The *Agency Guide to Cave and Mine Gates*, a 12-year History

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Abstract
Before White Nose Syndrome siphoned away all cave conservation funding, a small group of experts was focusing on protecting the most critical bat roost habitats in the United States. Utilizing state-of-the-art cave gate designs and placement based on bat ecology and the study of cave microclimates, this information rapidly became the "industry standard", adopted by the National Park Service, US Forest Service, US Fish and Wildlife Service, The Nature Conservancy, and many state land management agencies. In order to convey those concepts and practices in simple language to the agency folks making the decisions and providing the funding (and writing the RFPs), the most active "gaters" developed the *Agency Guide to Cave and Mine Gates*. New modifications and innovations meant that the *Agency Guide* has been periodically revised, with the latest revision occurring in time to be released at this Symposium.

Introduction
Bat gates have been evolving for many decades, having changed from simple barriers designed to prevent human access to caves and mines, to ecologically-transparent structures that do not impede the movement of air, water, nutrients, and small animals into and out of the cave ecosystem (Dalton, 2004; Elliott, 1996; Hathorn and Thornton, 1987, 1993; Hunt and Stitt, 1975, 1981; Kennedy, 2006; Kennedy and Powers, 2005; Powers, 1985, 1993, 2004; Tuttle, 1977; White and Seginak, 1987). Many materials have been used, in varying shapes and compositions before finally settling on 4″x⅜″ angle iron for accessibility, ease of use, strength, and lack of flight restriction (Dalton, 2004; Kennedy, 2012; Powers, 2004; Vittetoe, 2002; Werker, 2004; White and Seginak, 1987). There have been ample case studies documenting successful protection efforts using these materials and designs (e.g., Anonymous, 1985, 1993a, 1993b, 1995, 1997; Bobo and Greene, 2000). And there have been many studies of bat acceptance (Altenbach and Milford, 1995; Butchkoski, 2010; Currie, 2002; Herder, 2004; Kurta, 2002; Ludlow and Gore, 2000; MacGregor, 1993; Pugh and Altringham, 2005; Sherwin et al., 2004; Spanjer, 2004a, 2004b).

But not all "bat gates" were created equal. It was unfair to compare the success (or lack of) poorly designed and poorly situated gates with those having optimum characteristics. In fact many "bad" gates were eventually replaced with better ones. Around the same time these modern gate designs were being implemented, more attention was devoted to the cave and mine roost characteristics being selected most by the bats, including microclimate (Brown and Berry, 2004; Elliott and Clawson, 2001; Ingersoll et al., 2010; Kennedy, 2004b; King, 2005; Raesly and Gates, 1986; Tuttle and Kennedy, 2002; Tuttle and Stevenson, 1978).

Conservationists also noted that many sites had been already modified by human activities such as saltpeter mining or commercialization attempts, and that pre-existing conditions must somehow be returned for successful bat use (Kennedy, 2004a; Kennedy and Whitney, 2004; Martin et al., 2006; Murphy, 1993; Olson, 1996; Toomey et al., 2002. Parallel efforts were being made in modifying abandoned mines to improve microclimates (Carter and Steffen, 2010; Grol and Voûte, 2010).

The explosion of studies and articles and internet accessibility of the last several decades has resulted in some confusion for the field biologist or land manager not entrenched in the history of cave gate development. General guidelines have been published for local use (Altenbach et al., 2000; Dansby, 1995; Elliott, 2001; Gobla, 1994; Navo, 2001; Olson, 2004; Sherwin et al., 2009; Tuttle and Taylor, 1998; Wilhide and Ash, 2002), but no comprehensive guide was widely available.

Because of this confusion and due to the desire to "train up" additional contactors and land managers, a small cadre of the top bat gate builders in the United States collaborated to plan and teach the first National Bat Gate Workshop. Held near Yakima, Washington for two consecutive weeks in 1997, the workshop focused on classroom lectures in

the evenings and hands-on gate construction at Boulder Cave on the Wenatchee National Forest during the day, setting the format for successive workshops. Instructors were the late Jim Nieland, Cave Specialist for the U. S. Forest Service; Bob Currie, Endangered Species Biologist for the U.S. Fish and Wildlife Service; the late Roy Powers, the "Mastergater" and former President of the American Cave Conservation Association; and Jim Kennedy, Cave Resources Specialist with Bat Conservation International (BCI). This workshop was quickly followed-up with similar ones at Gregory Cave in Great Smoky Mountains National Park, and the privately owned Sinnett-Thorn Mountain Cave System in West Virginia. To date, eight such workshops have been held, with the last being in 2011 at Gorman Cave in Colorado Bend State Park, Texas. The retirement of one of the four principal instructors, and the deaths of two of the others, has placed a temporary halt to the series. However, there continues to be a great need for these workshops, and the remaining instructor, Jim Kennedy, plans to restart them once again in the coming years by recruiting additional experts.

The materials used for handouts at these workshops consisted of a variety of reprints, data sheets, and other pertinent material. However, they were only distributed to participants and instructors of the workshops. But another very important and useful publication soon became available, and much more widely distributed. *Bat Gate Design: a Technical Interactive Forum* (Vories et al., 2004) is a 452-page tome that is the result of a discussion group of invited cave and mine gate specialists from across the U. S. who were assigned topics based on their areas of expertise. The free download is no longer available on the internet, but a PDF is available from this author. The *Bat Gate Design* book did not become the bat-gating handbook that was originally envisioned, but it did set a new precedent in consensus standards for bat gates, planning, design, construction, monitoring, alternate designs for special circumstances, and many other gems of information that had never before been published outside of the gray literature.

Two other important cave-gating resources also deserve to be mentioned here. The *Proceedings* of the National Cave and Karst Management Symposia and related meetings have many useful papers and are freely available on the Karst Information Portal. And in 2006, the National Speleological Society published *Cave Conservation and Restoration,* a great resource with many related chapters, including one specifically on cave gates by this author (Kennedy, 2006).

The need for a simple decision-making guide still existed. Kennedy and Jerry Fant, a welder who worked closely with Kennedy on many gating projects, wanted to put together a user-friendly guide for persons with no prior gating knowledge. Building off of William Elliott's *Cave Gating Criteria* (2001) and other sources, they outlined a rough draft and sent it off to Elliott and Roy Powers for comment. The final result was the *Agency Guide to Cave and Mine Gating* (Fant et al., 2009, 2021) and originally released on BCI's website. Since that time, numerous refinements and additions have been incorporated, first in 2012, then 2017, and most recently in 2021 in time for the National Cave and Karst Management Symposium in San Marcos, Texas.

The *Agency Guide* tackles questions such as whether or not to gate, what style of gate is appropriate, where the gate is optimally located, when the gate should be built, and who is the best choice to design and construct the gate. There is a nice decision tree right up front, scaled schematics of gate design details, many photos of completed gates, and good tips on follow-up monitoring and maintenance. There is also a much longer gating bibliography than is included with this paper.

The standard bat gate styles remain from the 2009 edition, including the Basic Gate (a standard vertical angle-iron gate with horizontal bars placed in a horizontal opening), the Half Gate (a Basic Gate open at the top but protected by an overhanging shield, for large gray bat maternity colonies and big cave entrances) the Chute Gate (a Basic Gate with an angled tube extending outward and upward, for maternity colonies with much smaller entrance dimensions), and the Cupola Gate (a box-type gate over a vertical entrance). Later editions added gate variations such as the Window Gate (a three-sided Chute Gate built under an overhanging roof and therefore not projecting upwards from the gate), the Semi-Cupola Gate (built into a hillside or sinkhole, and therefore lacking one or two sides), the Folded Gate (one side and a top, built into a sinkhole), and the Flat Gate (just the top, built over a vertical entrance that is not used by bats but is important for maintaining airflow). Newer illustrations of each gate style were included, mostly from more recent projects. The publication can be obtained for free from the author.

There may never be an all-inclusive Bat Gating Manual. The individual nuances of each cave entrance, management directives, bat usage, access, and so on are just too diverse to cover each eventuality. The best information comes from working with an experienced gate builder on multiple projects. But for those agency folks tasked with making

management decisions about a resource they may have little time, money, or experience to deal with, the *Agency Guide to Cave and Mine Gating* can help answer many questions. We have included a copy of the latest revision as an appendix to this paper (Appendix A). Please feel free to copy and distribute it widely.

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The "Agency Guide to Cave and Mine Gates" is included as Appendix A on p. 137 of these Proceedings.