american ethnologist
JOURNAL OF THE AMERICAN ETHNOLOGICAL SOCIETY

FREDERICK ERRINGTON
Trinity College
DEBORAH GEWERTZ
Amherst College

Managing an endangered species:

Palliative care for the pallid sturgeon

A B S T R A C T
The pallid sturgeon, formally listed in the United States as endangered since 1990, remains in trouble. Evolving in a free-flowing Missouri River, this ancient fish finds itself imperiled by a system of dams regulated by the US Army Corps of Engineers (USACE). The USACE must now confront the "wicked problem" of adjusting its envirotechnical regime of water management to address not only human economic interests but also antithetical fish-focused imperatives. To achieve a convincing balance, the USACE musters an array of bureaucratic practices that are seemingly beyond criticism. Through such practices, especially as publically performed at the quarterly meetings of the Missouri River Recovery Implementation Committee, the USACE affirms both itself and the envirotechnical system it incarnates as the best the fish can expect.
[*bureaucracy, envirotechnical regimes, endangered species, "wicked problem," pallid sturgeon, Missouri River, United States*]

What is the value of an endangered species, especially one whose conservation entails substantial human inconvenience and economic cost? Relatedly, how can such a species be feasibly managed within bureaucratically administered legal mandates? Here we consider the pallid sturgeon (*Scaphirhynchus albus*), a species of fish that since 1990 has been officially listed as endangered under the US Endangered Species Act (ESA) of 1973.[1] This act was meant to ensure that no species would be lost "to the Nation and its people," regardless of any commensurate value it may have compared to other goods and services. Yet, although the ESA emphasizes kinds of incommensurate or incomparable value—"esthetic, ecological, educational, historical, recreational, and scientific"—those who implement the act often contend with a complex calculus of human interests.[2]

Both remarkable and in trouble, the pallid clearly qualifies for the act's protection. Autochthonous to the Missouri River, the fish has a ghostly appearance that is spectacularly archaic, attesting to the fact that its immediate ancestor was coeval with the dinosaurs (see Figure 1).[3] A slow-breeding, long-lived fish, weighing up to 50 pounds and reaching five feet in length, it is adapted to a seasonally flooded, sprawling, and meandering big-river system. The pallid, however, is finding itself out of its depth: it has an only tenuous hold on the now highly regulated Upper Missouri River. There, it encounters six immense dams and reservoirs, designed to meet established, if contending, human needs. The dams and reservoirs block the pallid's movements, destroy or alter its spawning areas, and impair its food sources. Simply put, the pallid can no longer reproduce under these circumstances. The wild population, diminished to fewer than 125, is dying of old age (Goldfarb 2016).[4] Portended is the "destruction of the *generativity* of such [ancient] generations" (Rose, van Dooren, and Chrulew 2017, 9). Thus, as an endangered big-river species, the pallid requires not only recognition of its inherent worth

AMERICAN ETHNOLOGIST, Vol. 45, No. 2, pp. 186–200, ISSN 0094-0496, online ISSN 1548-1425.
DOI: 10.1111/amet.12631

Figure 1. A pallid sturgeon and field biologist, Dave Fuller, along the Missouri River. (Courtesy of the Montana Department of Fish, Wildlife and Parks) [This figure appears in color in the online issue]

but also of its position in a field of disparate human interests within a highly modified ecosystem.

While the pallid's listing as endangered under the ESA rests on its incommensurate value, measures for its survival are adjudicated bureaucratically through various commensurate metrics. As Irus Braverman (2015) notes in applying Michel Foucault's discussion of "biopower" to the conservation of a nonhuman species, it is "through documentation, classification, quantification, and ranking [that] threatened species lists elevate the listed, nonhuman species from the realm of mere, or biological, life to that of a political life worth saving" (229). In fact, the pallid's political life is supervised by two federal bureaucracies that document, classify, quantify, and rank it. The first, the US Fish and Wildlife Service (USFWS), ensures that the second, the US Army Corps of Engineers (USACE), recognizes the interests of the fish relative to those of the humans as it operates the dams: fish and humans are apportioned rights as stakeholders, even if they are stakeholders of different sorts. Hence, in addition to providing flood control, hydroelectric power, recreational opportunities, water for irrigation and drinking, and flotation for barge traffic, the USACE must struggle to sustain the pallid. Although it must also sustain two endangered species of birds, their survival, unlike the pallid's, can be ensured relatively easily.[5] Certainly, it is the pallid on which vast sums have been expended: almost $69 million (as of 2014)—more than on any other endangered species, with no end in sight.

As it manages the Missouri River, the USACE strives to present itself as bureaucracy at its best. It is obviously reacting to critiques of bureaucracies as indifferent, opaque, ineffectual, rigid, and document driven (Hull 2012)—if not downright stupid and obstructionist (Graeber 2015). The USACE seeks to appear virtuous, at least in its engagement with those clients deemed stakeholders (Heyman 2004): accountable, responsive, transparent, professional, and committed to a public good (Bear and Mathur 2015; du Gay 2000). Moreover, differing from bureaucracies whose field operations take place in distant obscurity (Mathur 2016; Mathews 2011), the USACE manages a very big river with immediate and evident effects.

Indeed, with the ESA and the listing of the pallid as endangered, the USACE has recognized that it can no longer continue business as usual. It must evaluate, if only to justify as essential, its fundamental procedures: those techniques and technologies that environmental historian Sara Pritchard (2011) analyzes, in reference to the Rhône River, as constituting and normalizing a particular "envirotechnical regime" (23). Specifically, the USACE must determine whether these procedures allow it to confront the complexities of "value pluralism"—in which people making economic trade-offs must engage with morally grounded (and legally instantiated) preferences (Narotzky and Besnier 2014, S13). Clearly, the survival of the fish has challenged the USACE's strategies of river governance, including its usual allocation of the costs and benefits of resource management among various human stakeholders.

This challenge has achieved the status of a "wicked problem." A wicked problem presupposes an "attendant conflict over values and high uncertainty about system components and outcomes" (Batie 2008, 1179; see also Rittel and Webber 1973). It contrasts with "benign problems," in which stakeholders can broadly agree on objectives and criteria for achieving solutions. The wickedness of the problem has prompted the USACE to defend its commitment to accountability, responsiveness, transparency, professionalism, and the public good by marshaling an impressive array of highly rationalized "best practices."

One of these practices, "structured decision-making," delineates sequences of orderly thought, research, and action to aid agencies in negotiating seemingly intractable difficulties and uncertainties. It musters a scientific rationality so as to make hard decisions. To use the bureaucratic language of a USFWS document: structured decision-making articulates objectives, deals explicitly with uncertainty, and responds transparently to legal mandates and to public preferences and values in decision-making. In so doing, it explicitly integrates science and policy. Applicable to "public sector decisions involving multiple decision makers, scientists and other stakeholders" (USFWS 2008, 1), structured decision-making's "success is measured by the ability of management alternatives to meet peoples' fundamental concerns and to be implemented in a timely manner" (Gregory 2014, 15). Furthermore, this self-conscious process requires that the implemented alternatives be monitored and, if needed, adjusted, revised, or replaced through an allied practice known as adaptive management.

Structured decision-making and adaptive management are, thus, intended to determine research and other

agendas, reconcile conflicting interests, and implement agreed-on objectives. Nonetheless, the agendas, interests, and objectives are, as we shall see, constrained by those aspects of the river's envirotechnical regime still defined as essential. The regime delimits the range of possible ways to deal with the wicked problems that it itself has created. In effect, these problems are most comfortably addressed, or at least monitored, through iterative exercises of thinking *inside* the box. Through these exercises, the regime validates itself as willing to confront these problems and as having the techniques and technologies necessary to resolve them. This is to say, efforts to save the pallid through structured decision-making and adaptive management—the best practices of bureaucracy at its best—ultimately work to endorse the system of resource management that imperiled the fish in the first place.

The problem begins

On August 17, 1962, President John Fitzgerald Kennedy dedicated Oahe, the fifth and largest of the six main stem dams to be constructed on the Upper Missouri River. These dams were a response to the Dust Bowl and the Depression of the 1930s and the floods of the 1940s. By enacting the Pick-Sloan Flood Control Act in 1944, the US Congress mandated that the Missouri River be managed to provide flood control, hydroelectric power, recreational opportunities, water for irrigation and drinking, and flotation for barge traffic. The construction of the massive dams would, as well, provide employment for World War II veterans as the nation transitioned from wartime to peacetime production and from state-directed to private enterprise.

Kennedy spoke at Pierre, South Dakota, when the nearby Oahe Dam was beginning to produce power. Welcoming the opportunity to address the assembled "farmers and ranchers and merchants," he was unreserved in his praise for the prevailing envirotechnical regime:

> Too often we see no connection between this dam and our nation's prosperity, our national security and our leadership of those nations who cherish their freedom. But the facts of the matter are that this dam, and many more like it, are as essential to the expansion and growth of the American economy. . . . Let us remember that only a generation or two ago all the great rivers of America—the Missouri, the Columbia, the Mississippi and the Tennessee—ran to the sea unharnessed and unchecked. Their power potential was wasted—their economic benefits were sparse. . . . [Then] this nation began to develop its river resources more systematically, to conserve its soil and water more fully and to channel the destructive forces of torrential rivers into constructive ends of power and light. Today, as a result, the face of this nation has been changed—forests and fields are growing where once there was nothing but parched earth—and prosperity thrives where once there was only despair. . . . We look forward to the day when energy will flow whenever and wherever the demand requires through physically integrated supply systems owned and operated by both private and public institutions within our traditional framework of competition. (Kennedy 1962, 2–3)

Kennedy did not acknowledge that the Oahe Dam flooded immense tracts of fertile bottomland, much of it owned by Native Americans. Cheyenne River Sioux and Standing Rock Sioux lost over 206,000 acres of their very best land, seized by the government under eminent domain with virtually no compensation (Lawson 1982).[6] And, evidently, the vision of what nature could bring, when under proper productive control, left little room for the consideration of broader ecosystemic effects. As it happened, with the completion of the Oahe Dam, all natural reproduction of the pallid sturgeon in its critical habitat of the Upper Missouri ceased (see Figure 2).

Although Kennedy must have known how the dam affected Native Americans, he probably did not know about the perils facing the pallid. That said, there already was growing awareness about environmental degradation. Certainly, Rachel Carson's (1962) *Silent Spring*, published soon after Kennedy delivered his speech, led many people to recognize the adverse effects humans had on wildlife. In 1969 the Endangered Species Conservation Act authorized the establishment of a list of animals that were threatened with extinction. Then, in 1973, the ESA mandated that federal agencies protect all listed animals and plants and promote their recovery.

The listing of the pallid sturgeon

We met with historian and conservation writer Peter Carrels over lunch in Sioux Falls, South Dakota.[7] He told us that his petition in 1988 to the USFWS to have the pallid listed as endangered was not the first for the fish. Several previous petitions had failed, including one by Kent Keenlyne, a fish biologist and specialist on the pallid sturgeon employed in Pierre by the USFWS. Eventually, Keenlyne asked Carrels, then a coordinator for the Sierra Club's Northern Plains Chapter, to submit a fresh proposal (Carrels 1988). This time it was successful because, Carrels thought, it came from a member of the public like him rather than from a USFWS representative, and it was buttressed by additional scientific studies.

We asked Carrels whether the pallid was akin to the spotted owl, an "iconic species" that could focus public opinion and generate political resolve for its protection and that of its ecosystem. "Not iconic," he said, "just in very serious trouble." Moreover, the USFWS "understood that to help it would help everything else, including the Missouri River catfish population and grizzly bears." In essence, the pallid was to be "the canary in the coal mine." As such, we

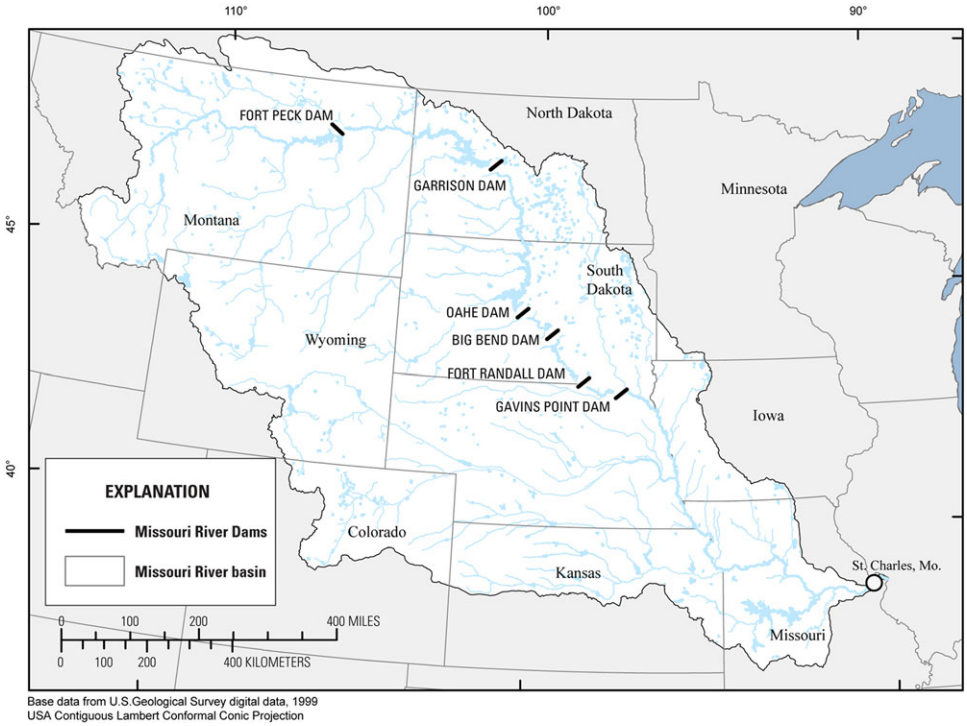

Figure 2. A map showing the dams and reservoirs along the Upper Missouri River. (Courtesy of the US Geological Service) [This figure appears in color in the online issue]

might add, it was an "indicator species," a designation that, as Andrew Lakoff (2016) notes for the endangered delta smelt, suggests "two temporally distinct value orientations" (240): one, conveying a past orientation which values an existing species as the product of evolution; the other, a future orientation which values the ongoing health of an ecosystem.

Set out in Carrels's (1988) petition as the "cause of concern" was "habitat destruction or modification" (4), given the multiple dams along the Missouri River; they, in their normal operations, had caused a "decline in the population, water quality problems (especially temperature and flow related), blockage of fish movements, [and] lack of documented reproduction for over 15 years" (4). These reflected the fact that "little or no consideration [was given to] the operation and management of [the dams and] the release, timing and fluctuation of flows on the Missouri or Mississippi Rivers where the species exists" (5). Correspondingly, "studies should be conducted and techniques developed to identify methods to restore viable populations of this ancient and unique fish" (5). In 1990 the listing was approved, with appropriate notification in the *Federal Register*.

The Oahe Dam in 2016

The Oahe Dam's Visitors Center—the most elaborate we found at any of the six dams—substantiated, albeit in less

Figure 3. The Oahe Dam and reservoir on the Missouri River. (Courtesy of the US Army Corps of Engineers) [This figure appears in color in the online issue]

jingoistic language, the sentiments expressed in Kennedy's 1962 dedication (see Figure 3). The primary message was that of "high modernism" (Scott 1998, 4): that the immense dam, and the regulated Missouri more generally, brought much-needed progress to the region. A five-minute video, for example, presented details of an engineering marvel: of earth moved (75,000 cubic yards daily); of machines

employed (including 25 twin-engine dump trucks weighing 50 tons each); of concrete poured (1,122,000 cubic yards); of men mobilized (800 working in three round-the-clock shifts at one phase).[8] Conveyed was a grand and heroic effort to harness nature's power and transform a frequently raging river into a benevolent instrument of progress. As one display placard explained, no longer was it a "common expression" that "it's going to be another bad year" with the "floodwaters of the Missouri River an annual threat." Indeed, for rural families, the dam's cheap electricity literally transformed darkness into light. As another placard explained, farm wives were now relieved of the drudgery of washboard laundering. The few trade-offs mentioned were qualified in interesting ways. Thus, a display about endangered species explained the pallid in this way:

> It evolved from a group of fishes that were dominant when dinosaurs roamed the earth. It has bony plates of armor, a flattened snout, and a long tail that make it look like a reptile. After surviving 70 million years, the pallid sturgeon is endangered today. It evolved in a flowing river system, complete with meandering channels and backwaters, and is comparatively ill-equipped for today's reservoirs.

That said, a brochure, published by the USACE and available at the Visitors Center, asserted that the reservoir—Lake Oahe—and its vast shoreline provided "critical habitat to many threatened and endangered species, including the pallid sturgeon" (USACE 2008, 2). Overall, the USACE conveyed that it was doing a good job at "balancing" (2) a diversity of interests, including those of endangered species.

This balance, of course, required trade-offs. All parties must accept some measure of compromise. By way of illustration, the Visitors Center provided a board game in which players imagined themselves as managers of the Oahe Dam, responsible for adjudicating the interests of those affected by the congressionally mandated missions, including that of species protection.[9] The interests were presented as commensurate and balancing them was a matter of equity, of being fair to all. Mindful that water allocated to one mission was water deflected from another, players had to equilibrate outcomes by regulating the flow of water through the dam. "If it seems difficult, don't feel bad—we know that the balancing act involved in managing the Oahe Dam is one of the toughest jobs around," the accompanying text advised.[10]

Leaving the Visitors Center, we entered the power plant for a tour. Our guide emphasized the nature of the envirotechnical balancing act through another board game, one showing how the six dams were managed in concert from a central office in Omaha. Playing the game meant making decisions under conditions of flood and drought. Hence, in a low-water situation, water should either be retained or let through the dams at a gradual rate. To illustrate, our guide pretended to be a recreational fisherman on one of the reservoirs, arguing that maintaining reservoir levels was the highest priority. This was eventually deemed wrong because it shortchanged other water users. Again, the desired outcome was to be equitable: after all, fair is fair.

Our tour of the power plant confirmed that, as a civil engineering project, Oahe was remarkable (especially since all the calculations had been made with slide rules, not computers!). That nature was under control and rendered benevolent was viscerally confirmed when visitors were invited to lean against an immense turbine, hear its pervading hum, and enjoy a gentle massage. Impressed, the two of us kept thinking about how the interests of the pallid would compete against the interests of the other stakeholders, those for whom Oahe had been built (White 1995).[11] What sort of balancing might there be? What sort of compromise might be possible? It clearly looked like a wicked problem.

Certainly, it would be desirable to find a way out. If the pallid, as a federally listed endangered species and as the titular autochthonous inhabitant of the river, were to become extinct, then there would have been a failure in management. Rather than an equitable adjudication of interests—a win-win all around—the result would be (from the pallid's stakeholder position) a catastrophic win-loss. Conversely, if the pallid could be saved, the whole project might be redeemed, and a wicked problem would become a benign one. As we suggested earlier, the apparent solution to the pallid's peril lay in the strategic and orderly application of the same scientific techniques and technologies that had made the problem wicked in the first place.

Confronting the wicked problem with science

The USACE's (2006) (occasionally revised) *Master Water Control Manual* is a highly technical delineation of thoroughly rationalized, bureaucratic procedures: of how water should be stored and released throughout the system of dams to accomplish designated goals, including the protection of fish and wildlife. As mandated by the National Environmental Policy Act of 1970, the USACE must evaluate the ecological consequences of its procedures. This evaluation precipitates a cascade of equally technical processes that yield impressively detailed documents. If the USACE determines that its actions may have significant ecological impacts, it must produce an environmental-impact statement. In its turn, the USFWS would respond with a "biological opinion." Significantly, in 2003, the USFWS concluded that the ecological consequences were serious: that the dam-regulating directives of the *Master Water Control Manual* caused "jeopardy to threatened and endangered species" (USACE, n.d. [a]). This finding prompted a bureaucratic perturbation, eliciting multiple responses from the USACE. These involved more science, more consultation,

and the drafting of a new environmental-impact statement specifying how the USACE planned to regulate the river in a more pallid-friendly fashion.

Among its responses, the USACE created the Missouri River Recovery Program. Through this program, the USACE supports extensive envirotechnical science directed toward mitigating the pallid's plight. In 2016 a USACE-funded summary of (mostly) USACE-funded science was released. The 242-page report, titled *Ecological Requirements for Pallid Sturgeon Reproduction and Recruitment in the Missouri River—a Synthesis of Science, 2005 to 2012* (DeLonay et al. 2016), seemingly leaves no stone unturned. Authoritative, detailed, and comprehensive, it is normative in its form and function; it seeks to render the pallid "legible" (Scott 1998, 2). It includes 259 references, eight appendixes (e.g., "Migration Pathways, Habitat Use, and Reproduction of Pallid Sturgeon in the Yellowstone River, 2012," v), 75 figures and tables in the main text (e.g., "Graphs Showing Variation in Hydrologic Alteration along the Missouri River," v), 62 appendix figures and tables (e.g., "Graphs Showing Data for Five Telemetered Pallid Sturgeon Migrating to Intake Dam on the Yellowstone River, April–August 2012," viii). The report also lists specific objectives for future pallid-focused research: principally, to specify precisely the fundamental requirements for pallid reproduction in a river likely to remain under a recognizable regime of management.

In addition to this science, the USACE supports six Missouri River Basin hatcheries through the Pallid Sturgeon Propagation and Population Augmentation Program. Granted, the extinction of the entire wild-born population would be lamentable—a failure of human stewardship and a likely loss to the species of behavioral and genetic fitness. Nonetheless, hatcheries do provide an envirotechnical stopgap: they ensure life support for the species by banking genetic diversity and stocking juveniles in the river. As well, the hatcheries provide pallids for experiments in the laboratory and the wild.[12]

We first visited the hatchery at Gavins Point, South Dakota, on a day that pallid spawning was induced. Since the facility contains 98 percent of the genetic material of pallids living in Upper Missouri River—again, that portion of the river controlled by the system of dams—access to it is restricted. After our interview, however, we were offered a tour by Wayne Nelson-Stastny, employed by the USFWS as Pallid Sturgeon Recovery Liaison and Coordinator of the Missouri River National Resources Committee.

Entering a large single-story, open-spaced structure, we saw many circular, blue, fiberglass fish tanks (four feet high and 20 feet in diameter). Everything in the facility was apparently controlled. The water in the tanks was a filtered mixture of Missouri River water and well water. The light in the building was muted to duplicate the conditions of a sediment-laden, free-flowing river. Each of the annual generations, established since the breeding program began in the early 1990s, was referred to by its birth year (e.g., "the class of 2003") and had its own tank. (Fishery experts joke wryly that hatchery-raised pallids are best adapted to their natal fish tanks.)

Figure 4. A pallid sturgeon being stripped of its eggs, June 8, 2016, in a hatchery breeding facility at Gavins Point, South Dakota. (Frederick Errington) [This figure appears in color in the online issue]

The spawning began as technicians waded into a partly drained tank to gather up the three, individually tagged female pallids previously placed there. These fish had been given a fertility hormone to induce egg production and an MRI to ascertain that the eggs were ready. When their bellies were squeezed, a process known as hand stripping, a stream of small, black eggs (otherwise known as caviar) was expressed into a plastic bowl (see Figure 4). To preserve as much of the wild genome as possible, the eggs of a particular female were mixed in the bowl with previously extracted sperm from a particular male. After a solution was added to prevent the fertilized eggs from clumping and suffocating, the batch was gently stirred (including briefly by us) for 30 minutes with a turkey feather.[13]

The pallids hatched in this center have various destinies. Some, such as the class of 2016, are kept as brood stock. Others are reintroduced into the Missouri River as juveniles in the hope that, after seven to nine years for males and seven to 15 for females, they will reach sexual maturity and encounter favorable (not clearly understood and delineated) conditions for spawning. Yet others become subject to experiments—in the laboratory and under closely observed, but natural, conditions.

Many of these experiments are formulated in relationship to a "conceptual life history model" of pallid sturgeon development (Wildhaber et al. 2008). This model traces developmental stages from embryos to larvae to reproductively mature adults, and it delineates the conditions and threats encountered at each stage within the regulated Missouri River. Specified within this model are human and nonhuman factors that contribute directly to

mortality (such as boating, fishing, damming, reservoir management, and predation by native and nonnative fishes); developmental and behavioral factors (such as disease, prey availability, and water contaminants); biotic factors (such as the presence of nutrients in the web of life); and abiotic factors (such as sediment, light, temperature, rates of flow, channel morphology).

At the hatchery complex, Kevin Buhl, a scientist with the US Geological Survey, showed us equipment he had designed to test the effects of water velocity on larval pallids. No longer relying for nourishment on their embryonic sac, these pallids have acquired sufficient mobility to find their own food, albeit most successfully under natural conditions—those of a turbid, meandering, and slow-moving river. By controlling the velocity of water flowing within a closed circuit, Buhl can study the effects of flow rates on larval mortality. Because his tanks feature slack water resting spots, he can measure the developmental stage at which the larvae can navigate into areas of respite. Moreover, since larval development is more related to water temperature than to the age per se, he keeps a thermal history of the laboratory fish. These experiments have implications for reservoir management and for river channel engineering. Not only is water velocity directly affected by the amount of water released from the dams and by the degree of channel constriction, so too is water temperature. Hydroelectric dams are structured so that releases are taken from deep in the reservoir, the region of relatively cold water; hence large releases (as for summertime barge traffic) will have a decidedly chilling effect.

Hatchery embryos are also destined for field studies. One study, derived from the conceptual life history model, addressed a "recruitment bottleneck" (Wildhaber et al. 2008, 9). Before becoming larvae, capable of controlling their own movements and finding food, newly hatched embryos merely drift downstream from where they were spawned. This "free embryo drift" stage should transition into the larval stage in 8 to 10 days. In the Upper Missouri, however, the distance between where adults might spawn (downstream of the massive Fort Peck Dam) and where the embryos encounter the next reservoir (the immense Lake Sakakawea) may be insufficient for this transition to take place. Unfortunately, a growing body of research has suggested that the delta at the entrance to a reservoir is a hostile environment for the embryos: too cold and too short of oxygen, and perhaps anoxic (Guy et al. 2015). Simply put, in the regulated river, the embryos may not develop the capacity to maneuver out of this danger.

To appraise this likely bottleneck, USACE-supported scientists at the major pallid research center in Columbia, Missouri, undertook an ambitious "drift study." In 2016 they released 700,000 pallid embryos, along with colored dyes and myriad small, plastic capsules, into the river below the Fort Peck Dam. The river was then sampled in its downstream progress, in part to discover whether any embryos entered the next reservoir and, if so, whether they survived. Following the precepts of adaptive management, the study was designed to facilitate decision-making by prioritizing and resolving key unknowns—"critical uncertainties" (MRRP 2017, 2). Thus, if insufficient drift distance could be established as a (if not, the) principal source of pallid mortality, then the researchers might determine what remediatory steps could be taken, provided they were reasonable and feasible, and subject to ongoing monitoring. Possible actions could include releasing warmer water from the top of the Fort Peck reservoir rather than the usual releases of colder water, from the bottom. An increase in water temperature might allow the embryos to develop more quickly so as to cope with their imminent entry into the perils of Lake Sakakawea. This practice, though, would likely be difficult to implement, given the structure of the dam. Other possibilities could include drawing down the level of Lake Sakakawea and thereby reducing its length; this would increase the amount of hazard-free drift time and distance. Unfortunately, such a drawdown would compromise many of the USACE's existing mandates for efficient dam operation. Other alternatives might be to foster spawning farther upstream from the reservoir as in the Yellowstone, one of the Missouri River's principal tributaries. If lack of drift distance was not the major problem, then a decision tree of other strong possibilities, perhaps inadequate food supply, would guide research.

The drift study was designed to meet scientific standards of objectivity, with the results to appear in scientific articles and figure in technical reports covering the USACE's responsibilities under the ESA.[14] Those scientists involved in this field experiment were primarily concerned with systematic observations within a envirotechnical regime: they sought to generate models relevant to the operation of a highly controlled—distinctly nonnatural—Missouri River. That, really, was what they had to work with. After all, as we frequently heard, although slight modifications in dam operations might be contemplated, removing the dams was off the table.

Confronting the wicked problem with negotiation

In its response to the USFWS's biological opinion, the USACE committed itself not just to supporting the pallid-focused, envirotechnical science that might provide guidance. It also committed itself to creating a committee of stakeholders that might likewise provide guidance. Committee members would represent those affected by the USACE's Missouri River actions, including actions reflecting the findings of the pallid-focused science. The USACE, thereby, could present itself as following exemplary bureaucratic procedures—as accountable, responsive,

transparent, professional, and committed to a public good. Moreover, the USACE was well aware that its management of the Missouri River had immediate and readily appraised effects.

Established in 2008, the Missouri River Recovery Implementation Committee (MRRIC), nicknamed Mr. Ric, meets quarterly. Its role in advising the USACE is to ensure that "public values" are incorporated into "a comprehensive approach to Missouri River recovery" (MRRIC 2014, 3). Even so, as often confounds environmental decision-making, these public values are diverse, and the paths to recovery—especially to the recovery of a species—are uncertain. If the MRRIC's challenge is to recognize and then move beyond these diversities and uncertainties, it has the best-use envirotechnical practices at its disposal. Indeed, in its organization and activities, the MRRIC has become an exemplar of structured decision-making and adaptive management. As we shall see, both are forms of "a governmental technology which simultaneously guides and problematizes actions in relationship to the environment" (Rutherford 1999, 58).

The diversity in public values is taken for granted in the committee membership and in proceedings. Adopting a strategy of inclusion, the some 70 members of the MRRIC represent "a wide array of local, state, tribal, and federal interests throughout the Missouri River Basin" (MRRP, n.d., 2). In mid-2017 the MRRIC had 28 stakeholder members who represented 16 nongovernmental categories of interest (navigation, irrigation, flood control, fish and wildlife, recreation, water quality, water supply, agriculture, conservation districts, waterway industries, major tributaries, thermal power, hydropower, cultural and historical preservation, local government, and environmental remediation). Added to the stakeholder members are representatives from eight states in the Missouri River Basin and 19 of the 29 tribes that are eligible to enroll representatives. Finally, there are representatives of 15 federal agencies, mostly scientists who "provide information, and state their opinions and recommendations" (MRRIC 2014, 5). With the exception of the latter, everyone can vote.

MRRIC membership entails substantial commitment. Before meetings, members are expected, at least, to peruse often extensive technical documents. The meetings are intense, if not draining. The days are long; many of the scientific presentations (on topics such as the drift experiment, attendant with slide presentations about the research decision tree) reward close attention. Service on subcommittees is time consuming. Most members take their obligations seriously, often becoming impressively informed. While not all MRRIC members attend every meeting, each category is usually represented. As we were told with some pride, there is never trouble in getting a quorum.

At the meetings we attended (August 8–11, 2016, near Omaha, Nebraska; May 22–25, 2017, in Sioux Falls), there were welcoming speeches by the chair of the MRRIC and by spokespersons from the USACE and the USFWS. Arranged around a horseshoe of tables, each committee member had a name placard and a microphone within easy reach. After the welcoming speeches, all members introduced themselves, providing their name, location, and areas of concern: "Bill Beacom, Sioux City, flood control"; "Tom Ball, Saint Louis, environmental conservation/Sierra Club"; "Elizabeth Wakeman, Flandreau Santee Sioux Tribe" (see Figure 5). Then the people on the peripheries identified themselves, virtually all of whom (other than ourselves) were support staff for the various government agencies. For our part, we gave our names and place of residence, adding that we were social scientists interested in environmental issues.

Figure 5. A meeting of the Missouri River Recovery Implementation Committee, August 11, 2016, at La Vista, Nebraska. (Deborah Gewertz) [This figure appears in color in the online issue]

In concert with the US Institute for Environmental Conflict Resolution, the meetings were orchestrated by professional negotiators from Resolve, a Washington, DC–based company dedicated to fostering "collaboration and consensus building in public decisions" (Resolve 2018). In fact, even before our first meeting, everyone with whom we discussed the MRRIC mentioned that all decisions were made by consensus, either through support or, at least, abstention. Support was registered by a thumbs-up; abstention by a thumbs-horizontal. Those abstaining were asked if they wished their votes to be recorded, with most saying no. Any thumbs-down vote would stop the whole process. This did not happen often, and when it did, those voting no were asked what it would take for them to agree. And consensus at one meeting was not enough. It had to be repeated at a subsequent meeting for the motion to be fully approved. As a former chair of the MRRIC commented, "Peer pressure is persuasive; it is very uncomfortable being the only person saying 'no' in a 70-member group" (Thorson 2011, 10). Conversely, some MRRIC members with whom we talked

lamented that those who did say no could veto any changes in river management that jeopardized their particular interests. Hence, consensus as a form of governance, while glossed as "fair play," virtually ensured that no significant shifts were made in the allocations of costs and benefits to stakeholders. As a former stakeholder representing conservation put it, the MRRIC's structure ensures that "it was very unlikely that . . . [members] would support any significant improvement of the river environment that might negatively impact their special interests" (Walker 2015, 2).

Unsurprisingly, many of the issues on which the MRRIC voted were routine and uncontroversial. Thus, at the August 2016 meeting, final consensus was reached on requesting "funding to support travel of MRRIC members to four plenary meetings per year" and for "continuing funding for pallid sturgeon research to provide life history information that will lead to species recovery" (MRRIC 2016, 6). Other issues were potentially more consequential. These dealt with the MRRIC's primary responsibility to guide the USACE in fulfilling its responsibilities to human stakeholders as well as its obligations to the pallid under the ESA. Indeed, the major item of business, and one which would occupy a number of meetings, was to get the MRRIC's response to the USACE's formulation, as delineated in its new Draft Environmental Impact Statement, of how it might feasibly manage the river.

The USACE had set out six alternatives in this document. Released online in 2016 and of often daunting complexity, it consisted of four volumes, totaling nearly 1,200 pages. Of the six alternatives, one was designated as "preferred." This alternative, presented as consistent with adaptive management, proposed a nine-year period of wait and see. During this period the USACE would monitor the pallid's response to the naturally occurring, variable conditions of rain and drought. In addition, the USACE would continue to support relevant science about why pallids were not naturally reproducing. Such scientific research could take place either in the laboratory or in the field under ambient circumstances, which did not require a significant "change [in] river conditions" (USACE 2016, xi). The lone alteration in river conditions proposed would be transient and modest: a one-time release of floodwaters to test the effects on spawning. Finally, the USACE would construct and monitor up to three spawning habitat sites.

Governing through consensus at the MRRIC

Our second MRRIC meeting (in Sioux Falls, May 22–25, 2017) began with a field trip, one designed to evoke a sense of common enterprise. The initial stop was the Gavins Point hatchery. We were all impressed by the facility, by the opportunity to witness artificially induced spawning (as it turned out, the fish were not quite ready), and by the chance briefly to hold foot-long pallids. Next was the Gavins Point dam complex, the farthest downriver of the six main stem dams. At the power plant, after lunch and a fact-filled presentation to a background of whirring turbines, the plant manager led us on a tour. Lastly, we ventured out on a part of the Missouri River, federally designated as "wild and scenic." This stretch lay between the upstream system of dams with their attendant reservoirs and the downstream confined banks of the barge navigation channel. Although still directly affected by the water releases mandated by the USACE's *Master Water Control Manual*, it was a relatively "natural" part of the river. Certainly, we all enjoyed the eagles and sandbar nesting birds.[15]

This outing did seem to reaffirm to members of the MRRIC that their enterprise was worthwhile. That said, after we left the hatchery, we did hear some grumbling that, as an ancient fish, the pallid should by now have figured out how to deal with pretty much anything that came its way. And we heard many say that, as a piece of engineering and one providing important services for many people, the dam-powerhouse complex was really impressive; pallid management would have to accept that these dams were not going away. In contrast, some found the relatively wild Missouri far too tame—its flows too controlled, its banks in private ownership too often fortified with riprap or chunks of cement. One person thought it "desecrated."

The following day, the meeting proper began. According to the distributed agenda, the overall objective was to "continue to develop a shared understanding about . . . current recovery and mitigations actions underway in the Missouri River Basin. Provide guidance to the Assistant Secretary of the Army for Civil Works [who is in charge of the USACE] with respect to these activities" (MRRIC 2017, 1). To this most general end, the primary business of the meeting focused on the MRRIC's response to the USACE's new Draft Environmental Impact Statement; this, in turn, would inform the MRRIC's plan for adaptive management.

The MRRIC spent the morning listening and responding as an advisory panel of independent scientists presented reports about the draft and the anticipated adaptive management plan.[16] After this, the techniques of structured decision-making were invoked for much of the afternoon. As a pillar of structured decision-making, core values—preferences and anxieties—should be revealed in a transparent process. Accordingly, each MRRIC member was invited to give a two-and-a-half-minute presentation expressing positive and negative responses to the reports just given. The MRRIC's chair, Gail Bingham, introduced the exercise as follows (in paraphrase):

> It is the essence of American democracy to agree to discuss differences. Everyone should participate—the federal agencies, the tribes, and the stakeholders. As we go around the room, some of us might have a question, but all of us can learn from the

perspectives of others. We can learn one another's interests and areas of concern so as to develop consensus comments and recommendations for the next meeting in August. We have to talk to one another.

Here are excerpts from some of the presentations (in paraphrase):

A TRIBAL REPRESENTATIVE. The tribes have wished to be active and to participate in discussions. We are interested in human considerations and cultural resources. We worry about human burials on USACE-controlled land. There are so many unknowns when it comes to our cultural resources. We have to slow down and examine the possible effects of implementing the USACE preferred alternative. Tribal monitors should be present as the project unfolds.

A NAVIGATION REPRESENTATIVE. We need truthful and objective science. We also need a comprehensive review of the economic impacts on navigation, both in the Missouri and the Mississippi Rivers. I would like to add one or two river navigation/transportation economists to look at the economic impacts of the USACE's plan. For instance, a one-time flow test [the spring water release to provide a possible cue for pallid spawning] must be evaluated in relationship to economic interests. [. . .]. Navigation, it should be remembered, is an authorized use of the river guaranteed by Congress.

A STATE REPRESENTATIVE. I am happy to think about expert opinions and to support science for the development of the recovery program key to the pallid. I do have issues with the regulation of flows because my state is worried about flooding. I think that the physical and mechanical effects of altering the system must be better understood before people experiment with flows.

A HYDROPOWER REPRESENTATIVE. We must think about wildlife. Yet, in so doing, the importance of hydropower for each alternative must be evaluated, and further analysis is needed. We can provide analysis of hydropower impacts through working closely with the USACE. Then we must take these impacts back to our constituencies for their reactions.

A CONSERVATION ORGANIZATION REPRESENTATIVE. We have to reconnect the river to the flood plain if the goal is a self-sustaining population of wildlife, and we must utilize natural processes to protect endangered species. We need high standards for the pallid sturgeon. We must protect its genetic diversity. And we must support funding from Washington for the monitoring of the pallid. I think we need to do more than outlined in the preferred alternative.

The chair then summarized major themes, including supporting a science-based approach; providing people with the time necessary to deal with proposed changes in flow; encouraging the USACE to conduct an enhanced flood control model that provides metrics about human costs; incorporating tribal monitors; and restoring river functions through land acquisitions and other means when possible—all the while taking human considerations into account.

Before the chair wrapped up the day, Major General Spellman of the USACE gave his scheduled presentation. Spellman, attired in an immaculate dress-white uniform, was a practiced speaker. In his brief comments he said that it had been valuable to hear everyone's responses to the Draft Environmental Impact Statement. He especially thanked MRRIC members for sticking to their difficult task. Be assured, he said, that the USACE, through him, has heard the MRRIC's positions. Regardless, he added, it simply will not be possible to remove the dams. He would be happy to talk with members at the social event that was to follow that day's adjournment.

***

Much of the MRRIC meeting emphasized iterative performances, not just in working toward consensus but in affirming procedures. Many were well established, as with regular reports from the USFWS on the current status of the relevant endangered species, the pallid in particular. Others were being worked out. Thus, one presentation, titled "Missouri River Adaptive Management Annual Governance Activities Process Map," was illustrated in complex, organizationally focused slide presentations. Intricate charts specified the formation and operation of "teams" as part of the MRRIC's adaptive management plan. The three teams addressed the apparently commensurate welfare of the "fish," the "birds," and the "humans." (Again, it was asserted that the needs of the tern and the piping plover could be met relatively easily.) Team members were scheduled to communicate regularly with staff of the USACE and the USFWS—whether in person, by phone, or through webinar. How these teams would operate was discussed in detail. That the teams could include outside experts resulted in a sustained discussion of whether these outsiders would vote along with the MRRIC members in approving each team's final report. Comparably, there was another prolonged discussion, one which some MRRIC members found amusing in its procedural specificity: since it was accepted practice for those abstaining in a vote to choose to have their abstentions formally noted, might they choose to have their reasons noted? If the reasons could be recorded, where in the minutes should they appear? Because the MRRIC Charter (MRRIC 2014) was found to be silent on this question, the matter was tabled.

We found much of this engagement with procedure exhausting, if not mind numbing, and asked a senior scientist working for one of the government agencies what he thought. He said that the MRRIC had matured over the years, with people largely conforming to organizational expectations. No longer were they banging on the table and shouting out the absolute inviolability of their special interests, as they had done earlier. Now, with the passage of time, they had established working relationships and were at least listening to each other. Moreover, everyone seemed willing to accept the independence and integrity of the science presented to them. Certainly, much good science had been accomplished. And it was important that the negotiations between the government agencies—primarily between the USFWS and the USACE—be out in the open.

Although he did not use the term, this scientist knew that the MRRIC was facing a wicked problem. He worried that the available strategies of adaptive management might not be up to the task of dealing with the complexity of the heavily regulated Missouri River. This complexity included that of interagency processes and of the MRRIC itself, with the diverse interests of its human stakeholders. And then there was the complexity surrounding the pallids. Would they benefit from the preferred alternative or from any other, necessarily modest, change in the operations of the dams?

In other words, were the problem-solving mechanisms of the prevailing envirotechnical regime adequate to resolving the wicked problem generated by that regime? Or, as a senior administrator had wondered to us, would the "personality" of the MRRIC remain fundamentally "schizophrenic," with significant differences among humans and nonhumans rendering consensus both circumscribed and fragile? In any case, as another MRRIC member told us about the aforementioned teams, "when faced with a wicked problem, at least you can form a committee." (Comparably, we note that a former MRRIC member has written that "river restoration is condemned to paralysis-by-analysis and death-by-committee" [Walker 2015, 1].)

Dueling bureaucracies

The capacity of the MRRIC, with its reliance on the techniques of structured decision-making, adaptive management, and consensus to balance the interests of the human stakeholders with each other and with those of the pallid, was challenged on the last day of the conference. In essence, the question of what the pallid's survival is worth was directly raised. Those at the MRRIC found that there was no easy way to reach consensus on how this question should even be formulated: What is the pallid worth, relative to what? Playing the "game" the USACE had set out of managing the river so as to balance the commensurate interests of humans was hard enough; giving proper weight to the incommensurate interests of the pallid made the game almost unplayable.

Our first inkling that a game change might be afoot occurred as MRRIC members were assembling for the final morning session. One MRRIC member alerted Deborah that the USFWS had told the USACE to "flood the farmlands." The previous evening, it seemed, MRRIC members received a copy of a letter (Stewart 2017) conveying the USFWS's criticism of the USACE's Draft Environmental Impact Statement and especially of the USACE's preferred alternative. Widely understood by MRRIC members as designed to protect the USFWS from likely lawsuits by environmental groups, the letter argued that the preferred alternative would not do enough: it would continue scientific study without sufficiently changing the management of the river for recovery of endangered species. Correspondingly, other alternatives in dam operation had been too readily dismissed as infeasible. (For instance, referencing research linked to the study on free embryo drift, the letter advocated using "surface water discharges from Fort Peck dam ... to increase river water temperatures" [Stewart 2017, 3].) In particular, the letter advocated that, unlike the wait-and-see procedures of the preferred alternative, "restoring natural flows should be a cornerstone of management approaches to river ecosystems" (2). In fact, "*Continued survival of pallid sturgeon depends on restoration of riverine forms and functions, as well as some semblance of the pre-development or natural hydrograph*" (2017, 3; italics in the original). While recognizing that the Draft Environmental Impact Statement concentrated on ESA-listed species, the USFWS was "also committed to an ecosystem approach for the benefit of all fish, wildlife, and people ... [a commitment to] the ecological health of the Missouri River benefitting a variety of species" (4).

MRRIC members' reactions were mixed, to say the least. Many disliked the tone of the letter; many resented that the letter, written a month earlier, was sprung on them at the last moment. (It was unclear who had orchestrated this surprise and for what reason.) They thought it dismissed the MRRIC's hard work to reconcile the interests of fish and people. They were alarmed about restoring some semblance of the natural hydrograph: How would this affect those involved with flood control, barge traffic, and the like? Conversely, some found the letter to be a much-overdue breath of fresh air. (One went so far as to caper around the room.)

Here, in paraphrase, are some reactions:

A WATERWAYS INDUSTRIES REPRESENTATIVE. My constituency has long memories. I have been abused by folks who didn't believe in MRRIC. They did, though, come to believe in me, to trust me. Now there is a $12 million port project at stake. My constituents will wonder if we are going to be in business. They have to deal

with the banks. They borrow on 20-year notes. All of this affects lending and business. This is all about people, not just about wildlife.

A HYDROPOWER REPRESENTATIVE. The tone of this letter is offensive. Things in this letter have never been discussed around this table. About the Fort Peck discharges, a fluctuation in power affects the whole state. There is no way in heck that something that has never been vetted around this table will be accepted by my constituents. We have spent time finding people's concerns, and this basically bypasses it. It really provides less confidence in the adaptive management plan.

A CONSERVATION REPRESENTATIVE. Let me quote the Endangered Species Act. "The purposes of ESA are to provide a means whereby the ecosystems upon which endangered species and threatened species depend may be conserved."

ANOTHER CONSERVATION REPRESENTATIVE. The letter isn't alarming or surprising. If you look at uncertainty from an industry perspective, you don't do anything until you fully understand. And the USFWS has to act, given the ESA. Wildlife is getting a voice. In the absence of all science, you have to go with the wildlife, even if you don't fully understand. There are those who say, why haven't you erred on the side of industry? But this is good because it errs on the side of the species.

The sense was palpable that the rug had been pulled out from under MRRIC members, for better or worse. People wondered how they could possibly sell this change in perspectives to their constituents and wondered what it would mean for the MRRIC itself. How could they, much less their constituents, trust the MRRIC process? Some even spoke of calling their congressional representatives to intervene. On the other hand, one told Fred that he believed the USFWS had grown some balls to stand up to the USACE.

Conclusion: What is the pallid worth?

Even if the bureaucracy of the USFWS did convince the bureaucracy of the USACE that the river should be managed in a more pallid-friendly way, the result would be delimited: less utility for some with, perhaps, less economic efficiency overall. It would not be a shift in the envirotechnical regime. Whatever "semblance" of natural flows gets negotiated—that is, whatever alterations in water storage and release the USACE agrees to—the river will still be actively managed. To do otherwise would beg revolt by those Americans accustomed to the current construction of nature: a construction that, as Kennedy did in his dedication speech, associates immense and wondrous human-made dams with the nation's strength, security, and prosperity. Clearly this was the perspective of many we met while on our mission to visit all six dams. Although dams elsewhere in the United States have been dismantled, this has generally occurred when costs exceeded benefits (Bellmore et al. 2017). In contrast, those dams on the Missouri River serve so many intersecting and interlocking economic interests that their removal (as the USACE often affirms) is widely understood as a political nonstarter. Into the foreseeable future the dams will likely remain monumental and their regulation, some variant of the *Master Water Control Manual* (USACE 2006). The USFWS may wish to expand the box but not to step out of it.

As for the fish, its ancient interests are already in a chronically uneasy relationship with those of other stakeholders, those negotiating with one another about their commensurate economic interests, as in barge traffic, flood control, and the like. To the extent that the pallid's value does remain incommensurate with those of these other stakeholders, its special circumstances will, nonetheless, remain audited by the MRRIC's best bureaucratic procedures.

Certainly, through the MRRIC, the USACE would like to take credit for a state-of-the-art renovation of its bureaucratic box. It would like to take credit for its current commitment to perform its congressionally authorized, multifaceted mandates in a virtuous manner: demonstrably accountable, responsive, transparent, professional, and committed to a public good. Indeed, the MRRIC has become an exemplar, a model of and for impeccable bureaucratic procedures. As such, its procedures are calibrated not just to solve routine problems but to address extraordinary—wicked—problems. These procedures function to make wicked problems go away, to render them benign. If problems are solved, it is fine, and everyone would be both relieved and pleased; if problems remain unsolved, then they can be defined as insolvable. In this latter instance, epistemology gives way to ontology: no further solution need be sought because none can be found. In the case of the pallid, the MRRIC's procedures frame its worth in a question meant to be unanswerable. Given the USACE's considerable efforts—including the creation of the MRRIC itself, the support of science, and the expenditure of some $69 million—what more could have (reasonably) been done for the fish?

Hence, if a successful bureaucratically determined, techno-environmental fix does not prove possible, pallid survival will remain dependent on some form of (palatable) life support, some carefully managed and monitored palliative care. Not surprisingly, either outcome—fix or support—endorses the envirotechnical regime that imperiled the pallid in the first place. Best bureaucratic practices may help build a better box, but they are unlikely to build a fundamentally different box. Indeed, as the best going, these bureaucratic practices inevitably authorize the regime that authorized them.

Notes

Acknowledgments. Although we have explored environmental issues in the US Midwest since 2012, our research on the pallid was primarily conducted during the summers of 2016 and 2017. Many friends and colleagues helped with this. We would especially like to thank Bill Beacomb, Jim Becic, Thomas Ball, Joseph Bonneau, Peter Carrels, Steven Chipps, Jan Dizard, Christopher Guy, Hannah Holleman, Robert Jacobson, Carter Johnson, Casey Kruse, Wayne Nelson-Stastny, Caterina Scaramelli, and Michael Thabault. Comments on our manuscript by Niko Besnier and anonymous reviewers were crucial to our thinking and writing. Finally, the Faculty Research Award Program at Amherst College gave generous support.

1. US Endangered Species Act of 1973, Pub. L. No. 93–205, 87 Stat. 884. https://www.fws.gov/endangered/laws-policies/esa.html.

2. The pallid, thus, differs from creatures like waterfowl and pheasants for which there is a strong constituency of hunters (Errington and Gewertz 2016; Gewertz and Errington 2015).

3. The pallid's advocates often struggle to make it moderately charismatic by calling it the "dinosaur fish" (Defenders of Wildlife 2015). In this sense, the pallid is "rhetorically disadvantaged" (Carrithers, Bracken, and Emery 2011, 664), although less so than the freshwater pearl mussel. These two water dwellers are, in turn, disadvantaged relative to species that have "big eyes and fur such as pandas and lemurs" (664). The pallid is also rhetorically disadvantaged in relation to species that have big ecological voices, like the malaria-carrying mosquito (Mitchell 2002, 19–53).

4. As Ursula Heise (2016) points out, the language concerning species listed as endangered oscillates between elegy and enumeration.

5. The plight of the two birds, the interior least tern and the Northern Great Plains piping plover, can be dealt with fairly easily. In contrast to the pallid, whose year-round habitat once encompassed most of the river, these birds spend much of the year elsewhere in the sunny South.

6. Kennedy's (1962) view that this dam was an unalloyed good thing is backgrounded by the Cold War context. His speech included statements like the following: "That the energy of powerful rivers is a national asset capable of ready translation into productive capacity has been fully appreciated by the Soviet Union" (3).

7. We use no pseudonyms in this article.

8. Ashley Carse (2014) reports that, during a 2008 Earth Day celebration at the Panama Canal, the announcer provided similar statistics of engineering achievements, describing the "colossal size, enormous cost, and impressive durability of its . . . locks, dams, and gates" (2). Comparably, in France, members of the press bragged about the system of 1950s dams along the Rhône: "They quantified and ranked the projects in terms of units of dirt, labor, and machines. [One science writer described a dam as a] 'gigantic project [that] concedes nothing to those in America'" (Pritchard 2011, 70, quoting Labadie 1949, page unknown).

9. This board game is akin to the video game found on the USACE's website; USACE, n.d.(b).

10. Ibid.

11. Richard White (1995) described himself, after visiting the turbine room of a big dam along the Columbia River, as becoming "fascinated by both salmon and dams, and appreciative of the virtues of each" (x).

12. Irus Braverman (2015) has written extensively about the linkage between *ex situ* and *in situ* breeding projects, especially as involving endangered species. See, too, Matthew Chrulew's (2017) analysis of attempts to save the golden lion tamarin. Hatcheries also provide stock for commercial and recreational fishing. See Joseph Taylor's (1999) discussion of managing Northwest salmon fisheries.

13. The Upper Basin Pallid Sturgeon Propagation Committee produced a highly detailed and comprehensive, 92-page "protocol" of the techniques and technologies for propagating pallid sturgeon within hatcheries (UBPSPC 2005).

14. The USACE's responsibility is set out in various documents. Central among these is the Effects Analysis, which is designed "as a systematic evaluation of how Federal agency actions may harm a listed species" (Jacobson et al. 2016, 1).

15. In contrast, the invasive silver carp we encountered—unlike the introduced sport fishes—were widely regarded as an unwelcome part of the river's emergent ecologies; the carp, stimulated by the vibration of outboard motors, might unexpectedly launch their 20-pound bulks into the persons of unfortunate boaters. (Marris 2011 and Kirksey 2015 stress the more positive aspects of emergent ecologies.)

16. The USACE (2017) describes this panel as follows: "The desire and need for independent scientific review and advice to support decisions and directions taken by USACE drove the creation of the MRRIC Independent Science Program. This program is managed by a Third Party Science Neutral who manages two Independent Advisory Panels which serve to provide impartial reviews of pertinent science and answer questions received from the MRRIC. These two panels are the Independent Science Advisory Panel (ISAP) and the Independent Social Economic Technical Review Panel (ISETR)."

References

Batie, Sandra. 2008. "Wicked Problems and Applied Economics." *American Journal of Agricultural Economics* 90, no. 5 (December): 1176–91.

Bear, Laura, and Nayanika Mathur. 2015. "Remaking the Public Good: A New Anthropology of Bureaucracy." *Cambridge Journal of Anthropology* 33, no. 1 (Spring): 18–34.

Bellmore, J. Ryan, Jeffrey J. Duda, Laura S. Craig, Samantha L. Greene, Christian E. Torgensen, Mathias J. Collins, and Katherine Vittum. 2017. "Status and Trends of Dam Removal Research in the United States." *Wiley International Reviews: Water* 4, no. 2 (March/April). http://onlinelibrary.wiley.com/doi/10.1002/wat2.1164/full.

Braverman, Irus. 2015. *Wild Life: The Institution of Nature.* Stanford, CA: Stanford University Press.

Carrels, Peter. 1988. "Petition for Rulemaking under the Endangered Species Act of 1973, as Amended, and the Administrative Procedure Act." May 31, 1988. http://www.pallidsturgeon.org/wp-content/uploads/2012/11/Pallid-Sturgeon-Petition.pdf.

Carrithers, Michael, Louise Bracken, and Steven Emery. 2011. "Can a Species Be a Person? A Trope and Its Entanglements in the Anthropocene Era." *Current Anthropology* 52, no. 5 (October): 661–85.

Carse, Ashley. 2014. *Beyond the Big Ditch: Politics, Ecology, and Infrastructure at the Panama Canal.* Cambridge, MA: MIT Press.

Carson, Rachel. 1962. *Silent Spring.* New York: Houghton Mifflin.

Chrulew, Matthew. 2017. "Saving the Golden Lion Tamarin." In *Extinction Studies: Stories of Time, Death, and Generation,* edited by Deborah Bird Rose, Thom van Dooren, and Matthew Chrulew, 49–87. New York: Columbia University Press.

Defenders of Wildlife. 2015. "Feds Place Hurdles Too High for 'Dinosaur Fish' Recovery." https://newsroom.defenders.org/feds-place-hurdles-too-high-for-dinosaur-fish-recovery/.

DeLonay, Aaron J., Kimberly A. Chojnacki, Robert B. Jacobson, Janice L. Albers, Patrick J. Braaten, Edward A. Bulliner, Caroline M. Elliott, et al. 2016. "Ecological Requirements for Pallid Sturgeon Reproduction and Recruitment in the Missouri in the Missouri River—a Synthesis of Science, 2005 to 2012." US Geological Survey, Scientific Investigations Report 2015–5145, January 20, 2016. https://pubs.er.usgs.gov/publication/sir20155145.

du Gay, Paul. 2000. *In Praise of Bureaucracy: Weber, Organization, Ethics*. London: Sage.

Errington, Frederick, and Deborah Gewertz. 2016. "Pheasant Capitalism: Auditing South Dakota's State Bird." *American Ethnologist* 42, no. 3 (August): 339–414.

Gewertz, Deborah, and Frederick Errington. 2015. "Doing Good and Doing Well: Prairie Wetlands, Private Property, and the Public Trust." *American Anthropologist* 17, no. 1 (March): 17–31.

Goldfarb, Ben. 2016. "Will a Dam Save the Pallid Sturgeon, or Doom It?" *High Country News* (Paonia, CO), November 2, 2016. http://www.hcn.org/articles/will-a-dam-save-the-pallid-sturgeon-or-doom-it.

Graeber, David. 2015. *The Utopia of Rules: On Technology, Stupidity, and the Secret Joys of Bureaucracy*. New York: Melville House.

Gregory, Robin. 2014. "Using Structured Decision Making Approaches to Clarify Environmental Management Choices." Lake Champlain Basin Program, February 12–13, 2014. http://www.lcbp.org/wp-content/uploads/2012/09/SDM_Overview_2014.pdf.

Guy, Christopher, Hilary B. Treanor, Kevin M. Kappenman, Eric A. Scholl, Jason E. Ilgen, and Molly A. H. Webb. 2015. "Broadening the Regulated-River Management Paradigm: A Case Study of the Forgotten Dead Zone Hindering Pallid Sturgeon Recovery." *Fisheries* 40 (1): 6–14.

Heise, Ursula. 2016. *Imagining Extinction: The Cultural Meanings of Endangered Species*. Chicago: University of Chicago Press.

Heyman, Josiah. 2004. "The Anthropology of Power-Wielding Bureaucracies." *Human Organization* 63, no. 4 (Winter): 487–500.

Hull, Matthew. 2012. "Documents and Bureaucracy." *Annual Review of Anthropology* 41:251–67.

Jacobson, Robert, Mandy L. Annis, Michael E. Colvin, Daniel A. James, Timothy L. Welker, and Michael J. Parsley. 2016. "Missouri River *Scaphirhynchus albu*s (Pallid Sturgeon) Effects Analysis—Integrative Report." US Geological Survey, Scientific Investigations Report 2016–5064. https://pubs.usgs.gov/sir/2016/5064/sir20165064.pdf.

Kennedy, John Fitzgerald. 1962. "Excerpts of President John F. Kennedy's Remarks at Oahe Dam Dedication, Pierre." South Dakota Digital Archive, South Dakota Historical Society. August 17, 1962. http://sddigitalarchives.contentdm.oclc.org/cdm/ref/collection/manuscript/id/425.

Kirksey, Eben. 2015. *Emergent Ecologies*. Durham, NC: Duke University Press.

Labadie, Jean. 1949. "L'aménagement du Rhône de Donzère à Mondragon." *Science et Vie*, no. 381, 380–85.

Lakoff, Andrew. 2016. "The Indicator Species: Tracking Ecosystem Collapse in Arid California." *Public Culture* 28, no. 2 (May): 237–59.

Lawson, Michael. 1982. *Dammed Indians: The Pick-Sloan Plan and the Missouri River Sioux, 1944–1980*. Norman: University of Oklahoma Press.

Marris, Emma. 2011. *The Rambunctious Garden: Saving Nature in a Post-wild World*. New York: Bloomsbury.

Mathews, Andrew. 2011. *Instituting Nature: Authority, Expertise, and Power in Mexican Forests*. Cambridge, MA: MIT Press.

Mathur, Nayanika. 2016. *Paper Tiger: Law, Bureaucracy and the Developmental State in Himalayan India*. Cambridge: Cambridge University Press.

Mitchell, Timothy. 2002. *Rule of Experts: Egypt, Techno-politics, Modernity*. Berkeley: University of California Press.

MRRIC (Missouri River Recovery Implementation Committee). 2014. Charter. Amended August 14, 2014. http://moriverrecovery.usace.army.mil/mrrp/mrrp_pub_dev.download_documentation?p_file=425.

———. 2016. *Annual Report*. http://moriverrecovery.usace.army.mil/mrrp/MRRP_PUB_DEV.download_documentation?p_file=8322.

———. 2017. Agenda. August 8, 2017. MRRP (Missouri River Recovery Program). 2017. *Fact Sheet*. January 2017. http://cdm16021.contentdm.oclc.org/cdm/pageflip/collection/p16021coll7/id/3054/type/compoundobject/show/3684/cpdtype/document/pftype/pdf.

———. n.d. *Missouri River Recovery Implementation Committee (MRRIC)*. http://moriverrecovery.usace.army.mil/mrrp/f?p=136: 3: 0::NO:::. Accessed December 22, 2017.

Narotzky, Susana, and Niko Besnier. 2014. "Crisis, Value, and Hope: Rethinking the Economy." *Current Anthropology* 55, no. (S9): S1–S35.

Pritchard, Sara. 2011. *Confluence: The Nature of Technology and the Remaking of the Rhône*. Cambridge, MA: Harvard University Press.

Resolve. 2018. "About." http://www.resolv.org/about.

Rittel, Horst, and Melvin Webber. 1973. "Dilemmas in a General Theory of Planning." *Policy Sciences* 4, no. 2 (June): 155–67.

Rose, Deborah Bird, Thom van Dooren, and Matthew Chrulew. 2017. Introduction to *Extinction Studies: Stories of Time, Death, and Generation*, edited by Deborah Bird Rose, Thom van Dooren, and Matthew Chrulew, 1–17. New York: Columbia University Press.

Rutherford, Paul. 1999. "The Entry of Life into History." In *Discourses of the Environment*, edited by Eric Darier, 37–62. Oxford: Blackwell.

Scott, James. 1998. *Seeing like a State: How Certain Schemes to Improve the Human Condition Have Failed*. New Haven, CT: Yale University Press.

Stewart, Robert. 2017. "Letter to Mark Harberg, Project Officer, USACE, Omaha District." Reference number 9043.1, ER 16/0715.

Taylor, Joseph. 1999. *Making Salmon: An Environmental History of the Northwest Fisheries Crisis*. Seattle: University of Washington Press.

Thorson, John E. 2011. "Case Study of a Public-Private Collaboration: The Missouri River Recovery Implementation Committee." *Alternative Dispute Resolution Committee Newsletter* (American Bar Association) 10, no. 1 (November): 8–11. https://www.americanbar.org/content/dam/aba/publications/nr_newsletters/adr/201111_adr.authcheckdam.pdf.

UBPSPC (Upper Basin Pallid Sturgeon Propagation Committee). 2005. *Upper Basin Pallid Sturgeon Propagation Plan*. October 26, 2005. https://esadocs.cci-dev.org/ESAdocs/misc/PallidPropagation2005.pdf.

USACE (US Army Corps of Engineers). 2006. *Missouri River Mainstem Reservoir System, Master Water Control Manual, Missouri River Basin*. Revised March 2006. http://www.nwdmr.usace.army.mil/rcc/reports/mmanual/MasterManual.pdf.

———. 2008. *Oahe: Dam and Lake*. Oahe Visitors Center brochure.

———. 2016. *Draft Missouri River Recovery Management Plan and Environmental Impact Statement*. http://cdm16021.contentdm.oclc.org/cdm/ref/collection/p16021coll7/id/3093.

———. 2017. "Missouri River Independent Advisory Panels." Last updated February 21, 2017. http://projects.ecr.gov/moriversciencepanel/.

———. n.d.(a). "Missouri River Recovery Program." Accessed December 22, 2017. http://moriverrecovery.usace.army.mil/mrrp/f?p = 136:1.

———. n.d.(b). "River Basin Balancer Game." Accessed December 22, 2017. http://www.nwo.usace.army.mil/Missions/Dam-and-Lake-Projects/Missouri-River-Dams/Basin-Balancer/.

USFWS (US Fish and Wildlife Service). 2008. "Structured Decision Making Fact Sheet." October 2008. https://www.fws.gov/science/doc/structured_decision_making_factsheet.pdf.

Walker, Brad. 2015. "'MRRIC'—a Lesson in How *Not* to Restore a River." Missouri Coalition for the Environment. November 3, 2015. http://moenvironment.org/files/Large_Rivers/%E2%80%9CMRRIC%E2%80%9D%20%E2%80%93%20A%20lesson%20on%20how%20not%20to%20restore%20a%20river,%20MCE,%2011-15.pdf

White, Richard. 1995. *The Organic Machine: The Remaking of the Columbia River*. New York: Hill and Wang.

Wildhaber, Mark, Aaron J. DeLonay, Diana M. Papoulias, David L. Galat, Robert B. Jacobson, Darin G. Simpkins, Patrick J. Braaten, et al. 2008. *A Conceptual Life-History Model for Pallid and Shovelnose Sturgeon*. US Geological Survey, circular 1315. https://pubs.usgs.gov/circ/2007/1315/pdf/circ_1315.pdf. First published 2007.

Frederick Errington
Distinguished Professor of Anthropology, Emeritus
Department of Anthropology
Trinity College
Hartford, CT 06106

frederick.errington@trincoll.edu

Deborah Gewertz
G. Henry Whitcomb Professor
Department of Anthropology
Amherst College
Amherst, MA 01002

dbgewertz@amherst.edu