The Impact of COVID-19 on Freshwater Fisheries Fieldwork and Data Collection

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U.S. Fish and Wildlife Service Fisheries crew baiting lines for Lake Sturgeon Acipenser fulvescens. Photo credit: Brett Billings, U.S. Fish and Wildlife Service.
COVID-19 has affected almost every aspect of society including freshwater fisheries fieldwork. Our study quantified the effects of the pandemic on fisheries fieldwork in the United States. We administered a survey to fisheries chiefs in all 50 states to assess the pandemic’s impact on fisheries fieldwork. Of the 37 participants, 91% reported the pandemic affected their fieldwork and 92% adapted their sampling methods in response to the pandemic. Common adaptation strategies included using personal protective equipment (100%), practicing social distancing (97%), using smaller crews (82%), and developing contingency plans (51%). Based on the survey results, we identified potential challenges to adaptations and offered strategies to improve them. Strategies we identified include adopting novel data collection techniques, finding new positions for temporary employees, and publicly sharing contingency plans. Ultimately, this paper offers novel guidance on how fisheries professionals can best move forward with fieldwork during a time of crisis.

**INTRODUCTION**

In January 2020, the World Health Organization classified SARS-CoV-2 (COVID-19) as a Public Health Emergency of International Concern and, less than 2 months later, characterized COVID-19 as a global pandemic (WHO 2020). Although the long-term impacts of the pandemic are still unknown, COVID-19 has touched almost every aspect of daily life, from public health, to the economy, to social dynamics. While the focus of the pandemic has rightfully been on human and economic costs, the rise of infectious diseases with pandemic potential is uniquely tied to environmental and ecological factors. Climate change, exotic species introductions, global trade networks, and human encroachment upon wildlands have resulted in an increase in the number of emerging infectious diseases worldwide (Lindahl and Grace 2015). Approximately 60% of emerging human pathogens are zoonotic and, of these pathogens, over 70% originated from wildlife (Cutler et al. 2010). The novel COVID-19 is no different, with its origins likely connected to bats (Chiroptera; MacKenzie and Smith 2020). Looking to the future, the progression of climate change, the continued exploitation of our natural resources, and the increasingly globalized world economy are likely to increase the incidence of infectious diseases reaching pandemic proportions (Lindahl and Grace 2015).

Maintaining biodiversity and healthy ecosystems can help prevent pandemics (Keesing et al. 2010), but little is known about how pandemics impact the management and conservation of natural resources (Buckley 2020; Corlett et al. 2020). A few studies have already shown beneficial results with regards to the status and utilization of natural resources even after just a brief disruption of typical human activities caused by COVID-19. In April 2020, NASA satellite data showed a 30% drop in air pollution over the northeastern USA and Friedlingstein et al. (2020) reported fossil CO₂ emissions were about 17% below their average 2019 levels globally, resulting in cleaner rivers in some parts of the globe (Pinder et al. 2020). In addition, wildlife has purportedly reclaimed lands temporarily devoid of people due to stay at home orders (Lombrana and Roston 2020). Clearly, efforts to study how the pandemic is impacting our natural resources have continued despite the pandemic, but the impact of the pandemic on efforts to monitor these changes and manage our natural resources is more nuanced.

The pandemic has resulted in disruptions to fisheries monitoring and management across the globe (FAO 2020). For example, in the United States, the Environmental Protection Agency temporarily suspended the enforcement of some environmental laws, which could have impacted inland water quality and fisheries (Beitsch 2020). Additionally, the National Marine Fisheries Service canceled five of its six Alaskan large-scale research surveys, which are important sources of fishery-independent data in the management of the largest fishery in the United States (NOAA Fisheries 2020a, 2020b). Furthermore, Wisconsin’s Department of Natural Resources canceled all 2020 field surveys and habitat projects, as this work was unable to be conducted in accordance with Centers for Disease Control and Prevention social distance guidelines (Smith 2020). These disruptions, along with the global nature of COVID-19, suggest that the pandemic has had widespread impacts on the ability of fisheries managers, researchers, technicians, and students to conduct research, manage resources, and maintain funding sources.

To date, reports of the pandemic’s impact on fisheries management efforts remain scarce and varied. The objective of our study was to quantify the effects of the pandemic on freshwater fisheries fieldwork and data collection in the United States. We chose to specifically focus on fisheries monitoring and data collection conducted in the field as this is an essential part of successful management that has been disproportionately affected by the pandemic because of the nature of the work (e.g., large field crews in close contact, overnight travel in shared vehicles, etc.). Assessing the pandemic’s impact on fieldwork, investigating adaptations to sampling protocols, and questioning the long-term effectiveness of these adaptations could provide state and federal agencies with useful information. Collating responses from fisheries professionals across the United States provides guidance on how fisheries scientists move forward to best continue data collection and monitoring during a time of crisis.

**METHODS**

**Survey Design**

We created a survey to assess how the pandemic has affected fisheries fieldwork and how fisheries managers are responding to these impacts. Survey questions were initially developed based on input from fisheries researchers at the University of Arizona. The survey was refined and pilot-tested to ensure that questions were easy to interpret and that the survey administration was unbiased. Next, the survey was uploaded to the survey software platform Qualtrics (Provo, Utah). A list of 50 participants was then compiled by the researchers consisting of state fisheries chiefs from each U.S. state. We sent a single email invitation with a link to the survey on July 28, 2020, to this list of potential participants. This invitation described the aim of the study and encouraged them to complete the survey. An additional reminder email was sent on August 19, 2020, in accordance with survey best practices (Dillman et al. 2014). The survey was open from July 28 to August 31, 2020.

The survey included a mix of 22 multiple choice, ranking, Likert-like scale, and open-ended questions (Table 1).
Table 1. A list of survey questions sent to fisheries chiefs with response counts and results. PPE = personal protective equipment.

| Question                                                                 | Response count | Results                                                                                           |
|-------------------------------------------------------------------------|----------------|---------------------------------------------------------------------------------------------------|
| 1. Please rate (1 no effect – 5 canceled fieldwork) how the pandemic has affected your ability to conduct fieldwork (e.g., routine monitoring, data collection)? | 34             | 1 (9%)  
2 (23.5%)  
3 (35%)  
4 (23.5%)  
5 (9%) |
| 2. Have you adapted your fieldwork in response to the pandemic?          | 37             | Yes (92%)  
No (8%) |
| 3. How have you adapted your fieldwork? (select all that apply)          | 34             | Smaller crews (82%)  
Social distancing (97%)  
Implement new sampling methods (21%)  
Wearing PPE (100%)  
Rescheduled fieldwork (88%)  
Other, please describe (53%) |
| 4. Please rate (1 very well – 5 not at all) how well you see these adaptations working for the duration of the pandemic or for future pandemics? | 32             | 1 (0%)  
2 (38%)  
3 (47%)  
4 (13%)  
5 (3%) |
| 5. Please rate (1 minimal – 5 irreparable) how impacted your research/work will be by the loss of a field season | 36             | 1 (8%)  
2 (42%)  
3 (33%)  
4 (17%)  
5 (0%) |
| 6. Has the pandemic impacted your ability to start new research projects? | 37             | Yes (59%)  
No (41%) |
| 7. How has the pandemic impacted your ability to start new research projects? (select all that apply) | 22             | Canceled projects (36%)  
The project is understaffed (41%)  
Delayed start on projects (50%)  
Revised project objectives (14%)  
Other, please describe (32%) |
| 8. Has the pandemic affected any long-term monitoring projects?           | 36             | Yes (66%)  
No (33%) |
| 9. Has the pandemic affected your ability to perform lab work associated with fieldwork? | 36             | Yes (33%)  
No (66%) |
| 10. How has the pandemic affected your ability to perform lab work associated with fieldwork? (select all that apply) | 13             | Fewer staff in lab (77%)  
Social distancing hindering projects (61%)  
Delayed lab projects (30%)  
Other, please describe (46%) |
| 11. Do you currently have or are you creating contingency plans for projects if this pandemic or future pandemics affect your ability to collect field data? | 37             | Yes (51%)  
No (49%) |
| 12. If yes, what information is guiding the creation of your contingency plan? (select all that apply) | 19             | Centers for Disease Control guidelines (68%)  
State guidelines (100%)  
Examples from other state fish and wildlife agencies (63%)  
Other, please describe (5%) |
| 13. If yes, what kind of information or resources are you currently lacking that would help in the creation of your contingency plan? | 12             | Open-ended |
| 14. Please select which option best describes the effect the pandemic has had on your agency's budget and subsequently your fieldwork | 37             | No change to funding (40%)  
Lost funding (30%)  
Delayed funding (5%)  
Additional funding (3%)  
Other, please describe (22%) |
| 15. Does your agency have access to the necessary PPE, sanitizers, and testing to safely conduct work during a pandemic? | 37             | Yes (86%)  
No (14%) |
| 16. If no select all that apply                                         | 5              | Access to PPE (60%)  
Access to Coronavirus testing (80%)  
Access to Antibody testing (80%)  
Access to hand sanitizer (40%)  
Access to cleaning supplies (20%)  
Other, please describe (20%) |
| 17. Do you have any safety concerns about working in the field during the pandemic? Rate (1 no concerns - 5 extremely concerned) | 37             | 1 (11%)  
2 (27%)  
3 (32%)  
4 (27%)  
5 (3%) |
We developed the first portion of the survey to evaluate how fisheries fieldwork activities had been directly affected by the pandemic. The second portion was focused on how fisheries agencies were adapting in response to the pandemic and if there were disadvantages to these adaptations. Using the participant’s responses, we quantified the impacts that the current pandemic is having on different aspects of fisheries fieldwork (funding, personnel, methodology), how agencies were adapting to these impacts, and how they might adapt in the future. Finally, we developed some options for maintaining fieldwork during a pandemic based on the results from the survey.

**Data Analysis**

Closed-ended questions with categorical data and ordinal data were analyzed using counts of total responses and relative frequency statistics (the number of responses in each category was divided by the total number of responses). Responses to open-ended questions were coded using inductive data-driven thematic analysis (Braun and Clarke 2006). This process requires carefully reading responses and generating codes that label important features of the data that may help to answer the research question. Direct quotes were also used to illustrate common themes among responses. Survey questions and response counts can be found in Table 1.

**RESULTS AND DISCUSSION**

Between July 28 and August 31, 2020, 37 individuals completed the survey (74% response rate). Although these results were based solely on participant perceptions, we hypothesized that because participants were fisheries chiefs they possessed sufficient knowledge of how the agency has been impacted by the pandemic as well as a greater ability to affect change at the organizational level (Berkhout 2012).

**How the COVID-19 Pandemic is Impacting Fisheries Fieldwork and Monitoring**

We began the survey by broadly asking participants to rank on a scale of 1 (no effect) to 5 (canceled fieldwork) how the pandemic has affected their ability to conduct fieldwork (e.g., routine monitoring, data collection). Ninety-one percent (31/34) reported that the pandemic had at least some effect on their ability to conduct fieldwork (Figure 1). The responses formed a bell curve, indicating that most participants fell in the middle with only 9% (3/34) of respondents reporting that the pandemic had canceled all fieldwork and 9% (3/34) reporting that the pandemic had no effect on fieldwork (Figure 1). While no one responded that the loss of a field season would irreparably impact their research, 92% (33/36) of participants indicated it would have negative effects on their research. Furthermore, 88% (30/34) of the respondents who did not face canceled fieldwork reported that their fieldwork had been rescheduled (Figure 2). Additionally, 66% (24/36) of participants reported that their long-term monitoring projects had been affected with one participant commenting “projects in progress now have a break in data collection, which will impact the results and analysis of some large projects which will impact major fisheries management decisions across the State.” The results also indicated that 60% (22/37) of participants reported that new field research projects originally scheduled to commence in 2020 were impacted by the pandemic, including 36% (8/22) who reported canceled new projects and 86% (19/22) who reported delayed new projects.

**How Fisheries Agencies are Adapting their Fieldwork in Response to the COVID-19 Pandemic**

In the face of these problems, fisheries professionals have found ways to adapt to ensure that they can continue to manage both fisheries and their personnel effectively. This knowledge will allow managers in the future to plan for and react to world-altering events such as pandemics. To combat the problem of reduced fieldwork, participants have shifted focus to other fisheries management activities. For

| Question                                                                 | Response count | Results                                                                 |
|--------------------------------------------------------------------------|----------------|-------------------------------------------------------------------------|
| 18. Has the pandemic affected your ability to hire new field technicians or seasonal employees? | 37             | Yes (73%) No (27%)                                                      |
| 19. Have field technicians been furloughed due to the pandemic?          | 37             | Yes (14%) No (86%)                                                      |
| 20. If yes, what percentage of field technicians have been furloughed due to the pandemic? | 5              | 0-10% (20%) 10–25% (20%) 50% or more (60%)                             |
| 21. Have any employees quit or taken a leave of absence during the pandemic? | 37             | Yes (20%) No (75%) Prefer not to answer (5%)                          |
| 22. Is there anything relevant that you would like to add?               | 15             | Open-ended                                                              |

Figure 1. Summary of responses to the question “How has the (COVID-19) pandemic affected your ability to conduct fieldwork (e.g., routine monitoring, data collection) (1 no effect; 5 canceled fieldwork)” (n = 34).
example, several participants noted that staff have created very effective models for collaboration via teleworking and the backlog of report writing has decreased. Other participants mentioned the increased need for flexible schedules and time off while dealing with child care, which could be provided more easily working from home than in the field. Ultimately, one participant expressed that “staff have gone above and beyond to make working remotely as productive as possible.”

When fisheries professionals were able to conduct fieldwork, nearly all respondents (92%; 34/37) reported that they had adapted their field work in response to the pandemic. Of the participants who had adapted their field work, all (100%; 34/34) reported using personal protective equipment (PPE; Figure 2) and a majority of agencies (86%; 32/37) reported having a sufficient supply of PPE to conduct field work during the pandemic. In addition to implementing PPE into field work protocols, many participants also reported employing common safety precautions associated with the pandemic, including practicing social distancing (97%; 33/34) and using smaller crews (82%; 28/34) to reduce the likelihood of exposure (Figure 2). Fifty-two percent of participants shared other examples of fieldwork protocol adaptations that were not included as multiple-choice options in the questionnaire. These included: traveling separately or with fewer people in each vehicle to field sites (32% 10/34), prohibiting or reducing overnight travel and implementing travel restrictions (9%; 3/34), prioritizing specific activities that require fewer people and allow for more distancing (9%; 3/34), and limiting fieldwork to only agency personnel (12%; 4/34).

A final technique that aids in adapting to current and future crises has been the development of contingency plans. Contingency planning is the process of developing strategies for events that may occur in the future to ensure rapid, effective response (Tang 2018). Results show that 51% (19/37) of survey participants either currently possessed or were developing a contingency plan for projects affected by pandemics. One-hundred percent (19/19) of participants who reported that they were engaged in the development of a contingency plan stated that it was based on state guidelines, while others said Centers for Disease Control guidelines (68%; 13/19) and examples from other state fish and wildlife agencies (63%; 12/19) also influenced the development of their plan.

**Potential Disadvantages to Adaptations in Fieldwork Due to COVID-19 Pandemic**

While a variety of fieldwork adaptations were reported, there were mixed responses from participants on how well they thought those adaptations would work long-term. Of 32 participants, 0 reported that adaptations worked extremely well; however, only 1 (3%) participant thought they would not work at all, with the majority falling in the middle, suggesting uncertainty (Figure 3). Although social distancing can slow the spread of COVID-19, it is not always a viable option while working in the field. For example, requiring everyone to take separate vehicles limits the number of crew that can be in the field at any given time due to the number of available vehicles. One participant said their agency had “canceled most fieldwork except that which can be accomplished by two or less staff.” Increasing the number of vehicles needed for field crews can also increase the cost associated with field work. This is problematic when one considers that 30% (11/37) of participants reported loss of funding during the pandemic and 21% (8/37) anticipated future budget cuts. Additionally, these restrictions limit the type of fieldwork that can be conducted, and one participant reported that the break in data collection may disproportionately affect smaller, short-term projects.

The “hiring freeze” on new seasonal positions was frequently mentioned as one of the biggest impacts the pandemic has had on fisheries fieldwork. Many participants reported that during the pandemic fieldwork was limited to agency personnel only, resulting in the exclusion of volunteers and seasonal employees. Fisheries professionals frequently begin their careers in these positions and the lack of opportunities could impact future employment. While most participants reported not having to furlough (86%; 32/37) employees, 73% (27/37) said the pandemic affected their ability to hire new field technicians. One participant stated that “we didn’t actually ‘furlough’ technicians, but at the beginning of the field season we made the decision to hire about 25% fewer seasonal field technicians.” Another participant mentioned that they believed the largest impact of the pandemic on their fieldwork “has been on hiring of seasonal technicians for a variety of programs and projects including field fisheries programs and AIS [aquatic invasive species] prevention programs.”

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![Figure 2](image1.png)

Figure 2. Summary of responses to the question “How have you adapted your field sampling (to the COVID-19 Pandemic)? Select all that apply (n = 34).”

![Figure 3](image2.png)

Figure 3. Summary of responses to the question “Please rate (1–5) how well do you see these adaptations working for the duration of the pandemic or for future pandemics?” (n = 35).
Finally, when asked what information agencies were lacking that would aid in the creation of a contingency plan, several participants mentioned that they would like to see what other agencies had implemented to remedy common problems, such as limited field staff in vehicles, smaller field crews, and increased need for IT support staff. Participants were also interested in knowing if other environmental agencies had innovative new sampling techniques and how data collected with new sampling protocols were affected compared to data collected with traditional methods from previous years. Finally, another common desire was to have more information specifically related to COVID-19, such as the risk of exposure.

Options for Fieldwork During a Pandemic

Based on survey results, we identified three primary options that may aid fisheries professionals in addressing disadvantages inherent to pandemic-related protocols. First, fisheries professionals who find creative methods to continue to collect and analyze data during a crisis can maintain programs to some degree if funding or safety regulations prohibit traditional field sampling methods. For example, fisheries professionals may focus on developing and perfecting more high-tech sampling techniques, such as the use of drone or satellite data that allow for fewer staff in the field (Link et al. 2021). Before COVID-19 disrupted fisheries fieldwork, researchers and managers had been investigating methods that require less personnel, time, and resources, such as eDNA sampling (Lacoursière-Roussel et al. 2016). Additionally, the use of high-quality citizen science data and crew data collected by recreational anglers may be useful in filling in data collection gaps (Fairclough et al. 2014; Link et al. 2021). It is still too early to tell, but COVID-19 might have expedited the use of new technologies and practices that make fieldwork methods more efficient, require less personnel, and are less expensive.

A second strategy is to ensure that there are still opportunities to train and employ new volunteers and seasonal technicians. The continued success of fisheries management is dependent on educated and enthusiastic fisheries students and community volunteers. While the pandemic limited traditional field monitoring, fisheries professionals can use this time to create innovative opportunities for online learning and networking that may lower certain barriers (cost, location, etc.) and increase engagement from people who were disproportionately affected by these barriers (Cooke et al. 2021). Finally, and perhaps most essential, developing contingency plans and making them publicly available helps to minimize the impact of crises on fisheries sampling activities. Many participants expressed interest in the details of how other environmental agencies were adapting to the pandemic and how they planned to prepare for future crises. While the COVID-19 pandemic was unprecedented, contingency planning and risk management has been recognized as a useful and essential tool in fisheries management (Sethi 2010). Communication and collaboration between state and federal agencies as well as with other fisheries organizations ensures the best practices are developed and adopted (Link et al. 2021).

CONCLUSION

In the final question, we asked participants to add any additional thoughts that may be relevant to this survey and many participants summarized their general feelings about pandemic adaptations and their effectiveness. One manager stated that the changes were problematic at first, but once in place, fieldwork resumed as close to normal as possible prior to this disruption. Another manager said that even with many problems, fieldwork had adjusted, and long-term monitoring continued. A third fisheries manager commented, “Fisheries managers are dedicated and resourceful. We can find ways to safely do our jobs.” The evidence provided by our survey shows that U.S. fisheries professionals, in most instances, were able to carry on their monitoring programs to some degree or level, despite some adjustments, during a major disruption such as a pandemic. Contingency planning for major disruptions may facilitate necessary changes to field work in the future.

Our survey was distributed to each state’s fisheries chief only a few months after the disruptions from the pandemic had taken effect in North America. It would be beneficial to conduct a follow-up survey once the pandemic is behind us to compare adaptive strategies among agencies and to see what changes remained even after the pandemic has ended as well as other long-term impacts (e.g., budget cuts, impacts on new projects).

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