes, such as the Nature Conservancy, the Trust for Public Lands, Conservation International, and World Wildlife Fund, can at times develop large enough pools of money to consider a large number of varied conservation projects. However, their local chapters and offices operate more like local land trusts, pursuing more-limited sets of projects in an ad hoc process and at times funneling those projects to the national organization for funding. These large NGOs would certainly benefit from adopting more-strategic approaches to funding conservation projects, but with a base of private donors, they also must consider a variety of political and other considerations when spending their funds.

The core principles of strategic conservation

Traditionally, conservation officials have prioritized projects offered using maps and other rating systems in an effort to identify the projects or parcels of land that would provide the greatest ecological value or public value in terms of resources and acquired those projects until their funds were exhausted. From the perspective of an economist, however, strategic conservation is important because, even in a capitalist free-market economy, markets are well known to "fail" especially in the context of the environment. In a conservation context, traditional markets underprovide public goods such as environmental preservation and ecosystem services. Both government agencies and NGOs such as The Conservation Fund (Will's organization), the Nature Conservancy, World Wildlife Fund, Conservation International, and thousands of land trusts worldwide work locally and regionally, and few follow the principles of strategic conservation and thus fail to be as effective as they could (or should) be.

Simply defined, strategic conservation is a planning process that considers multiple criteria when selecting a suite of projects to fund or initiate within a limited budget rather than relying solely on one criterion, such as environmental benefit. It can be applied to any environmental concern, including habitat protection for endangered species, erosion control, and preservation of farm land, forests, and open space

at risk of development. The specific criteria needed vary somewhat with the location and aims of the organization but generally will include the environmental benefits and the cost to acquire or fund the project. In recent years, a number of methods such as binary linear programming and goal programming have been developed that provide algorithms capable of comparing all possible sets of projects to identify the best deal overall. We have defined eight core principles of strategic conservation.

1. Set aspirational goals and establish measurable objectives. The goals, naturally, are the desired end results or state—such as significantly improve water quality of a particular watershed in ten years. Measurable objectives could include providing a monetary incentive to farmers to reduce their annual use of fertilizers and pesticides by 20% in year 1. Even better would be to install sensor in the watershed and directly measure the change in nitrogen and phosphorus levels in the river and look for reductions, since after all it is the quality of the water (output) that you want to measure, not just the inputs (such as the amount of fertilizers applied). Such metrics allow one not only to track progress toward the goal but also to quantify the benefits of the project. Cost-effective conservation tools can then compare those benefits to the cost required to obtain them.

2. Use the best available science and data. Many recent advances in the disciplines that underpin strategic conservation—including environmental planning, environmental and resource economics, land suitability analyses, GIS, decision theory, multi-criteria decision analyses, behavioral economics, structured decision-making, landscape ecology, conservation biology, geospatial analysis, and operations research—have enhanced the ability to make decisions, and "big data" and massive computer processing capabilities have made a wide variety of new information sources available for solving strategic conservation problems. The most cost-effective conservation efforts will make use of those sophisticated new tools.

3. Consider both the benefits *and* the costs. Every year, significant resources are devoted by conservation organizations to mapping and measuring ecological benefits offered by areas targeted for acquisition while the cost of those acquisitions is entirely ignored during the selection process. This occurs

despite the fact that measuring the cost is relatively straightforward in most cases because the markets are private. Organizations and agencies can search these markets for information about the cost of the land or an easement, the transaction, and legal fees. Likewise, costs associated with monitoring and stewardship can be readily discovered. By including these costs as a factor when strategically evaluating and comparing a pool of potential projects, conservation groups can significantly improve the efficiency of their funding use.

4. Recognize opportunity costs and tradeoffs. It is also important to understand what might be given up when selecting a particular strategy. The wine example illustrates the tradeoffs associated with pursuing a highest-rated option that costs significantly more than other options that deliver high quality at a lower price. Even conservation projects that offer unique and irreplaceable benefits still involve opportunity costs. Conservation organizations should carefully evaluate whether substitute projects are available that deliver significant benefits at a much lower cost.

5. Acknowledge limited resources. As with any endeavor, there is limited time, money, and human capital available to invest in achieving conservation goals. While an economist would define an "economically efficient solution" as one that invests in all of the conservation projects for which the social benefits exceed the social cost, the unfortunate reality is that limited budgets for conservation generally preclude that solution. Strategic conservation acknowledges and embraces those constraints, using them in the selection process to ensure the best possible conservation outcomes on the ground. With constraints come opportunities to protect what is truly valued on landscapes and in communities.

6. Embrace complexity but strive for simplicity. Identifying strategic conservation priorities can involve complex modeling and interpretation of resources on the landscape and human needs and preferences for protection of those resources. Sometimes the benefits provided by these resources are difficult to measure, but we can establish easy-to-understand proxies for their value using scientific valid methods that allows us to make "pretty good" estimates of the likely conservation benefits. The algorithms

developed to measure these benefits can be applied to the comparison of dozens to hundreds of potential sets of choices and thus provides an opportunity to both embrace complexity and solve selection problems using tools that rely on scientific information and processes and do the heavy lifting in terms of calculations. Science-based decision-support tools allow conservation professionals to make solid, well-informed decisions.

7. Take advantage of the idiosyncrasies of human decision-making. Humans can be incredibly rational at times, carefully calculating various benefits, costs, and risks associated with a choice. At other times, they behave irrationally, making choices that are actually detrimental to their own good. Behavioral economists refer to this as "bounded rationality." At times, the idiosyncrasies (irrationality) of human decision-making can provide important information for conservation professionals because programs can be designed to better account for people's preferences. For instance, people will traditionally accept less money today rather than more money in the future. This phenomena, known as "hyperbolic discounting", could be important when designing conservation programs. For instance, programs may get greater voluntary involvement if they offer landowners a large lump sum of money today instead of small payments over time. In fact, it may be possible that the government can get even more conservation by offering an initial lump sum of money that is less than the total of the small payments over time. These types of opportunities should be pursued when available and ethically permissible.

8. Innovate and select the right tool to get the best bang for the buck. The next generation of conservation efforts will likely require environmental organizations and agencies to be innovative and seek ways to stretch their available funds farther. They can ensure that benefits are being accurately calculated by taking advantage of tools such as land suitability analysis, structured decision making, and the Logic Scoring of Preference (LSP) method. They can achieve cost-effective conservation by taking advantage of the best tools available—conservation markets, behavioral nudges, and selection techniques such as linear programming, goal programming, and hybrid optimization.

We believe that adoption of these principles of strategic conservation can transform conservation efforts in the United States and throughout the world, thus better improving drinking water, protecting endangered species, securing magnificent landscapes, and adapting to a changing climate. In terms of practical implementation, the sheer computing power of mathematical programming will allow conservation organizations and agencies to compare tens to hundreds of potential combinations of projects using multiple criteria—their costs and benefits at a minimum but also additional criteria such as geographic or demographic distributions of funds and weighting of various factors—to identify the one optimal set that best meets all of the conservation goals and priorities given the amount of funding available.